11.6 Terrestrial Ecology

A Terrestrial Ecology Assessment was prepared for the proposed development by Niche Environment and Heritage Pty Ltd (2018), and is provided in **Appendix K**.

The ecology assessment has addressed the SEARs and Supplementary SEARs relevant to terrestrial biodiversity impacts. These requirements are listed in **Table 11-31**. SEARs relating to aquatic ecology have been addressed in **Section 11.7.**

Table 11-31 SEARs for the assessment of biodiversity impacts

Biodiversity SEARs	Section addressed
Biodiversity – including:	
• 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 s142(B)(1)(c) of *the Threatened Species Conservation Act 1995*, and having regard to OEH's requirements; and	**Section 11.6** (terrestrial), **Section 11.7** (aquatic) and **Appendix K**.
• a strategy to offset any residual impacts of the development in accordance with the NSW Biodiversity Offsets Policy for Major Projects.	**Section 11.6.5** and **11.7.5** and **Appendix K.**
Biodiversity Supplementary SEARs	
• The EIS must identify each EPBC Act listed threatened species and community 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 impacts. For species and communities potentially located in the project area or in the vicinity that are not likely to be impacted, provide evidence why they are not likely to be impacted.	**Section 11.6.3, 11.6.4, 11.7.3** and **11.7.4** and **Appendix K**

Biodiversity SEARs	Section addressed
• For each of the EPBC listed threatened species and communities likely to be impacted by the action the EIS must provide a separate: • description of the habitat (including identification and mapping of suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements 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 regard to the full extent of the species or community's range; • 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; • A description of any offsets proposed to address residual adverse significant impacts and how these offsets will be established; • Details of how the current published NSW Framework for Biodiversity Assessment (FBA) has been applied in accordance with the objects of the EPBC Act to offset significant residual adverse impacts; and • 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.	**Section 11.6.3, 11.6.4, 11.7.3** and **11.7.4** and **Appendix K**
• Any significant residual impacts not addressed by the FBA may need to be addressed in accordance with the EPBC Act Environmental Offset Policy.	Residual impacts to ecology were not identified for the proposed development
• The Department of the Environment's Reporting Tool (ERT) identifies that threatened species and communities may occur in the vicinity of the proposed action. 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 (SSFT) ecological community – Critically Endangered; • Bargo Geebung (*Persoonia bargoensis*) – Vulnerable; • Small-flower Grevillea (*Grevillea parviflora subsp. Parviflora*)– Vulnerable; and • Rufous Pomaderris (*Pomaderris brunnea*) – Vulnerable.	**Section 11.6.3, 11.6.4** and **Appendix K**

Biodiversity SEARs	Section addressed
• There is some risk that there may be significant impacts on the following matters and the level of impact should be further investigated: • Turpentine-Ironbark Forest of the Sydney Basin Bioregion – Critically Endangered; • Woronora Beard-heath (*Leucopogon exolasius*) – Vulnerable; • Koala (*Phascolarctos conereus*) – Vulnerable; • Macquarie Perch (*Macquaire australasica*) – Endangered; and • Greater Glider (*Petauroidies volans*) – Vulnerable.	**Section 11.6.3, 11.6.4, 11.7.3** and **11.7.4** and **Appendix K**

11.6.1 Background

The proposed development has the potential to impact on terrestrial ecology through the clearing of vegetation as part of the expansion of the REA, construction of ventilation shafts (and associated service infrastructure), and car park extension, as well as through the generation of subsidence movements as a result of longwall mining. The purpose of the Terrestrial Ecology Assessment was to identify terrestrial flora and fauna likely to occur within the ecology study area (refer **Section 11.6.2**), assess potential impacts of the proposed development on terrestrial ecology, and recommend mitigation measures where appropriate. The assessment has utilised available public information, including threatened biodiversity records and vegetation mapping.

The Project Area has been subject to several previous monitoring and ecological survey efforts in order to obtain sufficient baseline data and to inform the footprint of the proposed development. Previous studies and surveys include:

- several Reviews of Environmental Factors for the Bargo Exploration Program (2010-13), which involved ecological assessment and survey for several seismic survey lines and exploration boreholes within CCL 747 and CCL 716;
- Tahmoor South Terrestrial Ecology Pilot Study (2010-11), which involved a detailed literature review and field survey of the broader CCL 747 area. The outcomes of this study informed the detailed baseline monitoring program; and
- Tahmoor South Terrestrial Ecology Monitoring Program (2012-14), which involved collecting two years of baseline data on amphibian and riparian vegetation in order quantify those ecological values which may be sensitive to subsidence impacts. This program has been completed and the data have been used to inform the impact assessment for the proposed development, as well as monitor impacts during and after mining of the proposed development.

As described in **Section 11.6.2** additional survey assessments were completed in 2013, 2017 and 2018 for the proposed development within the ecology study area.

As discussed in **Section 8.1.4**, the *Biodiversity Conservation Act 2016* (BC Act) replaced the *Threatened Species Conservation Act 1995* (TSC Act) on 25 August 2017. However, the proposed development is subject to transitional provisions under the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* (clauses 27 (1)(b) and 28 of Part 7) as it meets the definition of a '*pending or interim planning application*', being a development for which an application would be submitted within 18 months of the commencement of the BC Act (i.e. by February 2019), will be accompanied by an EIS (this document), and the original SEARS were issued prior to the commencement of the BC Act (i.e. 9 June 2017). As such, in accordance with Clause 28, Part 7 of the Regulation '*Former planning provisions*' (being the provisions of the EP&A Act that were in force if that Act had not been amended by the BC Act) '*continue to apply to pending or interim planning applications*'. Prior to its amendment by the BC Act, the EP&A Act (Clause 5A) required assessment of threatened species, populations, ecological communities or their habitat under the TSC Act and as per the transitional provisions of the BC Act, this required under the TSC Act continues to apply to the proposed development. As such the proposed development has been assessed under the Framework for Biodiversity Assessment (FBA) method under the TSC Act. The assessment has used the BioBanking Credit Calculator (BBCC) Version 4 and the Major Project module for all development calculations.

Avoidance

The proposed development has, in the first instance, avoided biodiversity impacts where possible. Avoidance of impacts to biodiversity has been achieved through:

- designing the extent of longwall mining to avoid the Bargo and Nepean River valleys to maximise protection and reduce potential for impacts to the biodiversity values associated with these rivers;
- the longwalls in the south of the Project Area have been re-designed to be stand back from the Metropolitan Special Area (MSA), which comprises a water catchment area managed by WaterNSW. This avoids impacts to the MSA, as well as the Upper Nepean State Conservation Area and Cow Creek, located within its bounds. This will also avoid impacts to the Giant Burrowing Frog which was recorded during previous surveys along Cow Creek;
- removal of previously proposed mining within the 'Eastern Domain' thereby avoiding undermining and subsidence impacts including to Eliza Creek; and
- redesigning the REA (reducing the overall footprint) to avoid greater impacts to SSTF, *Persoonia bargoensis* and *Grevillea parviflora* subsp. *parviflora,* and to move the REA away from Tea Tree Hollow and the population of *Pomaderris brunnea*.

The adopted REA design takes into consideration a balance of environmental impacts relating to dust, noise and visual impacts to surrounding properties, as well as potential impacts on biodiversity. This included a cost benefit analysis of the design options considering biodiversity impacts and offset requirements associated with the options. Consideration was given to raising the northern section of the existing REA which has been rehabilitated; however this increased the number of impacted properties from dust and noise, and hence was not included in the proposed final design. The southern section of the REA is proposed to be increased in height as this change does not increase the number of potentially affected properties. Further information on REA design and the options considered is provided in **Section 6.2.6**.

Refer to **Section 5.0** and **Section 6.0** for further information regarding mine design constraints and alternatives considered for the proposed development.

11.6.2 Methodology

The Terrestrial Ecology Assessment was prepared by Niche Environment and Heritage Pty Ltd (2018) and included:

- a study area for the ecological assessment that comprised:
  - the SSA as per MSEC (2018) for subsidence related impacts; and
  - the extent of the proposed REA extensions and proposed surface infrastructure including ventilation shaft sites and carpark extension for surface vegetation clearance.
- a desktop review of background information, including:
  - a search of public databases including EPBC Act Protected Matters Search Tool (10 km search area), the OEH Atlas of NSW Wildlife, and the OEH BioBanking Threatened Species Profiles Database; and
  - review of previous studies within and surrounding the study area including studies undertaken by Niche Environment and Heritage Pty Ltd as part of the Tahmoor two year baseline monitoring program.
- defining potentially impacted species by considering the likelihood of occurrence and likelihood of impacts for each species that were identified through database and literature review, as potently occurring within the study area. Five categories of likelihood of occurrence were evaluated (Refer **Table 11-32**) with the species classified as 'Moderate', 'High' or 'Known' considered further.

Table 11-32 Likelihood of occurrence criteria

Likelihood rating	Threatened flora criteria	Threatened and migratory fauna criteria
Known	The species were observed within the study area.	The species were 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.

Likelihood rating	Threatened flora criteria	Threatened and migratory fauna criteria
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 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.

- Field surveys were undertaken in accordance with the Framework for Biodiversity Assessment methodology. The assessment utilised information from previous surveys within the Project Area and current surveys for the proposed development as follows:
  - Pilot study (2011-2012) - terrestrial ecology pilot study was conducted over four days from the 5 to 8 December 2011, and 11 and 16 April 2012 to determine ecological values that would require consideration during EIS for the Project. The survey involved habitat based flora assessment and opportunistic threatened flora survey;
  - Riparian Monitoring (2012-2013) - A riparian monitoring project was implemented for two monitoring years to gain baseline floristic data at 42 permanent monitoring sites along riparian areas within the Project 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 from 18 to 27 June 2012, and again from 5 to 13 December 2012. The second year of riparian vegetation monitoring was conducted between 3 June and 15 June 2013. The two different survey periods were aimed at targeting any potential seasonal differences in species presence;
  - REA detailed survey (2013) - The proposed REA expansion and surrounding vegetation was investigated from November 2012 to January 2013. The assessment included detailed vegetation mapping and threatened flora survey. The survey resulted in the collection of over 53 BioBanking plot/transects, rapid survey points, and targeted threatened flora survey and population counts for *Grevillea parviflora subsp. parviflora, Persoonia bargoensis*, and *Pomaderris brunnea*. With respect to fauna, the survey effort included camera traps, koala searches, spotlighting, stag watching, call playback, remote bat detectors, harp traps, arboreal cage traps, hair tubes, reptile spotlighting and reptile habitat searching/ rock turning, diurnal bird searches and habitat searches;
  - Previously proposed ventilation shaft sites and associated haul road and transmission lines (2013) - These sites were investigated 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 habitat assessment, and BioBanking plot collection, quadrats and random meanders, as well as spotlighting and camera traps. Whilst these ventilations sites and associated infrastructure are no longer proposed the surveys provided baseline information of vegetation and habitat within the Project Area;
  - Amphibian monitoring at a total of 39 locations along the following watercourses: Dog Trap Creek, Cow Creek, Carters Creek, Tea Tree Hollow, Hornes Creek, Eliza Creek, Dry Creek, Bargo River and tributaries of Bargo River during spring and autumn in 2012 and in 2013. The monitoring surveys at the sites included nocturnal aural and visual searches, nocturnal playback and tadpole searches;

- Detailed survey 2017 - An update of the previous survey assessments was completed in 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*. With respect to fauna the survey effort included camera traps, call playback, spotlighting/ stag watching, diurnal bird surveys, koala searches, amphibian searches (Dog Trap Creek, Tea TreeHollow Creek, Eliza Creek and Dry Creek), Cumberland Land Snail searches and reptile habitat searches; and

- Ventilation shafts, Hornes Creek and car park (2018) - Survey assessments were completed on 12-19 September 2018 to validate the vegetation mapping within the ventilation shaft sites and carpark and complete threatened flora survey and counts within these areas. During the assessment an additional seven BioBanking plots/transects were completed and targeted threatened flora surveys were undertaken across the disturbance areas, along with a population count for *Grevillea parviflora* subsp. *parviflora* and *Persoonia bargoensis*. The surveys also included a small portion of Hornes Creek in the north-west of the study area to confirm potential impacts from subsidence. With respect to fauna, the survey effort included camera traps, koala searches, spotlighting/ stag watching, call playback, diurnal bird searches and Cumberland Land Snail searches.

- The survey methods included:
  - vegetation verification, in particular native vegetation attributes such as coverage and species richness;
  - targeted searches for threatened flora species with the potential to occur within the study area, including those identified in the SEARs;
  - targeted searches for threatened fauna species with the potential to occur within the study area. The targeted surveys focused on species identified in the SEARs as well as 'species-credit species' which unlike 'ecosystem-credit species' cannot be assumed to be present based on habitat surrogates; and
  - habitat based assessment and opportunistic bird survey.
- assessment of potential impacts to affected vegetation communities and threatened species within the study area. This included calculating areas of vegetation disturbed as a result of surface activities and consideration of riparian vegetation impacted as a result of subsidence impacts to watercourses;
- recommendations for avoidance, mitigation and offsets for potential impacts on terrestrial ecology; and
- assessment of significance for Commonwealth listed species where it is determined that an impact to that species is likely to occur as a result of the proposed development.

11.6.3 Existing Environment

The existing environment has been characterised in forms of vegetation communities, threatened flora and fauna species, and State Conservation Areas and National Parks.

Vegetation Communities

Vegetation within the study area has been mapped as part of the *Native Vegetation of Southeast NSW* mapping project (Tozer *et al* 2006) and also as part of the Cumberland Plain Mapping Project (OEH, 2013). The mapped vegetation communities (OEH, 2013) are shown on **Figure 11.15**. Five vegetation communities have been mapped as occurring within the study area, of which two are considered to constitute EECs, as identified below. Vegetation communities verified through site surveys are shown in **Figure 11.16**.

- *Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin*. This plant community was considered to align with the Shale Sandstone Transition Forest (SSTF) threatened ecological community (TEC) listed as critically endangered under both the BC Act and EPBC Act. Verification surveys have confirmed the presence of this community within the proposed REA extension and ventilation shaft sites. This community has also been mapped within the subsidence limits of the study area. Within the study area approximately 308.2 ha of the community is mapped as being of 'moderate/ good' condition, 11.8 ha as 'moderate/ good-medium' condition and 5.6 ha as 'moderate/ good-derived' condition;

- *Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion.* This plant community aligns with the Cumberland Plain Woodland threatened ecological community listed as critically endangered under both the BC Act and EPBC Act. Verification surveys did not identify this vegetation community within the footprint of proposed surface infrastructure (REA, ventilations shafts or car park). 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. Approximately 9 ha of this community has been mapped within the subsidence limits of the study area.
- *Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin* (Upper Georges River Sandstone Woodland vegetation community). This community is not listed as a TEC or EEC. This community is mapped within the subsidence limits of the study area (approximately 493.8 ha), and verification surveys have confirmed the presence of this community within the REA;
- *Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in gullies of western Sydney, Sydney Basin sandstone* (Hinterland Sandstone Gully Forest vegetation community). This community is not listed as a TEC or EEC. This community is mapped within the subsidence limits of the study area (approximately one ha), however mapping and verification surveys indicates that this community does not occur within the surface infrastructure areas (REA, ventilation shaft sites and car park); and
- Plantings – 0.1 ha of plantings were identified through verification surveys within the proposed car park and 0.2 ha within the subsidence limits of the study area. This community type does not fit with any of the mapped plant community types and *Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin* was used in the vegetation mapping as a surrogate.

Upland Swamps are thought to be particularly susceptible to the impacts from mining induced subsidence and were therefore considered in the assessment. Upland Swamps include Montane Peatlands and Swamps of the New England Tableland, (listed as endangered under the BC and EPBC Acts) and Coastal Upland Swamps in the Sydney Basin Bioregion (listed as endangered under the BC and EPBC Acts). However, Upland Swamps are not mapped within the study area and were not recorded during field surveys. In addition, aerial photography interpretation has not identified any potential upland swamps.

Turpentine Ironbark Forest in the Sydney Bioregion was identified by DoEE (2018) as a TEC that could potentially be impacted by the proposed development. However, this TEC was not recorded during field surveys, nor has it been previously mapped as occurring within the study area by Tozer et al (2006) and OEH (2013). The Project Area occurs predominately within the Wollondilly LGA which is not an LGA listed in the Scientific Determination for the Sydney Turpentine Ironbark Forest. Whilst 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 have been identified. As such, it is considered highly unlikely that Sydney Turpentine Ironbark Forest occurs within the study area (Niche, 2018).

Landscape Features

The FBA requires landscape features to be considered and entered into the BioBanking Credit Calculator (BBCC) so that features such as landscape setting, connectivity and native vegetation cover can be taken into account.

The following Mitchell landscapes occur across the study area: Picton – Razorback Hills, Woronora Plataea, Nattai Plateau, and Upper Nepean Gorges. As the Picton – Razorback Hills occupies the majority of the study area it was entered into the BBCC.

The key landscape features of the study area are concentrated around the watercourses; namely Tea Tree Hollow Creek, Dog Trap Creek and Hornes Creek. Vegetation corridors along each of these watercourses are more prominent toward the far west of the study area near the Bargo River. This area is typically away from rural and residential lands. As per the FBA, the study area was classed as occurring within a strategic (connectivity) location as it contains riparian buffers that are of a 4th order or higher Strahler level (Bargo River– western edge of study area).

Two Assessment Circles (15, 000 ha and 1,500 ha) were placed over the study area and percentage native vegetation cover was estimated using GIS interrogation. Percentage native vegetation cover was determined to remain within the same class (71-75%), before and after the proposed development at both the 15,000 ha and 1,500 ha scales.

Based on the above inputs the BBCC calculated landscape score for the development is 21.0.

Threatened Flora

A total of 47 threatened flora listed under the BC Act and/or EPBC Act have been recorded or have potential habitat within 10 km of the study area. Of these, seven species have been recorded within or in close proximity to the study area during recent and/or previous surveys. These included: *Acacia bynoeana, Epacris purpurascens var. purpurascens, Grevillea parviflora subsp. parviflora, Persoonia hirsuta, Persoonia glaucescens var. glaucescens, Persoonia bargoensis,* and *Pomaderris brunnea.* Threatened flora species identified through surveys are shown on **Figure 11.17**.

Of these, three species (*Grevillea parviflora subsp. parviflora, Persoonia bargoensis,* and *Pomaderris brunnea*) have been recorded near the proposed surface infrastructure works, including the REA and ventilation shaft sites (refer **Table 11-33**).

Table 11-33 Records of threatened flora within the study area

Flora Species	Records	BC Act Listing	EPBC Act Listing
Acacia bynoeana	Not recorded during recent surveys undertaken for the proposed development and no records of the species by OEH occur within the study area. Approximately 20 individuals were recorded during surveys to the west of the study area along the entrance to a Fire Road off Ashby Close in land owned by Tahmoor Coal. The plants were recorded within plant community type *Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux, Sydney Basin* which does not occur within the surface infrastructure disturbance areas of the study area.	Vulnerable	Vulnerable
Epacris purpurascens var. *purpurascens*	Recorded along either side of Anthony Road, Bargo, and within Crown Land immediately to the north of Anthony Road. The population at this location consists of more than 500 individuals. Nil individuals recorded within the surface infrastructure areas of the study area (REA, ventilations shafts, car park).	Vulnerable	-
Grevillea parviflora subsp. *parviflora*	This species was recorded extensively during field surveys at the following areas: • REA Areas 1 and 2; • Ventilation shaft sites; • Outside of the REA development footprint to the east of Charlies Point Road; • Within the Anthony Road property owned by Tahmoor Coal; • Along Fire Road 5 in the Upper Nepean State Conservation Area; and • Within land owned by Tahmoor Coal off Ashby Close Bargo. An estimated 2,324plants occur within the core and outer habitat areas within the footprint of the surface infrastructure.	Vulnerable	Vulnerable
Persoonia bargoensis	Recorded within the surface infrastructure areas. A total of 692 individuals were recorded, the bulk of which occurs in the REA Area 2. Approximately 96 plants would be affected by the REA and four plants by the ventilation shaft sites.	Endangered	Vulnerable

Flora Species	Records	BC Act Listing	EPBC Act Listing
Persoonia hirsuta	Not recorded during recent surveys undertaken for the proposed development. A single OEH Bionet database recording occurs to the far west of the study area (outside of the surface infrastructure areas) within private property, which could not be verified. The records coincide with Dry Sclerophyll Forest vegetation located away from riparian zones within the Study Area. In addition, during surveys, a large population of the species was recorded outside of the study area in Tahmoor Coal owned land.	Endangered	Endangered
Persoonia glaucescens	Was not recorded during surveys of the surface infrastructure areas and riparian areas of the study area despite targeted surveys. One OEH Bionet databased record occurs within the REA Area 2, however no evidence of this species was identified during surveys of the REA. Other records for this species occur in private property, away from the surface infrastructure and riparian areas of the project. The records coincide with Dry Sclerophyll Forest vegetation located away from riparian zones within the study area. During survey, scattered individuals of this species were recorded outside of the study area in land owned by Tahmoor Coal.	Endangered	Vulnerable
Pomaderris brunnea	Recorded along Tea Tree Hollow Creek, immediately to the west of (but outside) the REA footprint. A population of 300 individuals were recorded at this location.	Vulnerable	Vulnerable

Threatened Fauna

A total of 74 threatened fauna listed on the BC and/ or EPBC Acts have previously been recorded or are predicted to have habitat within 10 km of the study area. Of these, 22 were identified as species-credit species that cannot be determined based on habitat surrogates.

A total of 78 fauna species were recorded within the Project Area during surveys, including eight amphibians, 45 birds, 17 mammals and eight reptiles. Of these 12 threatened fauna listed under the BC Act (nil listed under the EPBC Act) were recorded within the Study Area within, or immediately adjacent to the proposed surface infrastructure disturbance footprint. These comprised:

- 10 Ecosystem-credit species: Glossy Black Cockatoo *(Calyptorhynchus lathami),* Little Eagle *(Hieraaetus morphnoides),* Powerful Owl *(Ninox strenua),* Scarlet Robin *(Petroica boodang),* Sooty Owl *(Tyto tenebricosa),* Varied Sittella *(Daphoenositta chrysoptera)*, Eastern Free-tail Bat *(Mormopterus norfolkensis),* Large-footed Myotis *(Myotis macropus)*, Eastern Cave Bat *(Vespadelus troughtoni)* and Eastern False Pipistrelle *(Falsistrellus tasmaniensis)*;
- one species-credit species: Red-crowned Toadlet *(Pseudophryne australis)*; and
- one Ecosystem-credit/ species-credit species: Eastern Bentwing Bat *(Miniopterus schreibersii oceanensis*).

Two threatened amphibians were recorded during the Amphibian Monitoring Program in 2013: the Red-crowned Toadlet (*Pseudophryne australis*) as identified above and the Giant Burrowing Frog (*Heleioporus australiacus*). The Giant Burrowing Frog was recorded outside of the study area, within Cow Creek, whilst the Red-crowned Toadlet was recorded within the study area at Hornes Creek.

Threatened fauna species recorded near the proposed surface infrastructure works (including the REA and ventilation shaft sites) are shown on **Figure 11.18**.

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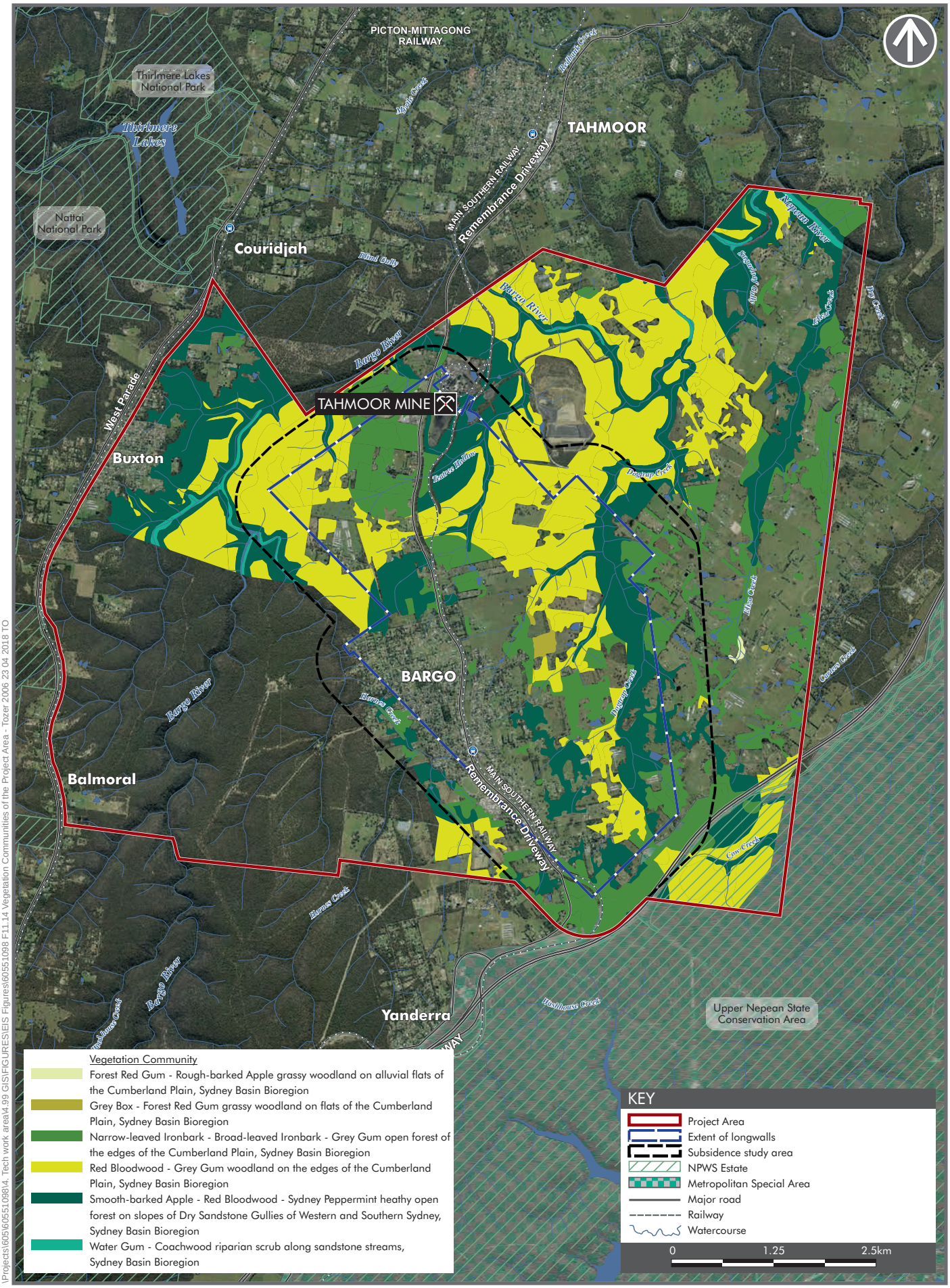

\Projects\605\605510981\4. Tech work area\v4.99 GIS\FIGURES\EIS Figures\605510981 F11.14 Vegetation Communities of the Project Area - Tozer 2006 23 04 2018 TO

SIMEC MINING

VEGETATION COMMUNITIES OF THE PROJECT AREA (OEH, 2013)

Tahmoor South Project
Environmental Impact Statement

Source: Niche Environment and Heritage (2013)

FIGURE 11.15

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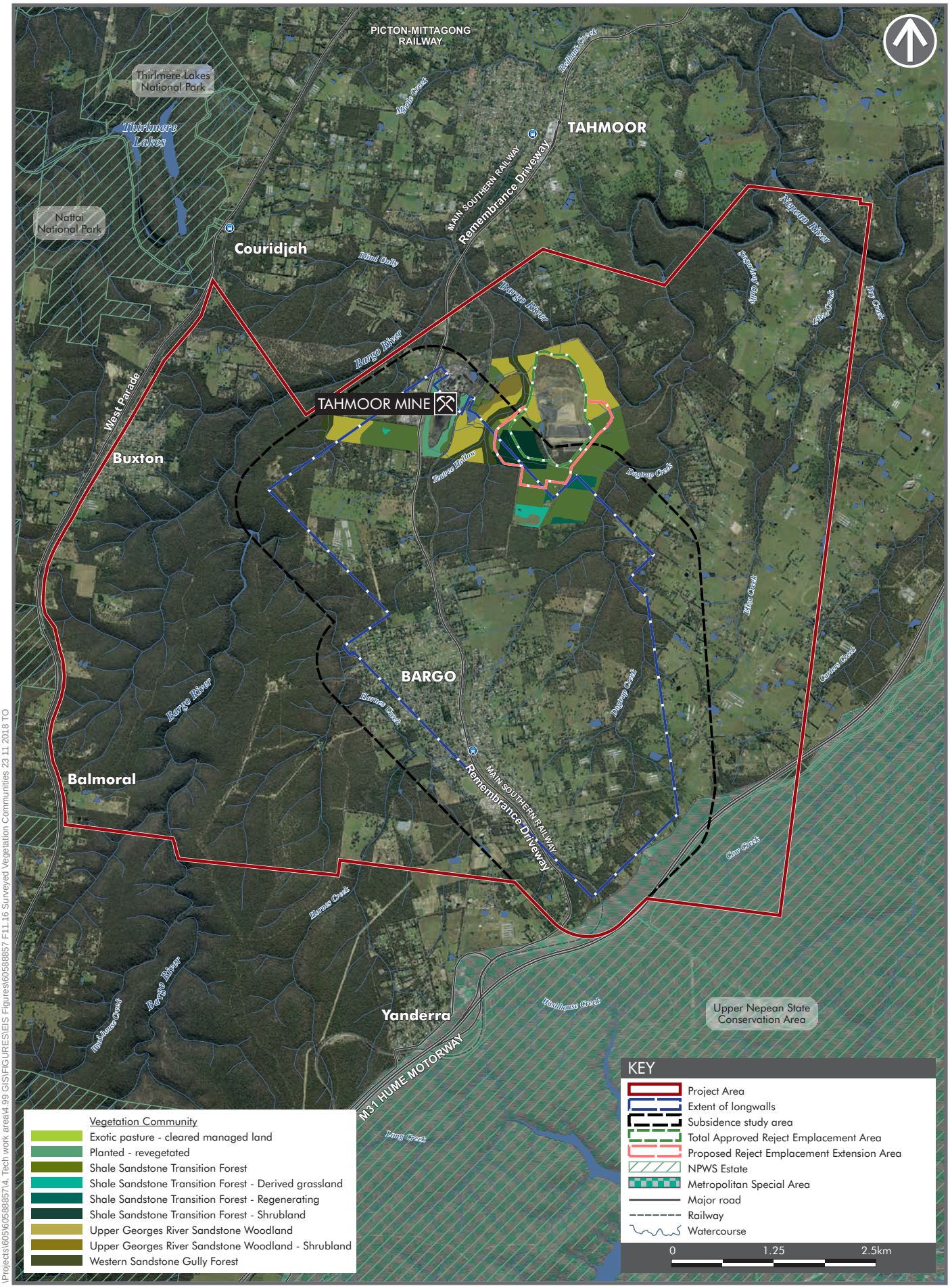

\Projects\605\605885714. Tech work area\4.99 GIS\FIGURES\EIS Figures\605885857 F11.16 Surveyed Vegetation Communities 23 11 2018 TO

SIMEC MINING

SURVEYED VEGETATION COMMUNITIES

Tahmoor South Project
Environmental Impact Statement

Source: Niche Environment and Heritage (2018)

FIGURE 11.16

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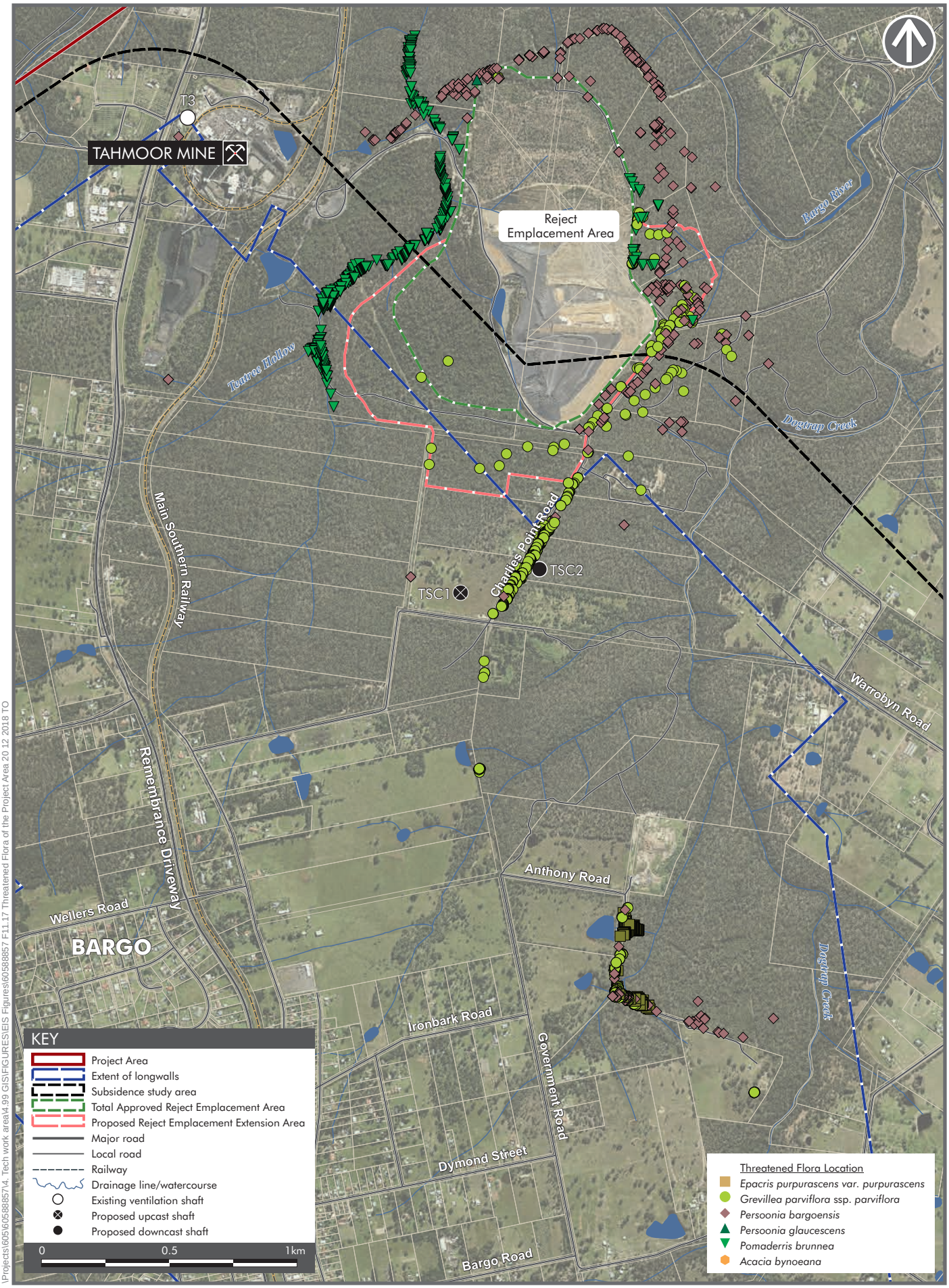

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SIMEC MINING

THREATENED FLORA OF THE PROJECT AREA

Tahmoor South Project
Environmental Impact Statement

FIGURE 11.17

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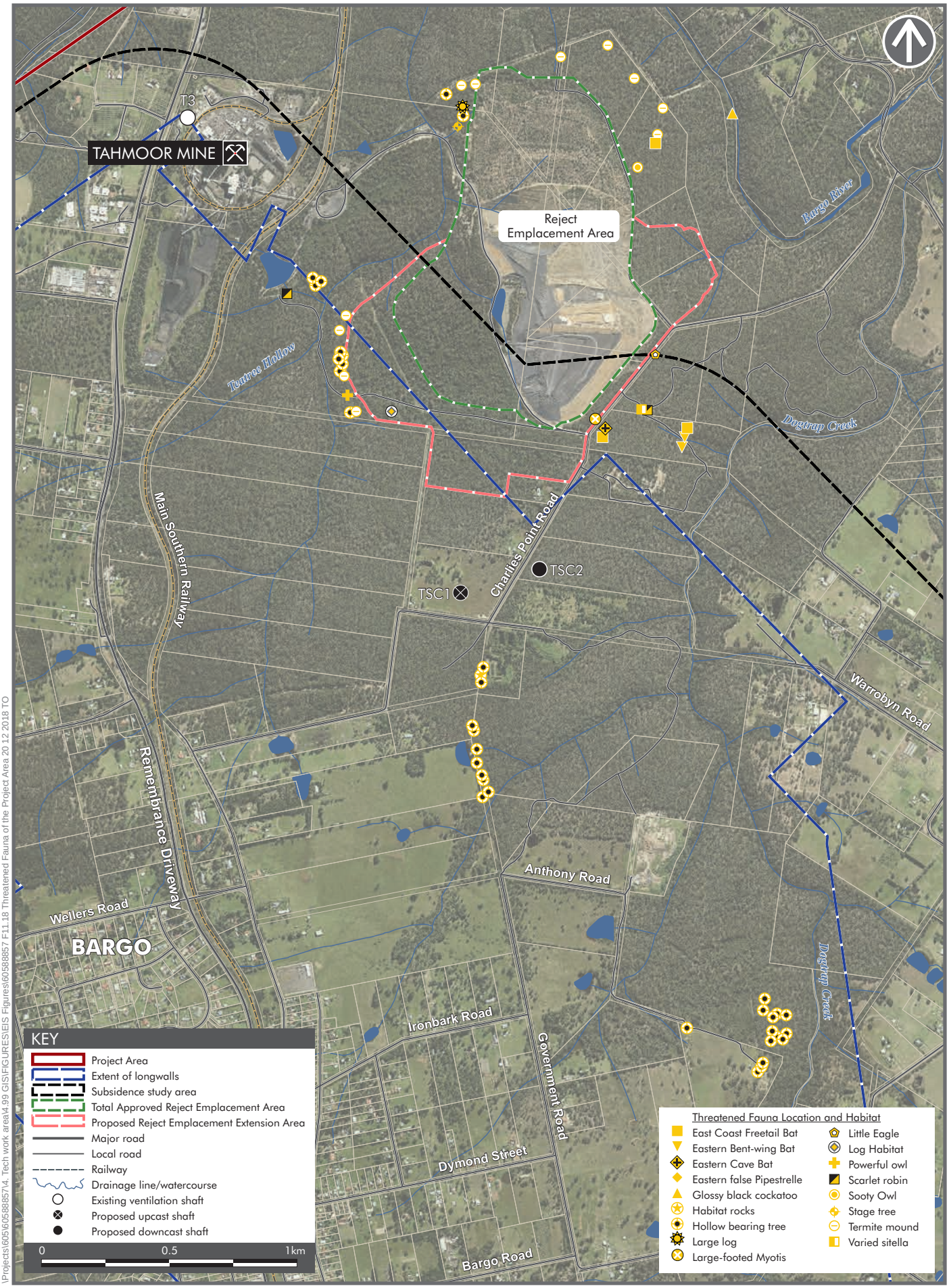


\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\EIS Figures\605888857 F11.18 Threatened Fauna of the Project Area 20 12 2018 TO

SIMEC MINING

THREATENED FAUNA SIGHTINGS WITHIN THE PROJECT AREA

Tahmoor South Project
Environmental Impact Statement

FIGURE 11.18

State Conservation Areas and National Parks

A number of State Conservation Areas and National Parks are located surrounding or partially within the Project Area as shown on **Figure 2.3**. Of these, the Upper Nepean State Conservation Area within the MSA comprises the only conservation area to be located within the study area along the south eastern boundary of the predicted subsidence limit. A summary of existing biodiversity records for these areas is provided in **Table 11-34**.

Table 11-34 Threatened communities and species within surrounding conservation areas

State Conservation Area or National Park	Known threatened communities, flora, fauna and habitat recorded within the conservation area (as noted in the Plans of Management for each area)
Upper Nepean State Conservation Area	- SSTF EEC; - *Grevillea parviflora subsp. Parviflora*; - *Epacris purpurascens var. purpurascens*; and - Potential habitat for the Red-crowned Toadlet and Giant Burrowing Frog.
Bargo State Conservation Area	- SSTF EEC; - Southern Highlands Shale Woodlands (SHSWs) EEC; - Grevillea parviflora subsp. Parviflora; - Persoonia hirsuta; - Persoonia glaucescens; - Gang-gang cockatoo; - Scarlet Robin; - Sooty Owl; - Koala; and - Potential habitat for the Broad-headed snake. It is also noted that the Bargo State Conservation Area is an integral part of the Bargo Linkage, a fauna habitat corridor in the Greater Southern Sydney Region which facilitates the movement of migratory species, nomadic species and other species that use sandstone habitat between the Woronora Plateau and Nattai Plateau, and ultimately the southern Blue Mountains.
Thirlmere Lakes National Park	- Australasian Bittern; and - Japanese Snipe (Gallinago hardwickii). Over 140 species of bush and water birds occur within the Park.
Nattai National Park	Over 22 listed threatened species have been recorded in the Park.

11.6.4 Impact Assessment

The impact assessment included consideration of potential construction and operational impacts which may result in direct or indirect impacts to vegetation communities and threatened species, such as clearing and subsidence related impacts. Key threatening processes likely to occur have been identified, and some Key Threatening Processes may be increased as a result of the proposed development.

A description of how the proposed development has been designed to avoid impacts to biodiversity where practicable is provided in **Section 11.6.1**.

Key Threatening Processes

The following Key Threatening Processes listed under Schedule 3 of the TSC Act most relevant to the proposed development (refer to **Appendix K**) are:

- alteration of habitat following subsidence due to longwall mining (resulting in potential impacts to threatened flora and fauna habitat and TECs);
- alteration to the natural flow regimes of rivers, streams, floodplains and wetlands (as a result of subsidence impacts);
- bush rock removal (as a result of all surface works);
- clearing of native vegetation (as a result of all surface works);
- loss of hollow-bearing trees (as a result of all surface works); and
- removal of dead wood and dead trees (as a result of surface works).

Vegetation Communities

Potential direct impacts to vegetation would occur as a result of the following:

- vegetation clearing for surface works including the expansion of the REA, construction of new ventilation shaft locations, and construction of the proposed car park; and
- subsidence impacts at the ground surface including surface cracking and impacts to watercourses and flow regime.

Vegetation Clearing

The proposed development will result in the clearance of a total of 49.2 ha of native vegetation. The majority of this vegetation consists of Shale Sandstone Transition Forest (SSTF) EEC (43.4 ha) as well as 5.7 ha of Upper Georges River Sandstone Woodland and 0.1 ha of planted vegetation that does not align to a mapped plant community type.

Most of the SSTF to be cleared is in a highly resilient and intact condition. This comprises: 26 ha classed as 'moderate/ good' and 11.8 ha classed as 'moderate/ good-medium'. The SSTF would be cleared for the REA expansion (34 ha) and ventilation shaft construction (9.4 ha).

Credits required to offset vegetation clearing impacts (comprising 43.4 ha of SSTF EEC and 5.7 ha of non-listed native vegetation) have been calculated using the BBCC and estimated at 2,246 credits for the SSTF and 287 credits for the Upper Georges River Sandstone Woodland community.

Subsidence Impacts

Subsidence from the Project may result in the following impacts to native vegetation:

- 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; and
- destruction/smothering of vegetation/tree fall by rock falls and/or slippage of earth and rocks down steep slopes.

Previous experience of mining in the Southern Coalfields indicates that vegetation dieback as result of gas emissions is a rare event. It has occurred previously on one occasion at the Tower Mine, over small areas at the base of the Cataract Gorge that had been directly mined beneath by Longwalls 10 and 14. These impacts were short term 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.

Plant communities that occur along the riparian zones of the study area include the Upper Georges River Sandstone Woodland and Hinterland Sandstone Gully forest communities. It is possible that some localised die back from gas emissions may occur to these communities where plants occur immediately above or adjacent to the point of gas emission. Given that the subsidence assessment has not predicted any significant gas emission releases along any of the water courses within the study area, it is expected that any impacts to plant communities would be limited in extent and temporal in nature. In addition, as for the sites previously affected by gas emissions, if it was to occur, the vegetation would be expected to 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 plant communities and habitat within the study area.

With respect to changes to riparian vegetation from fracturing related water flow and water retention impacts at watercourses, 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. It is considered likely that the vegetation along the watercourses is accustomed to periodically dry conditions. Given that the vegetation is not solely reliant upon groundwater for its survival, and the dry conditions currently experienced by riparian vegetation along watercourses within the study area, should water diversion occur as a result of subsidence, it is considered unlikely to result in significant alterations to the composition of the community or vegetation die back.

There is 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 Colliery Longwalls 22 to 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. Furthermore, rock falls can occur as natural events following major weather events and through natural stresses. Based on the above, 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 largescale slope failures are highly unlikely based on subsidence predictions.

Based on the above, significant subsidence related impacts are not considered likely on any vegetation community occurring within the subsidence limits of the study area, including the mapped EEC, SSTF. It is noted that this community was not identified within riparian vegetation mapped within the study area and as such would be of low risk from subsidence related water course changes or gas releases.

As noted in **Section 11.6.3**, it is possible that (previously unmapped) Cumberland Plain Woodland EEC may occur as small patches within some private properties throughout the study area outside of the verified surface infrastructure areas. However, the potential for direct impacts to this EEC from subsidence related changes are considered to be low given that this EEC occurs away from riparian areas, is not specifically groundwater dependant and as subsidence related vegetation changes have been assessed as being minor and localised. Any surface soil cracking within the EEC should it occur, is unlikely to result in any significant floristic or structural change to the community.

Indirect Impacts
Indirect impacts to vegetation include:

- introduction of weeds or introduction of native species into areas where they did not previously exist;
- introduction of diseases such as the introduced plant pathogen *Phytophthora cinnamomi*;
- dust, erosion and sedimentation of soils during construction which has the potential to reduce habitat quality;
- alteration of vegetation and habitat through increased fire risks during construction and operation of surface infrastructure (including the REA); and
- increased fragmentation, edge effects and loss of connectivity as a result of vegetation clearance.

The greatest risk for the potential spread of weeds as a result of the proposed development is associated with the expansion of the REA, which is located in relatively undisturbed vegetation. Weeds are not currently common in these areas and may be spread as a result of creating new access to these areas and from the use of machinery from more disturbed areas of the mine site or areas subject to agricultural land use (southern areas). This also has the potential to introduce/ spread disease. Weed and disease management measures would be incorporate into the Biodiversity Management Plan for the project to minimise and control the spread of weeds during construction and operation.

Construction activities for the expansion of the REA, ventilation shafts and surface facilities have the potential to increase dust generation, erosion and sedimentation which may impact habitat quality. Subsidence may also, to a lesser extent, contribute to increased erosion as a result of changes to slope, surface cracking and other deformations, in particular where these impacts may occur in watercourses. In addition operational activities including activities within the expanded REA would result in dust and noise generation that have the potential to impact on surrounding habitat and fauna. Impacts would be managed in accordance with relevant management plans to minimise nuisance emissions and comply with relevant project standards.

The construction and operation of surface activities may increase the risk of fire ignition and potential for bushfire. Bushfires are a natural occurrence to the ecosystem and are unlikely to significantly change habitat patterns in the long-term. However, consideration of increased risks from the proposed development suggests that risks are adequately managed within the existing Tahmoor Bushfire Management Plan.

Much of the habitat within the study area maintains a high level of connectivity. The proposed development has the potential to impact on connectivity due to fragmentation and edge effects as a result of direct vegetation clearance proposed for the expansion of the REA and construction of ventilation shafts and car park. Edge effects have been incorporated within the disturbance footprint and surface infrastructure would be progressively rehabilitated as mining progresses to minimise disturbance areas.

Threatened Flora

As a result of direct impacts to native vegetation communities, direct impacts to two threatened species previously recorded in the study area (refer **Section 11.6.3**) would occur as outlined in **Table 11-35**.

In addition, the subsidence related impacts discussed above 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 these areas. Of the threatened flora recorded within the study area, only *Pomaderris brunnea* was recorded within a gully habitat of the study area and potential subsidence related impacts are considered for this species in **Table 11-35**. The remainder of the recorded threatened flora were located away from the subsidence sensitive areas. Credits required to offset threatened flora impacts have been calculated using the BBCC and are included in **Table 11-35.**

Table 11-35 Direct impacts to threatened species

Species	Impacts of the proposed development	Credits required to offset
Grevillea parviflora subsp. parviflora	Removal of approximately 2,324 individuals for the surface infrastructure comprising: 2,312 from the core habitat area and a further 12 scattered plants outside of the core habitat area.	32,536
Persoonia bargoensis	Removal of approximately 100 plants for the REA and four plants from the ventilation shaft sites.	7,700
Pomaderris brunnea	No direct clearance of habitat. Subsidence related impacts are considered unlikely due to: - the section of Tea Tree Hollow Creek where the species was recorded being dry during much of the survey and monitoring period, indicating that the species can withstand natural drying events. This would indicate that changes to standing water levels as a result of subsidence is unlikely to result in significant die-back of this species; - the low likelihood of subsidence related gas emissions and the position of the plants away from the lowest point in the topography (should gas emissions occur), which would protect the species at the location from significants die-back; and - the low likelihood of major rock falls and there being no cliffs within this portion of Tea Tree Hollow.	None

Threatened Fauna

Potential impacts to threatened fauna include:

- death or injury of individuals;
- loss or disturbance of limiting foraging resources; and
- loss or disturbance of limiting breeding resources.

Based on previous recordings, survey results, literature reviews and habitat assessments, 55 threatened and migratory fauna were attributed a moderate to high likelihood of occurrence within the study area. A number of species were identified as having potential habitat 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 the 55 fauna species with a moderate to high likelihood of occurrence, the Red-crowned Toadlet, Large-eared Pied Bat, Large-footed Myotis, Eastern Cave Bat and Koala are considered the only species-credit fauna likely to occur within the study area.

The Project has been determined to have the following impacts to the following species-credit fauna:

- Koala (*Phascolarctos conereus*): Whilst not detected during the field survey, the Koala was assigned a high likelihood of occurrence given nearby records in the locality. Koala feed trees are associated with the vegetation communities to be cleared as part of the project. As such, the 43.5 hectares, comprising of the 'moderate/good' and 'moderate/good-medium' condition classes of SSTF and Upper Georges River Sandstone Woodland proposed to be cleared for surface infrastructure would require a biodiversity offset for this species. Given the localised and minor nature of subsidence related vegetation impacts, it was considered unlikely that Koala habitat or feed trees would be significantly impacted by subsidence;
- Red-crowned Toadlet (*Pseudophryne australis*): This species would not be impacted by direct clearing associated with the Project. The species was recorded within Hornes Creek which occurs on the far western portion of the study area. Based on subsidence predictions, there is a low likelihood that subsidence may reduce the number or holding capacity of pools within Hornes Creek, particularly since the creek would not be directly mined beneath. Given the low likelihood for impact, no offsets are proposed for this species;
- Large-eared Pied Bat (*Chalinolobus dwyeri*): Whilst this species was not detected during the site surveys, records for the species exist along the Nepean River outside the study area. It is likely given the proximity of records, that the species may utilise the study area for foraging habitat. Within the area proposed to be cleared for surface infrastructure, no breeding habitat features (such as caves, rocky crevices, old mine workings) would be removed. Based on past experience of mining within the Southern Coalfields, large scale rock instabilities are unlikely and as such subsidence related impacts to cliff lines used for roosting or breeding habitat are unlikely to be significant;
- The Large-footed Myotis (*Myotis macropus):* 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 on habitat surrounding waterways for roosting. Hollow-bearing trees, bridges, caves or artificial structures within 200 m of a riparian zone are considered areas of important habitat for the species. Portions of the proposed REA contain hollow-bearing trees that are within 200 m of Tea Tree Hollow Creek. The portion of habitat within 200 m of a riparian zone that would be removed as part of the development is 7.4 ha and this area of habitat would require offsetting. Based on subsidence predictions, changes to water capacity could occur at standing pools at Dog Trap Creek and Tea Tree Hollow, which could affect foraging habitat for this species. However, not all pools would be affected and subsidence could also generate ponding which could create foraging habitat for the Large-footed Myotis. Given this subsidence related changes are considered unlikely to disrupt the life cycle of the species such that the population would decline; and
- The Eastern Cave Bat (*Vespadelus troughtoni*): This species was recorded within the surface area footprint during targeted surveys (one recording on a single night). If a breeding colony was nearby, a greater detection of the species on the Anabat recorders would be likely. As such, it is considered unlikely that the vegetation to be cleared for the surface works contains important foraging or breeding habitat for the species. As with the other bat species discussed above, significant subsidence impacts are considered unlikely.

Credits required to offset threatened fauna impacts have been calculated using the BBCC and estimated as being 163 credits for the Large-footed Myotis and 1,131 credits for the Koala.

No fauna species listed under the Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA) and/or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) are likely to be significantly impacted by the proposed development.

State Conservation Areas and National Parks

Subsidence related impacts are not predicted to occur within Bargo State Conservation Area, Thirlmere Lakes National Park and Nattai National Park. Based on the relatively imperceptible impacts to the Thirlmere Lakes (compared to natural variability) concluded in the groundwater and surface water assessments (Hydrosimulations, 2018 and HEC, 2018), it is considered 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 such, impacts to the biodiversity values of the Thirlmere Lakes National Park are not anticipated.

As discussed in **Section 6.2.4** changes to the Mine Plan layout have significantly reduced the potential subsidence impacts to the Sydney MSA and Upper Nepean State Conservation Area. Further assessment and survey of sensitive heritage, geomorphological and ecological surface features was undertaken as part of baseline monitoring and preparation of this EIS. The results of this assessment have fed into an analysis of the risk of potential impacts to these sensitive surface features due to subsidence, and into the mine planning process, resulting in modification to the extent of longwalls and the location of ventilation shafts in these areas compared to previous versions of the Mine Plan.

Minimal subsidence impacts are predicted within the MSA and Upper Nepean State Conservation Area, which is located at the limits of subsidence predictions. No cliffs or watercourses are contained within the small portion of the conservation area within the subsidence limits of the study area. Cracking of soil within dry sclerophyll forest and woodland habitat is unlikely to result in any adverse impacts to flora or vegetation structure and as such, it is considered highly unlikely that the proposed development would result in any impact to conservation areas due to subsidence.

Matters of National Environmental Significance (MNES)

The proposed development was referred to the DoEE on 20 October 2017 (EPBC 2017/8084) for consideration as a controlled action, based on potential impacts to listed threatened species and communities, and water resources. It is noted that the referred proposal comprised the previously considered mine plan layout which included the Eastern Domain and additional mine ventilation shafts, which are no longer proposed (refer **Section 5.0** and **6.0**). The proposed development was determined to be a controlled action by DoEE on 12 January 2018, on the basis that it may impact the following MNES:

- Shale/Sandstone Transition Forest (SSTF) - a Critically endangered ecological community (CEEC) under the EPBC Act, identified within the surface facilities footprint including the proposed REA expansion area;
- Bargo Geebung (*Persoonia bargoensis*) - listed as vulnerable under the EPBC Act, which has also been identified within the footprint of the proposed REA expansion area;
- Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*) - listed as vulnerable under the EPBC Act, which has also been identified within the footprint of the proposed REA expansion area;
- Rufous Pomaderris (*Pomaderris brunnea*) - listed as vulnerable under the EPBC Act; and
- impacts to groundwater resources as a result of longwall mining (Water Trigger) (refer to **Section 11.3**).

In addition, the DoEE identified that there is some risk of significant impacts on the following matters and the levels of impact should be further investigated:

- Turpentine-Ironbark Forest of the Sydney Basin Bioregion – Critically Endangered;
- Woronora Beard-heath (*Leucopogon exolasius*) – Vulnerable;
- Koala (*Phascolarctos conereus*) – Vulnerable;
- Macquarie Perch (*Macquaria australasica*) – Endangered; and
- Greater Glider (*Petauroides Volans*) – Vulnerable.

A summary of the assessment of the MNES is provided in **Table 11-36**. Refer to **Appendix I** for further detail.

Table 11-36 Assessment of MNES

MNES	Assessment
Shale/Sandstone Transition Forest	An Assessment of Significance was undertaken (refer to Appendix 8 of **Appendix K**) which concluded a significant impact was likely. An offset has been provided (refer to **Section 11.6.5**).
Bargo Geebung (*Persoonia bargoensis*)	An Assessment of Significance was undertaken (refer to Appendix 8 of **Appendix K**) which concluded a significant impact was likely. An offset has been provided (refer to **Section 11.6.5**).
Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*)	An Assessment of Significance was undertaken (refer to Appendix 8 of **Appendix K**) which concluded a significant impact was likely. An offset has been provided (refer to **Section 11.6.5**).

MNES	Assessment
Rufous Pomaderris (*Pomaderris brunnea*)	An Assessment of Significance was undertaken (refer to Appendix 8 of **Appendix K**) which concluded that the proposed development would avoid direct impacts to the species.
Turpentine-Ironbark Forest of the Sydney Basin Bioregion	The ecological community does not occur within the study area.
Woronora Beard-heath (*Leucopogon exolasius*)	The species does not occur within the study area. An Assessment of Significance was undertaken (refer to Appendix 8 of **Appendix K**) which concluded a significant impact was unlikely.
Koala (*Phascolarctos conereus*)	The Koala was not recorded despite a targeted survey. An Assessment of Significance was undertaken (refer to Appendix 8 of **Appendix K**) which concluded a significant impact was unlikely. Regardless, an offset has been provided (refer to **Section 11.6.5**).
Macquarie Perch (*Macquaire australasica*)	An aquatic ecology impact assessment was completed for the Macquarie Perch (refer to **Section 11.7**).
Greater Glider (*Petauroides Volans*) – Vulnerable	The Greater Glider was not recorded despite a targeted survey. An Assessment of Significance was undertaken (refer to Appendix 8 of **Appendix K**) which concluded a significant impact was unlikely.

In addition to the species listed in the controlled action decision, Niche has also undertaken assessments of significance for additional Commonwealth listed species that have the potential to occur within the study area including: birds (Regent Honey eater Fork-tailed Swift, Great Egret, Cattle Egret and Rainbow Bee-eater, Satin Flycatcher, Swift Parrot), Large-eared Pied Bat, Broad-headed Snake, Grey-headed Flying Fox, *Acacia bynoeana, Persoonia glaucescens,* and *Persoonia hirsute*. The assessment of significance under the EPBC Act for each of these species is provided at Appendix 8 of the Biodiversity Assessment Report (refer to **Appendix K**).

11.6.5 Management and Mitigation Measures

In accordance with the NSW Biodiversity Offsets Policy for Major Projects and the FBA the proposed development has firstly utilised the principle hierarchy for impact avoidance and mitigation:

1) Avoid – unnecessary biodiversity impacts must be avoided where possible;

2) Minimise – where biodiversity impacts cannot be avoided by design or other preventative measures, then the impact must be minimised through mitigation measures and environmental safeguards; and

3) Offset – after all feasible measures have been undertaken to avoid or minimise impacts, offsets are to be used to compensate for any remaining impacts.

Avoidance

The proposed development has, in the first instance, avoided biodiversity impacts where possible. Avoidance of impacts to biodiversity has been achieved through:

- designing the extent of longwall mining to avoid the Bargo and Nepean River valleys to maximise protection of the natural features within these rivers and reduce potential for impacts to the biodiversity values associated with these rivers;
- the longwalls in the south of the study area have been re-designed to stand back from the Metropolitan Special Area (which includes the Upper Nepean State Conservation Area), and avoid impacts to Cow Creek, located within the Special Area. This will also avoid impacts to the Giant Burrowing Frog which was recorded during previous surveys along Cow Creek;
- no longer proposing longwall mining within the Eastern Domain resulted in the avoidance of potential subsidence impacts, including at Eliza Creek; and
- redesigning the REA (reducing the overall footprint) to avoid greater impacts to SSTF, *Persoonia bargoensis* and *Grevillea parviflora* subsp. *parviflora,* and to move the REA away from Tea Tree Hollow and the population of *Pomaderris brunnea.*

Mitigation

In order to minimise impacts to biodiversity as a result of the proposed development, impacts would be mitigated through the preparation and implementation of a Biodiversity Management Plan for the proposed development. The Biodiversity Management Plan would contain:

- native vegetation clearing protocol to:
  - define where clearing of native vegetation is to be undertaken or where native vegetation is to be retained;
  - specify methods of clearing of native vegetation, including approach for hollow-bearing trees; and
  - detail methods for pre-clearance surveys to identify biodiversity to be protected (including any threatened species) and allow fauna to escape.
- threatened species management measures including a map, list and description of all threatened species recorded in the vicinity of the surface infrastructure sites;
- weed management and disease prevention protocols; and
- other measures such as fire management and progressive rehabilitation of the REA to minimise fragmentation of vegetation.

An on-going monitoring program would be undertaken as part of the Biodiversity Management Plan for the proposed development. This program would include monitoring of potential flora and fauna impacts and would be implemented for as long as potential impacts could occur. Monitoring measures would include regular inspection, measures for response if impacts are detected, and monitoring of the success of mitigation.

In addition to the Biodiversity Management Plan, Tahmoor Coal will continue to implement a detailed ground disturbance permit procedure. Ground disturbance permits form part of Tahmoor Coal's EMS used to manage and reduce environmental impacts of activities covered by Tahmoor Mine's development consents, including impacts to flora and fauna. A ground disturbance permit is required for any surface disturbance work undertaken at Tahmoor Mine including slashing, tree lopping, removal of topsoil, clearing and access to rehabilitation areas. A ground disturbance permit requires approval from Tahmoor Coal's environment and community representative prior to works taking place.

Offset

The residual impacts of the proposed development will be offset in accordance with the proposed Tahmoor South Project – Biodiversity Offset Strategy (**Appendix K**). The Offset Strategy aims to develop an offset that satisfies both NSW and Commonwealth requirements. The package will:

- meet OEH's Principles for the use of biodiversity offsets in NSW;
- identify the conservation mechanisms to be used to ensure the long term protection and management of the offset sites; and
- include an appropriate management plan (such as vegetation or habitat) that has been developed as a key amelioration measure to ensure any proposed compensatory offsets, retained habitat enhancement features within the development footprint and/or impact mitigation measures (including proposed rehabilitation and/or monitoring programs) are appropriately managed and funded.

The Tahmoor South Project would impact on flora and fauna listed under both the BC Act and the EPBC Act, specifically with regards to:

- SSTF, listed as an EEC under the BC Act and EPBC Act (direct clearing of up to 43.4 ha);
- *Grevillea parviflora subsp. Parviflora* (Small-flower Grevillea), listed as Vulnerable under the BC Act and EPBC Act (removal of up to 2,324 individual plants);
- *Persoonia bargoensis* (Bargo Geebung), listed as Endangered under the BC Act and Vulnerable under the EPBC Act (removal of up to 100 individual plants);
- Large-footed Myotis listed as Vulnerable under the BC Act (removal of 7.4 ha of potential habitat); and
- Koala listed as Vulnerable under the BC Act (removal of 43.5 ha of potential habitat).

An Offset Strategy is proposed to achieve a long-term conservation gain for State and Commonwealth biodiversity, to offset residual significant impacts as a result of the Tahmoor South Project.

Not all impacts as a result of the proposed development would occur at once.

As vegetation clearing for the development would be staged, it is proposed that offsets be secured in a staged manner shown in **Table 11-37**.

Table 11-37 Staged offset credit requirements

Community or species	Credit Accruement		
	Stage 1 – Year 0	Stage 2 – Year 7	Total
SSFTF Shale Sandstone Transition Forest (Moderate/Good)	570	867	1,437
SSFTF Shale Sandstone Transition Forest (Moderate/good_medium)	-	599	599
SSFTF Shale Sandstone Transition Forest (Moderate good_derived)	210	-	210
Upper Georges River Sandstone Woodland community (Moderate/good)	-	287	287
Grevillea parviflora subsp. Parviflora	22,775	9,761	32,536
Persoonia bargoensis	7,392	308	7,700
Koala	403	728	1,131
Large-footed Myotis	-	163	163

Five sites have been identified to date within Tahmoor Coal landholdings which have potential to be offset sites. Detailed information on the sites is provided in **Appendix K**. These sites have been surveyed in accordance with BioBanking methodology to determine likely credits that would be generated, as summarised in **Table 11-38**.

Table 11-38 Credits generated from potential offset sites

Community or species	Potential for credits generated by Offset Sites							
	Credits Required	Pit Top	Rockford Road	Ventilation shaft No 2	Bargo Colliery	Anthony Road	Total	Credit Shortfall
Shale Sandstone Transition Forest EEC (*Narrow-leaved Ironbark - Broad-leaved Ironbark – Broad-leaved Ironbark -Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion*)	2,246	26	238	68	-	67	399	1,847

Community or species	Potential for credits generated by Offset Sites							
	Credits Required	Pit Top	Rockford Road	Ventilation shaft No 2	Bargo Colliery	Anthony Road	Total	Credit Shortfall
Upper Georges River Sandstone Woodland (*Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion*)	287	247	-	-	-	-	247	40
Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	0	57	49	-	242	-	348	0
Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	0	-	-	-	3,873	-	3,873	0
Acacia bynoeana	0	-	-	-	227	-	227	0
Epacris purpurascens var. purpurascens	0	36	-	-	-	-	36	0
Grevillea parviflora subsp. parviflora	32,536	149	-	71	226,611	-	226,831	0
Persoonia bargoensis	7,700	547	-	7	1,193	-	1,747	5,953
Persoonia glaucescens	0	-	-	-	398	-	398	0
Persoonia hirsuta	0	-	-	-	1,030	-	1,030	0
Pomaderris brunnea	0	1,001	-	-	320	-	1,321	0
Large-footed Myotis	163	212	-	-	213	-	425	0
Red-crowned Toadlet	0	-	-	-	19	-	19	0
Koala	1,131	212	-	-	1,917	-	2,129	0

Based on credits generated by the sites, there would be a shortfall of credits for the development as follows:

- shortfall of 1,847 credits for SSFTF;
- shortfall of 40 credits for Upper Georges River Sandstone Woodland community; and
- shortfall of 5,953 credits for *Persoonia bargoensis*.

A final decision on which combination of sites (and the extent of land) to be offered as part of the land-based component of the Offset Strategy, would be made by Tahmoor Coal. Offset sites would continue to be identified and refined during the approval process. Following the approval of the proposed development, the following actions would be undertaken by Tahmoor Coal:

- purchase credits that are available on the public register. Note: in order to satisfy the Commonwealth offset requirement for SSFT, only credits that meet the threshold criteria for the TEC as defined under the EPBC Act would be purchased;
- final layout of offset areas would be defined by Tahmoor Coal and formally established as a BioBank site(s), in consultation with OEH and DoEE regarding application, management actions and variation criteria (if required); and
- payment into the Biodiversity Conservation Fund if required in consultation with OEH and DoEE.

In relation to credit availability, a search of the BioBanking public register on 17 December 2018 shows that:

- there are 3,001 credits issued and a further 883 pending for SSTF (HN556);
- there are 1,131 credits issued and a further 221 pending for the Upper Georges River Sandstone Woodland community (HN564); and
- there are no credits available at present for Persoonia bargonensis.

11.6.6 Conclusion

The Terrestrial Ecology Assessment undertaken for the proposed development identified that potential impacts to terrestrial vegetation throughout the study area are not anticipated to be significant as a result of subsidence. Riparian vegetation is more susceptible to subsidence impacts. However, impacts are considered to be manageable.

Impacts to native vegetation (including SSTF EEC) will occur as a result of clearing necessitated by the expansion of the REA and the construction of other surface infrastructure. An Offset Strategy has been proposed to compensate for impacts to the SSTF EEC as impacts cannot be avoided. The Offset strategy would incorporate the following credits:

- 2,246 ecosystem-credits for the 43.4 ha of clearing impacts to SSTF;
- 287 ecosystem-credits for the 5.7 ha of clearing impact to the Upper Georges River Sandstone Woodland community;
- 7,700 species-credits for the removal of 100 *Persoonia bargoensis* plants;
- 32,536 species-credits for the removal of 2,324 *Grevillea parviflora subsp. parviflora plants*;
- 163 species-credits for the removal of 7.4 ha of potential habitat for the Large-footed Myotis; and
- 1,131 species-credits for the removal of 43.5 ha of potential Koala habitat.

Impacts to threatened species within the study area will be mitigated and managed through the implementation of a Biodiversity Management Plan and an on-going monitoring program.

11.7 Aquatic Ecology

An Aquatic Ecology Assessment was prepared for the proposed development by Niche Environment and Heritage Pty Ltd, and is provided in **Appendix K**. The Aquatic Ecology Assessment addressed the SEARs and Supplementary SEARs relevant to aquatic biodiversity impacts. These are listed in **Table 11-37**. SEARs relating to terrestrial ecology have been addressed in **Section 11.6**.

Table 11-37 SEARs for the assessment of aquatic biodiversity

Biodiversity SEARs	Section addressed
Biodiversity – including:	
• 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 s142(B)(1)(c) of the *Threatened Species Conservation Act 1995*, and having regard to OEH's requirements.	**Section 11.6** (terrestrial), **Section 11.7** (aquatic) and **Appendix K**
• a strategy to offset any residual impacts of the development in accordance with the NSW Biodiversity Offsets Policy for Major Projects.	**Section 11.6.5** and **11.7.5** and **Appendix K**
Biodiversity Supplementary SEARs	
Biodiversity	
• The EIS must identify each EPBC Act listed threatened species and community 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 impacts. For species and communities potentially located in the project area or in the vicinity that are not likely to be impacted, provide evidence why they are not likely to be impacted.	**Section 11.6.3, 11.6.4, 11.7.3** and **11.7.4** and **Appendix K**
• For each of the EPBC listed threatened species and communities likely to be impacted by the action the EIS must provide a separate: • description of the habitat (including identification and mapping of suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements 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 regard to the full extent of the species or community's range; • 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	**Section 11.6.3, 11.6.4, 11.7.3** and **11.7.4** and **Appendix K**

Biodiversity SEARs	Section addressed
activities to avoid and mitigate all impacts are taken into account; • A description of any offsets proposed to address residual adverse significant impacts and how these offsets will be established; • Details of how the current published NSW Framework for Biodiversity Assessment (FBA) has been applied in accordance with the objects of the EPBC Act to offset significant residual adverse impacts; and • 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.	
• Any significant residual impacts not addressed by the FBA may need to be addressed in accordance with the EPBC Act Environmental Offset Policy.	Residual impacts to ecology were not identified for the proposed development
• There is some risk that there may be significant impacts on the following matters and the level of impact should be further investigated: • Macquarie Perch (*Macquaria australasica*) – Endangered.	**Section 11.7.3** and **11.7.4** and **Appendix K**
Water resources, in relation to coal seam gas development and large coal mining development	
• The EIS should provide a description of the location, extent and ecological values of the identified water resources potentially affected by the project.	**Section 11.4.3, 11.6.3, 11.7.3** and **Appendix K**
• The assessment of impacts should include information on:	
• The habitat or life cycle of native species, including invertebrate fauna and fish species, dependent upon the water resource being seriously affected.	**Section 11.6.3, 11.6.4, 11.7.3** and **11.7.4** and **Appendix K**

11.7.1 Background

The Southern Coalfields Inquiry placed particular emphasis on aquatic ecosystems. Key recommendations of the Inquiry relevant to aquatic ecological investigations include:

- streams of 3rd order or above within the mine subsidence area should be considered as RMZs;
- a minimum of two years of baseline data, collected at appropriate frequency and scale should be provided for significant natural features; and
- monitoring of mine subsidence impacts should allow for back analysis and comparison of actual versus predicted effects and impacts, in order to review the accuracy and confidence levels of the prediction techniques used (i.e. the use of Before, After, Control, Impact design ecological studies (Underwood 1981)).

The Project Area has been subject to several previous monitoring and ecological survey efforts in order to obtain sufficient baseline data to inform the footprint of the proposed development. Previous studies and surveys include:

- Tahmoor South Pilot Study (2010-11), which involved a detailed literature review and field survey of the broader CCL 747 area. The outcomes of this study informed the detailed baseline monitoring program; and

- Tahmoor South Aquatic Ecology Monitoring Program (2012-13), which involved collecting two years of baseline data on aquatic habitat (including riparian vegetation), macroinvertebrates and fish in order quantify those ecological values which may be sensitive to subsidence impacts. This program has been completed and the data was used to inform the impact assessment for the proposed development, as well as monitor impacts during and after mining of the proposed development.

The aim of the Aquatic Ecology Assessment was to assess the potential impacts of the proposed development on stream ecology and aquatic threatened species, populations, communities or their habitats. The assessment addresses the impacts of subsidence from underground coal mining as well as discharge generated from the REA and surface facilities.

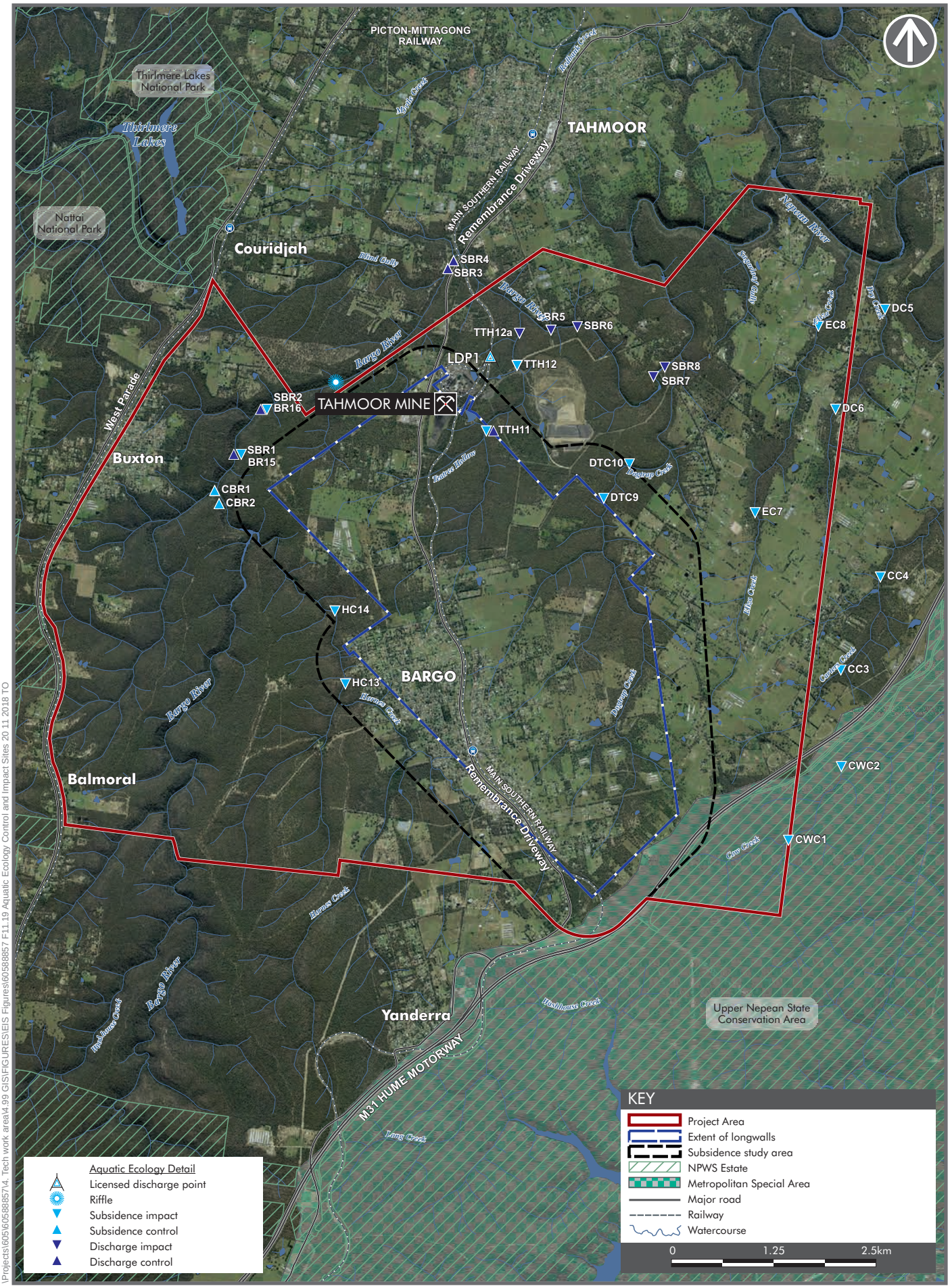
11.7.2 Methodology

The Aquatic Ecology Assessment was prepared by Niche Environment and Heritage Pty Ltd (2018) and included:

- Desktop review of background information, including:
  - A search of public databases including EPBC Act Protected Matters Search Tool (10 km search area), the OEH Bionet Atlas of NSW Wildlife (10 km search), and the Department of Primary Industries (DPI) threatened and protected species records viewer and spatial data portal (Hawkesbury-Nepean CMA and Wollondilly LGA) for species listed under the *Fisheries Management Act 1994* (FM Act); and
  - Review of previous studies within and surrounding the Project Area, including studies undertaken by Niche Environment and Heritage Pty Ltd as part of the Tahmoor two year baseline monitoring program.
- Defining subject species and affected species for further assessment.
- *Subject species* are defined as threatened species, populations or ecological communities which have been recorded or are considered to have important habitat features within 10 km of the Project Area as defined by the EPBC Act Protected Matters Search Tool, the Atlas of NSW Wildlife or DPI records viewer;
- *Affected species* are defined as subject species (including populations or ecological communities) which are known to occur or have a reasonable likelihood of occurrence and which may be impacted by the proposed development; and
- Five categories for 'likelihood of occurrence' (None, Low, Moderate, High, Known) were attributed to subject species to determine *affected species* after consideration of criteria such as known records, presence or absence of important habitat features on the subject site, and results of the field surveys. Species considered further in formal assessments of significance pursuant to relevant legislation were those in the 'Known' to 'Moderate' categories and where impacts for the species could reasonably occur from the development.
- Identifying monitoring sites (control and impact sites) for baseline monitoring. For the purpose of aquatic ecological assessment, monitoring points were selected in streams of 2rd order or above, as 1st order waterways within the Project Area were observed to have relatively small catchments, lower energy (and sediment transport), few pools (if any) and fewer areas of exposed bedrock features and therefore of low geomorphic and aquatic biota risk. The control sites and impact sites identified for monitoring and survey are shown on **Figure 11.19** and further details of monitoring locations are provided in Section 3.4 of **Appendix K**:
- Subsidence impact monitoring locations: Four potential impact watercourses within the Project Area (Dog Tap Creek, Tea Tree Hollow, Hornes Creek, Bargo River) and eight ecologically comparable creeks within and outside of the Project Area (control locations) (Cow Creek, Carters Creek, Dry Creek, Eliza Creek, Bargo River tributary, Moore Creek, Cedar Creek, Stonequarry Creek) were selected for monitoring, with two sampling sites at each location; and
- Discharge monitoring locations: two downstream potential impacts locations and two upstream control locations were monitored at Tea Tree Hollow and Bargo River.
- Field survey was undertaken in accordance with the *Australian River Assessment System (AUSRIVAS) Sampling and Processing Manual* (Turak et al 2004) and to address the recommendations of the Southern Coalfields Enquiry (refer **Section 11.7.1**). Surveys and monitoring were undertaken over a two year period in 2012/13. The surveys undertaken for the proposed development included:
  - Habitat assessment based on description of each survey site including description of topography, presence, extent and condition of riparian and aquatic vegetation, presence of fish habitat, stream level and width, instream features and stream substrate. A photo was taken at each site;

- Riparian, Channel and Environmental Inventory assessment (Chessman et al., 1997) of each survey site. This involved producing a score for each site based on a series of observations relating to the natural characteristics and degree of disturbance evident at each site, including recording changes to these characteristics;
- Surface water quality sampling to measure temperature, conductivity, pH, oxidation-reduction potential, dissolved oxygen and turbidity. Sampling results were compared to ANZECC guidelines (2000);
- Fish, macrophyte and aquatic macroinvertebrate sampling. Fish sampling using bait traps was undertaken at subsidence and surface works monitoring sites. In addition, any fish captured as part of the macroinvertebrate sampling were recorded. The presence/absence of macrophytes within a 100 m reach at each sample site was recorded and identified to species level. Aquatic macroinvertebrates were collected using both the AUSRIVAS protocol for NSW streams (Turak et al.2004), and quantitative method for surveying macroinvertebrates. (Note: AUSRIVAS utilises modelled reference stream for comparison of macroinvertebrate fauna, and as such the control watercourse monitoring sites were not utilised for the purposes of AUSRIVAS monitoring). Macroinvertebrate samples were analysed using the AUSRIVAS spring and autumn models for NSW pool edge habitat to identify the species expected to occur at the sites based on observed habitat conditions in the absence of environmental stress, such as pollution or habitat degradation; and
- Targeted surveys were undertaken for the threatened Sydney Hawk Dragonfly (*Austrocordulia leonardi*) on 24 - 26 July and 31st July - 2 August, 2013. The survey primarily targeted tributaries of the Bargo River and Nepean River, since Austrocorduliidae (the Sydney Hawk dragonfly family) were observed in Eliza Creek in baseline monitoring samples. Potential habitat for the species was determined based on geomorphology mapping (Fluvial Systems, 2013) and GIS modelling.

- Assessment of potential impacts to aquatic habitat and biota including threatened aquatic species within the Project Area as a result of subsidence impacts to watercourses and mine water discharge, including an Assessment of Significance for potential impacts to the Sydney Hawk dragonfly;
- Assessment of potential impacts to stygofauna (groundwater) and hyporheic fauna (streams) in a Stygofauna Assessment (provided in **Appendix K**). Risks and potential impacts to stygofauna and hyporheic fauna as a result of the proposed development were assessed in accordance with the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (Serov *et al*, 2012), and included sampling of 26 sites (separated into 13 bores and 13 hyporheic sites) (Refer **Figure 11.20**). GDEs listed on the *Water Sharing Plan for the Greater Metropolitan Regional Groundwater Sources 2011* are assessed in **Section 11.3.4**; and
- Recommendations for avoidance, mitigation and offsets for potential impacts on aquatic ecology.



\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\EIS Figures\605888857 F11.19 Aquatic Ecology Control and Impact Sites 20 11 2018 TO

SIMEC MINING

AQUATIC ECOLOGY - CONTROL AND IMPACT SITES

Tahmoor South Project
Environmental Impact Statement

Source: Niche Environment and Heritage (2013)

FIGURE 11.19

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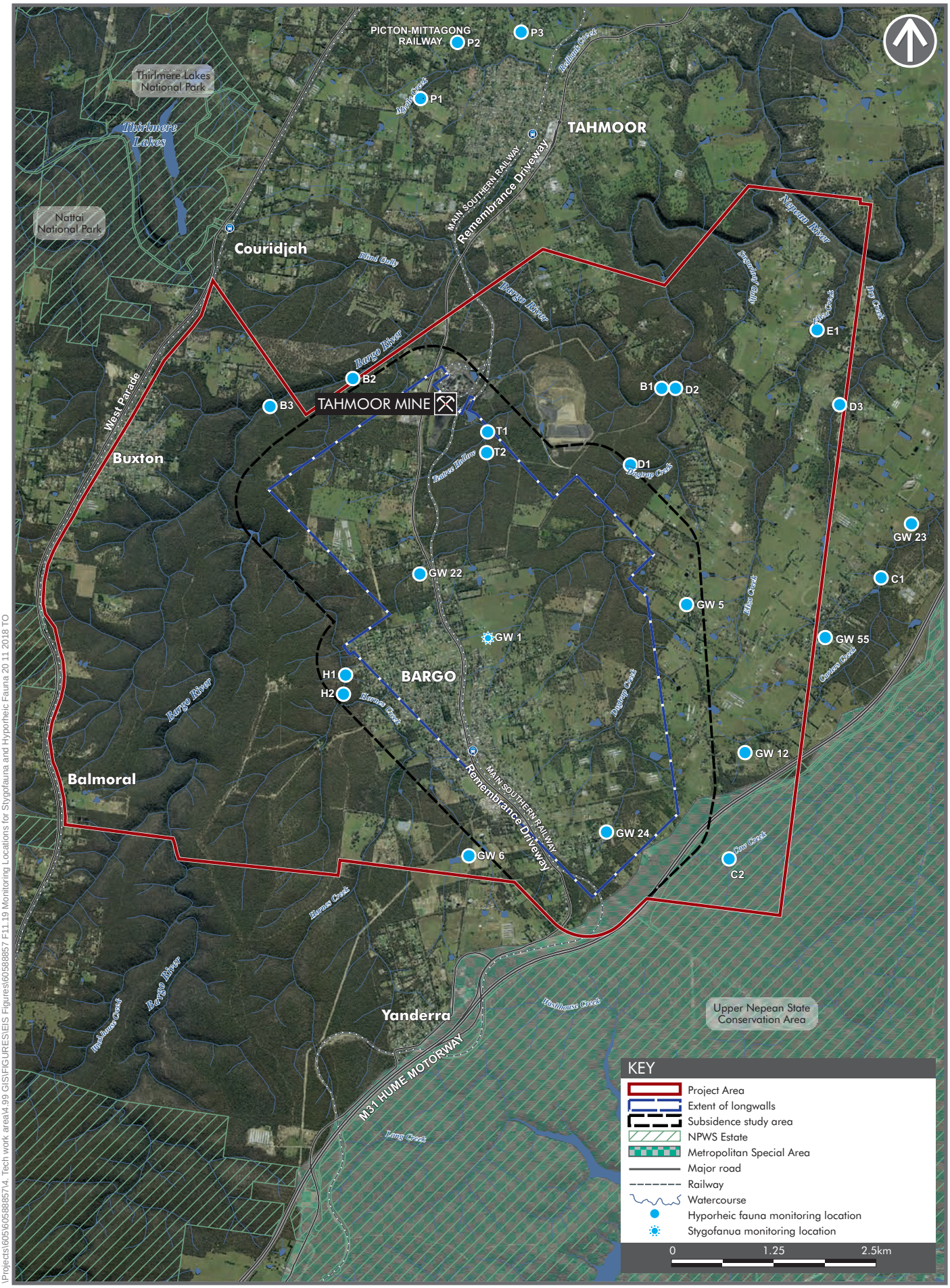

\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\EIS Figures\605888857-F11.19 Monitoring Locations for Stygofauna and Hyporheic Fauna 20 11 2018 TO

SIMEC MINING

MONITORING LOCATIONS FOR STYGOFAUNA AND HYPORHEIC FAUNA

Tahmoor South Project
Environmental Impact Statement

Source: Niche Environment and Heritage (2013)

FIGURE 11.20

11.7.3 Existing Environment

The geomorphology of watercourses within the Project Area is described in **Section 11.2** (and **Appendix H**), and the surface water impact assessment is described in **Section 11.4** (and **Appendix J**). These sections provide the background to the stream environment within which aquatic species and habitat may exist. The presence of riparian vegetation, aquatic habitat and aquatic species are reliant on varying stream features (e.g. pools, rock bars) and substrates (e.g. cobble, gravel, mud), as well as water quality (e.g. turbidity, pH, etc.). Geomorphological features of relevance to the aquatic environment are shown on **Figure 11.7**.

Riparian Vegetation

The riparian vegetation around Bargo River is dominated by Hinterland Sandstone Gully Forest. This vegetation community also occurs around Hornes Creek, Dog Trap Creek and Cow Creek. Cumberland SSTF is mapped along parts of Eliza Creek, Dry Creek and Carters Creek, while areas of Sydney Hinterland Transition Woodland occur predominantly along Eliza Creek and Dog Trap Creek (Tozer 2010).

Lomandra longifolia extensively colonises the low-level areas of all potential impact streams within the Project Area. Potential impacts of the proposed development on riparian vegetation are discussed in **Section 11.6.4**.

Aquatic Habitat and Biota

Streams within the Project Area are base flow GDEs and contain both surface and hyporheic (below river surface) habitats (**Appendix K**). It is considered that pools and riffle sections common to 1st and 2nd order creeks are likely to provide important macroinvertebrate habitat and fish refuge, whereas higher order streams are typically broader and are likely to provide habitat for larger fish species (NSW DoP, 2008). There are eight named creeks within the Project Area, ranging in order from 1st order to 4th order creeks (based on the Strahler river classification system) as identified in **Table 11-22** of **Section 11.4**. Descriptions of the aquatic habitat and habitat condition of these eight creeks ascertained through the field monitoring and survey is provided in **Appendix K**.

The majority of the creeks within the Project Area have a high percentage of bedrock and boulders instream. Habitat attributes within these creeks included pools with bank overhang and trailing bank vegetation, rock bars, small waterfalls and sections of dry bed dominated by *L. longifolia* and boulders. Hornes Creek and Tea Tree Hollow exhibited orange discolouration of the water, iron flocs and algae. Macrophytes were uncommon and many of the creeks contained freshwater yabbies *Cherax destructor*, freshwater shrimp *Paratya australiensis* and Mosquito Fish *Gambusia holbrooki*. Crofton Weed *Ageratina adenophora*, which is a Class 4 noxious weed under the NSW *Noxious Weeds Act 1993*, was present at Carters Creek and Tea Tree Hollow.

Macrophytes

Macrophytes are aquatic plants that provide food and shelter for fish, aquatic invertebrates and water birds. Submerged and floating macrophytes generally require permanent water; however they can, in time, recolonise dry areas if and when water levels return. At potential impact monitoring sites, sedges and rushes such as Spiny-head Mat-rush, *S. melanostachys*, Saw Sedge *G. clarkei, C. appressa* and *C. gracilis* were common and in some cases very dominant along creeks. However, the overall abundance, diversity and distribution of macrophytes recorded during aquatic monitoring surveys in the Project Area was low. Macrophytes recorded during surveys for the proposed development included:

- Spiny head Mat Rush;
- *S.melanostachys*;
- Saw Sedge *G. clarkei*;
- *C. appressa*;
- *C. gracilis*;
- Floating pond weed *Potamogeton sulcatus*;
- *Typha orientalis* and *Typha domingensis*;
- Slender knotweed *Persicaria decipiens*;
- Tall Spikerush *Eleocharis sphacelata*; and
- Jointed twig rush *Baumea articulate*.

Fish

A number of common and exotic fish species are present within the Project Area. Those recorded during the monitoring and survey of watercourses within the Project Area included:

- Mosquito Fish (*Gambusia holbrooki*) which was recorded in all waterways surveyed except Cow Creek;
- Firetail Gudgeon (*Hypseleotris galii*) which was recorded in Dry Creek;
- Common Jollytail (*Galaxias maculatus*) which were recorded in Hornes Creek and Eliza Creek;
- Australian Smelt (*Retropinna semoni*) which were recorded in Bargo River;
- Mountain Galaxias (*Galaxias olidus*) which was recorded in Hornes Creek;
- Freshwater crayfish (*Euastacus spinifer*) which were recorded in Hornes Creek;
- Freshwater Yabbies (*Cherax destructor)* which were recorded in all creeks within the Project Area; and
- Common freshwater shrimp (*Paratya australiensis)* which were recorded in all creeks within the Project Area.

Key Fish Habitat

Based on Key Fish Habitat mapping prepared for LGAs including Wollondilly (DPI, 2013c), sections of the following waterways within the Project Area (3rd order streams and above) have been mapped as Key Fish Habitat:

- Bargo River;
- Hornes Creek;
- Tea Tree Hollow;
- Dog Trap Creek;
- Eliza Creek;
- Carters Creek; and
- Cow Creek.

The Project Area has 3rd order streams and above which contain both:

- highly sensitive Key Fish Habitat (Type1) - “Freshwater habitats that contain in-stream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or 3 m in length, or native aquatic plants” (DPI 2013a); and
- minimal Key Fish Habitat (Type 3) - “Ephemeral aquatic habitat not supporting native aquatic or wetland vegetation” (DPI 2013a).

Macroinvertebrates

Macroinvertebrate fauna recorded at subsidence monitoring sites within the Project Area were generally comparable to AUSRIVAS modelled reference sites (Band A). However, at times, Bargo River, Tea Tree Hollow, Hornes Creek and Dry Creek scores lowered to Band B, possibly indicating impairment to macroinvertebrate communities at given times. The majority of sampling points at Bargo River indicated significantly impairment (Band B).

Watercourses within the Project Area generally recorded scores equivalent to moderate to severe pollution. It is noted that the scores are reflective of the dominance of pollutant tolerant species and can occur with the absence of pollution, if the waterway is subject to natural environmental stressors such as low rainfall/flow. Watercourses consistently recording high AUSRIVAS scores include Bargo River, indicating moderate pollution.

The dominant Macroinvertebrates recorded in watercourses within the Project Area include *Leptophlebiidae* (may fly) and *Chironomidae*, *Tanypodinae*, *Othocladinae* (non-biting midges), *Oligochaeta* (worm) larvae and *Leptoceridae* (caddis fly).

Threatened Aquatic Species

Database searches identified four threatened aquatic species with the potential to occur within 10 km of the Project Area (**Table 11-38**). Of these, only the Sydney Hawk dragonfly is considered to have potential habitat within the Project Area. However, the Sydney Hawk dragonfly was not recorded during targeted surveys conducted in July / August 2013.

Table 11-38 Threatened aquatic species recorded within the locality and likelihood of occurrence within the Project Area

Scientific Name	Common Name	Status	Likelihood of occurrence
Austrocordulia leonardi	Sydney Hawk dragonfly	Endangered (FM Act)	Moderate. Potential habitat occurs in the Bargo/Nepean River. Not recorded in targeted surveys.
Archaeophya adamsi	Adam's Emerald dragonfly	Endangered (FM Act)	Low. Only one potential riffle habitat located which will not be impacted by the proposal.
Petalura gigantea	Giant Dragonfly	Endangered (BC Act)	Low. No suitable habitat.
Macquaria australasica	Macquarie perch	Endangered (EPBC Act, FM Act)	Low. Potential habitat occurs in the Bargo/Nepean River outside of the Project Area only (barrier to fish passage at Mermaid Falls).

Stygofauna

Stygofauna (groundwater) and hyporheic fauna (streams) exist in small isolated populations within the Project Area (**Figure 11.20**):

- Stygofauna (hyporheic fauna) were recorded at seven of the stream sampling sites from the 13 sampled. Hyporheic fauna were recorded at all river sites that were supported by a perennial base flow but were low in diversity and abundance. Fauna recorded was dominated by surface macroinvertebrates, but also included ostracods and worms associated with aquifer environments; and
- Stygofauna were recorded at only one groundwater bore site (GW1 on Great Southern Road) from the 13 sampled.

Upland swamp complexes are known to support habitat for abundant levels of stygofauna. The nature of the geology, sediments and lack of fracture zones; as well as the hilly/sloping topography of the Project Area reduces the occurrence of upland swamp complexes (no upland swamps were identified in the Terrestrial Ecology Assessment, **Section 11.6**). It is considered that the limited diversity and abundance of stygofauna in the Project Area is due to the limited available stygofauna habitat associated with upland swamps. Further, in addition to the limiting geomorphology characteristics, the Stygofauna Assessment concluded that the diversity of the stygofauna composition is also limited by stream and groundwater water chemistry (i.e. very low levels of groundwater dissolved oxygen, high levels of dissolved iron, lower pH levels ranging from approximately 6-4 pH units), and the small, transient, disconnected nature of the riverine hyporheic zone habitats.

11.7.4 Impact Assessment

Potential impacts typical of longwall mining relevant to aquatic ecology relate to changes to stream geomorphology and hydrology and include the following:

- fracturing and surface water flow diversion;
- increased levels of ponding;
- changes to water quality as a result of:
  - subsidence induced fracturing; and
  - mine water discharge impacts.

Significant subsidence movements are not predicted at the Nepean River (outside the SSA) and the Bargo River (4^{th} order, 165 m section within the SSA) and these rivers would not be undermined, indicating that the quality and quantity of available aquatic habitat is unlikely to be impacted. However, potential impacts to aquatic habitat within the creeks located within the Project Area may occur as a result of subsidence impacts on surface water, as described in the sections below.

Fracturing, Surface Water Diversion and Draining of Pools

Fracturing resulting in surface water flow diversion is considered likely to occur for streams that are directly mined beneath by the proposed development. This fracturing also has the potential to drain or change levels in pools along creeks. It is not possible to predict the precise locations where fracturing would occur due to the proposed development or the flow capacity of subsurface fracture networks. However, analysis of past observations by MSEC (2018) indicates that some of the main factors that contribute to the fracturing of pools relate to the characteristics of the valley that the pool is located within including:

- pre-existing levels of stress in the valley floor;
- depth and shape of the valley;
- presence of rock bars and perennial pools and the presence and mobility of alluvium; and
- the geological characteristics of the valley.

A risk assessment for the potential fracturing of pools was undertaken based on the preliminary relationship between valley characteristics and potential fracturing that has been established by MSEC (2018). Areas within the Project Area identified as medium to high risk of impacts to pools include portions of Tea Tree Hollow and Dog Trap Creek. Mapped pools within these watercourses and potential subsidence impacts to these pools are listed below:

- Tea Tree Hollow: There were 14 mapped pools in Tea Tree Hollow and most of these pools are located in areas where there is a low risk of impact to pool levels. Two pools are located within an area of moderate risk of impact; and
- Dog Trap Creek: There were over 70 pools mapped in Dog Trap Creek. The majority are located in areas of low risk of impact to pool areas and 14 pools are located in areas of either moderate or high risk.

Overall, the assessment indicates that there would be a moderate or high risk (of losing water holding capacity) to around 19% of the mapped pools within these watercourses (MSEC, 2018). However, it should be noted that experience has shown that over time, pools tend to recover naturally from fracturing due to sealing by deposited fine sediment (Tahmoor Colliery, 2004, Centennial Tahmoor, 2005, Centennial Coal, 2006, Centennial Coal, 2007, Xstrata Coal, 2008).

Sudden drainage of pools or rapid drops in stream flow can result in changes to abundance, richness, and diversity of aquatic biota and possibly mortality of macroinvertebrates and native fish. Streams with soft sediment banks which retain moisture are likely to prolong survival (through protection from desiccation) compared to streams with bedrock substrate with limited natural refugia.

There is capacity for recovery of some stream biota, particularly macroinvertebrate fauna, as most taxa identified within the Project Area are able to adapt to drying conditions and have the potential to recruit back to pools once re-established. However, fauna with limited distribution and poor dispersal are not as adaptable and would be most impacted. Fish may be limited in their capacity to re-establish if river connectivity is reduced; however connectivity is likely to be re-established in periods of higher flow, allowing fish movement. Submerged and floating macrophytes generally require permanent water; however can, in time, recolonise dry areas when water levels return. It is noted that no threatened aquatic species have been identified as likely to be impacted within the Project Area and this is further discussed below. Should long term drainage impacts occur (where pools become permanently dry or reduce holding capacity), permanent changes to stream biota within the pools could occur as well as restrictions to the recovery of aquatic species that depend on stream connectivity (e.g. fish). Mitigation measures to monitor long term impacts and rehabilitate affected streams should impacts occur are outlined in **Section 11.7.5**.

For invertebrates, while there will be loss of habitat in sections of streams, and changes to invertebrate composition, density and family richness where these impacts occur; at a sub-catchment to catchment scale changes to overall assemblage and family richness are unlikely to be measurable.

A variety of possible remediation options would be considered when surface water diversion and draining of pools have the potential to have a substantial impact on aquatic ecology, as discussed further in **Section 11.7.5**. These could include one or a combination of the following:

- allowing natural sealing to occur over time;
- mechanical grouting of cracks and voids to promote surface flow; and
- the addition of sealers and/or binders to water flow to seal cracks and voids.

Increased Ponding

While the potential for increased scouring is not expected to be significant within the Project Area, there is a predicted reversal of grade along a naturally flat section of Dog Trap Creek, upstream of the tailgate of LW103, which results in increased potential for ponding in an area which is estimated to be up to 0.2 m deep and 150 m long. Increased ponding would provide a localised increase in available habitat for aquatic macroinvertebrates. Should an increase in ponding occur, and these ponds maintain connectivity to the streams, there may also be increased localised habitat for fish and macrophytes.

Changes to Water Quality

Changes to water quality may also impact the quality of aquatic habitat. Potential impacts to water quality could result from the liberation of contaminants from surface fractures causing localised increases in iron and other minerals. Scouring may also increase turbidity and suspended solids. These subsidence-related impacts could affect biota in Tea Tree Hollow and Dog Trap Creek and downstream watercourses. Impacts may be observed through a reduction in abundance, richness and changes to invertebrate community composition such as *Leptophlebiidae* (Mayfly). However, potential impacts to aquatic fauna are likely to be localised, and fauna are able to recover from transient spikes in concentrations (Niche, 2018).

Mine water discharge has the potential to elevate concentration levels of dissolved salts and metals and can pose environmental risks to aquatic biota. Elevated concentrations in metals can reduce abundance and diversity of macroinvertebrates. Barium precipitate was observed at the Tea Tree Hollow discharge point, which is thought to impact on benthic macroinvertebrates by smothering substrate and thereby limiting habitat and the availability of food resources. It is noted that the potential effect of discharges decrease with increasing distance from the source and would be diluted during periods of high flow.

As described in **Section 3.4.3** a waste water treatment plant (WWTP) was constructed at Tahmoor Underground Mine in June 2015. The purpose of the plant is to treat up to 6 ML/d of mine water to reduce the concentrations of Arsenic, Nickel and Zinc in the water discharged from the mine from the LDP1, with the treatment objectives set by a Pollution Reduction Program (PRP 22) on the EPL. During commissioning of the WWTP, it was found that the complex water chemistry of the underground mine waters was buffering chemical reactions in the treatment processes preventing the effective removal of metals. As such a range of upgrades to the WWTP were proposed and are currently being implemented. The PRP 22 was extended until November 2018.

Increases in heavy metals in mine water discharge are not predicted from the proposed development and it is expected that the commissioning of the upgraded WWTP (as part of PRP 22) will reduce concentrations of heavy metals from mine water discharge and also reduce barium precipitation. Completion of the program would most likely result in enhanced water quality in Tea Tree Hollow and the Bargo River downstream and thus improved habitat for primary producers and aquatic fauna. Within nine months of the WWTP recommissioning, an aquatic health assessment would be undertaken at Tea Tree Hollow and the Bargo River to confirm aquatic health in accordance with the requirements of PRP 26.

An investigation was undertaken by Cardno (2016) as part of PRP 23 to evaluate potential impacts to aquatic ecology from electrical conductivity (EC)/ salinity levels at the licensed discharge point at Tea Tree Hollow. The PRP 23 investigation found localised effects to aquatic ecology at Tea Tree Hollow and Bargo River, downstream of the licensed discharge point, comprising a reduction in pollution sensitive invertebrates and an increase in pollution tolerant invertebrates. The study found the effects of the discharge to be localised within a few km downstream of the discharge point and not excessive in the context of a system modified by other anthropogenic land uses. Whist EC levels at LDP1 were found to be elevated, the PRP investigation considered the levels to not be excessive and within the reported tolerances of many aquatic biota present in Tea Tree Hollow and the Bargo River. Additionally, EC levels at the Bargo River were found to be more influenced by background levels of EC and flow levels at the Bargo River compared to EC levels from discharge at LDP1. Based on the PRP investigation, changes to the existing licence limit for EC / salinity were not considered beneficial with respect to aquatic health.

The Water Management System and Site Water Balance Report indicated that the proposed water management system would have capacity to contain water on site and capacity to manage off-site releases within conditions of the EPL 1389 until at least 2031.

In order to maintain treatment of water to be discharged via LDP1, it is anticipated that the capacity of the WWTP will need to be upgraded at some stage after 2031. The WWTP would be upgraded as required to meet mine water treatment demand post 2031 to ensure that licensed discharge limits at LDP1 are met (see **Section 11.4.6** for further information).

Mine discharge water from the proposed development would be subject to existing EPL discharge limits with respect to EC/salinity. As such impacts to downstream water quality and aquatic ecology beyond existing levels are not expected to occur.

Key Fish Habitat

As identified in **Sections 11.1 – 11.4**, the proposed development has the potential to impact on waterways within the Project Area through subsidence related changes to stream processes and changes to stream flow, with consequent impacts to aquatic habitat. This includes sections of waterways mapped as Key Fish Habitat within the Project Area, particularly in areas along Dog Trap Creek and Tea Tree Hollow. Monitoring programs would be implemented to identify stream changes and undertake remediation measures where required. If monitoring indicates impacts to sections of waterways mapped as Key Fish Habitat, DPI Fisheries would be consulted to identify appropriate habitat rehabilitation measures and/or if environmental compensation (such as habitat replacement measures) are required. Any conditions will be incorporated into the monitoring and management of the waterways and key fish habitat. As part of the development of the required Extraction Plan and associated management plans for the Project, a TARP will be prepared, which will incorporate appropriate triggers, monitoring regimes and appropriate actions for key fish habitat in the Project Area.

Threatened Aquatic Species

The Sydney Hawk dragonfly was assessed as having a moderate likelihood of occurrence as potential habitat may occur within the Bargo and Nepean River. This species was subject to targeted survey. All pools with a predominantly boulder and/or cobble substrate were defined as containing potential habitat for this species and based on geomorphic mapping, a total of 29 potential habitat sites were identified within the Project Area. These sites were surveyed with two of the sites found to be dry and the remaining 27 sampled. No specimens of Sydney Hawk dragonfly were recorded during the site survey. Whilst specimens of the family *Austrocorduliidae* (to which the Sydney Hawk dragonfly belongs) were recorded at Eliza Creek, these were confirmed as the non-listed *Austrocorduliidae refracta* species. *A. refracta* can inhabit smaller streams whereas the Sydney Hawk Dragonfly is thought to be restricted to larger streams in coastal areas (Theischinger 2013). Therefore the presence of *A. refracta* does not necessarily indicate suitable habitat for the Sydney Hawk dragonfly. Larger watercourses within the Project Area, such as the Bargo and Nepean River, which could provide potential habitat for this species, are unlikely to be impacted by subsidence. An Assessment of Significance was undertaken for the Sydney Hawk dragonfly and determined the proposed development is unlikely to have a significant impact on this species.

The EPBC Act protected matters search tool reported the Macquarie Perch within a 10 km radius of the Project Area. The creeks within the Project Area have been assessed as having 'None' to 'Low' likelihood of containing Macquarie Perch habitat, based on available habitat being highly fragmented with rock bars and other barriers to fish movement, and the ephemeral nature of the 1st and 2nd order streams within the Project Area. The creeks also lack suitable spawning habitat. Whilst there are some sections on the Bargo River within the Project Area that contain suitable habitat for Macquarie Perch, they occur above Mermaid Falls and below Picton Weir. It is considered unlikely that a viable population of Macquarie Perch exists in this limited range and there are no recorded occurrences of this species within this section of the Bargo River despite surveys being conducted as part of this assessment and surveys by NSW DPI. As such, impacts to this species are considered unlikely.

Stygofauna

The Stygofauna Assessment concluded that the ecological value of the stygofauna community across the SSA is low, with 'hotspots' of biodiversity with potentially a high degree of endemism. The survey sites with the highest total number of recorded stygofauna individuals included B2 and B3 along the Bargo River, C2 along Cow Creek and GW 1 along Great Southern Road (refer **Figure 11.19**).

Subterranean ecosystems both in the aquifers and the river systems were identified to exist, although none are currently listed as endemic, relictual, rare, or endangered biota (fauna or flora) populations or communities as listed under the TSC Act, FM Act or the Commonwealth EPBC Act or identified by an acknowledged expert Taxonomist/Regional Ecologist as being important.

The risk assessment undertaken for the Stygofauna Assessment determined that the ecological value of the hyporheic sites across the SSA is mostly low, with only the site at Cow Creek (C2) assessed as being moderate, although there was connectivity between the shallow aquifers and the associated rivers. The assessment found moderate to low potential impacts to the subterranean ecosystems as a result of the proposed development. This was attributed to the separation of the shallow aquifers that support these ecosystems from the deeper aquifers, and also that most of the hyporheic sites are at lower risk from subduction from the project.

11.7.5 Management and Mitigation Measures

In accordance with the OEH NSW Biodiversity Offsets Policy for Major Projects and DPI *Policy and guidelines for fish habitat conservation and management* (2013), the proposed project has used the principle hierarchy for impact avoidance and mitigation:

1) Avoid – unnecessary biodiversity impacts must be avoided where possible;

2) Minimise – where biodiversity impacts cannot be avoided by design or other preventative measures, then the impact must be minimised through mitigation measures and environmental safeguards; and

3) Offset – after all feasible measures have been undertaken to avoid or minimise impacts, offsets are to be used to compensate for any remaining impacts.

Avoidance

The proposed development has, in the first instance, avoided biodiversity impacts where possible. Direct impacts during construction are forecast to be minimal as the project would not require works to occur within waterways. Indirect impacts on receiving waters may occur as a result of run-off effects, however these would be managed appropriately through the implementation of erosion and sediment controls (refer to **Section 11.18**).

The proposed Mine Plan was developed by Tahmoor Coal following extensive risk assessment process and included consideration of predicted subsidence impacts on the MSA and associated built and natural features including Cow Creek. Tahmoor Coal made a number of revisions to the original Mine Plan, including shortening Longwall 105 to 108 from the commencing ends of the longwalls such that they do not encroach into the MSA and Cow Creek and no longer proposing mining in the Eastern Domain to avoid impacts to Eliza Creek.

Early mine plans for the proposed development 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. Subsequent stages of the mine planning process investigated the longwall extraction of coal adjacent to the Bargo River and beneath Hornes Creek. The current mine plan avoids undermining the Bargo River and Hornes Creek and the project's SSA does not extend to: Carters Creek, Cow Creek, Dry Creek, Eliza Creek and Sugar Leaf Gully.

Refer to **Section 5.3.7** for further information regarding how potential impacts have been minimised for the proposed Mine Plan.

Mitigation

In order to minimise impacts to aquatic ecology as a result of the proposed development, impacts would be mitigated through:

- an aquatic ecology monitoring program to monitor aquatic heath downstream of the discharge from the proposed development, focusing on precipitates and impacts to benthic macroinvertebrates including in-situ quantitative sampling;
- monitoring of macroinvertebrates for a baseline period of two years prior to longwall extraction. The monitoring program may require adding or relocating monitoring sites according to the final mine plan, and using the same sampling methods as used in the aquatic monitoring conducted to date;
- a BACI (Before After Control Impact) designed monitoring program to compliment the baseline information collected and to assess monitoring impacts in an adaptive management framework;
- appropriate stream rehabilitation measures applied to areas that undergo significant impacts due to subsidence; and
- preparation and implementation of a Creek Remediation Action Plan and TARP for potential impacts to pools and other aquatic habitat features identified in the Aquatic Ecology Assessment (**Appendix K**). Stream triggers would be developed using baseline data and anticipated subsidence effects, with specific triggers continuing to be developed as monitoring continues and refined in consultation with key stakeholders. Where a trigger is exceeded, the cause and effect would be investigated. In the instance that the cause is directly related to mining, a corrective management action plan would be developed. The mitigation or remediation plans would outline methods to reduce ongoing impacts to levels below the impact assessment criteria as quickly as possible. This could include stream grouting and use of other engineering works.

Key Fish Habitat

The Project may affect habitat that has been mapped as key fish habitat in a number of locations, particularly in areas along Dog Trap Creek and Tea Tree Hollow (see **Section 11.7.4**), and therefore some remediation measures may be required. If monitoring indicates this is the case, DPI Fisheries will be required to be consulted to determine the appropriate habitat rehabilitation measures or if environmental compensation is required. Any conditions will be incorporated into the monitoring and management of the waterways and key fish habitat. Further, as part of the development of the required Extraction Plan and associated management plans for the Project, a TARP will be prepared, which will incorporate appropriate triggers, monitoring regimes and appropriate actions for key fish habitat in the Project Area.

11.7.6 Conclusion

The Subsidence Impact Assessment (refer to **Section 11.1**) identified that subsidence impacts would impact on natural and built features within the SSA. These impacts are primarily related to surface cracking, localised water loss and ground deformations which can damage or reduce values of these features. The Aquatic Ecology Assessment identified that aquatic habitats of streams within the SSA may be impacted by subsidence related impacts to surface water in Tea Tree Hollow, Dog Trap Creek and downstream watercourses, such as changes to stream beds, altering surface water flows and ponding, and changes to water quality.

The Aquatic Ecology Assessment determined:

- significant subsidence movements are not predicted at the Nepean and Bargo Rivers and these rivers would not be undermined, indicating that the quality and quantity of available aquatic habitat is unlikely to be impacted;
- only one listed threatened aquatic species is considered to have potential habitat within the Project Area (Sydney Hawk dragonfly). It was determined that the proposed development is unlikely to have a significant impact on this species; and
- there would be moderate to low impacts to stygofauna and hyporheic sites as a result of the proposed development.

Rehabilitation of subsidence impacts to land, including rehabilitation of surface cracking impacts to watercourses and drainage lines, would be undertaken for the proposed development as described in **Section 11.1.7**.Specific impacts to areas of Key Fish Habitat would be mitigated by the measures outlined in **Section 11.7.5** and residual impacts would be offset in negotiation with DPI (as required).

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11.8 Aboriginal Cultural Heritage

An Aboriginal Cultural Heritage Assessment (ACHA) was prepared for the proposed development by Niche Environment and Heritage and is provided in **Appendix L**.

The Aboriginal heritage assessment addressed the SEARs relevant to Aboriginal heritage impacts. These are listed in **Table 11-39**. Aboriginal parties who hold cultural knowledge relevant to determining the cultural significance of Aboriginal objects and/or places in the area of the proposed development were registered as part of the consultation process and were consulted throughout the EIS process. A detailed description of consultation with indigenous stakeholders carried out for the project is provided in **Section 11.8.2**.

Aboriginal site names, locations and photographs have been excluded from this public document at the request of the Knowledge Holders as they have been deemed culturally sensitive by local Registered Aboriginal Parties (RAPs).

Table 11-39 SEARs for the assessment of heritage impacts

SEARs	Section addressed
Heritage – including:	
• An assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development, having regard to OEH's requirements (see below).	**Section 11.8** and **11.9**, and **Appendix L**
OEH's requirements are reproduced below. The EIS must provide a heritage assessment including but not limited to an assessment of impacts to *State and local heritage* including conservation areas, natural heritage areas, places of Aboriginal heritage value, buildings, works, relics, gardens, landscapes, views and trees. Where impacts to State or locally significant heritage items are identified, the assessment shall:	**Section 11.8** and **11.9**, and **Appendix L**
- Outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) generally consistent with the NSW Heritage Manual (1996);	**Section 11.8.5** and **11.9.5**
- Be undertaken by a suitably qualified heritage consultant (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria),	The assessment in **Appendix L** was undertaken by Niche Environment and Heritage.
- Include a statement of heritage impact for all heritage items (including significance assessment);	**Section 11.8.3, 11.8.4, 11.9.3** and **11.9.4**
- Consider impacts including, but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, landscapes and vistas, and architectural noise treatment (as relevant); and	**Section 11.8.4, 11.9.4** and **11.10.4**.
- Where potential archaeological impacts have been identified develop an appropriate archaeological assessment methodology, including research design, to guide physical archaeological test excavation (terrestrial and maritime as relevant) include the results of these test excavations.	**Section 11.8.2**. Test excavations were not required as part of the survey methodology for the assessment.

11.8.1 Background

As described in **Section 2.3**, the Project Area comprises a gently undulating landscape with generally low relief and slight slopes and is within the traditional area of the Tharawal people. Topography becomes steeper nearer to the valleys of the Bargo and Nepean Rivers that are generally associated with a deeply incised sandstone landscape forming steep sided valleys, gorges and cliffs. The landscape presents a range of landforms that may have been utilised by traditional Aboriginal groups.

Subsidence predictions for the proposed development were prepared by MSEC (2018) and are summarised in **Section 11.1**. The assessment of potential subsidence identified natural surface features that are sensitive to subsidence movements including streams and valleys, which are known for providing areas for focused occupation for the Aboriginal community, including art and occupation sites in rock shelters. Consequently, the ACHA for the proposed development considered the potential effects of subsidence on these features.

Tahmoor Coal has consulted with RAPs and individuals regarding the proposed development and has sought their views about cultural significance of the area. As part of the development of the mine plan, a risk assessment process was undertaken to identify RMZs as detailed in **Chapter 5**. Heritage values were determined from consultation with indigenous stakeholders and through the preparation of the ACHA, the outcomes of which were used in the subsidence risk workshops. At the workshop, rock shelters were identified as being of high significance and project archaeologists and subsidence engineers therefore delineated RMZs to manage impacts on these heritage items.

Representatives from the Tharawal Local Aboriginal Land Council and Cubbitch Barta Native Title Claimants participated in the field survey undertaken for 16 days in 2013. Additional site surveys undertaken over three days in October 2017 were accompanied by a representative from Cubbitch Barta Native Title Claimants. As a result of consultation with RAPs and individuals, it was determined that all of the archaeological heritage sites hold cultural significance for the RAPs. Further, the consultation also determined specific sites of high significance including along Dog Trap Creek.

Longwall 102 and Longwall 103 have been designed to avoid mining beneath rock shelter sites along Dog trap Creek with artwork that is of high cultural and archaeological significance. The surface infrastructure for the proposed development would also avoid all grinding grooves and rock shelters, and therefore there would be no potential surface disturbance impacts to archaeological sites with moderate or high scientific significance. The mine plan has also been amended to avoid impacts to archaeological heritage sites and sensitive water features in the south east section of the Project Area south of the Hume Highway.

11.8.2 Methodology

The ACHA was undertaken in accordance with the following guidelines:

- *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (NSW Department of Environment, Climate Change and Water (DECCW), 2010a) (the Code);
- *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (OEH, 2011);
- *The Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (NSW OEH, 2011);
- *Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation* (DEC, 2005);
- *The Aboriginal cultural heritage consultation requirements for proponents 2010* (the ACHCRs) (DECCW, 2010b); and
- *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance* (Australia International Council on Monuments and Sites, 2013).

The following methodology was used to complete the ACHA:

- Review of background information, including:
    - Review of previous heritage assessments within and surrounding the Project Area;
    - A search of the AHIMS database; and
    - A search of other public heritage registers including: the National Heritage List and Commonwealth Heritage List (via the Australian Heritage database), State Heritage Register, S170 Heritage and Conservation Registers and the National Trust Register.

- Predictive modelling of the Project Area to establish a theoretical model for site location and distribution within the Project Area. The predictive model for the proposed development was based on a review of geologic, geomorphic, hydrologic and archaeological data obtained during a review of background studies.
- Field survey of sensitive landforms within the Project Area, in particular creeks and associated landforms identified in the predictive model including:
    - Areas designated within the Project Area that would be disturbed by surface infrastructure;
    - Rivers, creek lines and large sandstone rock platforms that have the potential to be affected by subsidence within the Project Area; and
    - Previously registered sites that fall within the potential subsidence zone (SSA) of the proposed longwalls, in order to verify their location and condition, as well as to complete a more systematic archaeological assessment of these areas.
- Consultation with Aboriginal communities in accordance with the ACHCRs, including:
    - Notifying the Aboriginal community of the proposed development (through advertisement and letters) and inviting local Aboriginal parties to register their interest for further consultation;
    - Presenting the proposed development to those Aboriginal parties who registered an interest;
    - Gathering information regarding cultural significance from the RAPs regarding the protocol for sourcing and holding cultural information, and their views on potential management options;
    - Enabling the RAPs to attend the field assessment component; and
    - Enabling the RAPs to review and provide comments on the assessment methodology and draft ACHA report.
- Preparation of statements of significance for the Project Area, prepared in consideration of comments received from the RAPs during the consultation process; and
- Formulation of recommendations based on the:
    - Scientific significance of the Aboriginal heritage sites;
    - The assessment of potential impacts; and
    - The suggested management and mitigation measures for potential impact on Aboriginal cultural heritage.

11.8.3 Existing Environment

Predictive Model

Predictive modelling aims to establish a theoretical model for site location and distribution within a given area. The predictive model for the proposed development was based on a review of geologic, geomorphic, hydrologic and archaeological data obtained during a review of background studies.

The predictive model for the proposed development determined that:

- open lithic sites (artefacts scatters and isolated artefacts) are the most likely site type to occur, and are most likely to occur in association with water-related landforms and gentle slopes less than 100 m from natural watercourses. Site sizes and densities are generally expected to increase with decreasing distance to natural watercourses;
- scarred trees may occur in the areas which feature native bush which has not been previously cleared;
- Aboriginal burials are unlikely to occur due to the lack of suitable soils landscapes;
- no Aboriginal places have been declared within the Project Area (November 2011) or listed on AHIMS;
- potential exists for bedrock exposure, consequently increasing the potential for sites such as axe grinding grooves or quarries; and
- the geological characteristics of the Project Area are consistent with those required for sandstone shelters. Previously unidentified sandstone shelters are likely to occur along Dog Trap, Eliza and Dry Creeks as well Tea Tree Hollow as systematic assessment has previously not occurred at these locations.

Registered Sites

A search of the AHIMS database was undertaken on 31 January 2013 and identified 37 previously recorded Aboriginal archaeological or cultural sites within the Project Area. An updated search of the AHIMS database was undertaken on 11 October 2018 and identified 40 previously recorded Aboriginal archaeological or cultural sites within the area (39 archaeological sites and one Aboriginal dream time story). Of the 39 Aboriginal archaeological sites registered in the Project Area, 27 were confirmed during the assessment. The remaining twelve artefact sites in the form of isolated stone artefacts and open camp sites have not been reassessed as part of this assessment because of access restrictions to the sites and due to the fact that mine subsidence would not harm these types of sites. AHIMS sites are shown in the ACHA in **Appendix L**. Descriptions of the previously recorded sites, as well as newly recorded sites, are also provided in **Appendix L**.

The most common site types recorded in the Project Area comprised of rock shelters with art and stone artefacts sites.

The location of registered Aboriginal archaeological or cultural sites is considered to be culturally sensitive information and so mapping of these sites is not provided as part of this EIS. However, the location of these sites has been considered and the mine plan has been amended to minimise impacts to aboriginal cultural heritage. As described in **Section 11.8.1**, the mine plan was redesigned to avoid mining directly under rock shelters with artwork that is of high cultural and archaeological significance identified with the Project Area around Dog Trap Creek. Archaeological sites of high cultural and archaeological significance are not located in areas proposed for surface infrastructure for the proposed development.

Dog Trap Creek

Dog Trap Creek features a high concentration and diversity of site types, in particular rock shelters with art. The majority of the sites recorded are associated with moderately steep slopes along the creek line. Dog Trap Creek is considered to be a significant archaeological and culturally significant complex due to the distinctive and representative assemblage of anthropomorphic motifs, and art assemblages that are locally notable for the number of stencils and motifs present. Factors that have contributed to the Dog Trap complex is the creek line itself, the existing sandstone geology which has allowed the formation of shelter sites suitable for habitation, and the surrounding topography (Niche, 2018).

11.8.4 Impact Assessment

A significance assessment of the Aboriginal cultural heritage sites and values of the Project Area was undertaken in accordance with the relevant guidelines and considered two main themes:

- cultural/social significance of Aboriginal objects and/or places to Aboriginal people as identified in consultation with RAPs; and
- scientific (archaeological) significance (the potential to provide information about the past through archaeological investigation).

The consideration of the themes described above was undertaken in consultation with RAPs and other individuals by appropriately qualified heritage professionals.

Cultural

The natural heritage and environmental features of the landscape hold landscape value in terms of Aboriginal cultural heritage. In addition, specific local features and places are considered to hold some Aboriginal cultural landscape value to local community groups.

Tahmoor Coal has consulted with RAPs and individuals regarding the proposed development and has sought their views about cultural significance of the area. Representatives from the Tharawal Local Aboriginal Land Council and Cubbitch Barta Native Title Claimants participated in the field survey undertaken for 16 days in 2013. Additional site surveys undertaken over three days in October 2017 were accompanied by a representative from Cubbitch Barta Native Title Claimants. As a result of consultation with RAPs and individuals, it was determined that all of the archaeological heritage sites hold cultural significance for the RAPs. However, the consultation also determined specific sites of high significance, including along Dog Trap Creek. The mine plan has been designed to minimise impacts to these sites as described below. Specific comments from the RAPs are included in the ACHA in **Appendix L**.

As described in **Section 11.8.1**, assessment and survey of sensitive heritage features along Dog Trap Creek have been undertaken as part of baseline monitoring and preparation of this EIS. The results of this assessment have fed into an analysis of the risk of potential impacts to these sensitive surface features due to subsidence,

and into the mine planning process, resulting in modification to the extent of longwalls and the location of ventilation shafts in these areas. Longwall 102 and Longwall 103 have been designed to avoid mining beneath four rock shelter sites along Dog Trap Creek with artwork that is of high cultural and archaeological significance.

Archaeological

Of the 40 Aboriginal heritage sites identified within the Project Area, one comprises a cultural site (Bandibong – Aboriginal dream time story) and the remaining 39 comprise archaeological sites.

The scientific significance of the archaeological sites was assessed based on research potential, representativeness and rarity criteria.

The findings of the archaeological significance assessment undertaken for the 39 archaeological items recorded within the Project Area identified the following:

- two sites (shelters with art, including one with axe grinding groves, both at Dog Trap Creek) were assessed to be of moderate-local archaeological or scientific significance (52-2-1524 and 52-2-1527);
- four sites (shelters with art, including some with axe grinding grooves, artefacts and deposits, at Dog Trap Creek) were assessed to be of high-local archaeological or scientific significance (52-2-1523, 52-2-1525, 52-2-1528 and 52-2-1529); and
- The 33 remaining archaeological sites were considered to be of low archaeological significance.

Rock shelter sites 52-2-1523, 52-2-1524, 52-2-1525, 52-2-1527, 52-2-1528 and 52-2-1529 were identified as moderate to high scientific significance due to their location, high density of art, high intactness of art, evidence of chronology provided by motifs, motif representation and the rarity of these motifs/ art technique within the region.

The remaining sites were assessed as low significance as they were considered to be a commonly representative Aboriginal site or Aboriginal object type exhibiting low research potential, and where many more similar examples can be confidently predicted to occur within the Project Area, and in the region. The mine plan has been designed to avoid direct impacts to the archaeological heritage sites along Dog Trap Creek and avoid direct impacts to archaeological heritage sites in the south east section of the Project Area south of the Hume Highway.

Summary of Potential Impacts to Archaeological Sites

Table 11-40 provides a summary of the potential impacts of the Project on Aboriginal heritage sites within the Project Area, including the type of potential impact on each site (i.e. surface impacts, subsidence impacts or no impacts).

Of the 40 Aboriginal heritage sites identified:

- no impacts are predicted to the cultural site (Bandibong – Aboriginal dream time story);
- one archaeological site (Charles Point Road – open camp site) has the potential to be impacted by surface disturbance works and subsurface works (i.e. direct impacts); and
- 26 archaeological sites have the potential to be impacted by subsidence impacts (i.e. indirect impacts).

The mine plan has been designed to avoid direct (undermining) impacts to the rock shelter with art archaeological heritage sites identified along Dog Trap Creek and to avoid impacts to archaeological heritage sites in the south east section of the Project Area south of the Hume Highway.

Table 11-40 Assessment of potential impacts to Cultural and Archaeological sites

No.	AHIMS	Site Name	Site Type	Scientific Significance	Impact	Type of impact	Degree of impact
1	52-2-1599	Bandibong	Aboriginal dreaming story	Low	None	Indirect	None
2	52-2-1520	Dog Trap Creek	Sandstone shelter with art	Low	Potential subsidence	Indirect	Partial
3	52-2-1521	Dog Trap Creek	Sandstone shelter with art	Low	Potential subsidence	Indirect	Partial
4	52-2-1522	Dog Trap Creek	Sandstone shelter with art	Low	Potential subsidence	Indirect	Partial
5	52-2-1523	Dog Trap Creek	Sandstone shelter with art and deposit	High	Potential subsidence	Indirect	Partial
6	52-2-1524	Dog Trap Creek	Sandstone shelter with art and axe grinding grooves	Moderate	Potential subsidence	Indirect	Partial
7	52-2-1525	Dog Trap Creek	Sandstone shelter with art	High	Potential subsidence	Indirect	Partial
8	52-2-1526	Dog Trap Creek	Sandstone shelter with art	Low	Potential subsidence	Indirect	Partial
9	52-2-1527	Dog Trap Creek	Sandstone shelter with art	Moderate	Potential subsidence	Indirect	Partial
10	52-2-1528	Dog Trap Creek	Sandstone shelter with art	High	Potential subsidence	Indirect	Partial
11	52-2-1529	Dog Trap Creek	Sandstone shelter with art and axe grinding grooves	High	Potential subsidence	Indirect	Partial
12	52-2-1530	Dog Trap Creek	Modified tree	Low	Potential subsidence	Indirect	Partial
13	52-2-1532	Dog Trap Creek	Sandstone shelter with art	Low	Potential subsidence	Indirect	Partial
14	52-2-1533	Dog Trap Creek	Sandstone shelter with art	Low	Potential subsidence	Indirect	Partial
15	52-2-1534	Dog Trap Creek	Sandstone shelter with art and deposit	Low	Potential subsidence	Indirect	Partial
16	52-2-1538	Bargo	Sandstone shelter with art and deposit	Low	Potential subsidence	Indirect	Partial
17	52-2-1539	Bargo	Sandstone shelter with art and axe grinding groove	Low	Potential subsidence	Indirect	Partial
18	52-2-1540	Bargo	Sandstone shelter with art	Low	Potential subsidence	Indirect	Partial
19	52-2-3872	Bargo Sports Ground-AFT001	Isolated find	Low	Potential subsidence	None	None
20	52-2-3921	Dog Trap Creek AGG-1	Axe Grinding Grooves	Low	Potential subsidence	Indirect	Partial
21	52-2-3922	Dog Trap Creek IA-1	Isolated find	Low	None	None	None
22	52-2-3938	Eliza Creek OAS 1	Open camp site	Low	None	None	None

No.	AHIMS	Site Name	Site Type	Scientific Significance	Impact	Type of impact	Degree of impact
23	52-2-3944	Dry Creek GG 1	Axe Grinding Groove	Low	None	None	None
24	52-2-3942	Dry Creek OAS 1	Open camp site	Low	None	None	None
25	52-2-3943	Dry Creek IA 1	Isolated find	Low	None	None	None
26	52-2-3968	Remembrance Driveway 2013.1	Isolated Find	Low	Potential subsidence	None	None
27	52-2-3969	Eliza Creek 2013.3	Sandstone shelter with art	Low	Potential subsidence	Indirect	Partial
28	52-2-3970	Eliza Creek 2013.2	Sandstone shelter with art and deposit	Low	Potential subsidence	Indirect	Partial
29	52-2-3971	Dog Trap Creek 2013.2	Sandstone shelter with art	Low	Potential subsidence	Indirect	Partial
30	52-2-3972	Dry Creek 2013.1	Isolated find	Low	None	None	None
31	52-2-3960	Dog trap Creek 2013.1	Shelter with art	Low	Potential subsidence	Indirect	Partial
32	52-2-4194	BDTC-GG01	Axe grinding groove	Low	Potential subsidence	Direct	Partial
33	52-2-4195	BDTC-AS01	Open Camp Site	Low	Potential subsidence	None	None
34	52-2-4034	SW Corner Bargo Sportsground	Isolated find	Low	Potential subsidence	None	None
35	52-2-4395	Government Road AGG-1	Axe grinding groove	Low	Potential subsidence	Direct	Partial
36	52-2-3975	Bargo Artefact Scatter 3	Open Camp Site	Low	Potential subsidence	None	None
37	52-2-3976	Bargo Isolated Find 1	Isolated Find	Low	Potential subsidence	None	None
38	52-2-4471	Tea Tree Hollow 2013.1	Shelter with art and deposit	Low	Potential subsidence	Indirect	Partial
39	52-2-4473	Eliza Creek 2013.1	Shelter with deposit	Low	None	None	Partial
40	52-2-TBC	Charlies Point Road	Open Camp Site	Low	Surface disturbance	Direct	Total loss

Management measures have been developed in accordance with the hierarchy of controls to avoid impacts where possible in the first instance, and then mitigate where avoidance is not possible. Impacts have initially been avoided through the design of the mine plan. Longwall 102 and Longwall 103 have been designed to avoid mining beneath four rock shelter sites along Dog Trap Creek with artwork that is of high cultural and archaeological significance. The surface infrastructure for the proposed development would also avoid all grinding grooves, rock shelters and therefore there would be no potential surface disturbance impacts to archaeological sites with moderate or high scientific significance.

The mine plan has been amended to avoid impacts to archaeological heritage sites in the south east section of the Project Area south of the Hume Highway. Sites that have been avoided include:

- one axe grinding groove site (AHIMS site 52-2-3358);
- one axe grinding groove and shelter with art site (AHIMS site 52-2-2048); and
- three isolated artefact find sites (AHIMS sites 52-2-3359, 52-2-3360, 5-5-3371).

As described above the exact location of the sites listed above is considered to be culturally sensitive information by the RAPs and so mapping of these sites is not provided as part of this EIS.

Where impacts cannot be avoided, mitigation measures have been provided to manage these impacts as described in **Section 11.8.5**. Mitigation measures would be included in a Heritage Management Plan (HMP).

Surface Infrastructure Impacts

Direct harm is not predicted for 39 of the identified archaeological or cultural sites as a result of surface infrastructure disturbance from the ventilation shafts or REA. One archaeological site (an open camp site, AHIMS site 52-2-TBC) falls within the footprint of a proposed ventilation shaft and may be impacted. This site was assessed as having low scientific significance as the site was comprised of three artefacts only. This site should be avoided by the final footprint. However in the event that direct impact to this site is required and cannot be avoided, further management should be undertaken in consultation with a suitably qualified archaeologist and in accordance with an Aboriginal Heritage Management Plan (AHMP).

Indirect impacts could occur to some archaeological items within proximity to ventilation shaft sites and ancillary infrastructure, due to the partial loss of site context from the clearing of vegetation at the surface infrastructures sites.

The location of all ancillary infrastructure, such as transmission lines and gas pipelines, would be finalised during detailed design to avoid identified Aboriginal heritage sites, as far as practicable. If direct impacts cannot be avoided in the location of surface infrastructure, further management would be undertaken in consultation with the RAPs and a suitably qualified archaeologist in accordance with the HMP. During construction appropriate measures such as fencing would be considered for inclusion in the HMP to avoid impacts to identified items.

Subsidence Impacts

The ACHA identifies the following potential impacts to sites as a result of subsidence impacts:

- scarred tree - From past longwall experience, the incidence of impacts on trees is extremely rare. Impacts on trees have been previously observed where the depths of cover were extremely shallow, in the order of 50 m or less, or on very steeply sloping terrain, in the order of 1 in 1 grade or greater. The scarred tree within the Project Area is located 150 m east of the nearest longwall and is unlikely to be affected by the proposed mining;
- artefact scatters and isolated finds - Open camp sites can potentially be affected by cracking of the surface soils as a result of mine subsidence movements. However it is unlikely that scattered artefacts or isolated finds would be significantly harmed by such surface cracking;
- axe grinding grooves – Based on maximum predicted subsidence movements for the proposed development, it is possible that fracturing could occur in the bedrock in the vicinity of grinding groove sites as a result of proposed mining. Minor and isolated fracturing has been observed in streams up to around 400 m outside previously extracted longwalls in the Southern Coalfield. Two axe grinding groove sites on sandstone platforms are located directly above longwalls (Site 52-2-4395 above longwall 103 and 52-2-4194 above longwall 104) and have the potential to be impacted;

- sandstone shelters - The likelihood of shelters becoming unstable as a result of subsidence movements is dependent on a number of factors. These factors include jointing, inclusions, weaknesses within the rock mass, groundwater pressure and seepage flow behind the rock face. Subsidence impacts to the four rock shelter sites that have been given a high significance rating (52-2-1523, 52-2-1525, 52-2-1528 and 52-2-1529) are predicted to experience between 125 and 175 mm of vertical subsidence due to the extraction of the proposed longwall 102. However, given the setback distances of the proposed longwalls to the sites (Refer Table 32 of **Appendix L**) it is considered that the likelihood of impacts is low. The experience from the Southern Coalfield indicates that the likelihood of significant physical impacts on rock shelters within the area (as a result of subsidence) is relatively low.

11.8.5 Management and Mitigation Measures

Management measures have been developed in accordance with the hierarchy of controls to avoid impacts where possible in the first instance, and then mitigate where avoidance is not possible. Impacts have initially been avoided through the design of the mine plan. Longwall 102 and Longwall 103 have been designed to avoid mining beneath rock shelter sites along Dog Trap Creek with artwork that is of high cultural and archaeological significance. One of the archaeological sites identified within the Project Area occurs within the direct footprint of the surface facilities; this site was assessed as having a low scientific significance. The surface infrastructure for the proposed development would avoid all grinding grooves and rock shelters and therefore there would be no potential surface disturbance impacts to archaeological sites with moderate or high scientific significance. The mine plan has been amended to avoid impacts to archaeological heritage sites in the south east section of the Project Area south of the Hume Highway.

A HMP would be prepared for the proposed development in consultation with RAPs to include specific background information and mitigation measures proposed by this EIS and the ACHA (Niche, 2018), including:

- mine plan layout;
- mapping to indicate the location of known Aboriginal heritage sites;
- site specific management measures, including buffer zones and barriers where appropriate;
- protocols that describe the involvement of the RAPs in cultural heritage works conducted under the HMP, focusing on members of the RAPS identified during the ACHA consultation process;
- a communications protocol that describes clear methods of communication, including expectations of suitable notification and response time, between Tahmoor Coal and the RAPs;
- a protocol to allow for reasonable access to identified significant Aboriginal heritage sites;
- procedures to establish, maintain and update a current GIS database of Aboriginal heritage sites identified within the Project Area (i.e. the Project Sites Database);
- a protocol for the discovery and management of human remains, including stop work provisions and notification protocols;
- procedures for the management and reporting of previously unknown Aboriginal heritage sites that may be identified during the life of the proposed development; and
- protocols for heritage awareness training to be incorporated into mine site inductions for employees and sub-contractors who may be conducting works that have the potential to impact on any Aboriginal heritage sites.

The final locations of all ancillary infrastructures (e.g. transmission lines, gas pipelines etc.) would be confirmed during detailed design with the aim of avoiding identified Aboriginal sites as far as possible. This would include, systematic survey of the relevant area(s) (in consultation with the RAPs) if the area has not already been surveyed. Any previously unidentified sites would be managed in accordance with the management measures described in the HMP and in consultation with the RAPs. If impacts to any existing (or newly identified) sites cannot be avoided, additional management, mitigation and archival recording measures would be determined in consultation with the RAPs and statutory agencies.

A subsurface test excavation program in consultation with the RAPs would be implemented at the TSC 2 ventilation shaft and fan site, after the confirmation of its final location. Should any new Aboriginal objects be identified these would be managed in consultation with RAPs and statutory agencies.

The Extraction Plan developed for the longwalls for the proposed development (refer to **Section 11.1.7**) would include:

- a schedule for undertaking monitoring at nominated sites;
- appropriately detailed baseline and archival site recordings, including high resolution digital photographs and an impact Trigger and Action Response Plan TARP specific to each of the sites being monitored;
- archival site recordings would include three dimensional scans and digital rendering of rock shelters of high significance which would be provided for use to RAPs; and
- adaptive management techniques for sites 52-2-1523, 52-2-1525, 52-2-1528 and 52-2-1529. Should monitoring detect the early development of potentially severe differential movements at these archaeological sites during the extraction of Longwalls 101 and 102, consideration would be given to shortening the commencing position of Longwall 103.

11.8.6 Conclusion

The ACHA identified that the majority of potential impacts on cultural heritage sites are limited to potential subsidence impacts, in particular to rock shelters which are more likely to experience adverse impacts that could result in harm such as increased rock falls and cracking. One archaeological site of low scientific significance (an open camp) falls within the footprint of a ventilation shaft and may be impacted directly.

Impacts to Aboriginal heritage have initially been avoided through the design of the mine plan. Tahmoor Coal has consulted with RAPs and individuals regarding the proposed development and has sought their views about cultural significance of the area. As a result of consultation with RAPs and individuals, it was determined that all of the archaeological heritage sites hold cultural significance for the RAPs. However, the consultation also determined specific sites of high significance including along Dog Trap Creek.

Heritage values were determined from consultation with indigenous stakeholders and through the preparation of the ACHA, the outcomes of which were used in the subsidence risk workshops. At the workshop, rock shelters were identified as being of high significance and therefore project archaeologists and subsidence engineers delineated RMZs to manage impacts on these heritage items.

Longwall 102 and Longwall 103 have been designed to avoid mining beneath rock shelter sites along Dog Trap Creek with artwork that is of high cultural and archaeological significance. The mine plan has been amended to avoid impacts to archaeological heritage sites in the south east section of the Project Area south of the Hume Highway.

One cultural site (Bandibong – Aboriginal dream time story) and a total of 39 archaeological sites were identified within the Project Area during the assessment (including previously recorded and newly recorded sites). Of the 39 archaeological sites, four are considered to be of high significance and two are considered to be of moderate significance. Twenty six (26) archaeological sites have the potential to be impacted by subsidence impacts, and one archaeological site has been identified as having potential to be directly impacted by the surface infrastructure. During detailed design and construction planning care would be taken to site surface infrastructure (including power lines and gas infrastructure) to avoid disturbance of identified archaeological sites, as far as practicable. If direct impacts cannot be avoided in the location of surface infrastructure, further management would be undertaken in consultation with the RAPs and a suitably qualified archaeologist, as part of a HMP.

Mitigation and management for potential impacts to cultural heritage includes the preparation and implementation of a HMP for the proposed development. The HMP will include all sites identified as having the potential to be impacted, including both previously recorded and newly recorded sites. Should monitoring detect the early development of potentially severe differential movements at these archaeological sites during the extraction of Longwalls 101 and 102, adaptive management techniques would be applied.

11.9 Non-Aboriginal Heritage

A Historical Heritage Assessment was prepared for the proposed development by Niche Environment and Heritage Pty Ltd, and is provided in **Appendix L**.

The Historic Heritage Assessment addressed the SEARs relevant to historic heritage impacts. These are listed in **Table 11-41**.

Table 11-41 SEARs for the assessment of heritage impacts

SEARs	Section addressed
Heritage – including:	
• an assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development, having regard to OEH's requirements (see below).	**Section 11.8** and **11.9**, and **Appendix L**
OEH's requirements are reproduced below. The EIS must provide a heritage assessment including but not limited to an assessment of impacts to *State and local heritage* including conservation areas, natural heritage areas, places of Aboriginal heritage value, buildings, works, relics, gardens, landscapes, views and trees. Where impacts to State or locally significant heritage items are identified, the assessment shall:	**Section 11.8** and **11.9**, and **Appendix L**
- Outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) generally consistent with the NSW Heritage Manual (1996);	**Section 11.8.5** and **11.9.5**
- Be undertaken by a suitably qualified heritage consultant (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria),	The assessment in **Appendix L** was undertaken by Niche Environment and Heritage.
- Include a statement of heritage impact for all heritage items (including significance assessment);	**Section 11.8.3, 11.8.4, 11.9.3** and **11.9.4**
- Consider impacts including, but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, landscapes and vistas, and architectural noise treatment (as relevant); and	**Section 11.8.4, 11.9.4,** and **11.10.4**.
- Where potential archaeological impacts have been identified develop an appropriate archaeological assessment methodology, including research design, to guide physical archaeological test excavation (terrestrial and maritime as relevant) include the results of these test excavations.	**Section 11.9.2**. Test excavations were not required as part of the survey methodology for the assessment.

11.9.1 Background

The Bargo area was first explored by Europeans in the late 1790s and was occupied from the early 1800s. Since its initial settlement in 1815, the Bargo township and surrounding area was developed to include farming and early road and creek crossings (including the Great Southern Road and Rockford crossing), homesteads, commercial and public buildings (including the Bargo Hotel and Bargo post office), public spaces (such as the Bargo Cemetery) and road and railway infrastructure. The land to the east and south east of Bargo Township was identified as a possible State Coal Mine Reserve in 1917. However, mining in the area was not commissioned until 1979 when the existing Tahmoor Mine commenced operations.

The Historic Heritage Assessment considered the potential physical effects on historic heritage items within the SSA, anticipated as a result of the proposed development. Subsidence predictions for the proposed development were prepared by MSEC (2018) to inform the assessment (refer **Appendix F**).

11.9.2 Methodology

The Historical Heritage Assessment for the proposed development was undertaken as follows:

- desktop review of background studies including:
  - review of Commonwealth, State and Local Government heritage lists and databases including the Australian Heritage Database (comprising the National Heritage List, Commonwealth Heritage List, and the non-statutory Register of the National Estate archive), State Heritage Register, State Heritage Inventory, State Government agency S170 Registers, Wollondilly LEP, and the National Trust Register;
  - review of existing heritage studies relevant to the Project Area and surrounding areas; and
  - review of available baseline data from Tahmoor Coal, such as previous environmental studies and other relevant data.
- field survey of identified historic heritage items, which included an initial survey in 2014 and subsequent survey on 28 September 2017. The surveys were undertaken to inspect items identified during the desktop review (including items listed on heritage registers, heritage studies and Schedule 5 (Environmental heritage) of the Wollondilly LEP), and in particular those heritage items anticipated to be most impacted by the proposed development;
- assessment of potential impacts on identified heritage items through consideration of the value of each item and the maximum predicted subsidence at those sites, based on the findings of the Subsidence Impact Assessment (**Appendix F**); and
- recommendation of management measures for heritage items which may experience potential impacts as a result of subsidence.

11.9.3 Existing Environment

The database searches and desktop review identified 22 existing historical heritage items within the SSA. Of these historic heritage items within the SSA:

- one item ('Tahmoor Colliery') is not registered or listed on any heritage register. However, the item has been identified as having historical values in local and regional heritage studies. This item was identified as a heritage item of local significance in the *Macarthur Heritage Study 1986* (JRC Planning Services, 1986). It is noted that one other item of historical value (Anderson's Inn) was identified through research and previous studies. However, the item is no longer present, likely to have been demolished during residential redevelopment and is therefore not considered further in the assessment or in the item count;
- 21 items are locally listed on the Wollondilly LEP, including:
  - one item which is also listed on the State Heritage Register: Wirrimbirra Sanctuary (listing number 01508);
  - one item which is also listed on a State (S170) Heritage and Conservation Register - Bargo Railway Station Toilet Block);
  - two items which are also listed on the Register of the National Estate (RNE) which is a non-statutory Commonwealth, public archive - Wirrimbirra Sanctuary (Place ID 3302, natural heritage place), and Bargo Railway Station (Place ID 101967); and
  - one item which is also listed with the National Trust of Australia (NSW) - Wirrimbirra Sanctuary; and
- no items are listed on the Commonwealth or National Heritage Lists.

In addition to the above one new heritage item (Great Southern Road, Bargo) was identified by the current Historic Heritage Assessment through historical research and field survey.

The 23 historic heritage items in total identified within the SSA are listed in **Table 11-42** and are shown on **Figure 11.21**. Of these historical heritage items, 19 are situated directly above the proposed longwall mining area.

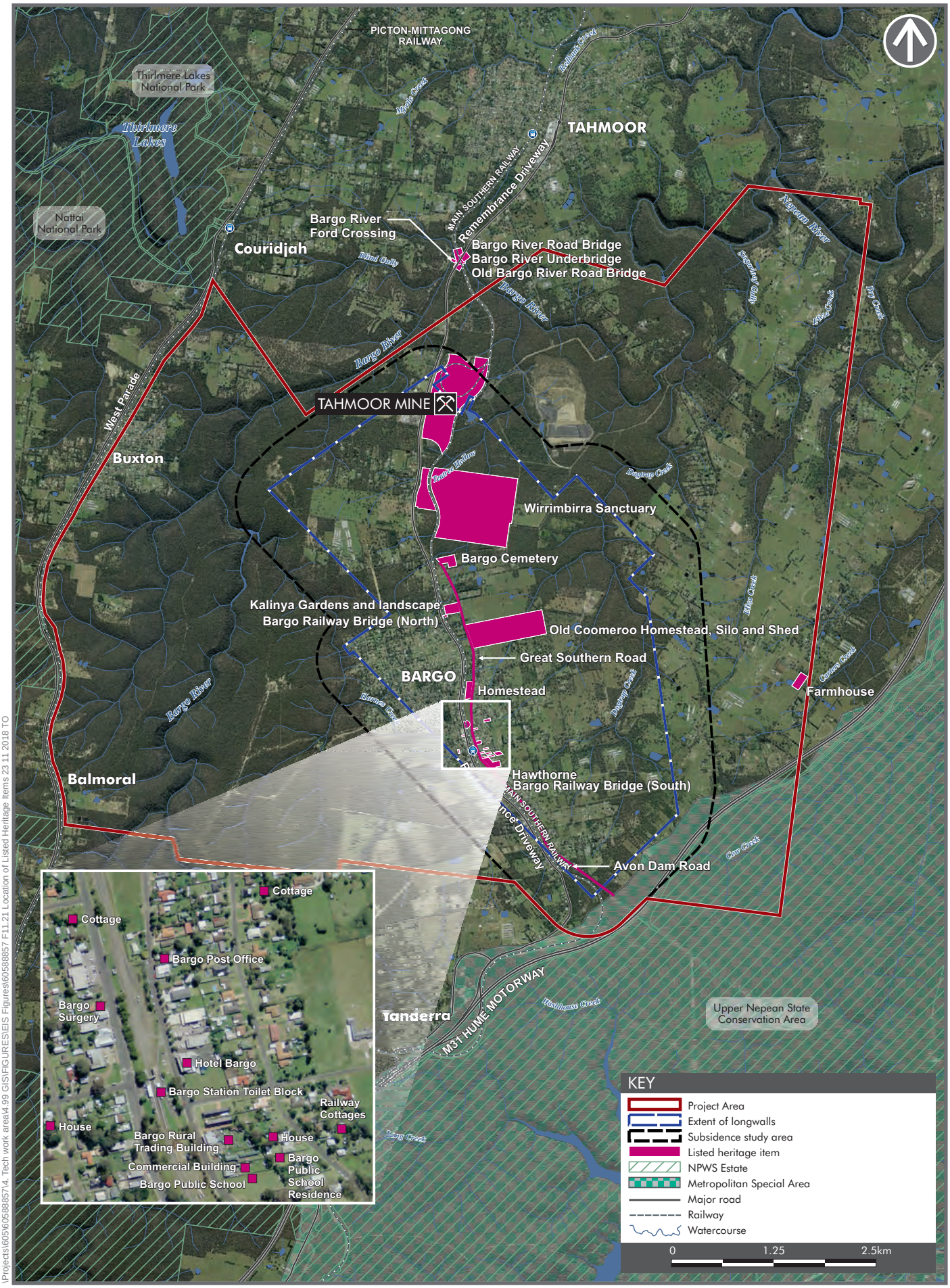
Condition and integrity assessments were undertaken for each of the identified items. The overall condition of the buildings or archaeological relics were categorised as Good, Fair, or Poor, depending on how well-maintained or degraded the fabric of the items were. Integrity assessments evaluated the degree of retained original fabric within the heritage item. Each item was assessed as having High, Medium or Low integrity, with the items assigned the highest integrity ratings retaining the most original features, such as windows or doors. Items assigned low integrity rating were those with replaced fittings or additions to the original item. The condition and integrity ratings of the items are summarised in **Table 11-42** below, along with the heritage significance of the items, based on their statutory listing / or previous assessed significance (for previously recorded items), or assessed significance under the current study (for the newly identified site).

Table 11-42 Summary of historical heritage items within the SSA

Ref #	Item Name	Location in relation to nearest longwall (LW)	Assessment of Condition / Integrity	Significance	Listing[1]
Listed historic heritage items					
1	Bargo Cemetery	Directly above LW mining area	Fair / High	Local	LEP
2	Kalinya Gardens and landscape	Directly above LW mining area	Good / High	Local	LEP
3	Old Coomeroo Homestead, silo, shed	Directly above LW mining area	Poor / Low to Medium	Local	LEP
4	Homestead 170 Great Southern Road	Directly above LW mining area	Good / Medium	Local	LEP
5	Bargo Post office	Directly above LW mining area	Fair / Medium	Local	LEP
6	Hotel Bargo	Directly above LW mining area	Good / Low	Local	LEP
7	Bargo Rural Trading Building	Directly above LW mining area	Poor / Low	Local	LEP
8	Commercial Building	Directly above LW mining area	Fair / Medium	Local	LEP
9	Bargo Public School	Directly above LW mining area	Fair / Medium	Local	LEP
10	Cottage, 91 Hawthorne Road	Directly above LW mining area	Good / Low to Medium	Local	LEP
11	House, 118 Hawthorne Road	Directly above LW mining area	Good / Medium	Local	LEP
12	Bargo Public School Residence	Directly above LW mining area	Good / High	Local	LEP
13	Railway Cottages	Directly above LW mining area	143 – Fair / High 145 – Fair / Low 147 – Good / Medium	Local	LEP
14	Hawthorne	Directly above LW mining area	Fair to Good / High	Local	LEP
15	Bargo Railway Station Toilet Block	Directly above LW mining area	Fair / Medium	Local	RNE S170

Ref #	Item Name	Location in relation to nearest longwall (LW)	Assessment of Condition / Integrity	Significance	Listing[1]
					Register LEP
16	House, 8 Noongah Street	~130m from LW mining area	Good / Medium	Local	LEP
17	Bargo Surgery (74 Railside Ave)	Directly above LW mining area	Fair / High	Local	LEP
18	Cottage, 121 Railside Ave	~80m from LW mining area	Poor / Medium	Local	LEP
19	Wirrimbirra Sanctuary	Directly above LW mining area	N/A / High	Local, State	RNE National Trust of Australia (NSW) State Heritage Register LEP
20	Bargo Railway Bridge (road over rail) (South)	~100m from LW mining area	Good / High	Local	LEP
21	Bargo Railway Bridge (road over rail) (North)	Directly above LW mining area	Good / High	Local	LEP
Items of Historical Value (Not listed)					
24	Tahmoor Colliery	Centre of surface facilities ~500m from LW mining area	Good / Medium	Local	N/A
25	Anderson's Inn	The exact location of the Inn is unclear based on historical records. However, the land parcels on which the Inn was likely situated are located directly above the LW mining area	N/A Not Located. (The Inn no longer exists. It was likely demolished during residential development, and has not been included in the heritage item count.)	None	N/A
Newly identified historic heritage items					
29	Great Southern Road, Bargo	Directly above LW mining area	Poor / Low	Local	N/A

[1] LEP = *Wollondilly Local Environmental Plan 2011* Heritage Schedule



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SIMEC MINING

HISTORIC HERITAGE WITHIN THE SUBSIDENCE STUDY AREA

Tahmoor South Project
Environmental Impact Statement

Source: Niche Environment and Heritage (2018)

FIGURE 11.21

11.9.4 Impact Assessment

The potential impacts of the proposed development on historical heritage could relate to:

- direct impacts at Tahmoor Mine (Tahmoor Colliery), due to upgrades of the existing surface infrastructure facilities, expansion of the REA and construction of additional ventilation shafts; and
- indirect impacts to all heritage items resulting from subsidence of the ground surface following longwall extraction of coal.

Direct impacts include physical disturbance associated with clearing, earthworks and other construction activities required during the upgrade of the surface infrastructure area, expansion of the REA and new ventilation shafts. Based on an analysis of design drawings for these works, there would be very little impact on the CHPP and other items of historical value at Tahmoor Mine. No other heritage items are located in proximity to these upgrade works. Direct impacts to heritage items are therefore not expected to occur as a result of the proposed development.

Potential indirect impacts from subsidence to built structures include cracking of internal linings, dislodgement of external weatherboards (for timber structures) and cracking of brickwork and chimneys. Masonry structures are considered to be more susceptible to impacts than timber based structures, experiencing greater impacts ranging from minor cracking to substantial cracking of walls. If impacts are left untreated, there is the potential for reduction of the heritage values associated with that item. Similarly, if restoration works or repairs are poorly undertaken, heritage values can also be diminished.

An assessment of potential subsidence related impacts to each heritage item identified within the SSA was undertaken and determined that there would be a nil to low likelihood of severe impacts to any built structure (refer Table7 of **Appendix F**). Impacts to the heritage values of these items would therefore be nil to minor, particularly if subsidence related damage is corrected through repair or restoration. It is noted that should damage occur and is left untreated, overtime the condition could deteriorate, potentially resulting in severe impacts. Table 7 of **Appendix L** provides further detail on potential impacts for each heritage item identified.

Further discussion on potential impacts to State Heritage items in the subsidence study area are provided below.

Impacts to State Heritage

One item listed on the National Trust of Australia (NSW), State Heritage Register and State (S170) Heritage and Conservation Register is located within the SSA: Wirrimbirra Sanctuary. In addition a second item listed in the State (S170) Heritage and Conservation Register is also located within the SSA: Bargo Railway Station Toilet Block.

Wirrimbirra Sanctuary

Access to the Wirrimbirra Sanctuary was limited during the field survey for the assessment and detailed inspection of the historical ruins within the Sanctuary was not possible (due to access restrictions), however based on historical research it is understood that they are in poor condition.

The Historical Heritage Assessment considered potential subsidence related impacts to Wirrimbirra Sanctuary, including potential impacts to stone hut foundations and the remains of low stone walls. It is likely that the proposed development would result in the fracturing of the rock bed at Tea Tree Hollow, within the Wirrimbirra Sanctuary. Potential associated surface water impacts such as diversion of surface water and the draining of pools may impact on the natural heritage values of the Sanctuary.

However overall, impacts to heritage features within the sanctuary due to subsidence have been assessed to be nil to minor (Niche, 2018; **Appendix L**).

Whilst impacts to the Wirrimbirra Sanctuary have been assessed to be nil to minor; in consideration of its State heritage significance additional assessment including a detailed site inspection would be undertaken at Wirrimbirra Sanctuary prior to the commencement of mining. The assessment would include a detailed site inspection to assess the condition and structural integrity of the historic items within the sanctuary and the contribution of these items to the overall significance of Wirrimbirra Sanctuary. The results of the assessment would inform the preparation of a site-specific Heritage Management Plan and Statement of Heritage Impact for Wirrimbirra Sanctuary. The site-specific Heritage Management Plan would form part of the Extraction Plan for the relevant longwalls in the vicinity of the Sanctuary, and would identify specific measures to manage potential subsidence related impacts to Wirrimbirra Sanctuary. The Statement of Heritage Impact would be prepared in consultation with approved guidelines, the landowner (National Trust of Australia) and the NSW Heritage Council or its delegate.

Bargo Railway Station Toilet Block

Longwall mining would occur under the Bargo Railway Station Toilet Block. Based on the predicted subsidence impacts, nil to minor impacts are predicted to the structures of this heritage item, including potential damage to the face brickwork and the brick water closet. There is potential for the platforms to slightly move apart and a low chance that they would move closer together, which could encroach on platform clearances. To manage subsidence impacts pre-mining inspections would be carried out, along with monitoring measures during longwall mining to identify and guide restoration measures should minor damage occur. With the implementation of mitigation measures, adverse impacts to the heritage values of the site are not anticipated.

11.9.5 Mitigation Measures

The existing Cultural Heritage Management Plan (CHMP) for the Tahmoor Mine incorporates management of both Aboriginal heritage and historic heritage. The CHMP would be updated for the proposed development to include relevant information from the Historic Heritage Assessment (Niche, 2018; **Appendix L**).

In addition, the following mitigation measures would be implemented by Tahmoor Coal and included in the updated CHMP:

- a site specific Heritage Management Plan would be prepared for each heritage site of local and/ or State significance identified within the SSA, including: Wirrimbirra Sanctuary, Bargo Railway Station and Toilet Block, Bargo Cemetery, Bargo Railway Bridges (South and North) and Tahmoor Mine. Each Heritage Management Plan would form part of the Extraction Plan for the longwalls relevant to each item, and would be developed in consultation with property owners/managers and the Wollondilly Shire Council prior to commencement of mining. The Heritage Management Plans would include:
  - assessment of the pre-mining condition of the heritage item;
  - mitigation or strengthening measures prior to mining such as structural reinforcement;
  - monitoring measures such as the monitoring of ground movements and building movements through regular visual inspections; and
  - measures such as remedial or repair works.
- measures to manage direct and indirect construction impacts (including construction vibration) to structures of heritage value within the Tahmoor Mine and the SSA during the upgrade of surface infrastructure facilities and associated ancillary works;
- Heritage Management Plans or other measures (including pre-mining inspection) for the Bargo Railway Station and Bridges (South and North) would be prepared in consultation with Transport for NSW; and
- as described in **Section 11.9.4**, additional assessment, including a detailed site inspection, would be undertaken for Wirrimbirra Sanctuary. The results of the assessment would inform the preparation of a site-specific Heritage Management Plan and Statement of Heritage Impact prepared in consultation with the landowner (National Trust) and the NSW Heritage Council, or its delegate. The Heritage Management Plan and Statement of Heritage Impact for the Sanctuary would be finalised as part of the Extraction Plan for the longwalls relevant to the Sanctuary.

The undertaking of pre-condition assessment and the preparation of a Heritage Management Plan for the identified heritage items is consistent with the conservation principles of the Burra Charter and ensures an understanding of the significance of the items and makes use of techniques available to conserve the place.

11.9.6 Conclusion

The Historic Heritage Assessment identified that potential impacts on heritage items are primarily limited to subsidence associated impacts. Potential impacts include cracking of internal lining, dislodgement of external weatherboards (if the structure is timber), cracking of brickwork and brick chimneys. Masonry structures were considered as more susceptible to these impacts and were prioritised in the assessment. In most instances restoration works will mitigate impacts to heritage values of affected items.

A total of 23 historical heritage items were identified during the assessment, with 19 located directly above the proposed longwall mining area. The assessment concluded that there was nil to low likelihood of physical impacts to all masonry or timber heritage items, and that any impacts are predicted to be minor. Mitigation measures have been identified to manage potential impacts, including the preparation and implementation of a site specific Heritage Management Plan for each heritage site of State/ local significance identified within the SSA.

Heritage values of Wirrimbirra Sanctuary, which is listed on the State Heritage Register, are not expected to be reduced by the proposed development. However, additional assessment of the Sanctuary would be undertaken prior to mining and would inform the preparation of a site specific Heritage Management Plan and Statement of Heritage Impact in consultation with approved guidelines, the landowner (National Trust of Australia) and the NSW Heritage Council or its delegate.

11.10 Noise and Vibration

A Noise and Vibration Impact Assessment (NVIA) was prepared by EMM Consulting Pty Ltd (EMM) for the Tahmoor South project (EMM, 2018) which assessed the potential noise and vibration impacts of the proposed development in the context of the existing mine noise and acoustic environment. This included assessment of construction noise and vibration, sleep disturbance and operational noise impacts including road traffic noise and rail noise. The NVIA is provided in **Appendix M**.

The NVIA addressed the SEARs relevant to noise and vibration impacts, listed in **Table 11-43**.

Table 11-43 SEARs for the assessment of noise and vibration impacts

Noise and Vibration SEARs	Where addressed
Noise and Vibration – including:	
• an assessment of the likely operational, rail "wheel squeal" and construction noise impacts of the development under the NSW Industrial Noise Policy (as may be updated or replaced), paying particular attention to the obligations in chapters 8 and 9 of the policy, and the Voluntary Land Acquisition and Mitigation Policy (DPE);	**Section 11.10.1** and **11.10.4**
• if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the Interim Construction Noise Guideline;	**Section 11.10.4**
• an assessment of the likely road noise impacts of the development under the NSW Road Noise Policy; and	**Section 11.10.4**
• an assessment of the potential vibration and low frequency noise impacts of the development.	**Section 11.10.4**

11.10.1 Background

Tahmoor Mine has been operating since 1979. Since its original development, numerous changes have occurred that are relevant to the consideration and assessment of operational noise, in particular the encroachment of residential and other development in the vicinity of the mine and the increasing amount of traffic on Remembrance Driveway, which borders the mine surface infrastructure area. There have also been significant changes to government policy relating to the management of noise since development consent was originally approved for the mine, including the introduction of the EPA's *Industrial Noise Policy* (INP) in 2000, and the *Noise Policy for Industry* (NPfI) in 2017 which supersedes the INP.

The most recent development consent relating to existing operations at Tahmoor Mine and which includes operational noise criteria is the 1994 development consent. The Tahmoor mine is also regulated by an Environmental Protection Licence (EPL 1389), however the licence does not contain noise limits relevant to the site nor requirements to monitor noise emissions. However, it has in the past included a number of noise related Pollution Reduction Programs (PRPs). Extensive work has subsequently been undertaken at the site to implement the PRPs, as described further in **Section 11.10.5,** and Section 4.2 of **Appendix M**. The success of these PRPs is demonstrated by the significant reduction in noise related complaints at the site, which have reduced from around 100 complaints in 2010, to only one in 2018.

Noise Policy

In 2017 the NSW EPA released the *Noise Policy for Industry*, which replaced the INP for the assessment of new developments. At the time that the SEARs were issued, the project fell within the transitional arrangements for noise assessments, so that the INP still applies to the assessment of noise and vibration for the project. This approach was confirmed by the NSW EPA at a meeting on 16 November 2017.

In 2018, the NSW EPA released the revised *Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments* (VLAMP). This policy outlines how acquisition and mitigation rights are assigned to landholders in relation to State significant resource projects in NSW. Once the rights are established they may be voluntarily triggered by landholders at any time. The noise assessment for the proposed development has been undertaken with consideration of this policy.

11.10.2 Methodology

Noise modelling

Noise modelling was based on three-dimensional digitised ground contours of the surrounding land and surface infrastructure for the existing mine operations, as well as the construction and operational phases of the proposed development. Noise predictions were carried out using the Brüel & Kjær Predictor software.

A summary of the operational noise sources and associated sound power levels used in the noise model are provided in Table 7.1 and Table 7.3 of **Appendix M**. The equipment items and numbers of each item are based on the current operations at the mine and largely based on noise measurements of existing activities at the site. Where this was not possible, sound power data has been obtained from an EMM database of similar plant and equipment.

Applying the INP to existing sites – Operational Noise

Section 10 of the INP describes how the policy is to be applied to existing industrial premises with legacy noise issues, in particular those sites where existing noise emissions are above noise levels that would apply based on the current noise policy, as is the case at Tahmoor Mine (refer to **Section 11.10.3**).

Accordingly, the following steps were taken in the assessment of operational noise emissions from the Tahmoor Mine, consistent with those outlined in Section 10 of the INP:

1. Measure and determine existing background and ambient noise levels.
2. Measure and predict noise levels produced by the existing infrastructure at Tahmoor Mine, having regard to meteorological effects such as from wind and temperature inversion.
3. Determine project-specific noise levels (PSNL) based on intrusive and amenity noise criteria.
4. Compare the measured and/or predicted noise levels from the site with the PSNL.
5. Where the PSNL are exceeded, assess feasible and reasonable noise mitigation strategies.
6. Determine achievable noise limits for the site. Describe the noise reduction measures to be implemented and their proposed timing.

Existing Noise Monitoring Program

Noise at the mine is monitored through quarterly attended night-time surveys (at locations M1 to M10), and by two continuous real-time noise monitors which operate 24 hours per day 7 days per week. The continuous real-time noise monitor located onsite has been programmed with pre-defined alarm trigger levels, which are linked to the site's control room and Citect control system, for monitoring night-time operational noise. The system allows the site to proactively manage noise levels during night-time hours (the most sensitive noise period), with the intent of managing identified elevated noise levels as they occur, ultimately reducing the number of community complaints.

Attended noise monitoring was also completed in November 2017 and January 2018 to measure night-time L_{Aeq} one-third octave band centre frequency levels (10-160 Hz), low frequency noise (LFN) threshold levels and C-A weighted levels.

Quarterly noise compliance monitoring and attended noise monitoring locations are shown on **Figure 11.22**. The results of the monitoring are discussed in **Section 11.10.3**.

Background Noise Monitoring

For the purposes of the current assessment, long term noise loggers and short-term operator-attended noise monitoring were used to quantify the existing background noise environment, including any existing industrial noise where present. Unattended noise monitoring was completed by EMM at five locations surrounding the site from 16 to 29 May 2018. Operator-attended noise monitoring was also completed by EMM at the same five locations and four additional off-site locations surrounding the site. Consideration has also been given to the existing quarterly noise compliance monitoring locations (QM1 to QM10) and previous unattended noise monitoring undertaken by Atkins Acoustics in 2012. Noise assessment monitoring locations are provided on **Figure 11.22**. The results of the monitoring are discussed in **Section 11.10.3**.

Meteorology

During certain weather conditions such as high winds, mine noise emissions may increase or decrease. A conservative approach has been selected for the consideration of potentially noise-enhancing weather conditions in accordance with Section 5 of the INP. Noise emissions from the mine have been predicted for both calm and worst-case noise-enhancing conditions as provided in **Appendix M**.

Assessment locations

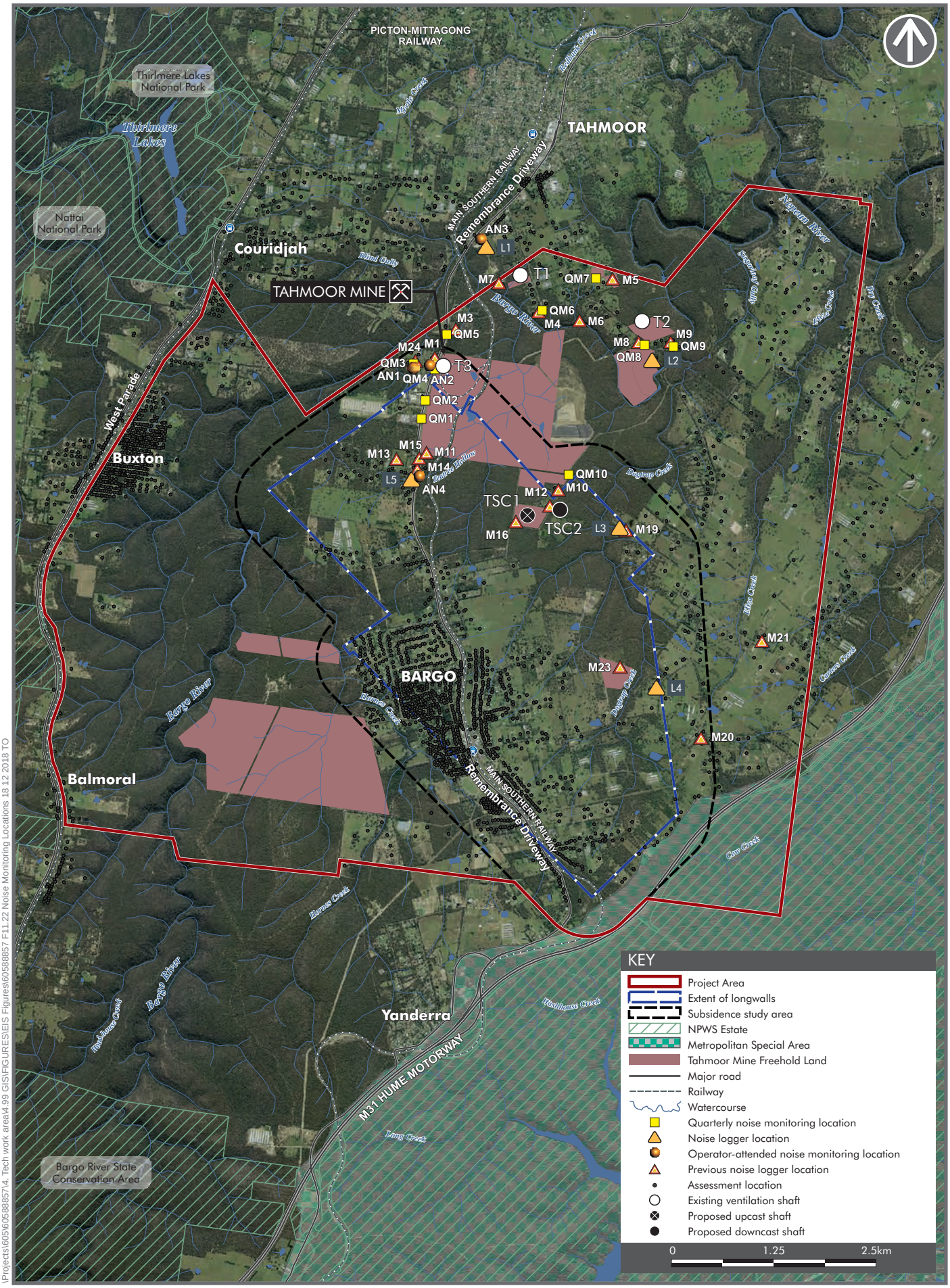
Sensitive receptors, including private dwellings and other noise-sensitive developments (e.g. Wollondilly Anglican Church and College), have been identified near the site and are referred to as assessment locations. Assessment locations have been categorised into nine noise catchment areas (NCA) based on similar ambient acoustic environments. NCAs including corresponding assessment locations (represented as black dots) are shown on **Figure 11.23.**

A description of the NCAs, and the relevant monitoring locations for each catchment, are outlined in **Table 11-44**.

Table 11-44 Noise Catchment Areas

NCA	Description and relation to Noise Monitoring
1	This is the area located within 100 m of Remembrance Driveway and is represented by the ambient noise levels recorded at logger location 5 (L5) which was located 70 m from Remembrance Driveway. It was found that ambient noise levels measured here were generally consistent (within 2 dB) with those measured at other similar locations by Atkins Acoustics (i.e. M11, M14 and M15).
2	This is the area located within 200 m of Remembrance Driveway and is represented by the ambient noise levels recorded at L1.
3	This is the area located south-east of the mine toward the Hume Motorway and is represented by the ambient noise levels recorded at L4. Ambient noise levels measured at L4 were generally lower than those measured at other similar locations by Atkins Acoustics (i.e. M20, M21 and M23) however the lower levels have been utilised for this assessment and provides a conservative approach for the determination of PSNLs in this area.
4	This area is representative of all other typically rural locations within the project study area. Ambient noise levels in this area are consistent with the minimum level provided in the INP and consistent with those measured at locations L2, L3, M10, M12 and M16.
5	This area is located north-east of the mine and represents most residences located on this northern section of Rockford Road, Tahmoor. It is represented by ambient noise levels measured at M5 and M6.
6	This area is located north-east of the mine and represents most residences located on Stratford Road, Tahmoor. It is represented by ambient noise levels measured at M4 and M7.
7	This area contains three residential dwellings adjacent to the service station north of the mine on Remembrance Driveway. It is represented by the ambient noise levels recorded at M3.

NCA	Description and relation to Noise Monitoring
8	This area is relevant to the western end of Olive Lane and is represented by the ambient noise levels recorded at M2.
9	This area is located south-west of the mine and represents most residences located on Caloola Road and Yarran Road, Bargo. It is represented by the ambient noise levels recorded at M13.



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NOISE MEASUREMENT LOCATIONS

Tahmoor South Project
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FIGURE 11.22

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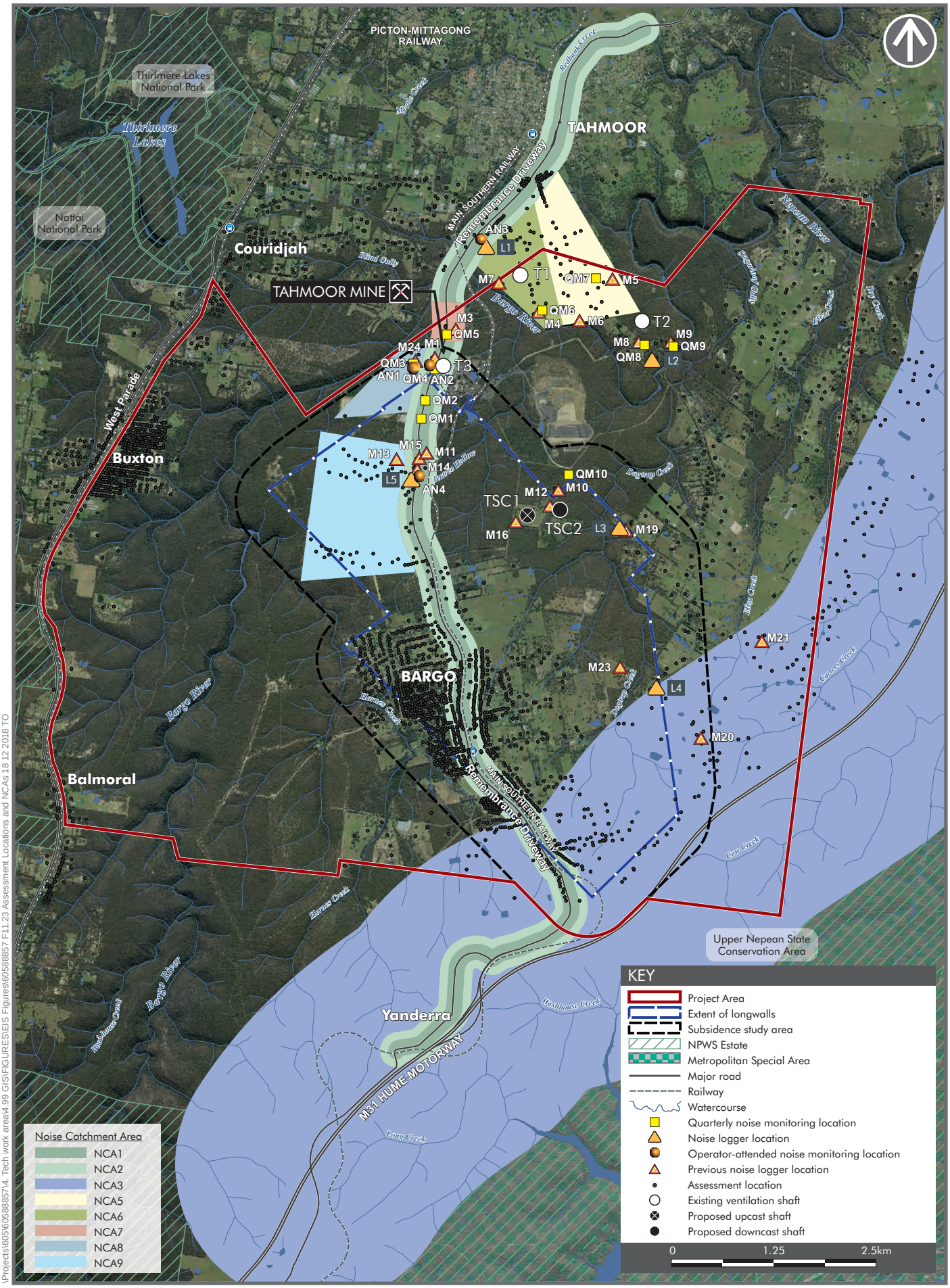

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ASSESSMENT LOCATIONS AND NOISE CATCHMENT AREAS

Tahmoor South Project
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FIGURE 11.23

Noise and Vibration Criteria

Operational Noise

Project specific noise limits (PSNLs) were determined for the proposed development. As per normal INP practice, these limits are generally taken as equal to the lower of the derived intrusiveness and amenity criteria.

The intrusiveness criterion is equal to the rating background level (RBL) plus 5 dB(A), which means that the equivalent continuous noise level of the source should not be more than 5 dB(A) above the measured background level.

The RBL for each NCA (as determined from noise monitoring described in **Section 11.10.2**), and the associated intrusive noise criteria are provided in **Table 11-45**. Where the RBL for the evening or night period is higher than day period RBL, the lower RBL for the day period has been adopted as the evening and night period in accordance with the INP Application Notes.

Table 11-45 Intrusive noise criteria

NCA (representative logger location)	Adopted RBL, dB			Intrusive criteria, $L_{Aeq,15min}$, dB		
	Day	Evening	Night	Day	Evening	Night
1 (L5)	44	37	30	49	42	35
2 (L1)	39	37	30	44	42	35
3 (L4)	33	33	30	38	38	35
4 (L2, L3)	30	30	30	35	35	35
5 (M5, M6)	32	30	30	37	35	35
6 (M4, M7)	34	32	32	39	37	37
7 (M3)	41	37	34	46	42	39
8 (M2)	41	40	32	46	45	37
9 (M13)	39	38	30	44	43	35

Amenity noise criteria are provided by the INP and are specific to land uses and activities. The criteria relate only to industrial-type noise and do not include road, rail and/or community noise. Assessment locations within NCA1, 2, 7, 8 and 9 have been categorised as per the INP as suburban amenity (i.e. an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry). All other assessment locations have been categorised as per the INP as rural amenity category (i.e. an area with an acoustical environment that is dominated by natural sounds and generally characterised by low background noise levels). Due to the lack of other existing or proposed (approved and not yet built) industry in the area, no adjustment to the acceptable amenity levels was required.

The INP amenity criteria relevant to the proposed development are provided in **Table 11-46.**

Table 11-46 Operational noise amenity criteria

NCA	Indicative area	Recommended 'acceptable' noise, $L_{Aeq,period}$, dB			Recommended 'maximum' noise, $L_{Aeq,period}$, dB		
		Day[1]	Evening	Night	Day	Evening	Night
1	Suburban	55	45	40	60	50	45
2	Suburban	55	45	40	60	50	45
3	Rural	50	45	40	55	50	45
4	Rural	50	45	40	55	50	45
5	Rural	50	45	40	55	50	45
6	Rural	50	45	40	55	50	45
7	Suburban	55	45	40	60	50	45
8	Suburban	55	45	40	60	50	45
9	Suburban	55	45	40	60	50	45
College[2] (internal)	All	$L_{Aeq(1hour)}$ 40	-	-	$L_{Aeq(1hour)}$ 45[3]-	-	-
Place of worship (internal)	All	$L_{Aeq(1hour)}$ 40	$L_{Aeq(1hour)}$ 40	$L_{Aeq(1hour)}$ 40	$L_{Aeq(1hour)}$ 45	$L_{Aeq(1hour)}$ 45	$L_{Aeq(1hour)}$ 45

1. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; evening: 6 pm to 10 pm; night: all remaining periods.
2. The recommended acceptable noise amenity level for an existing school affected by existing industrial noise sources has been established as per Note 10 to Table 2.1 of the INP. Amenity criteria for the College applies "when in use" – it has been assumed the College operates during the day period only.
3. It has been inferred that the recommended maximum amenity noise level for an existing school affected by existing industrial noise sources is 5 dB higher than the recommended acceptable level, consistent with all other receiver types listed in Table 2.1 of the INP.

The PSNLs for the project were determined as the lowest of the intrusive criteria and the amenity criteria. For all receivers the intrusive criteria were lower and have therefore determined the PSNLs for the proposed development and are shown in **Table 11-47** below.

Table 11.47 Project specific noise levels

NCA	Intrusive criteria, $L_{Aeq,15min}$, dB			Amenity criteria, $L_{Aeq,period}$, dB			PSNL, $L_{Aeq,15min}$, dB		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
1	**49**	**42**	**35**	55	45	40	**49**	**42**	**35**
2	**44**	**42**	**35**	55	45	40	**44**	**42**	**35**
3	**38**	**38**	**35**	50	45	40	**38**	**38**	**35**
4	**35**	**35**	**35**	50	45	40	**35**	**35**	**35**
5	**37**	**35**	**35**	50	45	40	**37**	**35**	**35**
6	**39**	**37**	**37**	50	45	40	**39**	**37**	**37**
7	**46**	**42**	**39**	55	45	40	**46**	**42**	**39**
8	**46**	**45**	**37**	55	45	40	**46**	**45**	**37**
9	**44**	**43**	**35**	55	45	40	**44**	**43**	**35**
College (internal)	**-**	**-**	**-**	$L_{Aeq(1hour)}$ 40	-	-	$L_{Aeq(1hour)}$ 40	**-**	**-**
Church (internal)	**-**	**-**	**-**	$L_{Aeq(1hour)}$ 40	$L_{Aeq(1hour)}$ 40	$L_{Aeq(1hour)}$ 40	$L_{Aeq(1hour)}$ 40	$L_{Aeq(1hour)}$ 40	$L_{Aeq(1hour)}$ 40

Low Frequency Noise

The modifying factor adjustments outlined in Fact Sheet C of the NPfI (EPA 2017) have been used when assessing the characteristics of a noise source. As a result of the guidance in Fact Sheet C, 2 dB or 5 dB positive adjustments have been made depending on the tonal characteristics of the noise.

Construction Noise

The proposed development will involve a period of construction to establish site facilities (such as ventilation shafts) before staged longwall mining can commence. The Interim Construction Noise Guideline (ICNG) quantitative methodology, which is suited to major construction projects with a typical duration of more than three weeks, is appropriate for construction associated with the proposed development and hence has been adopted for this assessment. This method requires noise emission predictions from construction activities at the nearest assessment locations and assessment against ICNG recommended noise levels.

Noise management levels (NMLs) for residential sensitive receptors as outlined in the ICNG are reproduced in **Table 11-48**. NMLs were used to assess potential noise impacts on construction receptors during standard and non-standard construction hours.

Table 11-48 ICNG construction noise management levels for residential land uses.

Time of day	Management level $L_{Aeq(15\ minute)}$	Application
Recommended standard hours: Monday to Friday 7 am to 6 pm, Saturday 8 am to 1 pm, No work on Sundays or public holidays	Noise-affected RBL + 10 dB	The noise-affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq(15\text{-}min)}$ is greater than the noise-affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB	The highly noise-affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: i. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); ii. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Time of day	Management level $L_{Aeq(15\ minute)}$	Application
Outside recommended standard hours	Noise-affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise-affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see Section 7.2.2 of the ICNG.

Sleep Disturbance

The existing mine and proposed development include 24 hour operations and as such an assessment of sleep disturbance was undertaken. In addition, sleep disturbance was considered in relation to construction noise, as construction works outside of standard hours (i.e. night time works) are proposed.

While absolute criteria for sleep disturbance is not available, the INP Application Notes suggests that a site-related $L_{A1(1min)}$ or L_{Amax} level of 15 dB above the RBL is a suitable screening criterion for sleep disturbance for operation in the night-time period (10pm-7am).

For residential receivers the accepted noise attenuation of 10 dB for the facade of a residential building of standard construction with a partially open window has been adopted.

Sleep disturbance criteria for operation of the proposed development, as derived from the INP, are provided in **Table 11-49**.

Table 11-49 Sleep disturbance screening criteria

NCA	Adopted RBL, dB	Sleep disturbance screening criteria, L_{Amax} (dB)
1	30	45
2	30	45
3	30	45
4	30	45
5	30	45
6	32	47
7	34	49
8	32	47
9	30	45

Road Noise

Traffic routes for construction and operational traffic related to the proposed development comprise Remembrance Driveway (north and south of the mine entrance), Rockford Road and Charlies Point Road. These are all categorised as either arterial or sub-arterial roads as per the categories provided in the RNP.

The relevant RNP road traffic noise assessment criteria for noise sensitive receptors are reproduced in **Table 11-50**.

Table 11-50 Road traffic noise assessment criteria for residential land uses

Receiver type	Road category	Type of project/development	Assessment criteria – dB Day (7 am to 10 pm)	Night (10 pm to 7 am)
Residence	Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeway/arterial/sub-arterial roads generated by land use developments.	$L_{Aeq,15hr}$ 60 (external)	$L_{Aeq,9hr}$ 55 (external)
School	Any	Proposed road projects and traffic generating developments	$L_{Aeq,1hr}$ 40 (internal) when in use	-
Place of worship	Any	Proposed road projects and traffic generating developments	$L_{Aeq,1hr}$ 40 (internal) when in use	$L_{Aeq,1hr}$ 40 (internal) when in use

Additionally, the RNP states that where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2 dB.

The RNP states that any assessment location experiencing an increase in total traffic noise levels above those presented in **Table 11-51** should be considered for mitigation.

Table 11-51 Road traffic relative increase criteria for residential land uses

Road category	Type of project/development	Total traffic noise level increase – dB	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Freeway/arterial/sub-arterial roads and transit ways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road.	Existing traffic $L_{Aeq(15\text{-}hr)}$ + 12 (external)	Existing traffic $L_{Aeq(9\text{-}hr)}$ + 12 (external)

Construction and Operation Vibration - Human Comfort

Humans can detect vibration levels which are well below those causing any risk of damage to a building or its contents. The actual perception of vibration depends on a range of individual factors. The accepted degrees of perception of vibration for humans are outlined in German Standard DIN 4150 Part 2 1975 (**Table 11-52**).

Table 11-52 Peak vibration levels and human perception to motion

Approximate vibration level	Degree of perception
0.10 mm/s	Not felt
0.15 mm/s	Threshold of perception
0.35 mm/s	Barely noticeable
1.00 mm/s	Noticeable
2.20 mm/s	Easily noticeable
6.00 mm/s	Strongly noticeable
14.00 mm/s	Very strongly noticeable

The NSW guideline for the assessment of vibration *Environmental Noise Management – Assessing Vibration: a technical guideline* (DEC 2006) presents preferred and maximum vibration values for the use in assessing human responses to vibration. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended that the operator negotiate directly with the affected community.

The guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria. The three vibration types are continuous vibration, impulsive vibration and intermittent vibration.

Intermittent vibration is representative of construction activities such as impact hammering, rolling or general excavation work. Intermittent vibration is assessed using the vibration dose concept which relates to vibration magnitude and exposure time. Calculation of Vibration Dose Values (VDV) and acceptable VDV values are outlined in Section 3.9.1 of **Appendix M**.

It is expected that consideration of transient vibration provides a worst-case scenario in terms of potential human-comfort vibration impacts. Continuous vibration has not been considered given the transient nature of operations and the relative separation to vibration-sensitive receptors. Impulsive vibration can be caused by blasting which is not applicable to the general operations or construction phase of the proposed development.

Construction and Operation Vibration – Structural Effects

The assessment of the project's potential to affect buildings and other structures has been based on BS 7385 Part 2-1993 'Evaluation and measurement for vibration in buildings Part 2'. This standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated.

The recommended limits (guide values) for transient vibration to manage the risk of cosmetic damage to structures are presented numerically in **Table 11-53**.

Table 11-53 Transient vibration guide values for minimal risk of cosmetic damage

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s	50 mm/s
Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Under certain circumstances, the criteria values have been reduced in line with the recommendations of the standard. However, the BS 7385 states that a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.

11.10.3 Existing Environment

Existing Mine Noise

A summary of the quarterly noise monitoring results for the period between Q1 2014 and Q1 2018 is provided in Table 4.1 of **Appendix M**. These results indicate that noise levels from the mine are generally in compliance with the existing noise limits (i.e. within 2 dB) at the relevant residential monitoring locations. These results also show that existing mine noise emissions from the site at the eastern end of Olive Lane (M4) are in the order of 47 to 50 dB during calm conditions. However, location M4 is not a residence, so the exceedance would not result in impacts at this location. Modelled existing mine noise contours are provided in **Figure 11.24**.

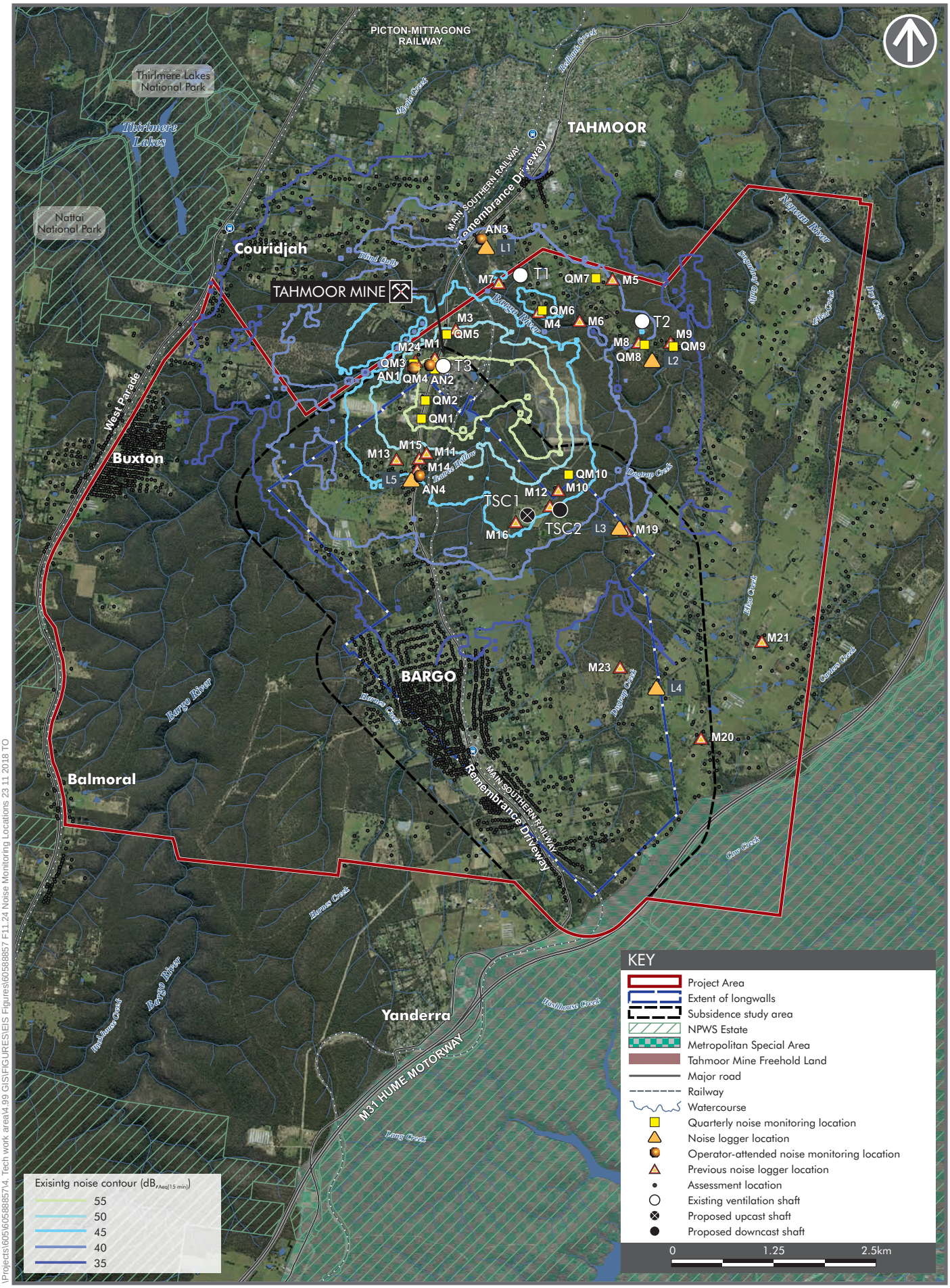
Attended noise monitoring undertaken between November 2017 and January 2018 (**Table 4.2** and Table 4.3 of **Appendix M)** indicate that low frequency noise above the relevant thresholds as a result of operation of the CHPP is present in the vicinity of Olive Lane (M3 and M4) and the Wollondilly Anglican Church and College (M2). Low frequency noise impacts as part of the operation of the mine have been assessed in **Section 11.10.4**.

Existing Acoustic Environment

In addition to the quarterly noise monitoring undertaken around the mine site and previous unattended noise monitoring undertaken by Atkins Acoustics in 2012, EMM conducted attended and unattended noise monitoring at five locations surrounding the site in May 2018 to characterise the existing background noise environment for the purposes of the current assessment.

A summary of the noise monitoring results is provided in Table 5.1 and Table 5.2 of **Appendix M**.

The results of noise monitoring conducted around the site show that, with the exception of the area west of the mine in Olive lane, the existing noise environment surrounding the Tahmoor mining operation is dominated by sources other than the mine. The existing noise environment west of the site, in Olive Lane, is dominated by noise from Tahmoor mine and traffic on Remembrance Driveway. North of the site the existing noise environment is dominated by local traffic and some commercial activity with some contribution from Tahmoor mine. Noise levels at residences south of the site are dominated by traffic noise from Remembrance Driveway and trains. Noise levels in residential areas west of the site are dominated by typically rural sounds and local traffic.



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EXISTING MINE NOISE CONTOURS

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FIGURE 11.24

11.10.4 Impact Assessment

Construction Noise

Of the construction activities required to be undertaken for the proposal, construction of the ventilation shaft site(s) have been modelled as the representative, worst-case construction activities for the proposal.

Site establishment and construction activities associated with the ventilation shafts (other than drilling) would be undertaken between 7am and 6pm Monday to Friday, and 7am to 1pm Saturday, and therefore consistent with the ICNG standard hours. Ventilation shaft drilling would be continuous 24 hours a day, 7 days a week.

TSC1 is proposed to be constructed over a period of approximately two years; 18 months of site establishment and developing site access followed by fan installation over approximately six months. Construction of TSC2 will follow immediately after TSC1 is complete and over a similar timeframe.

Mobilisation for each site would include delivery of approximately forty standard and two wide semitrailer loads of drill rig components, auxiliary drill rig items, storage containers, temporary site amenities and construction equipment. The plant and equipment likely to be used during the site establishment works include excavators, dozer, tippers, trucks, graders, vibratory rollers, compactor, asphalt pavers and water carts. In addition to the drilling rig and gantry itself, associated drilling plant and equipment comprises excavator, loader, crane, compressor, welding machines and water pumps. Plant and equipment items, sound power levels and quantities adopted in the noise modelling are summarised in Table 10.1 of **Appendix M.**

Predicted noise levels over a typical worst case 15-minute scenario were modelled and assessed for comparison against the relevant NMLs. Noise predictions were undertaken assuming calm and noise-enhancing meteorological conditions.

A summary of predicted construction noise emissions for ventilation shaft construction is provided in **Table 11-54** for select representative assessment locations. The assessment locations nearest the proposed construction site are all located within NCA 4 and are all representative of typically rural locations. Hence, minimum construction noise NMLs have been applied.

Table 11-54 Predicted ventilation shaft construction noise – noise enhancing conditions

Location	Predicted ventilation shaft construction noise, $L_{Aeq,15min}$, dB					
	Ventilation ShaftTSC1			Ventilation Shaft TSC2		
	Site Est. (Standard hours)	Drilling (Standard hours)	Drilling (Outside standard hours)	Site Est. (Standard hours)	Drilling (Standard hours)	Drilling (Outside standard hours)
215 Charlies Point Rd	58	48	39	62	52	44
185 Charlies Point Rd	67	57	44	66	56	50
80 Charlies Point Rd	52	42	<35	51	41	<35
Nearest on Great Southern Rd	45	35	<35	42	<35	<35
70 Warrobyn Rd	48	38	<35	52	42	<35
Nearest on Ironbark Rd	42	<35	<35	41	<35	<35
Nearest on Remembrance Driveway	46	36	<35	43	<35	<35
NML ($L_{Aeq,15\ minute}$, dB)	**40 75 highly affected**	**40 75 highly affected**	**35**	**40 75 highly affected**	**40 75 highly affected**	**35**

Construction noise levels are predicted to exceed the NMLs but would be below the highly noise affected level for all works during standard construction hours. Given that the predictions assume noise-enhancing conditions as well as simultaneous operation of plant and equipment, it is likely that actual construction noise levels would be less than those predicted most of the time. Notwithstanding, noise mitigation measures and application of good practice noise management have been considered. Noise mitigation and management measures are discussed below.

Construction noise levels outside of standard hours are predicted to exceed the NML at two locations only: the two nearest privately-owned residences on Charlies Point Road. Tahmoor Coal has commenced negotiations with the owners of both of these properties. Noise from the out-of-hours activity will generally be continuous in nature. Therefore, given the magnitude of predicted L_{Aeq} construction noise levels, the maximum noise level (ie L_{Amax}) from out-of-hours drilling is likely to be below relevant sleep disturbance screening criteria at all nearby assessment locations.

Due to the significant separation between the construction sites and the nearest non-residential sensitive receptors (e.g. Wollondilly Anglican Church and College), potential construction noise impacts at these locations would be negligible.

Operational Noise

Three scenarios were modelled for the operational noise assessment:

- existing mine operations;
- unmitigated proposed development operations; and
- mitigated proposed development operations.

All sources were assumed to operate continuously during all periods (day, evening and night) for both the existing and unmitigated proposed development scenarios to assess a worst case scenario.

Operational noise predictions for Wollondilly Anglican Church and College are presented as internal values. This accounts for a 25 dB reduction in noise at the façade and assumes the affected façade does not have any open windows or doors.

The results of the existing and unmitigated modelling scenarios showed that noise levels from the existing mine and the proposed development exceed the PSNLs. This is despite noise levels generally being in compliance with current noise criteria and is a reflection of changes in both noise policy and the surrounding environment that have occurred since the mine began operation almost 40 years ago.

In consideration of the noise modelling results for the existing and unmitigated scenarios, feasible and reasonable mitigation measures were then considered in accordance with the guidance provided in the INP, so as to minimise noise impacts on sensitive receivers. The proposed development was then modelled with the measures considered reasonable and feasible in place (i.e. the mitigated scenario). A description of these noise mitigation measures is provided in **Section 11.10.5**.

In relation to LFN, tonality corrections were applied to noise levels predicted at the Olive Lane residences and Wollondilly Anglican Church and College, based on the results of the quarterly noise compliance monitoring.

Results for the unmitigated and mitigated operation of the proposed development are presented in the NVIA (**Appendix M**) and illustrated in **Figure 11.25** and **Figure 11.26** below.

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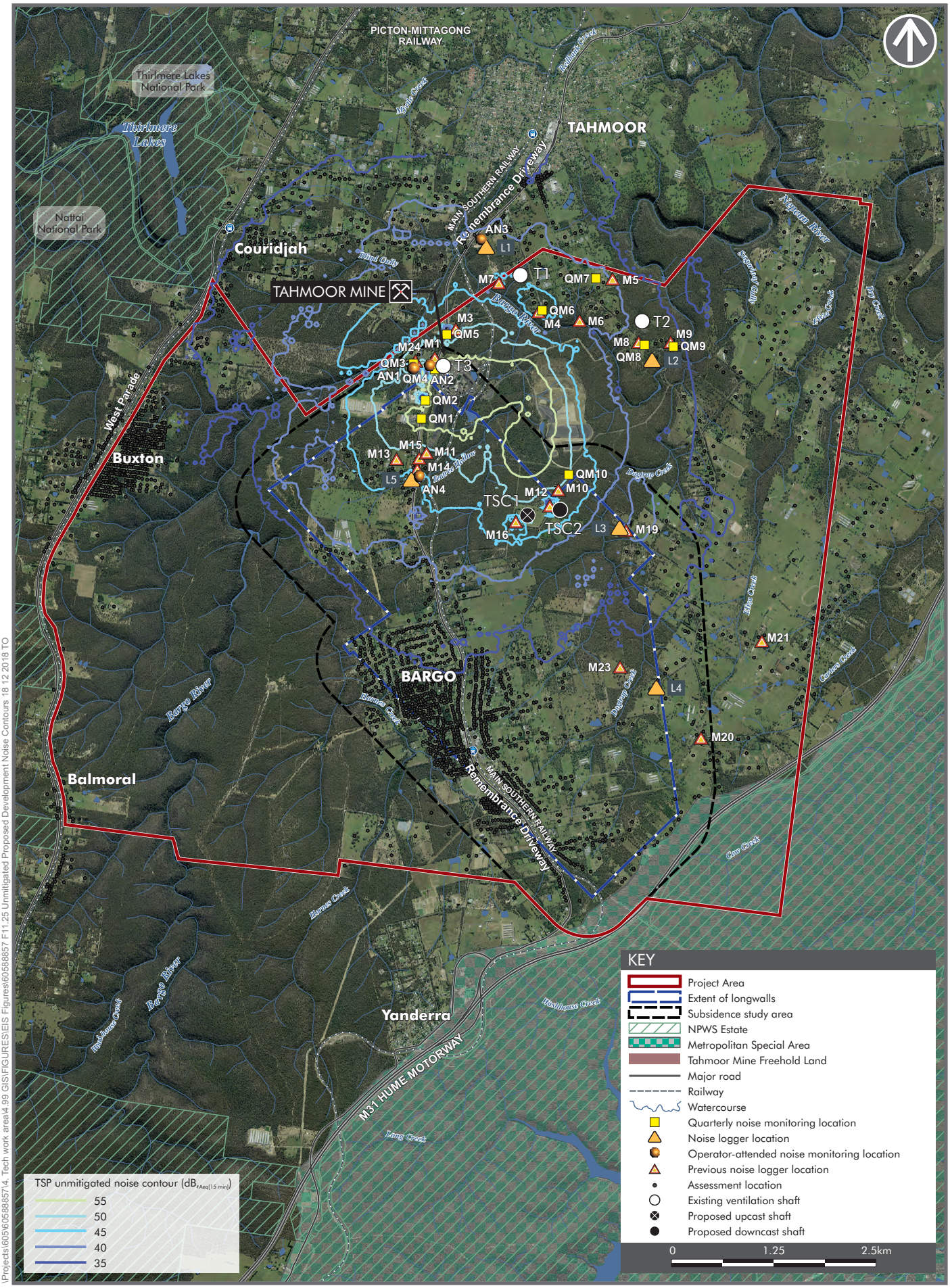

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SIMEC MINING

UNMITIGATED PROPOSED DEVELOPMENT NOISE CONTOURS

Tahmoor South Project
Environmental Impact Statement

FIGURE 11.25

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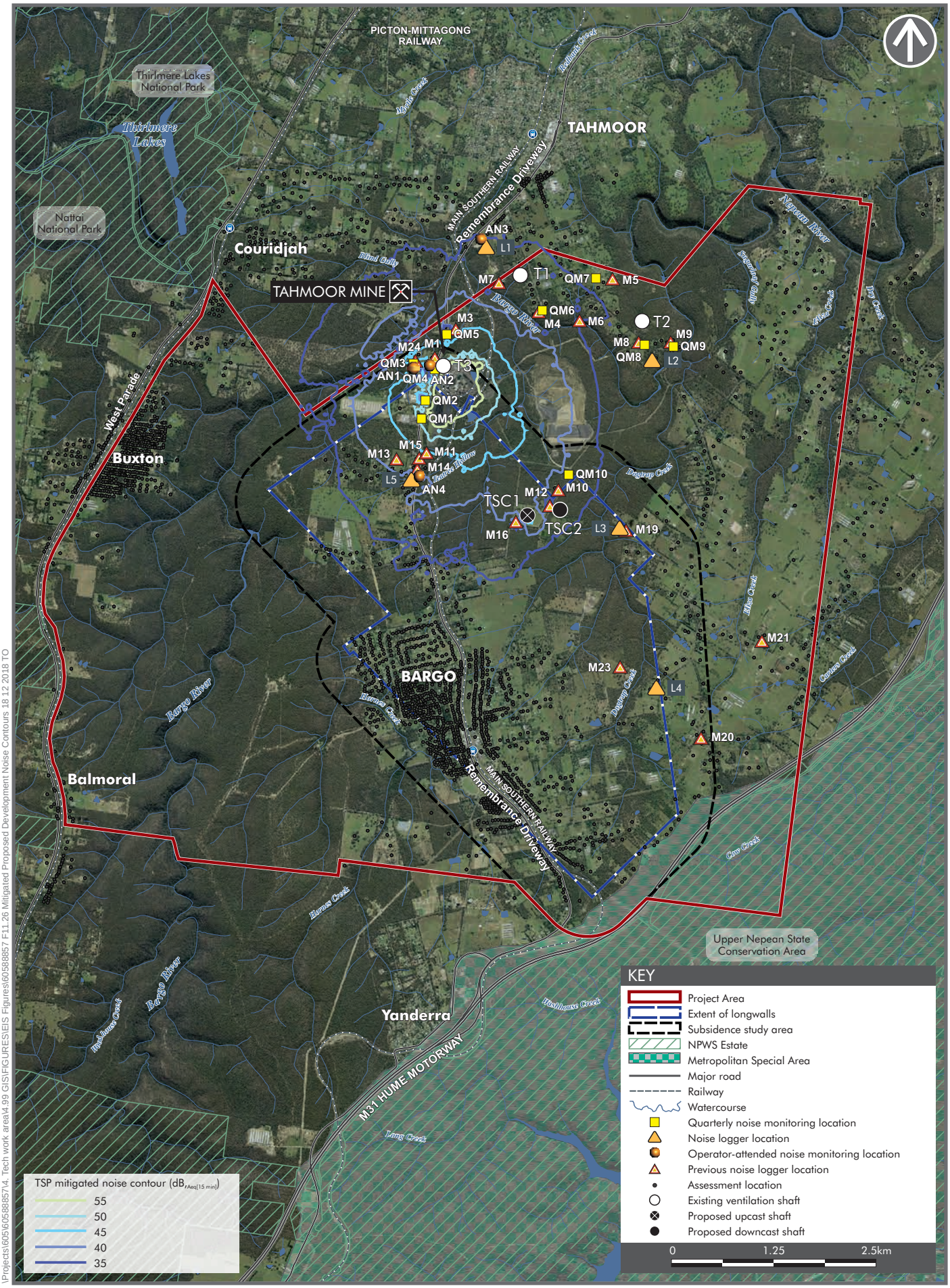

\Projects\605\605885714. Tech work area\4.99 GIS\FIGURES\EIS Figures\605885857 F11.26 Mitigated Proposed Development Noise Contours 18 12 2018 TO

SIMEC MINING

MITIGATED PROPOSED DEVELOPMENT NOISE CONTOURS

Tahmoor South Project
Environmental Impact Statement

FIGURE 11.26

Table 11-55 provides a summary of the number of assessment locations for each operational scenario (existing, unmitigated and mitigated proposed development) where predicted noise emissions are in the following categories:

- no more than 2 dB above PSNL;
- 3-5 dB above PSNL; and
- more than 5 dB above PSNL.

Table 11-55 Number of assessment locations compared to PSNLs

Category	Existing Tahmoor mine			The project unmitigated			The project mitigated		
	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night
Noise-enhancing meteorological conditions									
No more than 2 dB above PSNL	2,585	2,556	2,464	2,585	2,553	2,460	2,683	2,657	2,716
3-5 dB above PSNL	128	133	172	124	129	167	70	70	28
More than 5 dB above PSNL	50	74	127	54	81	136	10	36	19
Calm meteorological conditions									
No more than 2 dB above PSNL	2,697	2,675	2,619	2,700	2,675	2,610	2,749	2,721	2,743
3-5 dB above PSNL	58	67	86	55	68	95	12	35	12
More than 5 dB above PSNL	8	21	58	8	20	57	2	7	7

The key outcomes of the operational noise assessment are summarised as follows:

- the mitigated proposed development will result in a significant reduction in the number of privately-owned dwellings affected by night-time mine noise emissions that are more than 5 dB above the relevant PSNL; 19 for operation of the mitigated Tahmoor South Project compared to 127 for existing Tahmoor mine operations.
- mine noise associated with the mitigated Tahmoor South Project is expected to reduce at all assessment locations during the night-time period compared to existing levels by at least 2 dB and up to 9 dB.
- mine noise during the day and evening periods associated with the mitigated Tahmoor South Project is expected to reduce by up to 6 dB compared to existing levels at all but two assessment locations. The exceptions are the residences at 185 and 215 Charlies Point Road (south of the REA) where noise levels are predicted to increase by 3 dB compared to existing mine levels as a result of the southern extension to the REA and the new ventilation fans. Predicted night-time noise levels at these two properties are 40 dB and 39 dB (ie 5 dB and 4 dB above PSNLs, respectively). Negotiations with these two properties have commenced, as described in **Section 11.10.5**.
- mine noise at the Anglican Church and school are predicted to achieve the relevant internal amenity noise levels.

Where a proposal is predicted to exceed the PSNLs, the INP describes the process for the negotiation of what represents the best achievable level that is practicable for a development. In the event that a negotiation process is an outcome of this assessment, predicted 'achievable' noise levels at locations around the mine have been provided in Table 7.6 of **Appendix M.**

As identified in **Section 11.10.1** the VLAMP (NSW Government, 2018) outlines how acquisition and mitigation rights are assigned to landholders in relation to State significant resource projects in NSW where PSNLs are exceeded. A summary of the number of assessment locations in each noise impact category, in accordance with Table 1 of the VLAMP are illustrated on **Figure 11.27** and summarised in

Table 11-56. These categories are: significant, moderate, marginal or negligible, consistent with VLAMP definitions.

The characterisation of noise impacts outlined in the VLAMP is generally based around human perception to changes in noise levels. For example, a change in noise level of 1 to 2 dB is typically indiscernible to the human ear. The characterisation of a residual noise impact of 0 to 2 dB above the PSNL is therefore considered negligible. This characterisation of residual noise impacts is outlined further in Table 3.2 of **Appendix M**.

In some cases, locations categorised as significant are relatively further from the mine than those with a moderate or marginal impact category. This is due to several factors including rounding of noise predictions, local topographical features and the relative criteria for these locations (with respect to amenity as per Table 1 of the VLAMP).

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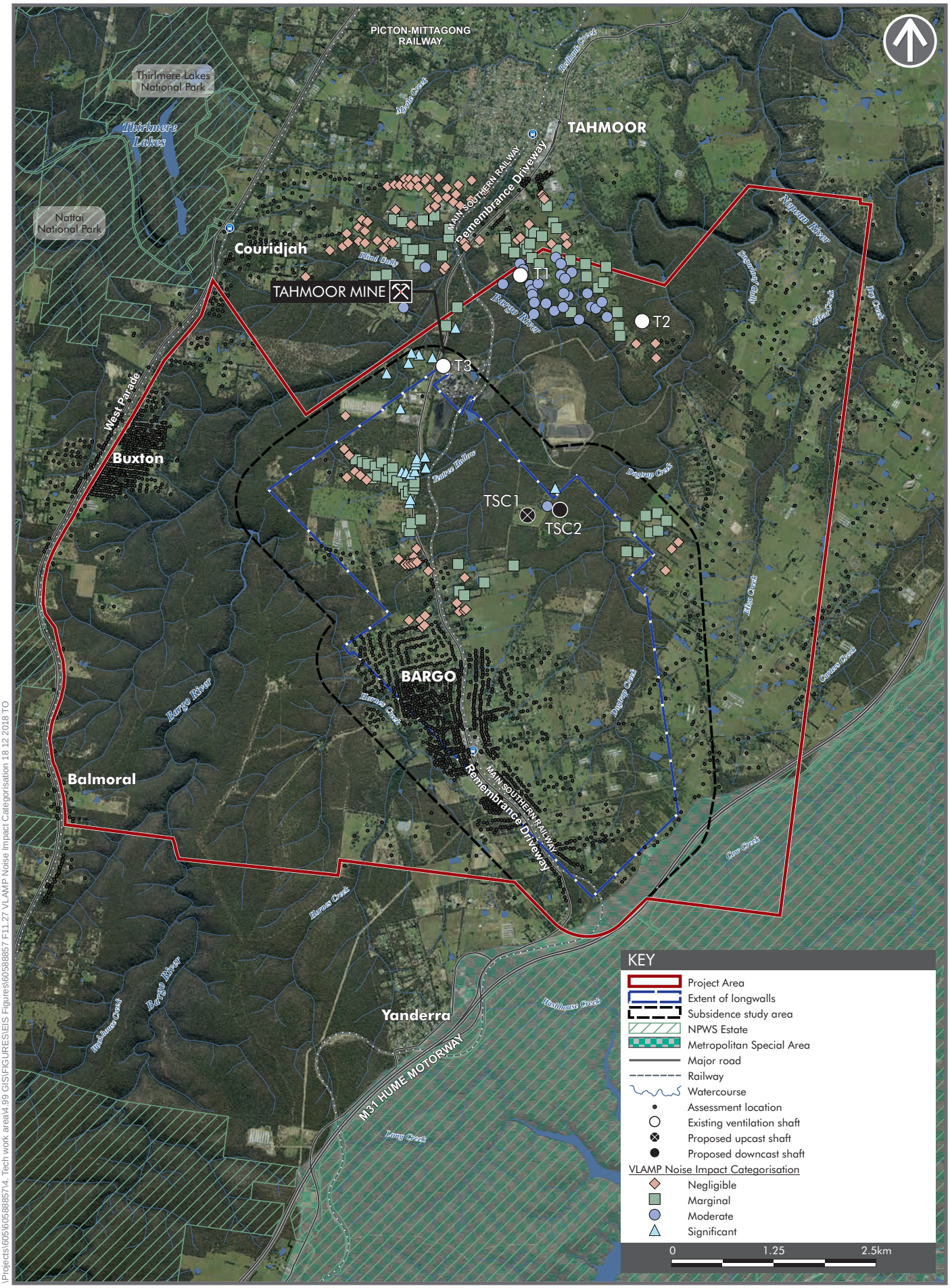

\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\EIS Figures\605888574 F11.27 VLAMP Noise Impact Categorisation 18 12 2018 TO

SIMEC MINING

VLAMP NOISE IMPACT CATERIGISATION

Tahmoor South Project
Environmental Impact Statement

FIGURE 11.27

Table 11-56 Number of assessment locations in each noise impact category for mitigated proposed development

Satisfies PSNL	Negligible	Marginal	Moderate	Significant
2,538	93	83	28	20

As described in **Section 11.10.5**, Tahmoor Mine will progress negotiations where required with properties predicted to be marginally, moderately or significantly affected by the proposed development, with the aim of achieving negotiated agreements as per the VLAMP. If voluntary mitigation or acquisition rights were to be applied, then mitigation rights could be applied to those properties predicted to experience impacts categorised as marginal or moderate (i.e. 111 properties), and voluntary acquisition rights could be applied to properties where impacts are categorised as significant (i.e. 20). Notwithstanding, and as described above in this section, the proposed development will have a beneficial outcome in relation to noise impacts at a site which has legacy noise issues, in that it will reduce noise levels from the mine at all nearby properties during the night-time and all but two during the day. Accordingly, achievable noise limits are presented in **Appendix M** for the proposed development.

Sleep Disturbance

Based on the results of operator-attended noise surveys undertaken by EMM in Olive Lane, existing maximum noise levels from Tahmoor Mine are in the order of L_{Amax} 53 dB from general dozer activity or loading coal into wagons. Based on a partially open window providing 10 dB of sound reduction this would equate to an approximate internal noise level of L_{Amax} 43 dB. Although this external level is above the relevant screening criteria, the calculated internal noise levels are well below those that are likely to cause awakening reactions.

Maximum noise levels from existing operations have previously been the subject of a PRP. Engineered mitigation controls have been effectively implemented as part of the Tahmoor Mine's PRPs to reduce and control maximum noise events. In addition, the noise reduction measures proposed as part of the proposed development (refer to Section 11.10.5) will also have the effect of further reducing maximum noise levels from site. It is expected that both the frequency and level of maximum noise events from the proposed development will be lower compared to the existing operation due to the mitigation measures to be implemented as part of the proposed development. Operation of the proposed development during the night-time is likely to result in maximum noise events below those likely to cause awakening reactions and satisfy the relevant maximum noise level screening criteria. A noise monitoring program would continue to be implemented at the mine to verify operational noise levels from the mine including maximum noise events during the night time (refer **Section 11.10.5**).

Road Traffic Noise

The nearest sensitive receptors potentially affected by an increase in road traffic volumes as a result of the proposed development are primarily located on Remembrance Driveway, north and south of the site access road. Road traffic movements associated with some of the proposed construction activities (i.e. TSC1 and TSC2 ventilation shaft construction) will require the use of additional roads surrounding the site including Rockford Road (from Remembrance Driveway north of the site access road) and Charlies Point Road. Hence, the potential for road traffic noise impact has also been considered at the nearest sensitive receptors along these roads during the TSC1 and TSC2 ventilation shafts construction.

Existing traffic volumes were referenced from the *Traffic Impact Assessment for Tahmoor South Project* prepared by Transport and Urban Planning Pty Ltd (TUP), November 2018. Peak period traffic counts corresponding to the shift change periods at the site were undertaken by TUP in August 2017. Road traffic volumes have been based on the traffic surveys and are summarised in **Table 11-57**. This assessment of road traffic noise has been based on existing average daily traffic (ADT) volumes.

Table 11-57 Existing traffic volumes

Road	Road section	ADT (2017)	% Heavy vehicle
Remembrance Driveway	North of site access road	9,467	7.3
Remembrance Driveway	South of site access road	8,866	7.5
Rockford Rd	North of Charlies Point Rd	2,762	6.2
Charlies Point Rd	North of TSC1/TSC2	119	7.5

Site employee (operational) traffic volumes are expected to increase between approximately 2019 and 2020 (peak in 2020) as a result of the proposed development. Construction generated traffic would also occur between approximately 2020-2024 with equipment deliveries continuing till approximately 2027. Given peak operational traffic generation in 2020, overlapping construction and operational traffic volumes for 2020 have been considered as the worst-case year in this assessment for predicting road traffic noise and is considered to be conservative. Site traffic for the construction of TSC1 and TSC2 will travel north from the site access road then on to Rockford Road and Charlies Point Road.

Road traffic noise levels predicted at the nearest sensitive receivers to the relevant roads for the proposed development are shown in **Table 11-58.**

Table 11-58 Road traffic noise results

Road	Road section	Receiver type (distance from road)	Existing (2017) noise levels $L_{Aeq,period}$, dB		Future[1] (2020) noise levels $L_{Aeq,period}$, dB		Criteria $L_{Aeq,period}$, dB		Increase between existing and future, dB	
			Day	Night	Day	Night	Day	Night	Day	Night
Remembrance Driveway	North of Rockford Rd	Residence (10 m)	63	58	63	58	60	55	<1	<1
	Between site and Rockford Rd	Residence (14 m)	61	55	61	56	60	55	<1	<1
	South of site	Residence (18 m)	62	57	62	57	60	55	<1	<1
		School/ Church[1,2]	48 (internal)	N/A	48 (internal)	N/A	40 (internal)	N/A	<1	N/A
Rockford Rd[3,4]	North of Charlies Point Rd	Residence (15 m)	63	58	64	58	60	55	<1	1
Charlies Point Rd[3,4]	North of TSC1/ TSC2	Residence (40 m)	46	41	53	49	60	55	7	8

Notes: 1. Levels for this receiver are $L_{Aeq,1hr}$ internal noise levels, where an external-to-internal reduction of 10 dB has been applied for partially opened windows.
2. Internal $L_{Aeq,1hr}$ criterion applies when in use.
3. Existing site generated traffic volumes on this road are generally very low.
4. Site related traffic on this road are only for TSC1 and TSC2 construction.

Existing (2017) road traffic noise levels currently exceed or are equal to the relevant RNP criteria at the nearest affected receivers along Remembrance Driveway and Rockford Road. At receivers along Charlies Point Road, the existing (2017) level of road traffic noise is calculated to be well below the relevant criteria.

The proposed development (peak) traffic volumes are predicted to marginally increase (by up to 1 dB for the relevant periods) the future (2020) road traffic noise levels at the nearest sensitive receptors on Remembrance Driveway and Rockford Road. Such an increase is considered negligible and satisfies the RNP 2 dB allowance increase following all feasible and reasonable mitigation measures.

At receivers along Charlies Point Road, future (2020) road traffic noise levels are predicted to increase by up to 7 dB and 8 dB compared to the existing (2017) levels of road traffic noise calculated for day and night. However, this is below the RNP road traffic relative increase criteria ($L_{Aeq,period}$ + 12 dB) for residential land uses and overall road traffic noise levels that are predicted to be below the relevant day and night-time criteria. Therefore, the proposed development is not expected to result in significant road traffic noise impacts at the nearest potentially affected sensitive receptors. It is noted that traffic volumes (and associated noise) would be expected to reduce after 2020.

Rail Noise

Tahmoor Mine currently has four allocated train paths per day between the site and Port Kembla. This allocation is equivalent to the transport of approximately 4 million tonnes of product coal per annum and is sufficient to accommodate the full life of the proposed development. Hence no increase in rail capacity between Tahmoor Mine and Port Kembla will be required for the proposed development. As the existing rail infrastructure and the number of allowable train movements would remain unchanged, an assessment of off-site rail traffic noise was not considered necessary.

The current rail movements to and from Tahmoor Mine were described in the EIS for the current Tahmoor North operations, and were subsequently approved as part of the 1994 Tahmoor North Consent (Reference number: D47-0029). The Tahmoor North EIS noted that productivity increases associated with the Tahmoor North project would result in an average of 3.5 trains per day, with peaks of eight trains per day. The Tahmoor South Project would continue to operate at a similar capacity of an average of four trains per day.

The existing on-site rail loop design is configured with two radii of approximately 170 m and 200 m. Wheel squeal from trains on the Tahmoor Mine rail loop has never been the subject of noise complaints. Further, investigations during on-site and off-site routine monitoring audits have not identified rail “wheel squeal” as a component of the noise from coal trains entering or leaving the rail loop. The main component of train noise on this loop has been identified as locomotive engine noise. This noise source has been modelled as part of the operational noise assessment for the proposed development.

Construction Vibration

As a guide, safe working distances for typical items of vibration intensive plant are listed in **Table 11-59**. The safe working distances are quoted for both “cosmetic damage” and “human comfort” as defined in British Standard BS 6472-1. The safe working distances are indicative and will vary depending on the particular item of plant and local geotechnical conditions.

In relation to human comfort (response), the safe working distances relate to continuous vibration and apply to residential receivers. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels than those listed under the human response in **Table 11-59**, occurring over shorter periods are allowed.

Based on the safe working distances for typical plant items and the location of surrounding sensitive receptors, it is unlikely that human response vibration criteria will be exceeded. Most of the assessment locations are greater than 170 m away from any likely construction activity, which is greater than the maximum safe working distance of 100 m for an 18 tonne (or greater) vibratory roller. Human response criteria are more stringent than cosmetic damage criteria; therefore cosmetic damage criteria would be satisfied at privately owned sensitive receptors.

The exception to this is the privately owned sensitive receptor at 185 Charlies Point Road; vibration intensive construction plant may operate within approximately 30 m of this residence when site establishment activities occur for TSC1. Cosmetic damage thresholds would be met and site establishment would be during standard hours only. Tahmoor Coal has commenced consultation with the resident at 185 Charlies Point Road.

Table 11-59 Recommended safe working distances for vibration intensive plant

Plant item	Rating/Description	Safe working distance	
		Cosmetic damage (BS 7385)	Human response (BS 6472)
Vibratory roller	<50kN (Typically 1-2 tonnes)	5 m	15 to 20 m
	<100kN (Typically 2-4 tonnes)	6 m	20 m
	<200kN (Typically 4-6 tonnes)	12 m	40 m
	<300kN (Typically 7-13 tonnes)	15 m	100 m
	>300kN (Typically 13-18 tonnes)	20 m	100 m
	>300kN (>18 tonnes)	25 m	100 m
Small hydraulic hammer	(300 kg - 5 to 12t excavator)	2 m	7 m
Medium hydraulic hammer	(900 kg - 12 to 18t excavator)	7 m	23 m
Large hydraulic hammer	(1600 kg - 18 to 34t excavator)	22 m	73 m
Vibratory pile driver	Sheet piles	2 m to 20 m	20 m
Pile boring	≤ 800 mm	2 m (nominal)	4 m
Jackhammer	Hand held	1 m (nominal)	2m

Operational Vibration

Vibration from operational activity is not expected to change and given the separation distance between the site and the nearest residence (>200m), ground-borne vibration from equipment operating at the pit-top is not expected to be perceptible.

11.10.5 Management and Mitigation Measures

Construction Noise and Vibration

The ICNG recommends the following where NMLs are predicted to be exceeded:

- application of feasible and reasonable work practices to minimise noise;
- inform potentially affected residents of the nature of the works to be carried out, expected noise levels and duration and relevant contact details; and
- negotiation with the community where noise from work outside standard hours is predicted to exceed the relevant NML by more than 5 dB.

Tahmoor Coal would manage construction noise from the site by adopting work practices such as:

- constructing during ICNG standard hours only, excluding drilling of ventilation shafts;
- selection of lower noise emitting equipment where feasible and reasonable;
- regular reinforcement with construction staff (such as at toolbox talks) of the need to minimise noise and vibration;
- avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon residents;
- parking of vehicles in locations that minimise noise;
- minimising the need for vehicle reversing for example, by arranging for one-way site traffic routes (largely achieved by site layout design);
- use of broadband audible reverse alarms on vehicles and elevated work platforms used on site; and

- minimising the movement of materials and plant and unnecessary metal-on-metal contact.

Tahmoor Coal will manage construction noise levels where exceedances of NMLs have been identified. The construction noise management methods will be detailed in a construction noise and vibration management plan which will be developed prior to commencement of construction activities and include, but not be limited to, the following:

- a detailed assessment of feasible and reasonable work practices that will be implemented to minimise noise and vibration impacts;
- strategies to promptly deal with and address noise and vibration complaints; and
- procedures for notifying nearby residents of forthcoming works that are likely to produce noise and vibration impacts.

Tahmoor Coal has commenced negotiations with the owners of the two properties on Charlies Point Road that are predicted to exceed construction NMLs during non-standard (night-time) construction hours.

Existing Mine Noise

Noise mitigation and management measures that are currently implemented at the Tahmoor Mine include the following:

- enclosure of acoustically significant fixed plant such as the Coal Handling and Preparation Plant (CHPP), transfer and processing buildings and conveyor galleries;
- broadband reversing alarms on all surface mobile equipment;
- acoustic barriers such as the earth bund adjacent to the rail loop and on the western side of the clean coal stockpile area; and
- concrete coal storage bins.

Tahmoor Mine has been the subject of numerous pollution reduction programs (PRPs) in relation to noise, the outcomes of which have been accepted by the EPA and evidenced by a significant reduction in noise complaints over time. Noise mitigation works undertaken as part of PRPs included the following:

- use of a Programmable Logic Controller (PLC) to control the operation of the main surface shaker screen at the CHPP;
- GPS tracking installed in REA haul trucks to monitor speed and truck movements;
- secondary acoustic treatments to the Ventilation Shaft 2;
- decommissioning of the Shaft 3 ventilation system;
- acoustic treatments to the head of the drift conveyor to reduce the airborne noise and vibration transfer impacts from processing product coal;
- dampening of product deflector plates, external insulation and cladding of the reject bin; and
- replacement of building cladding and closing of openings in buildings.

Other works implemented as a result of the PRPs specifically targeted at reducing maximum noise events from the site include the following:

- laminated transfer chutes at conveyor transfer points;
- lagging of the reject stone bin;
- limit switches to ensure the stone bin levels are maintained at not less than 30% full;
- replacement of mobile plant reversing alarms with low level, broad-spectrum alarms (colloquially referred to as “quackers”); and
- a real-time noise monitoring network and alarm reporting system.

The Tahmoor South Project - Operational Noise

The main operational noise sources at the site are the CHPP and dozers. Other significant sources that contribute to off-site noise emissions include rail loading activity (locomotives and loading coal into wagons), compressors and the reject haul truck. These activities would continue as part of the proposed development. Mitigation strategies have been considered in the following hierarchical approach:

1. control of noise at the source;
2. once the feasible and reasonable controls at the source are exhausted, controlling the transmission of noise; and
3. once feasible and reasonable controls are exhausted for source and transmission, consider mitigation measures at the noise-sensitive receivers.

Mitigation measures determined to be reasonable and feasible for the proposed development (and therefore included in the noise modelling and assessment) include:

- at-source controls:
  - close openings on CHPP facades (reduction of CHPP noise emissions up to 10 dB);
  - improved cladding and insulation for CHPP roof (reduction of CHPP noise emissions up to 10 dB);
  - improved cladding and insulation for north, east and western facades of the CHPP (reduction of CHPP noise emissions up to 10 dB);
  - noise suppression kit for dozer (4 dB reduction to dozer sound power level);
  - use of only one dozer at night (either on the ROM or stockpile area);
  - restrict night time dozer operation to northern section of stockpile area;
  - restrict activity in the REA to day and evening only – no haulage or dozer operation in REA at night;
  - improve feed chute into rail wagons (5 dB reduction to activity sound power level); and
  - improvement to enclosure of compressors (8 dB reduction to compressor sound power level).
- transmission noise control:
  - barrier around coal stockpile area, in the form of 3 shipping containers stacked; and
  - improve performance (increase height) of bund to shield northern section of rail loop.
- at receptor control:
  - receptor mitigation at two receptors (185 and 215 Charlies Point Road), where mitigation measures depend on the outcome of commenced negotiations with the receptors.

All the feasible and reasonable noise mitigation measures identified above, with the exception of at receiver controls, were modelled in the mitigated proposed development scenario and will be completed within three years of operational commencement of the Project.

Tahmoor Coal will continue to investigate options for further noise mitigation into the future including, but not limited to, the following:

- mitigation for the CHPP; and
- consideration of noise mitigation initiatives in the purchase and/or design of all new equipment as well as any new site buildings and access roads.

Sleep Disturbance

Additional noise reduction measures considered as reasonable and feasible and therefore committed to as part of the proposed development that will have the effect of further reducing maximum noise levels from site include the following:

- increased height of the barrier adjacent to the north-western side of the rail loop;
- improvements to feed chute into rail wagons to reduce impact noise when loading of coal commences into each wagon (5 dB reduction to activity sound power level);
- additional cladding and insulation on the CHPP building (reduction of CHPP noise emissions up to 10 dB);
- noise-suppression kit for dozer (4 dB reduction to dozer sound power level); and
- no activity (haulage or dozer) will occur in the REA during the night time.

11.10.6 Conclusion

Significant work has been undertaken at Tahmoor over recent years to mitigate noise emissions from the mine, and existing mine noise emissions are generally in compliance with the current noise criteria for the site. However, operational noise emissions from the existing Tahmoor mine were found to be above the relevant PSNLs in accordance with contemporary EPA noise policy at a number of assessment locations. Accordingly, a detailed investigation has been undertaken into the feasible and reasonable mitigation measures that could be applied to further reduce noise emissions from the proposed development, in consideration of contemporary noise criteria.

A number of mitigation measures determined to be feasible and reasonable have been committed to by Tahmoor Mine and incorporated into the operational noise model for the proposed development. Subsequently, the noise emissions from the proposed development are predicted to reduce compared to existing Tahmoor Mine operational noise emissions at almost all noise-sensitive receptors during the day and evening periods and, importantly, most significantly during the night-time period at all noise-sensitive receptors. Under noise-enhancing weather conditions it is predicted that up to 19 properties would be affected by noise emissions more than 5 dB above the PSNL during the night-time period, which is a significant reduction from 127 for existing Tahmoor mine operations.

Night-time noise associated with the proposed operational mine (with mitigation applied) is expected to be lower than existing noise levels by at least 2 dB (and up to 9 dB) at all assessment locations. During the day and evening periods mitigated operational noise is expected to be lower by up to 6 dB compared to existing levels at all but two assessment locations; residences at 185 and 215 Charlies Point Road. These residences would experience minor increases as a result of the southern extension to the REA and the operation of the new ventilation fans. Predicted noise levels at these two properties are 40 dB and 39 dB (i.e. 5 dB and 4 dB above PSNLs, respectively). Negotiations between Tahmoor Coal and the owners of the two residences have commenced, for the purpose of acquiring the two properties. Mine noise at the Wollondilly Anglican Church and College is predicted to achieve the relevant internal amenity noise levels for these facilities.

It is expected that both the frequency and level of maximum noise events from the proposed development will be lower compared to the existing operation due to the mitigation measures to be implemented as part of the proposed development. Operation of the proposed development during the night-time is likely to result in maximum noise events below those likely to cause awakening reactions and satisfy the relevant maximum noise level screening criteria.

Road traffic noise associated with construction and operation of the project is predicted to satisfy the requirements of the RNP. Hence, the project is not expected to generate significant road traffic noise impacts at the nearest potentially affected receivers.

Construction noise levels are predicted to exceed the relevant NML at some locations but would remain below the highly noise affected level for all works during standard construction hours at all assessment locations. Construction noise levels outside of standard hours are predicted to exceed the NML at the two nearest sensitive receptors on Charlies Point Road. Noise from out-of-hours construction activity would generally be continuous in nature and given the magnitude of predicted L_{Aeq} construction noise levels, the maximum noise level is likely to be below the sleep disturbance screening criteria at all nearby assessment locations.

Based on the safe working distances for construction related vibration from typical plant items and the location of surrounding sensitive receptors, it is unlikely that human response vibration criteria will be exceeded. Since human response criteria are more stringent than cosmetic damage criteria, cosmetic damage criteria would be satisfied for most receptors. The exception to this is the residence at 185 Charlies Point Road, with whom negotiations have commenced for the purpose of acquiring the property. Vibration from operational activity is not expected to change, with ground-borne vibration from equipment operating at the pit-top not expected to be perceptible.

Tahmoor Coal will continue to monitor and actively manage noise and vibration as part of the proposed development, and will continue to investigate options for further operational noise mitigation into the future.

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11.11 Air Quality

The Air Quality Impact Assessment (AQIA) prepared by ERM (2018) to inform this EIS assessed the potential air quality impacts of the proposed development, in the context of existing background levels, including the ongoing operation of the Tahmoor Mine's Surface Facilities Area and other local pollutant sources. The complete AQIA is provided in **Appendix N** of this EIS.

The AQIA addressed the SEARs relevant to air quality impacts. These are listed in **Table 11.60**. The EPA's requirements relating to the assessment of air quality impacts, including where they are addressed in the EIS, are listed in **Appendix A**.

Table 11-60 SEARs for the assessment of air quality impacts

Air Quality SEARs	Where addressed
Air Quality – including:	
• an assessment of the likely air quality impacts of the development in accordance with the Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW, having regard to EPA's requirements (see Attachment 2);	**Section 11.12.5**
• an assessment of the likely greenhouse gas impacts of the development; and	**Section 11.13.3**
• an odour assessment of the ventilation shafts in accordance with the Technical Framework – Assessment and Management of Odour from Stationary Sources in NSW.	**Section 11.12.5**

11.11.1 Background

Particulate Matter

The emission of dust and Particulate Matter (PM) are the key air quality issues associated with mining. Odour can also be an issue. PM is formed when a particulate becomes entrained in the atmosphere by the turbulent action of wind, by the mechanical disturbance of materials, or through the release of particulate-rich gaseous emissions from combustion sources. PM is generated at mines from a number of activities including vegetation stripping and removing topsoil, the removal and handling of coal rejects, the abstraction and handling of coal, heavy vehicle movements and wind erosion from stockpiles and exposed surfaces. Particle size is an important factor which influences the dispersion and transport of PM in the atmosphere, and its potential effects on human health. Typically, the size of suspended particles ranges from 0.005 to 100 micrometres (µm) and is often described by the aerodynamic diameter of the particle. Common particulate size ranges include:

- TSP: total suspended particulate matter refers to all suspended particles in the air. The upper size range is typically 30µm to 50µm;
- PM_{10}: all particles with an equivalent aerodynamic diameters of less than 10µm;
- $PM_{2.5}$: all particles with equivalent aerodynamic diameters of less than 2.5µm, often referred to as fine particles. Fine particles are derived primarily from combustion processes such as vehicle emissions, wood burning for power generation and natural processes such as bushfires. Fine particles also include secondary organic aerosol from volatile organic compound (VOC) emissions, and sulphate and nitrate particles; and
- $PM_{2.5-10}$: the difference between PM_{10} and $PM_{2.5}$ mass concentrations, often described as coarse particles. Coarse particles are derived mainly from mechanical processes resulting in the suspension of dust, soil or other materials from roads, farming, mining and dust storms, pollen, mould, spores and plant parts.

Reviews of the health effects of particulate matter have generally identified that the smaller PM are of greater health concern as these particles can penetrate further into the respiratory tract.

In addition to health impacts, airborne dust also has the potential to cause nuisance effects by depositing on surfaces, including native vegetation and crops. Larger particles do not tend to remain suspended in the atmosphere for long periods of time and will deposit relatively close to source. Dust fallout can soil materials and generally degrade aesthetic elements of the environment and are assessed for nuisance or amenity impacts. Mining-related dust is likely to be comprised predominantly of coarse PM and larger.

The key pollutants released from flaring of coal seam methane are oxides of nitrogen NOx (comprised of nitric oxide (NO) and nitrogen dioxide (NO_2)), Carbon Monoxide and Volatile Organic Compounds (VOCs). Concern with nitric oxide is related to its transformation to nitrogen dioxide and its role in the formation of photochemical smog. Carbon monoxide and VOCs can be harmful to health.

Odorous discharge can occur from mine ventilation shafts of return air, for example when longwall mining exposes odorous shale oil within mine workings. There are no instrument-based methods that can measure an odour response in the same way as the human nose. Therefore “dynamic olfactometry” is typically used as the basis for odour management and regulation. Dynamic olfactometry is the measurement of odour by presenting a sample of odorous air diluted to the point where a trained panel of assessors cannot detect a change between the odour free air and the diluted sample. The concentration is then doubled until the difference is observed with certainty. The units for odour measurement using dynamic olfactometry are “odour units” (ou).

Air quality is influenced by a number of environmental factors, including local topography, and local climate conditions such as seasonal wind patterns, rainfall and the occurrence of temperature inversions.

11.11.2 Criteria

Air Quality

Air Quality criteria are intended to protect the community against the adverse effects of air pollutants and generally reflect the current Australian Standards for the protection against nuisance effects and health.

The EPA’s *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (EPA, 2016) (Approved Methods) specifies the air quality assessment criteria relevant for assessing impacts from air pollution. The air quality assessment criteria for dust include consideration of background dust levels and relate to the total dust burden in the air and not just the dust attributable to the proposed development. These criteria are consistent with the National Environment Protection Measures for Ambient Air Quality (Ambient Air NEPM) (NEPC, 1998). The air quality concentrations adopted for the AQIA are summarised in **Table 11.61**.

Table 11-61 Air Quality Impact Assessment Criteria for the proposed development

Pollutant	Averaging Period	Standard/Criteria	Agency
TSP	Annual mean	90µg/m^3	National Health and Medical Research Council (NHMRC)
PM_{10}	24-hour maximum	50µg/m^3	EPA impact assessment criteria; Ambient Air NEPM reporting goal, allows five exceedances per year
	Annual mean	25µg/m^3	EPA impact assessment criteria
$PM_{2.5}$	24-hour maximum	25µg/m^3	Ambient Air NEPM
	Annual mean	8µg/m^3	

Airborne dust is assessed for nuisance or amenity impacts. The maximum acceptable increase in dust deposition above the existing dust levels from an amenity perspective are detailed in **Table 11.62**, and are set by the EPA (2016) to protect against nuisance impacts.

Table 11-62 Criteria for dust fallout

Pollutant	Averaging Period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 grams per square m per month	4 grams per square m per month

Development consent conditions for the existing Tahmoor Mine include air quality criteria as shown in **Table 11.63**. The current criteria for TSP and PM_{10} exclude extraordinary events such as bushfires and dust storms. The total impact referred to in **Table 11.63** includes the impacts of the mine and all other sources. Incremental impact refers to the impact of the mine considered in isolation. The assessment criteria applying to the Tahmoor South Project are the criteria outlined in the EPA 2016 Approved Methods.

Table 11-63 Air Quality Criteria for the existing Tahmoor Mine

Pollutant	Criterion	Averaging Period	Application
TSP	90 µg/m^3	Annual mean	Total impact
PM_{10}	50 µg/m^3	24-hour average	Total impact
	25 µg/m^3	Annual mean	Total impact
Deposited dust	2 grams per square m per month	Annual mean	Incremental impact
	4 grams per square m per month	Annual mean	Total impact

Nitrogen Oxides, Carbon Monoxide and Volatile Organic Compounds

EPA prescribed ambient impact assessment criteria for NO_2 and CO are detailed in **Table 11.64**.

Table 11-64 Ambient air quality goals for nitrogen dioxide and carbon monoxide

Pollutant	Averaging Period	Goal	
		Parts Per Million (ppm)	Micrograms per cubic metre
Nitrogen Dioxide	1 hour	0.12 ppm	246 µg/m^3
	Annual	0.03 ppm	62 µg/m^3
Carbon Monoxide	8 hour	9 ppm	10 mg/m^3
	1 hour	25 ppm	30 mg/m^3
	15 minute	87 ppm	100 mg/m^3

VOCs result from the flaring of coal seam methane. Organic hydrocarbons comprise a collection of various hydrocarbons, several of which may be toxic, including BTEX and methane. Organic hydrocarbons also include reactive organic compounds which can also contribute to the formation of photochemical smog, and can be hazardous to human health. There are no impact assessment criteria for total VOCs. Modelling predictions can however be compared to impact assessment criteria for individual organic pollutants that may be present in the extracted gas.

Odour Criteria

Odour Concentration

The detectability of an odour is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation. The theoretical minimum concentration is referred to as the odour threshold or one odour unit (OU). An OU of less than one means there is theoretically no odour present.

The determination of odour goals and the way in which they should be applied with dispersion models is guided by the EPA, although it is recognised as a difficult topic in air pollution science. The level of exposure is used to reflect the fact that odour impacts are determined by several factors including the frequency, intensity, duration and offensiveness of the odour, as well as the location of the odour source.

Whether or not an individual considers an odour to be a nuisance depends on these factors. Although it is possible to derive formulae for assessing odour annoyance in a community, the response of any individual to an odour is still unpredictable and odour goals need to consider these factors. Odour goals need to consider what level of exposure to odour is acceptable to meet current community standards in NSW and how dispersion modelling can be used to determine if a source of odour meets the goals which are based on this acceptable level of exposure.

Compliance with odour goals is often determined through the use of dispersion modelling, which is typically only able to directly predict concentrations over a one hour averaging period or greater. However, the human nose responds to odour over periods of the order of a second or so. Odour levels can fluctuate significantly within a one hour period depending on the nature of the source. To predict the variation that may be experienced, the peak-to-mean or P/M ratio; which is the ratio between one second peak concentrations and longer period average concentrations is used for various odour sources. The application of P/M ratios in NSW is shown in Table 3.6 of the AQIA at **Appendix N**.

Complex Mixtures of Odorous Pollutants

The EPA's Approved Methods (2016) include ground level concentrations for complex mixtures of odorous air pollutants which are shown in **Table 11.65**. The ground level concentrations odour criteria must not be exceeded more than one percent of the time for different population densities. The difference between odour criteria is based on considerations of risk of odour impact. For a given odour level there will be a wide range of responses in the population exposed to the odour. For instance, in a densely populated area there will be a greater risk that some individuals within the community will find the odour unacceptable than in a sparsely populated area. Given the proximity of the new upcast shaft to nearest sensitive receptors, an impact assessment ground level concentration (glc) criterion of 7 OU is appropriate for this area (refer to **Figure 11.28** for sensitive receiver locations).

Table 11-65 Odour performance criteria for the assessment of odour (EPA, 2016)

Population of affected community	Criterion for complex mixtures of odorous air pollutants (99th percentile) (OU)
Equal to or less than two	7
10	6
30	5
125	4
500	3
Urban area (2000) and/or schools and hospitals	2

11.11.3 Methodology

The methodology for the AQIA was undertaken in accordance with the EPA's Approved Methods (2016).

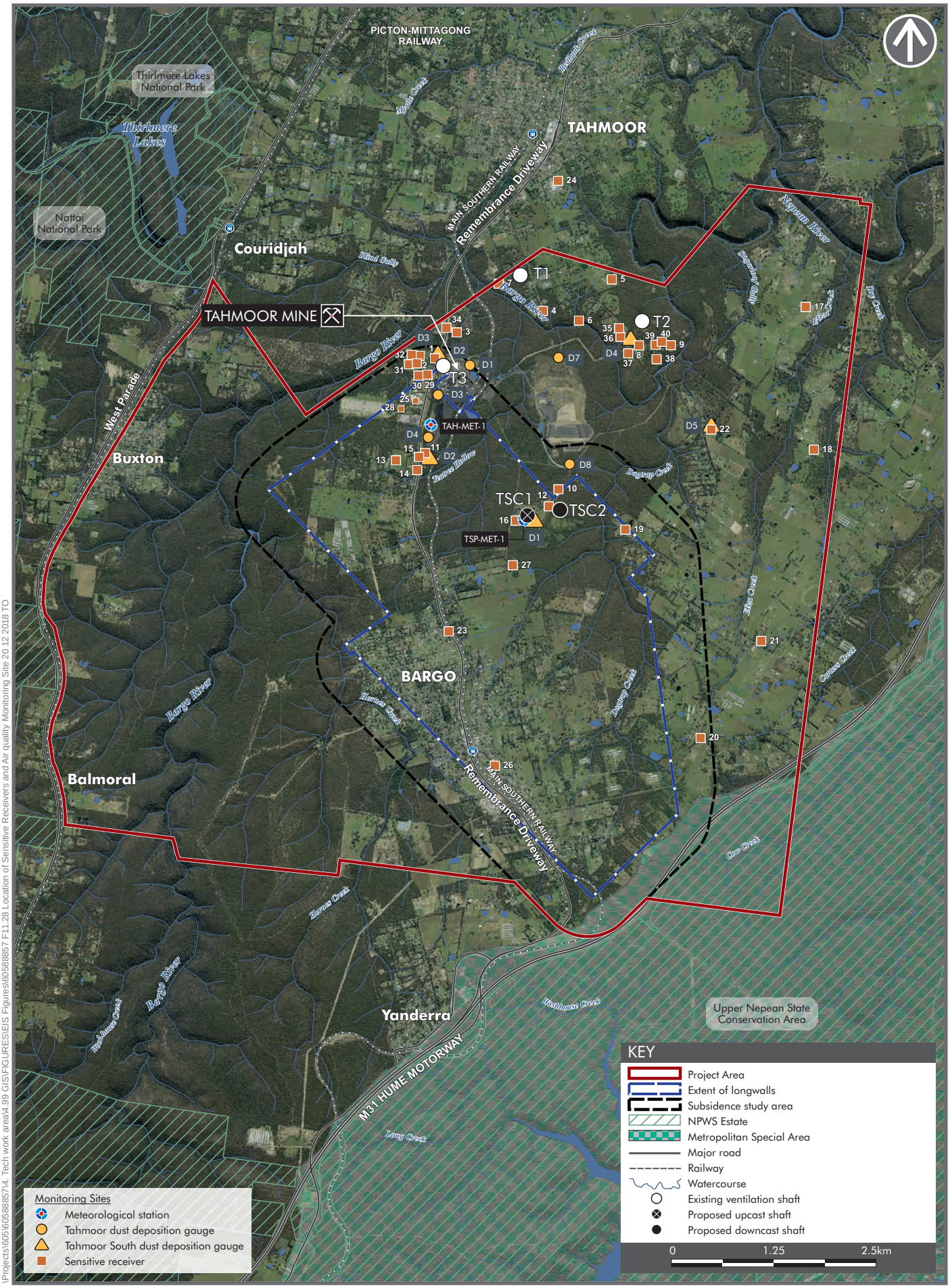
Sensitive Receptors

Sensitive receptors within the vicinity of the proposed development that have been assessed as part of this AQIA are detailed in **Table 11.66** below and shown in **Figure 11.28**.

Table 11-66 Air quality impact assessment sensitive receptors

Receptor ID	Address
1	2 Olive Lane
2	4 Olive Lane
3	2897 Remembrance Driveway
4	130 Stratford Road
5	7 Hodgson Grove
6	20 Dietrich Road
7	84 Stratford Road
8	250 Rockford Road
9	11 Kammer Place
10	215 Charlies Point Road
11	3085 Remembrance Driveway
12	185 Charlies Point Road
13	30 Caloola Road
14	3092 Remembrance Driveway
15	3076 Remembrance Driveway
16	115 Charlies Point Road
17	60 Lyrebird Road
18	45 Knox Road
19	70 Warrobyn Road
20	70 Hinkler Avenue
21	105 Dwyers Road
22	10 Pheasants Nest Road
23	Edge of Bargo Township closest to site
24	Edge of Tahmoor Township closest to site
25	Wollondilly Anglican College – Remembrance Driveway
26	Bargo Public School 245-261 Great Southern Road
27	80 Charlies Point Road
28	3030 Remembrance Driveway
29	1 Olive Lane
30	5 Olive Lane
31	7 Olive Lane
32	6 Olive Lane
33	4 Olive Lane (b)
34	2900 Remembrance Driveway
35	230 Rockford Road (a)
36	230 Rockford Road (b)

Receptor ID	Address
37	260 Rockford Road
38	280 Rockford Road
39	285 Rockford Road
40	5 Kammer Place



\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\EIS Figures\605888857 F11.28 Location of Sensitive Receivers and Air quality Monitoring Site 20 12 2018 TO

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SENSITIVE RECEIVERS AND AIR QUALITY MONITORING SITES

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FIGURE 11.28

Construction Air Quality Impacts

An emissions inventory was prepared for construction activities associated with the proposed development. Estimated PM_{10} emissions were then compared with emissions during mining.

Operational Air Quality Modelling Approach

The air quality assessment was undertaken based on the use of CALPUFF, a multi-layer, multi-species non-steady state puff dispersion model that can simulate the effects of time and space, varying meteorological conditions on pollutant transport, transformation and removal (ERM, 2018).

Local meteorology was modelled using a combination of the CSIRO's TAPM modelling (The Air Prediction Model) and the CALMET models. CALMET is a meteorological pre-processor that includes a wind field generator containing objective analysis and parameterised treatments of slope flows, terrain effects and terrain blocking effects (ERM, 2018). Output from TAPM, plus data from the Tahmoor South weather station were entered into CALMET, which was then used to compile a representative meteorological dataset suitable for use in the plume dispersion model CALPUFF.

Dispersion model predictions were made for one scenario, involving the development of Area 2 of the REA. The REA is expected to have the most impact when it is moving closer to the southern residences during construction of Area 2. The year with high production rates during construction of Area 2 of the REA was therefore selected for the air assessment. Dispersion modelling for this scenario is considered to be representative of the worst case scenario for the proposed development at any sensitive receptor.

Modelling was used to determine the impact of the proposed development on sensitive receivers with regards to annual average PM_{10}, annual average $PM_{2.5}$, annual average TSP, annual average dust deposition, 24-Hour Average PM_{10} and 24-hour average $PM_{2.5}$. Contour plots of particulate concentrations and deposition levels are shown in Figure 10.1 to Figure 10.6 of **Appendix N**. CALPUFF modelling was also used to predict the impact of emissions of Carbon Monoxide and Nitric Oxides from flaring at the site.

Cumulative 24-hour Average PM10

The use of dispersion modelling to accurately predict cumulative 24-hour PM_{10} concentrations is difficult due to daily variability in the intensity, duration and location of mining activities, weather conditions and dust levels, as well as the spatial and temporal variation in other anthropogenic activities and natural events such as agricultural activities and bushfires. Cumulative 24-hour PM_{10} impacts have been evaluated using a Monte Carlo statistical approach that focuses on representative receptors in the vicinity of the mine which were modelled as having 24-hour PM_{10} concentrations greater than 35µg/m^3 as a result of Project-only contributions. Additional receptors downwind of the predominant wind direction and receptors away from operations were also selected to provide an overview of the potential cumulative 24-hour average PM_{10} impacts.

Additional detail regarding the modelling approach for cumulative 24-hour PM_{10} concentrations is provided in Section 10.4 of **Appendix N**.

Odour

Odour dispersion modelling was undertaken using both dispersion modelling and computational fluid dynamics (CFD) modelling for the ventilation shafts associated with the proposed development, which generated a 99th percentile glc odour contour plot. Odour modelling for the proposed development was undertaken using in-stack measurements from existing ventilation shafts during shale oil operations in May 2010 (AECOM, 2010).

11.11.4 Existing Environment

Topography

The proposed development is located in a gently undulating landscape with generally low relief and small slopes. The topography becomes steeper towards the valleys of the Bargo and Nepean Rivers in the north and western portions of the Project Area.

Land use within the Project Area comprises semi-rural and partly forested landscapes, along with a mix of rural and environmental land uses as well as the existing facilities associated with current

Tahmoor Coal mine. Rural uses include small-scale agricultural activities such as farming produce, poultry, cattle grazing and horse studs. The Project Area also extends underneath the residential, semi-rural and agricultural areas of Buxton, Bargo, Balmoral and Pheasants Nest.

Meteorological Data

Meteorological data is collected at the Tahmoor South meteorological station. Annually, the most common winds are from the south-west and south-south-west (refer to Figure 5.2 of **Appendix N** for seasonal wind roses), with the exception of summer, when the predominant winds are from the north-east. The average wind speed is 1.6m/s and calm wind conditions (less than or equal to 0.5m/s) are present about 24% of the time.

Climatic data from the Bureau of Meteorology is collected from the Picton Council Depot Automatic Weather Station (approximately 6 km from the proposed development). The annual average maximum and minimum temperatures were recorded as 23.4°C and 8.8°C respectively. On average, January is the hottest month, July is the coldest month and February is the wettest month.

Existing Air Quality Monitoring Network

An air quality monitoring network was established for the proposed Tahmoor South project in 2012 to evaluate existing air quality conditions and inform assessment. The monitoring network consists of the following:

- one High Volume Air Sampler (HVAS), which measures TSP concentrations for 24 hour periods on a one-in-six day run;
- one Tapered Element Oscillating Microbalance Instrument (TEOM), which measures PM_{10} on a continuous basis at five minute intervals;
- five dust monitoring gauges; and
- one meteorological station.

The Tahmoor South monitoring locations are in addition to the six dust deposition gauges and meteorologic station established at the existing Tahmoor Mine (refer to **Figure 11.28**).

In addition to the monitoring data collected on-site, data from a number of NSW EPA monitoring stations has been analysed. There are five monitoring stations in South West Sydney, comprising:

- Bargo (Silica Road) located approximately 6 km south of the proposed development;
- Oakdale (Ridge Road) located approximately 23 km northwest of the proposed development;
- Macarthur (UWS Campbelltown Campus) located approximately 27 km northeast of the proposed development;
- Campbelltown West (Campbelltown TAFE) located approximately 28 km northeast of the proposed development; and
- Camden (aerodrome) located approximately 24 km north of the proposed development.

Data from these EPA monitoring sites between 2007 and 2017 have been used to provide an indication of existing ambient air quality for the area. The on-site data is considered to be more representative of the nearest receptors (such as Wollondilly Anglican College) but regional data is useful to demonstrate the levels in the wider area.

Existing Ambient Air Quality

Background air quality data from the Tahmoor Mine and EPA monitoring stations shows that the ambient air quality does not generally exceed the relevant criteria. Although the average measurements are shown to meet criteria, there were isolated recorded incidences where exceedances were experienced. These were attributed to dry weather, dust events, bushfires or isolated local incidents. The background ambient air quality compared to the relevant criteria is summarised in **Table 11.67**.

Table 11-67 Background ambient air quality

Ambient Air Quality Measurement	Period of data collection	Source of data	Average	Criteria	Comment
TSP	9 Mar 2012 to 26 July 2013 and 6 Dec 2014 to 29 July 2017	Tahmoor South HVAS	18.3 µg/m^3	90 µg/m^3	
PM_{10}	Jan 2012 to July 2013 and Jan 2015 to August 2017	Tahmoor South TEOM	12.6 µg/m^3	25 µg/m^3 – annual average	
			N/A	50 µg/m^3- 24-hour average	Exceedance of criteria on 6 days*
	2007 to 2013	EPA monitoring stations	14.3 µg/m^3	25 µg/m^3 – annual average	
			N/A	50 µg/m^3- 24-hour average	Exceedances at all locations
$PM_{2.5}$	December 2012 to 2017*	EPA Monitoring Station - Camden	6 µg/m^3	8 µg/m^3	
Dust Deposition	April 2012 to May 2013 and Dec 2015 to June 2017	Tahmoor South Dust Deposition Gauges (5)	1.4 grams per square metre per month	4 grams per square metre per month	Dust deposition gauges within proposed development area
	2008 to Aug 2017	Tahmoor Mine Dust Deposition Gauges (6)	1.2 grams per square metre per month	4 grams per square metre per month	Dust deposition gauges within existing Tahmoor Mine area
NO_2	2004 to 2017	EPA monitoring stations (Bargo, Camden, Macarthur and Campbelltown West)	N/A	246 µg/m^3	All four monitoring stations well below criteria. Maximum concentration of 166 µg/m^3
CO	2005 to 2017	EPA Monitoring Stations (Camden, Macarthur and Campbelltown West)	N/A	10 mg/m^3 – 8-hour maximum	All monitoring stations well below criteria. Maximum concentration of 2.3 mg/m^3

**PM_{10} measured at the TEOM exceeded the criteria on 31 October and 1 November 2012, 6 May 2015, and on 25 March, 7 May and 22 May 2016 which may be associated with dry weather and a number of bushfires/hazard reduction burns.*

Based on an evaluation of air quality data from Tahmoor South, the existing Tahmoor Mine, and surrounding EPA monitoring stations, the following background air quality levels were adopted for the purposes of assessment (taken from the either the on-site monitoring station or closest station to the site with over one year of data available, whichever is relevant for each pollutant):

- Annual Average PM_{10} – 12.6 µg/m^3
- 24-hour PM_{10} – varies daily
- Annual Average TSP – 18.3 µg/m^3
- Annual Average $PM_{2.5}$ – 5 µg/m^3
- Dust deposition – 1.4 g/m^2/month.

11.11.5 Impact Assessment

Construction

Construction of the two mine ventilation shafts and the expanded rejects emplacement area has the potential to result in dust deposition, visible dust plumes, elevated PM_{10} concentrations from dust generating activities and emissions from diesel-powered construction equipment. Sensitive receptors close to construction areas would be most sensitive to construction dust; however, these impacts would be short term and temporary in nature. Management and mitigation measure to minimise these impacts are provided in **Section 11.11.6** below.

Construction of the proposed development would be across several separate areas and construction is unlikely to occur simultaneously. As shown in **Table 11.68**, estimated PM_{10} emissions from construction of the proposed development as a whole would be significantly less than the estimated emissions for operational mining activities.

Table 11-68 Estimated PM10 emissions for construction and operational scenarios

Activity	Estimated PM_{10} Emissions (kilograms per year)
Construction	
Construction of ventilation shaft (per ventilation shaft)	3,980
Construction of REA	2,105
Upgrades to surface facilities	5,386
Operation	
Development of Area 2 of the REA	84,219

Operation

TSP and Deposited Dust

There are no predicted exceedances of the air quality criteria as a result of the proposed development only, or when other sources are also considered, for annual average TSP or annual average deposited dust.

Particulate Matter

Annual Average $PM_{2.5}$

There are no predicted exceedances of the annual average $PM_{2.5}$ Ambient Air NEPM standard as a result of the proposed development only, or when other sources are also considered.

Project-only 24-hour $PM_{2.5}$

Contour plots for the predicted 24-hour average $PM_{2.5}$ concentrations as a result of emissions from the proposed development only are shown in **Figure 11.30**. There are no predicted exceedances of the 24-hour advisory reporting standard for $PM_{2.5}$ at any private receptors due to the project alone.

Annual Average PM_{10}

Emissions at sensitive receptors are not predicted to exceed the annual average PM_{10} criterion of 25 µg/m^3. The highest project only prediction is at R29 with an annual average PM_{10} concentration of 9.1 µg/m^3. Once background concentrations are taken into account, the cumulative concentration at R29 is 21.7 µg/m3, which remains below the criterion. The results are considered to be conservative as the modelling incorporated a background annual average PM_{10} concentration of 12.6 µg/m^3, which accounts for 50% of the annual average PM_{10} criterion of 25 µg/m^3. The results indicate the relatively low contribution of the project to cumulative PM_{10} concentrations.

Project-only 24-hour PM_{10}

Only one receptor (R10) is predicted to experience maximum 24-hour average PM_{10} concentrations above the criterion of 50 µg/m^3 as a result of the proposed development (project-only). Contour plots for the predicted 24-hour average PM_{10} concentrations as a result of emissions from the proposed development only are shown in **Figure 11.29**.

R10 is in close proximity to the REA (refer to **Figure 11.28**). Notably, the exceedance (51 µg/m^3) is predicted to occur at this receptor on only one day during the year due to the proposed development operations alone. Measures to manage potential air quality impacts are outlined in **Section 11.11.6**.

Cumulative 24-hour PM_{10}

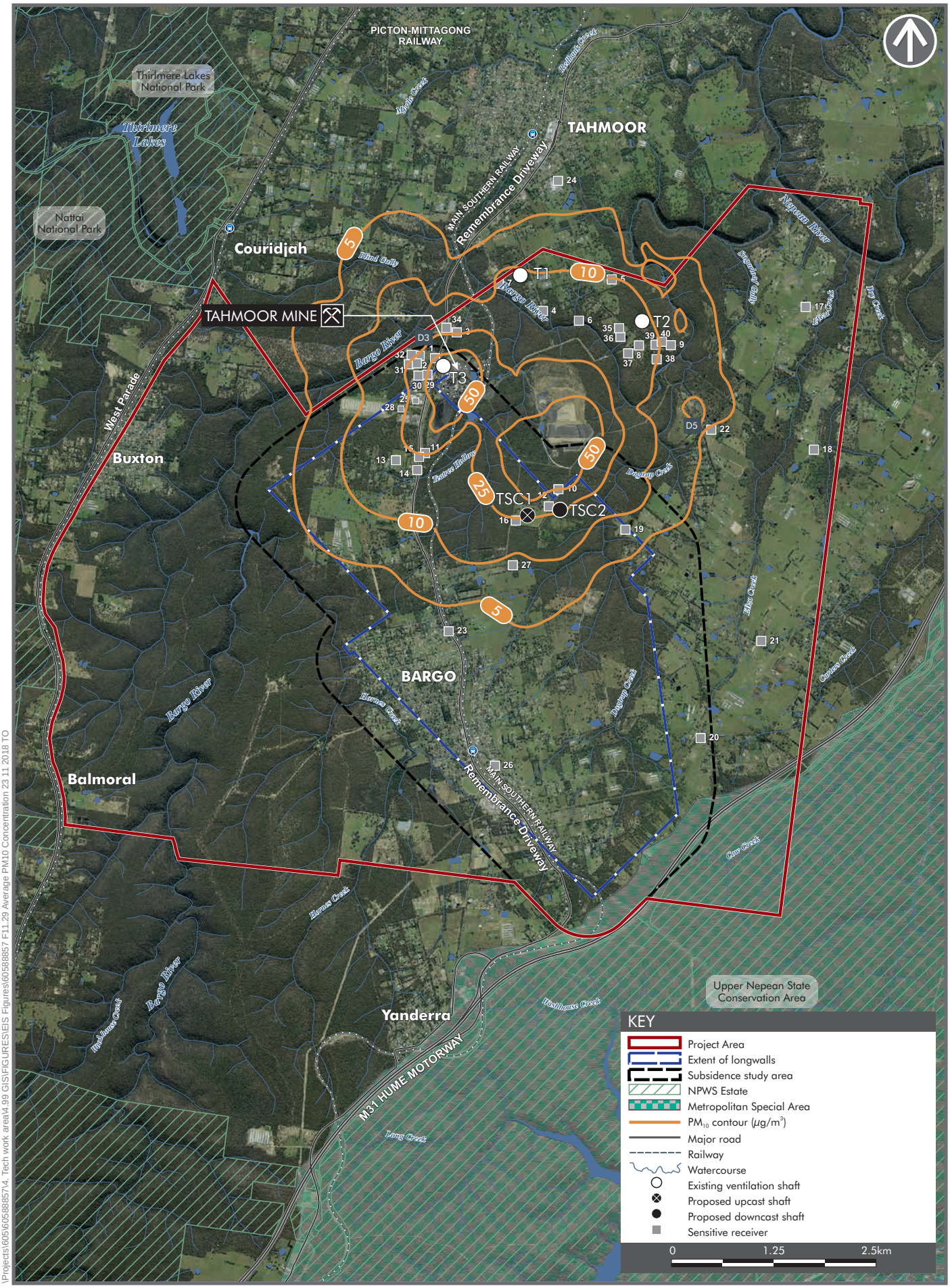
Due to the difficulty of accurately predicting cumulative 24-hour PM_{10} concentration using dispersion modelling, cumulative air quality impacts have been evaluated using a statistical approach (Monte Carlo Simulation). This approach is considered appropriate to characterise cumulative 24-hr average concentrations from coal mines.

Table 11-69 presents a summary of the number of days that the 24-hour PM_{10} concentration would exceed the relevant criteria as a result of the operation of the mine only and cumulative scenarios. The actual number of exceedances per year from cumulative impacts cannot be predicted precisely and would depend on actual mine activities, other nearby dust generating activities, weather conditions as well as the implementation of real-time controls.

The analysis predicted that when cumulative impacts are considered, the probability of a 24-hour PM_{10} exceedance is between one and nine days during a year. The highest prediction of exceedances is at receptor 10, where up to 9 days of exceedances are predicted. The analysis also shows that due to background concentrations alone, the 24-hour average PM_{10} criterion would likely be exceeded on approximately one day per year.

Table 11-69 Exceedances of 24-hour PM10 concentrations for mine alone and cumulative scenarios

Receptor	Maximum predicted 24-hr PM_{10} Concentration (mine alone) Criteria = 50µg/m^3	Predicted days over 50µg/m^3 (mine alone)	Predicted days over 50µg/m^3 (background)	Predicted days over 50µg/m^3 (cumulative)
1	47	0	1	5
2	29	0	1	2
10	51	1	1	9
12	30	0	1	2
25	30	0	1	3
30	36	0	1	3
33	28	0	1	2



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PREDICTED 24 HOUR AVERAGE PM_{10} CONCENTRATION

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Source: Pacific Environment Limited (2018)

FIGURE 11.29

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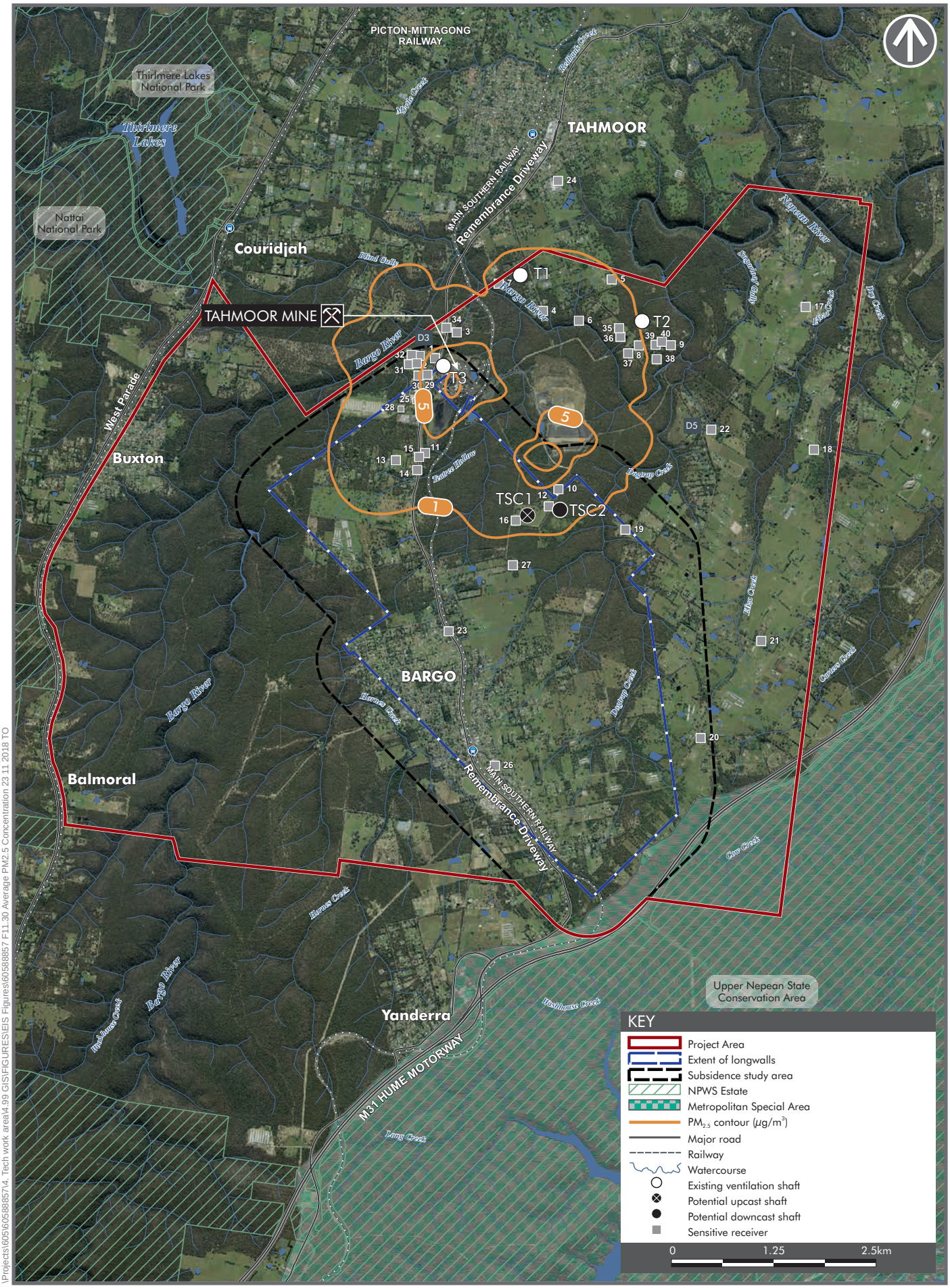

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PREDICTED 24 HOUR AVERAGE $PM_{2.5}$ CONCENTRATION

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Source: Pacific Environment Limited (2018)

FIGURE 11.30

Odour

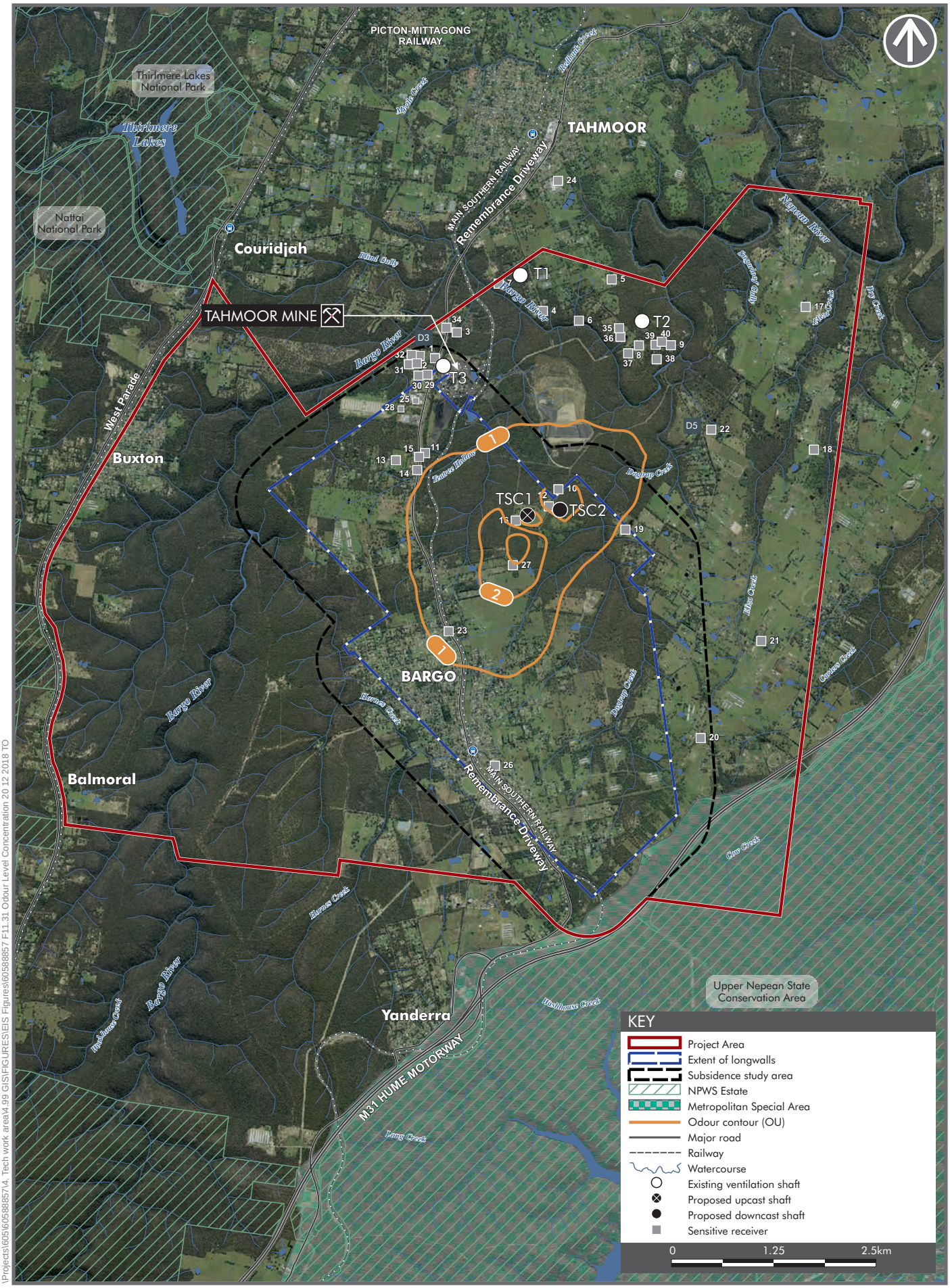
The 99th percentile odour concentration is predicted to remain below the relevant criterion of 7OU at nearby residences, and 2OU at schools (R25 - Wollondilly Anglican College and R26 – Bargo public school) (refer to **Table 10.8** of **Appendix N**). The contour plot for the predicted 99th percentile nose response average ground level odour concentrations are shown on **Figure 11.31**.

There may be instances throughout the year where some residences in close proximity to ventilation shafts (refer to **Figure 11.28**) experience concentrations above 7OU (refer to **Table 11-68**).

Due to a history of odour complaints from local residences, in 2012 significant odour modelling work was undertaken for the existing T2 shaft to better understand the conditions that cause occasional spikes in odour levels. Modelling determined that ground level odour concentrations could be reduced by increasing the height of the ventilation shaft, and by increasing the velocity at which ventilation air is emitted. Ventilation Shaft T2 does not form part of this assessment as it will only be operated as a backup during times when TSC1 is not available, such as during maintenance periods.

Table 11-70 Odour dispersion modelling – receptors which exceed Criterion

Receptor ID	Odour Level (OU) 99th percentile criteria – 7OU (2 OU for schools)
1	0
2	0
3	0
8	0
9	0
11	0
13	0
14	0
15	1
25 - School	2
26 - School	1
29	2
30	1
31	1
32	1
33	1
35	0
36	0
37	1
38	0
39	0
40	1



\Projects\605\605885714. Tech work area\4.99 GIS\FIGURES\EIS Figures\605885857 F11.31 Odour Level Concentration 20 12 2018 TO

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PREDICTED 99th PERCENTILE NOSE RESPONSE AVERAGE GROUND LEVEL ODOUR CONCENTRATIONS

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Source: Pacific Environment Limited (2018)

FIGURE 11.31

Carbon Monoxide, Nitric Oxide and VOC Impacts from Flaring

CALPUFF modelling was used to predict the impact of emissions from flaring at the site. The predicted 1-hour and 8-hour average for CO were well below their respective EPA criterion of 10 mg/m^3 and 30 mg/m^3. Similarly, the predictions for 1-hour average and annual average oxides of nitrogen (NOx) were below the respective criterion of 246 µg/m^3 and 62 µg/m^3, respectively, even with predicted NO_x concentrations assumed to be 100% NO_2, which is very conservative.

With respect to VOCs, the US EPA provides speciation of emissions from flaring of natural gas and the emissions consist of 30% ethane, 20% formaldehyde, 20% methane and 30% propane (US EPA, 2013). The highest predicted hydrocarbon concentration is at receptor 35 of 52 µg/m^3. Assuming that 20% is formaldehyde (US EPA, 2013), the predicted concentration of 10.4 µg/m^3 is well below the EPA 1-hour average formaldehyde criterion of 20 µg/m^3.

The predicted air quality results for these pollutants are provided in Table 10.9 of **Appendix N**.

11.11.6 Management and Mitigation Measures

Construction

A Construction Air Quality Management Plan would be developed and implemented as part of the CEMP for the proposed development. The construction AQMP would include management and mitigation measures to minimise dust generation as a result of the proposed development as much as possible, including:

- disturbed areas would be stabilised as soon as practicable to prevent or minimise wind-blown dust;
- unsealed roads would be watered and sealed where possible;
- unsealed trafficable areas would be kept damp to minimise dust generation;
- construction activities would be modified or stopped during periods of high wind;
- stockpiles would be maintained in a condition that minimises windblown or traffic generated dust;
- waterways, sprinklers and water carts would be used as required to adequately dampen stockpiles, work areas and exposed soils to prevent the emission of dust from the site;
- all equipment would be maintained for dust control by keeping it in good operation condition; and
- erosion and sediment control structures would be regularly maintained to ensure silt does not become a source of dust.

Operation

Tahmoor Coal implements a reactive and predictive Air Quality Control System to manage dust impacts. The system would continue to be implemented during operation of the proposed development and would include daily alerts for site personnel of meteorological conditions and predicted daily dust risk over the proposed development and at nominated receptors around the Project Area. The existing Air Quality and GHG Management Plan would be updated to align with the operation of the proposed development and would include the dust control measures currently implemented and shown in **Table 11.71**.

Table 11-71 Existing general dust management measures which would continue to be implemented

Management Measure	Unsealed Roads	Sealed Roads	Exposed Areas	Stockpiles (ROM, product and topsoil)
Daily watering with a water truck with increased frequency during adverse weather conditions	✓	✓	✓	✓
Application of chemical dust suppressant at least once per month	✓		✓	
Obsolete roads would be ripped and revegetated;	✓			
Transport of loads by heavy vehicles would be covered if material being hauled has less than 10% moisture content	✓	✓		
Operators avoid overloading and minimise spillage	✓	✓		
Spillages regularly cleared off roads	✓			
Visual inspection at the start of each shift to determine if additional dust controls are required	✓	✓	✓	✓
Speed limits of plant and vehicle reduced to suit road conditions and around stockpiles	✓	✓		✓
Minimise haulage distances as much as possible	✓	✓		
Utilise road sweeper as required		✓		
Unutilised exposed areas would be sealed and/or revegetated			✓	
Revegetation of topsoil stockpiles based on a risk based approach.				✓
Automatic water sprays are triggered by wind speed monitoring at the on-site Weather Station linked back to CHPP Control. If wind is in excess of 5m/s they are automatically triggered. The CHPP Control Room also has the ability to manually override them so that they may be switched on at any time as required by conditions				✓

In addition to the ongoing implementation of the measures outline above:

- Tahmoor Coal would implement a TARP relating to meteorological triggers for dust generation;
- for receptors in close proximity to the Surface Facilities Area, a dust management plan will be developed in consultation with the landowner to manage and reduce potential dust impacts and an additional real-time PM_{10} monitor would be implemented to monitor impacts and enable adaptive real-time management of air quality impacts;
- an odour management plan will be developed and implemented to monitor, manage and mitigate potential odour impacts at receptors where maximum odour levels are predicted as having the potential to exceed the odour criteria; and
- the proposed ventilation stack design would incorporate odour modelling recommendations to reduce ground level odour concentrations. This includes increasing the height of the ventilation shaft, and increasing the velocity at which ventilation air is emitted.

Action for Air

Action for Air, a 25 year air quality management plan for Sydney, Wollongong and the Lower Hunter was implemented by the NSW Government in 1998 (DECCW, 2009). The plan seeks to provide long-term ongoing emission reductions, meet the national air quality standards for six pollutants as identified in the Ambient Air NEPM and reduce the population's exposure to air pollution, and the associated health costs.

The six pollutants in the Ambient Air NEPM include CO, NO_2, SO_2, lead, ozone (O_3) and PM_{10}. The main pollutant from the proposed development that is relevant to the Action for Air is PM_{10}. Action for Air aims to reduce air emissions to enable compliance with the Ambient Air NEPM targets with a focus on motor vehicle emissions.

The proposed development is located within the area relevant to the Action for Air plan and generally addresses the aims of the Action for Air Plan in the following ways:

- air quality emissions potentially associated with the proposed development have been quantified;
- dispersion modelling has been conducted by ERM to predict the impact of these emissions on nearby receptors and assess these emissions against the Ambient Air NEPM goals; and
- potential mitigation measures have been identified for the proposed development.

11.11.7 Conclusion

The AQIA for the proposed development assessed the worst case air quality impact, involving the preparation of detailed emission inventories and dispersion modelling to predict the ground level concentrations for relevant pollutants.

Construction of the proposed development has the potential to result in dust deposition, visible dust plumes, elevated PM_{10} concentrations from dust generating activities and emissions from diesel-powered construction equipment. Sensitive receptors close to construction areas would be most sensitive to construction dust; however, these impacts would be short term and temporary in nature. Estimated PM_{10} emissions from construction of the proposed development as a whole would be significantly less than the estimated emissions for operational mining activities.

Operation of the proposed development is not predicted to result in exceedances of air quality criteria for annual average $PM_{2.5}$, annual average PM_{10}, annual average TSP or annual average deposited dust under the worst case scenario, when considering project only contributions or when including cumulative (background) contributions.

No sensitive receptors are predicted to exceed the maximum 24-hour $PM_{2.5}$ criterion of 25 µg/m^3 as a result of the proposed development (project-only contributions).

One private receptor near the REA (R10) is predicted to experience maximum 24-hour average PM_{10} concentrations above the criterion of 50 µg/m^3, due to the proposed development's operations alone. This receptor is predicted to exceed the 24-hour average impact assessment criterion on only one day of the year as a result of emissions from the proposed development.

Assessment of cumulative PM_{10} 24-hour impacts concluded that there was a probability that the selected receptors may exceed the EPA criterion of 50 µg/m^3 when impacts are considered cumulatively. Receptor (R10) had the highest estimated number of days exceeding the 24-hour average PM_{10} criterion (up to 9 days per year). However, with the incorporation of the TARP and other dust management practices, these exceedances would be well managed.

11.12 Greenhouse Gas

This section provides an assessment of the predicted greenhouse gas emissions associated with the proposed development and is supported by the Tahmoor South Project Greenhouse Gas Assessment (ERM, 2018). The Greenhouse Gas Assessment is provided in **Appendix O**.

The greenhouse gas assessment addressed the SEARs relevant to greenhouse gas impacts. These are listed in **Table 11-72**.

Table 11-72 Secretary's Environmental Assessment Requirements (SEARs)

Greenhouse Gas SEARs
Air – including an assessment of the likely greenhouse gas impacts of the development.

11.12.1 Background

The proposed development will generate greenhouse gas through the creation of Scope 1, 2 and 3 emissions. Consequently, a Greenhouse Gas Assessment has been undertaken to:

- quantify the potential Scope 1, 2 and 3 greenhouse gas emissions generated by the proposed development;
- assess the potential impacts of these emissions on the environment; and
- determine reasonable and feasible measures to minimise greenhouse gas emissions and ensure energy efficiency.

11.12.2 Methodology

The Greenhouse Gas Assessment was undertaken in line with the methods outlined in the following documents and guidance material:

- The World Resources Institute/World Business Council for Sustainable Development Greenhouse Gas Protocol *The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard Revised Edition* (GHG Protocol) (2004);
- National Greenhouse and Energy Reporting (NGER) (Measurement) Determination 2008; and
- The National Greenhouse and Energy Reporting Scheme Measurement. Technical Guidelines for the Estimation of Greenhouse Gas Emissions by Facilities in Australia (the NGER Guidelines) (DoEE, 2016b).

In accordance with the GHG Protocol, greenhouse gas emissions were categorised into three different scopes (Scope 1, Scope 2 and Scope 3). Categorising emissions enables the delineation of direct and indirect emission sources, improves transparency, and provides a degree of flexibility for individual organisations to report based on their organisational structure, business activities and business goals. The three scopes of greenhouse gas emissions as defined by the GHG Protocol are as follows:

- Scope 1 emissions: direct greenhouse gas emissions occurring from sources owned or controlled by the company, such as vehicle fleet, fuel combustion and fugitive emissions. Any negative emissions (sequestration) are also included as Scope 1;
- Scope 2 emissions: indirect greenhouse gas emissions from purchasing electricity or heat from other parties; and
- Scope 3 emissions: indirect emissions which occur due to the company's business activities, but from sources not owned or controlled by the company, such as emissions from the production of purchased material, product use, outsourced activities, contractor owned vehicles, waste disposal, employee business-related air travel etc. The principal Scope 3 emission associated with the proposed development would be the combustion of the product coal that would be produced.

The Greenhouse Gas Assessment has calculated emissions for two scenarios; where the WCMG Power Plant (as described in **Section 3.2.2**) is, and is not operational at Tahmoor Mine.

All greenhouse gas calculations undertaken for the proposed development have used equations and emissions factors given within the NGER Measurement Determination. The equations were undertaken using the following data provided by Tahmoor Coal:

- consumption data for fiscal years 2009/2010, 2010/2011, 2011/2012 and 2012 to March 2013 in the form of NGER Scheme declarations; and
- ROM and product coal values for the years that consumption data was provided, as well as projections for the life of the project (approximately 2019 to 2035).

Projections for future years consumption data was undertaken using intensity factors of consumption per tonne of ROM coal. The derivation of these intensity factors is provided in Table 4-1 of the Greenhouse Gas Assessment at **Appendix O**. A summary of these intensity factors is provided in **Table 11-73**.

Table 11-73 Intensity factors for consumables used for Scope 1 emissions calculations

Year	Diesel (kL)	Petrol (kL)	Oils (kL)	Lubricants (kL)	Electricity (MWh)	SF6 (CO_2-et/t)
Intensity Factor (Usage per kt ROM)	0.44	0.008	0.0001	0.095	36.9	0.12

11.12.3 Impact Assessment

Scope 1 Emissions

The major Scope 1 emission sources associated with the proposed development are anticipated to comprise:

- ROM coal extracted from gassy underground mine (including post-mining);
- collection and venting/flaring of pre-drained gas and goaf gas (post drainage);
- venting of mine ventilation return air;
- diesel oil combustion;
- petrol combustion;
- post-mining activities; and
- the potential use of sulfur hexafluoride (SF_6).

Estimates of Scope 1 emissions from fugitive methane were provided by Tahmoor Coal. The projections assumed that pre-gas drainage Scope 1 emissions would occur from 2020, and would then continue for the remainder of the proposed development.

Commercial agreements are in place between Tahmoor Coal and EDL for the WCMG Power Plant to operate until 2020. If the WCMG Power Plant is not operated, the gas will be diverted to the Tahmoor Mine Flare Plant, which has sufficient design capacity to accommodate this additional gas. The Greenhouse Gas Assessment considered two scenarios; one in which the WCMG Power Plant operates at Tahmoor Mine, and one without the WCMG Power Plant operating where gas will be sent to the Tahmoor Mine Flare Plant.

For the purposes of this assessment GHG emissions are reported as tonnes of carbon dioxide equivalent (t CO_2-e).

A summary of the types of Scope 1 emissions that these activities generate is provided in **Table 11.74**.

Table 11-74 Activities that will generate Scope 1 greenhouse gas emissions

Emission source type	Activities that will generate emissions
Fugitive Methane	Mine ventilation, pre-gas drainage, post-drainage, flaring and third party power generation (use of the WCMG Power Plant, if available).
Diesel	Exploration and drilling, underground coal extraction and coal handling activities.
Unleaded Petrol	Mining support services at the Surface Facilities Area.
Oils and lubricants	Not considered further*.
Sulfur hexafluoride gas (SF_6)	Potentially emitted through use of SF_6 in insulated switch gear and circuit breaker applications.
Post-mining activities	ROM coal extraction and processing.

**NGER reported oils and lubricants data is used only in terms of characterising the associated energy consumption, as opposed to greenhouse gas emission. This is because typically, such oils and lubricants are consumed below their temperature of combustion, whereby while energy is consumed there is no associated emission and they are deemed 'consumed but not combusted'. As a result, oils and lubricants are not considered further in the scope of this greenhouse gas assessment.*

The Greenhouse Gas Assessment estimates that over the life of the proposed development, approximately 13.5 million tonnes of CO_2-e Scope 1 emissions would be generated with the WCMG Power Plant operating at Tahmoor Mine (refer to **Table 11-75**). Fugitive methane emissions are the major source of Scope 1 emissions, accounting for 93.5% of direct (Scope 1) emissions that would be generated by the proposed development (with the WCMG Power Plant operating at Tahmoor Mine), followed by post-mining activities, which would generate 6.0% of total Scope 1 emissions (refer to **Table 11-75**). The estimated Scope 1 greenhouse gas emissions intensity of the proposed development is about 0.35 t CO_2-e/t saleable coal, which is comparable with the emissions intensity of existing gassy underground mines in Australia (Deslandes, 1999).

The proposed development's contribution to climate change and the associated impacts would be in proportion with its contribution to global greenhouse gas emissions. Average annual Scope 1 emissions from the proposed development (0.84 million tonnes CO_2-e) would represent about 0.19% of Australia's commitment under the Paris Agreement (431 Mt CO_2-e), and a very small portion of global greenhouse emissions given that Australia contributed approximately 1.5% of global GHG emissions in 2005 (Commonwealth of Australia, 2011).

Without the operation of the WCMG Power Plant, total estimated Scope 1 Emissions for the proposed development would be 17,375,791 tonnes CO_2-e/t.

Scope 2 Emissions

The only source of Scope 2 greenhouse gas emissions associated with the proposed development would be electricity consumption. Over the life of the proposed development, electricity consumption is anticipated to generate 1,463,663 tonnes CO_2-e (refer to **Table 11-75**).

Scope 3 Emissions

The GHG Protocol provides that the reporting of Scope 3 emissions is optional. Typically, only major sources of Scope 3 emissions are accounted for and reported, which for the proposed development is the burning of product coal. Notably, the GHG Protocol notes that reporting Scope 3 emissions can result in double counting, as these emissions are reported as direct emissions by the facility using the coal. Further, the Protocol recognises that compliance regimes are more likely to focus on point of release emissions (i.e. direct emissions) and/or indirect emissions from the purchase of electricity. Notwithstanding, for completeness Scope 3 emissions from the burning of coal are reported in the Greenhouse Gas Assessment for the proposed development.

The burning of product coal over the life of the proposed development is anticipated to generate about 104.5 million tonnes CO_2-e of Scope 3 emissions.

Table 11-75 Summary of estimated Scope 1, Scope 2 and Scope 3 greenhouse gas emissions CO2-e (tonnes)

Year	Scope 1 Emissions (t CO_2-e) (With WCMG Power Plant Operating)						Scope 2 Emissions (t CO_2-e)	Scope 3 Emissions (t CO_2-e)
	Diesel	Unleaded Petrol	Fugitive Methane	SF_6	Post-mining Activities	Total	Electricity	Energy Production
2020	375	6	253,700	0.3	5,330	259,412	9,613	618,071
2021	1,284	22	248,207	1.2	18,246	267,760	32,909	2,145,039
2022	3,289	56	255,826	3.0	46,750	305,924	84,318	5,341,094
2023	4,250	72	652,940	3.9	60,414	717,681	108,963	7,274,286
2024	4,150	70	625,918	3.8	58,993	689,135	106,399	7,654,222
2025	4,231	72	740,259	3.9	60,146	804,712	108,478	8,076,159
2026	4,310	73	723,693	4.0	61,265	789,345	110,497	8,121,181
2027	4,670	79	931,985	4.3	66,383	1,003,121	119,727	8,871,963
2028	4,380	74	1,368,976	4.0	62,258	1,435,692	112,287	8,119,980
2029	4,042	69	1,403,072	3.7	57,449	1,464,636	103,615	7,409,838
2030	4,527	77	1,436,056	4.2	64,348	1,505,012	116,057	8,772,232
2031	4,199	71	1,072,983	3.9	59,689	1,136,946	107,654	7,810,812
2032	4,211	71	1,180,287	3.9	59,862	1,244,435	107,966	8,259,963
2033	4,727	80	479,393	4.4	67,196	551,401	121,194	8,236,845
2034	3,110	53	489,559	2.9	44,211	536,936	79,739	5,438,160
2035	1,336	23	735,991	1.2	18,988	756,339	34,247	2,403,145
Total	**57,094**	**968**	**12,598,845**	**53**	**811,527**	**13,468,487**	**1,463,663**	**104,552,988**

The estimated Scope 1 greenhouse gas emissions provided in **Table 11-75** are based on the WCMG Power Plant operating at Tahmoor Mine. As noted above, the total estimated Scope 1 emissions for the proposed development would be 17,375,791 tonnes CO_2-e/t without the WCMG Power Plant operating.

11.12.4 Management and Mitigation Measures

A number of options were evaluated to determine reasonable and feasible measures to minimise Greenhouse Gas emissions from the proposed development. The reduction of fugitive methane emissions by flaring and the diversion of waste mine gas to the WCMG Power Plant (if available) are considered to be best practice methane management measures for underground coal mines.

Management and mitigation measures will be incorporated into the various stages of the proposed development in order to reduce the volume of greenhouse gas emissions and the resultant impact of the proposed development on the environment. These management and mitigation measures are listed below.

General Operations

- implement the following fugitive methane emissions abatement measures:
  - flaring at the Tahmoor Mine Flare Plant;

  - methane recycling through the use of third party power generation (WCMG Power Plant, if available); and
  - use of ventilation control devices in sections of the mine not in use enabling them not to be ventilated (unless required for safety purposes), thereby reducing fugitive emissions.
- an electric winder will continue to be used for the drift and man and materials winder in ventilation shaft 3, instead of diesel powered; and
- longwall panels will be sealed to reduce methane emissions from the goaf into the return ventilation where it is not feasible to capture.

Monitoring

- use real-time gas (methane and carbon dioxide), temperature, pressure and associated volumetric flow monitoring at the upcast ventilation shafts to allow accurate measurement of ventilation (including methane and carbon dioxide) emissions, which will then allow further feasibility assessment of reuse options. A Continuous Emission Monitoring (CEM) system such as this is currently in place at the Tahmoor Mine. A similar system will be installed for the Tahmoor South Project which would meet the monitoring requirements of Method 4 as described within Part 1.3 of the NGER Measurement Determination (refer to Section 8.2.1 of the Greenhouse Gas Assessment at **Appendix O**).

Recording

- maintenance, calibration and record keeping will be undertaken on the main ventilation shaft and fans to allow calculation of greenhouse gas emissions; and
- records of monthly electricity use and ROM coal production will be maintained to enable greenhouse gas emissions calculations.

Management Plans

In accordance with the Guidelines for Energy Savings Action Plans (DEUS, 2005), an Energy Savings Action Plan would be prepared and implemented. The Energy Savings Action Plan would include Standards to minimise energy use and greenhouse gas emissions from the operation of the proposed development. The Energy Savings Action Plan would be incorporated into the OEMP and would include objectives, commitments, procedures and responsibilities for:

- assisting in general industry research and promoting low emission coal technologies;
- improving energy use and efficiency;
- considering of the use of alternative fuels where economically and practically feasible;
- review of mining practices to minimise double handling of materials and ensuring that materials haulage is undertaken using the most efficient routes;
- ongoing scheduled and preventative maintenance to ensure that diesel and electricity powered plants operate efficiently;
- the development of targets for greenhouse gas emissions and energy use, as well as monitoring and reporting against these to input to the National Greenhouse and Energy Reporting scheme;
- implementation of a detailed energy monitoring programme, including monitoring electricity and diesel usage on-site to identify main sources of greenhouse gas emissions and provide a baseline of energy use to apply appropriate reduction mechanisms where possible;
- regular maintenance of diesel powered equipment to ensure operation at peak efficiency; and
- assessing lighting plant efficiency.

11.12.5 Conclusion

The proposed development will generate an annual average of 0.84 million tonnes CO_2-e of Scope 1 emissions, equating to approximately 13.5 million tonnes CO_2-e over its life. Without the WCMG Power Plant operating, the proposed development will generate approximately 17.4 million tonnes CO_2-e/t over its life. Importantly, average annual Scope 1 emissions would represent a very small portion of Australia's commitment under the Paris Agreement, at about 0.19%. In addition, the proposed development will generate approximately 1.5 million tonnes CO_2-e of Scope 2 emissions and approximately 104.5 million tonnes CO_2-e of Scope 3 emissions over its life. Management and mitigation measures will be incorporated into the proposed development to reduce Scope 1 and 2 emissions where feasible and practical.

11.13 Traffic

A Traffic Impact Assessment (TIA) was undertaken by Transport & Urban Planning Pty Ltd to assess the potential traffic impacts of the proposed development.

The TIA is provided in **Appendix P** and summarised in the following sub-sections.

The traffic assessment addressed the SEARs relevant to road traffic impacts. These are listed in **Table 11.76**. Impacts on rail and port capacity are addressed in **Section 11.14**.

Table 11-76 Amended SEARs

Traffic & Transport SEARs
Traffic & Transport – including:
• Transport – including an assessment of the likely transport impacts of the development on the capacity, condition, safety and efficiency of the rail network and the local and State road network.

11.13.1 Methodology

Overview

The TIA was undertaken to provide:

- an overview of existing traffic and transport conditions, including existing operational performance of local roads, including Remembrance Driveway, Avon Dam Road, and Tahmoor Mine Access Road, and key intersections such as the Tahmoor Mine Access Road/Remembrance Driveway and Avon Dam Road/Remembrance Driveway intersections;
- transport appraisal of the proposed Tahmoor Mine Access Road/Remembrance Driveway intersection upgrade with reference to the existing and proposed volumes of traffic;
- an assessment of traffic impacts for different stages of the proposed development including the peak stages of construction and operation;
- an assessment of increased transport of product coal and rejects from the mine by road transport up to 200,000 tpa; and
- management measures developed to mitigate the impact of the potential traffic and transport issues identified.

Traffic Counts and Modelling

Traffic counts were undertaken to establish existing traffic volumes and vehicle classifications on the local road network between 17 and 23 October 2018. Traffic count locations included: Remembrance Driveway at several locations, Avon Dam Road Rail Overbridge and Avon Dam Road, Rockford Road and Charlies Point Road. Daily volume and classification counts were also undertaken in the Tahmoor Mine Access Road.

In addition, weekday AM and PM peak period intersection counts were undertaken on 15 August 2017 between 6.00am and 9.30am and 2.00pm and 6.00pm at the principal intersections of Remembrance Driveway/Tahmoor Mine Access Road and Remembrance Driveway/Avon Dam Bridge Road.

Traffic modelling scenarios took into account:

- an assessment of a future timeframe of 10 years (as recommended by RMS);
- an assessment of existing conditions in the AM and PM periods including mine peak hours;
- projected employee numbers in 2020, as this is the anticipated peak year for employment levels for the proposed development;
- shift work hours for peak traffic generation; and
- future scenarios based on dates for construction and operation.

Intersection Performance Modelling

Traffic modelling has been undertaken to determine the potential impact of additional traffic volumes, generated by the proposed development, on critical intersections along Remembrance Driveway. Intersection performance has been evaluated using SIDRA Intersection 6, a computer-based modelling package designed for calculating isolated intersection performance. The main performance indicators used in SIDRA 6 include:

- Degree of Saturation – a measure of the ratio between traffic volumes and lane/approach capacity at the intersection. A degree of saturation below 1.0 suggests that the intersection operates with spare capacity, whereas a degree of saturation of over 1.0 results in increasing delays and vehicle queue lengths;
- Average Delay – duration, in seconds, of the average vehicle delay at an intersection; and
- Level of Service (LoS) – a measure of the overall performance of an intersection, with LoS A to C being good to satisfactory, LoS D being near capacity and LoS E being at or above capacity. Detailed descriptions of the different LoS can be found in **Appendix P**.

Detailed outputs of the SIDRA Intersection 6 modelling results are provided in **Appendix P**.

11.13.2 Existing Environment

The principal road network that services the Tahmoor Mine is shown in **Figure 11.32** and includes:

- The Hume Highway;
- Remembrance Driveway;
- Avon Dam Road; and
- Tahmoor Mine Access Road and other local roads that provide access to the eastern side of the Tahmoor Mine site.

Hume Highway

The Hume Highway is a national road that links Sydney, Canberra and Melbourne, forming the high speed connection between Sydney and the Southern Highlands.

Between Campbelltown and the Southern Highlands, the Hume Highway is known as the M31 Hume Motorway and comprises a four lane road with a divided carriageway, and has a posted speed limit of 110 km/hour.

Local Road Network

The principal road network that services the Mine and the surrounding local area includes Remembrance Driveway and Tahmoor Mine Access Road which provide access to the Mine site's Surface Facilities Area. Avon Dam Road provides a link between Remembrance Driveway and the M31 Hume Motorway. The local road network, including the key local roads identified in this section, is shown on **Figure 11.32**.

Key intersections within the local road network include:

- Tahmoor Mine Access Road/Remembrance Driveway - Tahmoor Mine Access Road forms a T-junction with Remembrance Driveway. The intersection is characterised by an auxiliary right turn lane treatment and auxiliary left turn treatment channelisation and priority control on Tahmoor Mine Access Road;
- Olive Grove Lane/Remembrance Driveway – Olive Grove Lane forms a minor T-junction with Remembrance Driveway, approximately 95 m north of the Tahmoor Mine Access Road and is characterised by a basic left turn and basic right turn treatment. An auxiliary through lane exists for the southern approach to allow through vehicles to pass a right turn vehicle at this location;
- Wollondilly Anglican College Access Road - Wollondilly Anglican College Access Road forms a T-junction with Remembrance Driveway, approximately 330 m south of the Tahmoor Mine Access Road. It is characterised by a channelized right treatment/lane and auxiliary left turn lane treatment and priority control on the school access road;

- Avon Dam Road/Remembrance Driveway intersection - A rail overbridge links Remembrance Driveway to Avon Dam Road at Bargo and provides the most direct route to the M31 Hume Motorway for travel to and from Sydney. At this intersection, Avon Dam Road forms a T Junction and railway crossing with a basic left turn and basic right turn treatment and priority control on the rail crossing; and
- Wellers Road/Remembrance Driveway intersection - A rail overbridge provides an alternative or second rail crossing at Wellers Road north of Avon Dam Road at Bargo. Wellers Road forms a cross junction intersection with a basic left turn and basic right turn treatment and stop sign control.

The sight distances at all intersections above are considered satisfactory.

Existing Traffic Volumes

Average Daily Traffic Volumes

Table 11.77 presents the five day weekday average daily traffic and the seven day average daily traffic on the local road network, as well as the proportion of heavy vehicles.

Table 11-77 Five Day Average and Seven Day Average Traffic Volumes (Transport & Urban Planning, 2018)

Location	5 Day Average (Weekday)				7 Day Average (Average Daily Traffic)			
	North-bound	South-bound	Total	% Heavy Vehicles	North-bound	South-bound	Total	% Heavy Vehicles
1	4,376	4,413	8,789	11.2%	4,060	4,076	8,136	10.4%
2	4,192	4,256	8,448	8.0%	3,896	3,937	7,833	7.0%
3	4,559	4,354	8,913	8.6%	4,284	4,023	8,307	7.6%
4	2,248	2,236	4,484	14.1%	2,129	2,152	4,282	12.6%
5	2,442	2,505	4,947	9.3%	2,250	2,296	4,546	8.5%
6	2,016	2,015	4,032	17.7%	1,820	1,824	3,634	16.5%
Location	**East-bound**	**West-bound**	**Total**	**% Heavy Vehicles**	**East-bound**	**West-bound**	**Total**	**% Heavy Vehicles**
7	383	383	766	10.2%	313	313	626	9.3%

Note – 1: Remembrance Driveway, north of Tahmoor Mine Access Road; 2: Remembrance Driveway, south of Wollondilly Anglican College Access Road; 3:Remembrance Driveway, North of Avon Dam Road Rail Bridge; 4:Remembrance Driveway, South of Marshalls Avenue; 5:Avon Dam Road Rail Bridge, East of Remembrance Driveway; 6:Avon Dam Road, North of Arina Road; 7:Tahmoor Mine Access Road.

Weekday AM and PM Peak Hour Traffic Volumes

AM Peak

The AM peak period at the principal intersections of the Tahmoor Mine Access Road intersection and the Remembrance Driveway/Avon Dam Road intersection occur between 7.45am – 8.45am and 7.30am – 8.30am respectively. The highest traffic generation of Tahmoor Mine in the AM peak period does not coincide with the peak period at these principal intersections.

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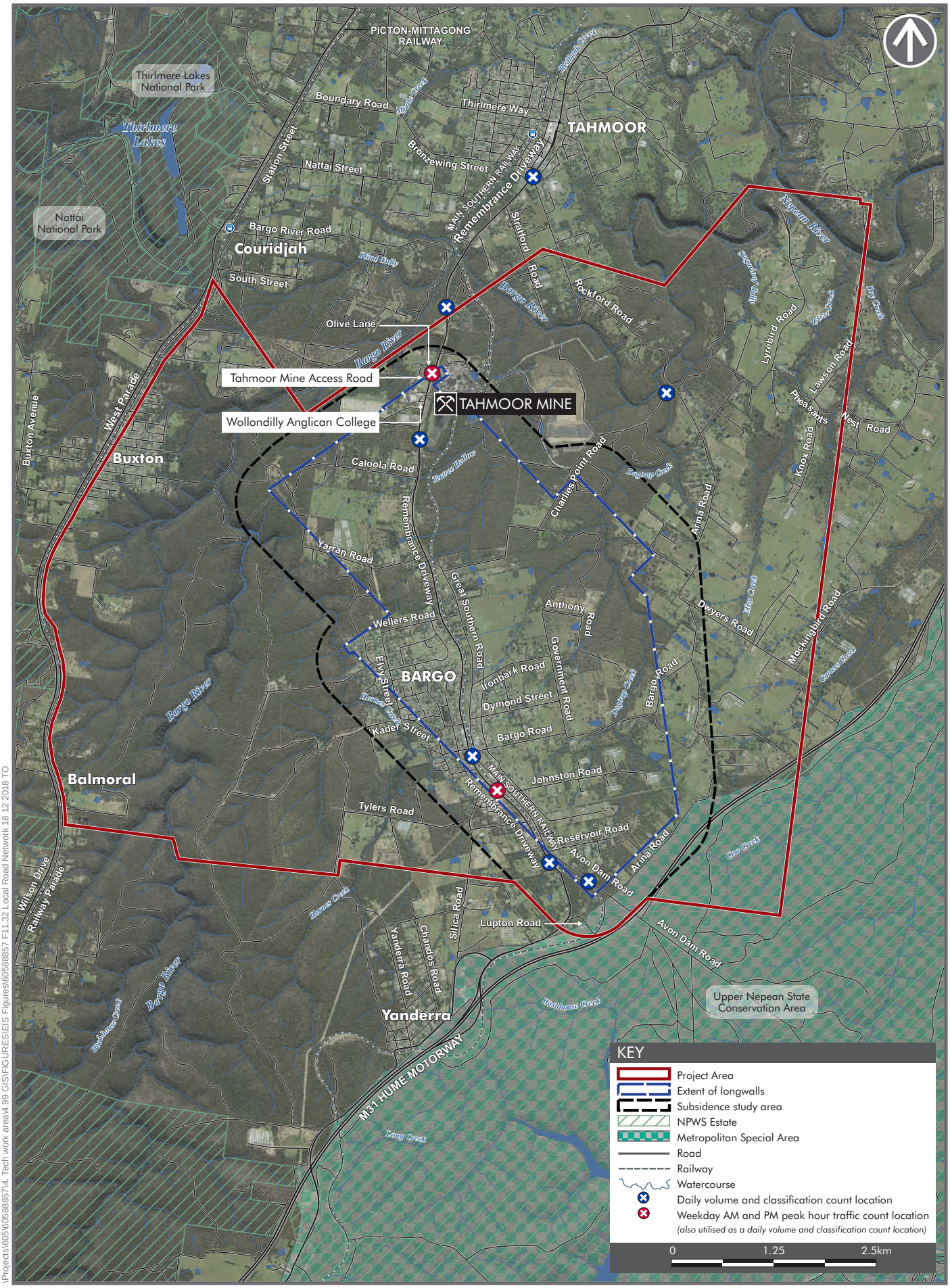

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SIMEC MINING

LOCAL ROAD NETWORK

Tahmoor South Project
Environmental Impact Statement

FIGURE 11.32

During the AM peak (7.45am-8.45am) at the Tahmoor Mine Access Road intersection:

- Traffic volumes using Remembrance Driveway totalled 342 vehicles per hour (vph) travelling northbound and 365 vph travelling southbound; and
- The entry and exit movements to and from Tahmoor Mine were 19 vph and 53 vph respectively.

During the AM peak (7.30am – 8.30am) at the Remembrance Driveway and Avon Dam intersection:

- Traffic volumes using Remembrance Driveway totalled 135 vehicles per hour (vph) travelling northbound and 234 vph travelling southbound;
- The left and right turn movements into Avon Dam Road Rail Bridge were 172vph and 32vph respectively; and
- The left and right turn movements out of Avon Dam Road Rail Bridge were 34vph and 105vph respectively.

PM Peak

The PM peak period for the principal intersections, occurs between 3.30pm and 4.30pm. In this period:

- Northbound and southbound through volumes at the Remembrance Driveway/Tahmoor Mine Access Road intersection were 362vph and 313vph respectively;
- Entry and exit movements from Tahmoor Mine were 6vph and 79vph respectively. The left turn out of the Mine Access Road was the highest movement at 50vph;
- Northbound and southbound through volumes at the Remembrance Driveway/Avon Dam Road Rail Bridge intersection accounted for 197vph and 130vph respectively;
- The left and right turn into Avon Dam Road Rail Bridge were 165vph and 35vph respectively; and
- The left and right turn out of Avon Dam Road Rail Bridge were 36vph and 249vph respectively.

The peak traffic generation of Tahmoor Mine in the PM peak period occurs before the commuter peak hours.

Existing Tahmoor Mine Traffic Generation

The existing Tahmoor Mine operation (based on 2018 traffic counts) generates some 39 two way heavy vehicle movements per day on weekdays (i.e. 39 in/39 out). The majority of these vehicles are rigid trucks with up to two semi-trailers per day.

The existing Tahmoor Mine operation generates on average 344 light vehicle movements per day on weekdays (i.e. 344 in/344 out).

Road Safety

A review of RMS accident statistics for Remembrance Driveway and Avon Dam Road was undertaken for the five year period between 1 October 2011 and 30 September 2016. A summary of these statistics is provided in the following sections. Seventeen of the accidents occurred in proximity to intersections on Remembrance Driveway.

Remembrance Driveway

Between 2011 and 2016, a total of 39 accidents were recorded along Remembrance Driveway between the M31 Hume Motorway, Yanderra, and Thirlmere Way, Tahmoor. Of the 39 accidents, there was one accident, which involved a fatality, 20 injury-related accidents, and 18 non-casualty accidents involving damage to property only.

At the intersection of Remembrance Driveway and Tahmoor Mine Access Road, there were a total of three accidents. These included one head on fatal accident 200 m south of the intersection, as well as two injury accidents involving a northbound car on Remembrance Driveway colliding with a right turning vehicle waiting to turn into Tahmoor Mine. The proposed upgraded channelisation to provide a dedicated right turn bay in the southern approach of Remembrance Driveway (refer to **Section 11.13.4**) would reduce the potential for accidents at this intersection.

The remaining intersection accidents were spread over a number of intersections along Remembrance Driveway including at Wellers Road, (three accidents) Avon Dam Road (two accidents) and Yarran Road (two accidents). However, the data does not indicate an identifiable accident pattern at the intersections.

The reduction of the speed limit in recent years from 100km/h to 80km/h in the section of Remembrance Driveway near Tahmoor Mine should result in an improvement in road safety outcomes on Remembrance Driveway.

Avon Dam Road

A total of 12 accidents were recorded along Avon Dam Road, between Remembrance Driveway, Bargo, and the M31 Hume Motorway at Pheasant Nest, for the five year period between 2011 and 2016. Of the 12 accidents, there were three injury-related accidents, and nine non-casualty accidents involving damage to property. Of the 12 accidents, seven occurred within proximity of an intersection.

All seven intersection accidents (non-fatal) were recorded at the intersection of Anna Road/Avon Dam Road/Lupton Road. Four of the total, were cross intersection accidents and the three remaining accidents included a vehicle overtaking and two single vehicle accidents.

It is noted that a roundabout has been constructed at this intersection in recent times and that the speed limit in the section of Avon Dam Road between the M31 Hume Highway and the edge of the township has been reduced to 60km/h. These measures would assist in reducing the number of crashes in this section of Avon Dam Road.

Car Parks

Tahmoor Mine currently has three car parks with a total of 278 car spaces. As part of the proposed development, a new car park would be constructed which would incorporate another 150 parking spaces, providing a total car parking capacity of 428 spaces.

Public Transport

Bus services operate along Remembrance Driveway between Picton and Bargo/Yanderra on weekdays and Saturdays. Picton Bus Lines operates seven services per day on weekdays and two services on Saturdays. County Transport also operates bus services between Picton and Bargo, with four services provided on weekdays and two on Saturdays. No bus services are provided on Sundays.

11.13.3 Impact Assessment

Construction Activities

Traffic volumes associated with the construction of the proposed development are defined in terms of a number of construction activities. These include:

- construction of the underground mine workings between 2020 and 2024;
- delivery of equipment between 2024 and 2027;
- construction of additional surface infrastructure and upgrades to existing infrastructure within the Surface Facilities Area, between 2020 and 2024;
- upgrade of the Remembrance Driveway/Mine Access Road intersection between 2020 and 2021; and
- ventilation shaft construction, one at a time, between 2021 and 2024.

As shown in **Table 11.78**, the upgrade to the Surface Facilities Area (including mine access upgrade) and construction of the two ventilation shafts are likely to generate the greatest construction impact on the local road network.

Table 11-78 Summary table of construction traffic volumes by construction activity

Activity	Year of development	Light vehicles	Heavy vehicles
Underground mine workings	2020 to 2024	-	2-3 semi-trailer deliveries per month (approx. 1 per week in and out).
Delivery of equipment	2024 to 2027	-	5-8 semi-trailer deliveries per month (1-2 per week in and out).
Surface Facilities Area Remembrance Driveway/Mine Access Road intersection	2020 to 2024	30 construction workers in 6am – 7am 30 construction workers out 5pm – 6pm	On average 10-15 large rigid truck and articulated semi-trailer deliveries per month (2-3 per week in/2-3 per week out) Note – during construction of the new parking area and internal road and Remembrance Driveway intersection up to 15 heavy vehicles per day may be required to deliver materials to site (15 movements in and out) Additional heavy vehicle movements would also occur associated with delivery of materials, concrete pours, asphalting etc., although these would spread over the day.
Ventilation shafts (x2) TSC1 - Upcast TSC2 - Downcast	2021 to 2024	13 construction worker trips 5.30am – 6.30am 13 construction worker trips 5.30pm – 6.30pm	Site establishment works – 40 semi-trailer loads over three weeks for each shaft location. Construction of ventilation shafts – 1-2 heavy vehicle deliveries per day (1-2 in/1-2 out) for the 18 months to two year construction period except for heavy concrete pours when up to an additional 13 deliveries per day (approx. 1-2 per hour). Demobilisation works – 40 semi-trailer loads over three weeks for each shaft location. Note: Ventilation shafts would be constructed one at a time.

Surface Facilities Area and Mine Access Upgrade

While an increase in vehicles is anticipated for construction of the proposed development, the order of this increase is less than the proposed additional peak traffic generated in the operational phase. In addition, construction traffic would be generated at different times than operational traffic and primarily outside of the AM and PM peak hours on the road network. On this basis, the potential construction impacts are considered satisfactory in the context of the overall proposed development.

Ventilation Shafts

As shown in **Table 11.78**, two ventilation shafts will be constructed between 2021 and 2024. Construction vehicle access to TSC1 and TSC2 would be via Rockford Road and Charles Point Road. The existing weekday traffic on these roads is between 1,576-1,607 vehicles per day (vpd) (12.2-13.2% heavy vehicles) and 131-135vpd (6.8-7.8%heavy vehicles), respectively. The additional 26 light vehicle trips and 14-16 heavy vehicle trips (worst case) generated by the construction of TSC1 and TSC2 are not considered to impact the capacity of these roads.

Operation

The employment at Tahmoor Mine (i.e. employees and contractors) is expected to vary from current levels, with the peak year for employment occurring in 2020. After 2020 employment levels are anticipated to reduce. At the request of RMS, traffic volumes generated by the Tahmoor Mine have been considered for the existing situation (2017/2018) and the future timeframe of 10 years (2028). In addition, the peak employment scenario (2020) has been assessed. As employment levels are expected to decrease post 2020, the 2020 scenario represents the most conservative assessment for the operational phase.

The increase in employment as a result of the proposed development (compared to 2017) will be proportional across all the shifts worked at Tahmoor Mine and therefore the increase in the traffic generation over the day including at peak times (i.e. shift changeover times) would also be expected to be proportional. Weekdays have the highest number of employees and traffic generation from Tahmoor Mine. Based on anticipated employment trends the existing and projected traffic impacts during operation are shown in **Table 11.79**.

Table 11-79 Existing and future traffic at Tahmoor Mine during weekday AM and PM peak hour (Transport and Urban Planning, 2018)

Hourly period	2017 (existing)		2020 (peak employment)		Increase from 2017 volumes		2028 (future)		Increase from 2017 volumes	
	In	Out	In	Out	In	Out	In	Out	In	Out
7.45am – 8.45am	19	53	27	74	+8	+21	22	61	+3	+8
3.30pm – 4.30pm	6	79	9	110	+3	+31	8	91	+1	+12

Traffic Generation

As noted in **Table 11.79**, the peak traffic volumes generated by the proposed development will occur in 2020 during the 7.45am-8.45am period and the 3.30pm – 4.30pm period on weekdays. Figures 11 and 12 in **Appendix P** show the additional volumes and directional splits assigned to the road network during these periods based on the existing traffic patterns. In summary:

- during the 7.45am-8.45am period the increase in traffic volumes due to the proposed development would be:
  - a 14 vph increase in Remembrance Driveway north of Tahmoor Mine Access Road with 9 northbound vehicles and 5 southbound vehicles;
  - a 31 vph increase south of Tahmoor Mine Access Road with 11 northbound vehicles and 20 southbound vehicle;
  - a 15 vph increase on Remembrance Driveway south of Avon Dam Road; and
  - a 16 vph increase on Avon Dam Road.
- during the 3.30pm – 4.30pm period the increase in traffic volumes due to the proposed development would be:
  - a 13 vph increase on Remembrance Driveway north of Tahmoor Mine Access Road with 11 northbound vehicles and 2 southbound vehicles;
  - a 37 vph increase on Remembrance Driveway south of Tahmoor Mine Access Road with 9 northbound vehicle and 28 southbound vehicles;
  - a 18 vph increase on Remembrance Driveway south of Avon Dam Road; and
  - a 19 vph increase on Avon Dam Road.

The impact of additional traffic on both Remembrance Driveway and Avon Dam Road is considered relatively minor in terms of midblock capacity.

The transportation of the 200,000 tpa of coal and other products by road would generate on an average day an additional 16 truck loads (i.e. 16 in/16 out) and a maximum of 79 truck loads per day (using trucks and quad dog articulated vehicle) on a campaign basis (i.e. 79 in/79 out). This would add (at maximum) an additional 8 truck loads per hour (i.e. 8 in/8 out) in the AM and PM peak hours.

Operational Performance of Intersections

Traffic modelling using SIDRA examined the impacts of additional traffic movements from the proposed development on critical intersections on Remembrance Driveway.

The TIA considered the future operational performance of the Remembrance Driveway/Mine Access Road intersection (refer to **Section 11.13.4** for further information) for the existing traffic volumes (2017) and for the 2020 scenario with traffic generated by the proposed development and a lineal background traffic growth rate of 3.3 percent per year. A summary of the intersection performance is provided in **Table 11-80** for the existing 2017 and forecast 2020 traffic flows (further details of the SIDRA results are in Tables 4.4 to 4.7 in **Appendix P**).

Table 11-80 Intersection performance

Scenario (all vehicles)	Existing (2017)		Future Conservative (2020) with Operation of Proposed Development	
	Degree of Saturation	Level of Service	Degree of Saturation	Level of Service
Remembrance Driveway/Tahmoor Mine Access Road during the AM Tahmoor Mine Peak Hour	0.193	A	0.216	B
Remembrance Driveway/Tahmoor Mine Access Road during the PM Tahmoor Mine Peak Hour	0.165	A	0.216	B
Remembrance Driveway/Avon Dam Road during the AM Tahmoor Mine Peak Hour	0.317	A	0.338	B
Remembrance Driveway/Avon Dam Road during the PM Tahmoor Mine Peak Hour	0.561	B	0.733	B

Note: For the Remembrance Driveway/Tahmoor Mine Access Road intersection, the modelling adopted the existing channelisation for 2017 (and the proposed upgraded channelisation with the right turn bay in 2020.
At Remembrance Driveway/Avon Dam Road (Rail Bridge) intersection, the existing traffic management has been used for the 2017 and 2020 models.

Table 11-80 shows that all intersections will maintain a satisfactory to good level of service (Level of Service B) in the 2020 scenario. The assessment predicts small increases in vehicle delay for the right hand turn movement of the Remembrance Driveway/Tahmoor Mine Access Road interchange from 13.8 to 16.5 seconds per vehicle in the AM peak and 12.8 to 15.4 seconds in the PM peak (less than 3 seconds in each case). Similar small increases in vehicle delays (less than 2 seconds per vehicle) are predicted at the Remembrance Driveway/Avon Dam Road intersection during the morning peak in 2020. Whilst an increase in delays of between six and seven seconds per vehicle is predicted for the PM peak, the overall operation of the intersection is predicted to remain satisfactory at a Level of Service B.

The above two critical intersections were also modelled for the 10 year future scenario, comparing the 2028 base case without the proposed development (assuming background traffic growth of 3.3% lineal average) and the 2028 scenario with the proposed development plus background traffic growth (Refer Tables 4.8 to 4.11 of **Appendix P**). The intersection modelling indicates that the Remembrance Driveway/Tahmoor Mine Access Road interchange would retain a satisfactory to good operation in 2028 with the proposed development, compared to the 2028 base case, with a predicted Level of Service of B in both the AM and PM peak periods. The delays for the right turn out of the Mine Access Road increases by around 1 second per vehicle with the proposed development as compared to the 2028 base case, which is a minimal impact.

With respect to the Remembrance Driveway/Avon Dam Road intersection, the modelling indicates a satisfactory to good Level of Service (B) during the AM peak in 2028 with the proposed development in place. Only a small increase in vehicle delay of 1-2 seconds is predicted for the right turn out of Avon Dam Road Rail Bridge compared to the 2028 base case, which is considered minor.

In the PM peak, the background traffic growth over the 10 year period to 2028 (if realised) will increase the vehicle delay for right turns out of Avon Dam Rail Bridge Road to 51.9 seconds per vehicle (the equivalent of a Level of Service D operation). With the proposed development in place the delay to the right turn movement will increase to 67.4 seconds per vehicle (the equivalent of a Level of Service E operation). However the proposed development will only generate an additional 24 vehicle trips at this intersection in the PM peak hour in 2028, as compared to the background 2017 volumes and would therefore only account for a very small proportion of the increase in the overall traffic volumes predicted to use this intersection in 2028. As such, the proposed development's contribution to the intersection performance when compared to predicted existing traffic volumes in 2017 is considered to be relatively small. It is noted that the traffic generated by the proposed development would reduce from its peak in 2020 and by 2023 the increases associated with the Project will be 50% less than in 2020. From 2023 to 2035 employment levels at the mine will be the same as the employment level in 2011. The only additional traffic will be eight truck loads per hour (i.e. 8 in/8 out) associated with the road transport of coal products, which would only occur on a campaign basis where required.

Parking

As part of the upgrade works to the existing surface infrastructure of the Mine, additional parking facilities would be provided to accommodate the increased number of employees.

Parking surveys undertaken for a week in February 2013 found that the maximum parking demand at Tahmoor Mine at the time was 262 vehicles which occurred in the morning. This included all vehicles parked in the car parks, plus adjacent the frontage of the Tahmoor Mine site. This represents a maximum demand parking rate of 0.70 cars/spaces per employee (based on 378 employees in 2013). Adopting this parking rate for 510 employees (peak employment in 2020) indicates a parking requirement of 357 spaces. However, due to the arrival of workers prior to shift handover additional car parking spaces would likely be required and these additional spaces have been allowed for in the project description. As noted above, Tahmoor Mine will have a total of 428 spaces with the additional 150 car spaces and therefore will have adequate parking to accommodate its peak parking demand including additional parking spaces for shift handover.

11.13.4 Management and Mitigation Measures

Potential impacts on the local road network as a result of traffic generated by the proposed development are anticipated to be minor. However, mitigation and management measures would be implemented to avoid, minimise or manage potential traffic impacts, where possible.

The proposed development incorporates a number of measures as part of the proposed development designed to minimise potential impacts to traffic, and to improve road safety and performance, including:

- upgrade to the Remembrance Driveway/Mine Access Road intersection to improve the performance and safety of the intersection, particularly with regard to reducing the incidence of rear end collisions between vehicles turning right onto Mine Access Road at the southbound approach to the intersection and northbound vehicles on Remembrance Driveway. The intersection will be designed and constructed in accordance with relevant Austroads standards and relevant RMS supplementary documents, where appropriate;
- staging of construction of the proposed ventilation shafts, with one ventilation shaft constructed at a time. A benefit of this approach is that it will reduce the cumulative impact of heavy and light vehicle movements on the local road network and reduce the overall traffic volume generated by the proposed development; and
- construction of a new car park at the Surface Facilities Area to accommodate the increased number of employees and contractors. No offsite parking is anticipated to be required.

Construction

Upgrade to the Tahmoor Mine Access Road / Remembrance Driveway Intersection

Upgrade of the Tahmoor Mine Access Road/Remembrance Driveway intersection would improve potential road safety issues associated with the incidence of rear end collisions between vehicles turning right onto Mine Access Road at the southbound approach to the intersection and with northbound vehicles on Remembrance Driveway. The Project is not expected to have any negative impacts on road safety.

The proposed upgrade is shown on **Figure 11.33**, and will include:

- a channelised right hand turning bay for the southern approach of Remembrance Driveway (i.e. for vehicles travelling northbound), together with a separate northbound lane so that northbound vehicles may pass vehicles turning right onto Mine Access Road in a safe manner;
- a dedicated left turn lane from Remembrance Driveway onto Olive Grove Lane for vehicles travelling northbound, so that northbound traffic may pass vehicles turning left onto Olive Grove lane in a safe manner;
- an auxiliary left hand turning lane in the northern approach of Remembrance Driveway, so that southbound traffic, particularly heavy vehicles associated with the Mine, may turn left into Mine Access Road and reduce potential congestion for southbound traffic; and
- a painted median between northbound and southbound traffic on the northern approach of Remembrance Driveway Widening of Mine Access Road to provide two approach lanes at the intersection. This will allow greater movement of vehicles, reducing delays for vehicles turning left southbound on Remembrance Driveway and avoiding congestion associated with vehicles turning right northbound on Remembrance Driveway. The upgrade of Mine Access Road will also provide access to the new parking facilities constructed within the Surface Facilities Area.

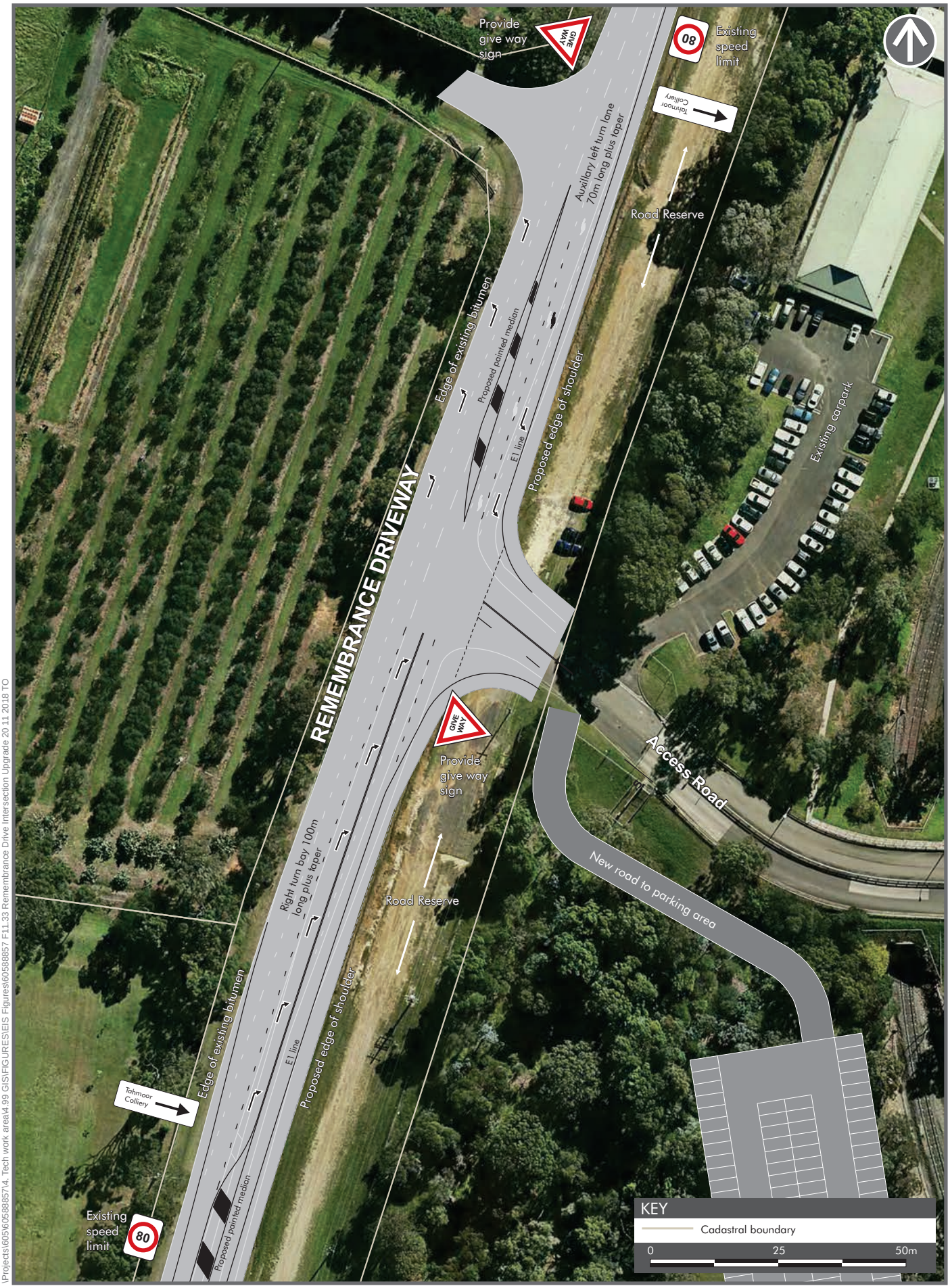
The intersection will be designed for a design speed greater than 80 km per hour in accordance with Austroads Standards, and has been designed to accommodate a 19 m articulated vehicle turning into and out of Mine Access Road. The available sight distance at the intersection is satisfactory and meets Austroad requirements for sight distance for the posted speed limit and the estimated vehicle operating speeds in Remembrance Driveway.

Construction Traffic Management Plan

A Construction Traffic Management Plan (CTMP) will be prepared prior to construction of the proposed development. The CTMP will provide mitigation measures to be implemented to address potential impacts on local road users during construction, with specific management measures developed in consultation with RMS and Wollondilly Shire Council.

Potential traffic impacts resulting from construction of the proposed Remembrance Driveway/Mine Access Road intersection upgrade will be managed through a separate CTMP, which will be prepared in consultation with RMS and Wollondilly Shire Council, prior to the commencement of the upgrade works. The CTMP will include details of any staging requirements and will include Traffic Control Plans to manage traffic at the intersection under the changed traffic conditions.

Prior to construction, an additional CTMP will be prepared and implemented to manage potential impacts of construction traffic for each proposed ventilation shaft. The CTMP would include details of the proposed works, transport routes required for access to the ventilation shaft sites and for the delivery of construction materials and equipment, as well as any upgrades to local roads required to accommodate heavy vehicles. The CTMP will be prepared in consultation with RMS and Wollondilly Shire Council.



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SIMEC MINING

CONCEPTUAL REMEMBRANCE DRIVEWAY INTERSECTION UPGRADE

Tahmoor South Project
Environmental Impact Statement

Source: Traffic and Urban Planning (2018)

FIGURE 11.33

Potential impacts on local traffic during the construction phase would be managed and mitigated onsite by the construction contractor, in accordance with the CTMPs. Traffic management measures likely to be included in the CTMPs would include:

- dilapidation surveys and 'make good' commitments;
- appropriate signage and implementation of temporarily reduced speed limits in proximity to construction activities, particularly for the upgrade of the Mine Access Road/Remembrance Driveway intersection;
- restriction of heavy vehicle movements to designated haulage routes and access points to minimise the impacts to residents and the local road network;
- transportation of oversized construction equipment and machinery in accordance with the RMS guidelines for oversized movements; and
- notification to the local community.

Operation

Operational traffic volumes generated by the proposed development are anticipated to be managed in line with current traffic management for the existing operations, and any existing management measures or procedures would be updated accordingly.

Tahmoor Coal will prepare and implement a Driver's Code of Conduct for traffic movements required during both construction and operation of the proposed development, with particular reference to heavy vehicle movements along local roads, such as Charlies Point Road to access the proposed ventilation shafts TSC1 and TSC2. The Code of Conduct will be used to reinforce best practice measures and behaviour in terms of light and heavy vehicle movements to minimise potential impacts to other road users and to maintain road safety.

11.13.5 Conclusion

The Traffic Impact Assessment for the proposed development identified existing and future traffic volumes on the local road network. Anticipated traffic volumes for the construction and operation of the proposed development were identified and show that the operational phase will result in a greater increase in traffic (when employment is at its peak) than the construction phase. While an increase in construction and operational traffic is anticipated as a result of the proposed development, given the capacity of the existing road network this increase is considered minor.

The upgrade of the mine access intersection with Remembrance Driveway in accordance with Austroads standards is expected to improve road safety at this intersection. SIDRA traffic modelling undertaken for the intersection indicates that it will have a satisfactory to good operation in terms of vehicle delay when the proposed development reaches its peak employment (and therefore its peak traffic generation).

The potential impacts of the proposed development would be managed through the implementation of Construction Traffic Management Plans which will be prepared in consultation with both RMS and Wollondilly Shire Council.

11.14 Rail and Port Capacity

A Rail and Port Assessment was undertaken by Jacobs (2017) to assess the capacity of the rail and port network, with regard to the strategic objectives for both passenger and freight transport, and to assess the impacts of the proposed development on this network. This section provides a summary of the assessment, which is provided in **Appendix P.**

The SEARs relevant to transport and rail network impacts are listed in **Table 11-81**. Impacts on road traffic are addressed in **Section 11.13**.

Table 11-81 Amended SEARs

Rail and Port SEARs
Transport – including:
• Transport – including an assessment of the likely transport impacts of the development on the capacity, condition, safety and efficiency of the rail network and the local and State road network; and

11.14.1 Background

The proposed development would utilise existing rail and port infrastructure in order to transport product coal to Port Kembla for export. As a result, an assessment was undertaken in order to determine whether sufficient capacity exists within the existing rail and port infrastructure to cater for the proposed development.

11.14.2 Methodology

To determine the existing capacity within the port and rail network, an analysis of data from the ARTC regarding rail movements along the Main Southern Railway Line and Moss Vale to Unanderra Line within ARTC's jurisdiction was undertaken. Jacobs then examined the results of rail network modelling previously undertaken by Tahmoor Coal.

The capacity of alternative rail paths was considered, along with the potential for the receipt, storage and shipping of product coal through Port Kembla Coal Terminal. An investigation was then undertaken to identify potential future rail paths and upgrades which may be required to transport product coal from the proposed development to Port Kembla Coal Terminal.

Rail Network Modelling

Rail network modelling was undertaken by Tahmoor Coal using the following assumptions:

- four rail paths would be utilised per day;
- minimum annual product coal transported to Port Kembla Coal Terminal: 1.8 Mtpa;
- average annual product coal transported to Port Kembla Coal Terminal: 2.6 Mtpa; and
- maximum annual product coal transported to Port Kembla Coal Terminal: 3.1 Mtpa.

11.14.3 Existing Environment

Rail Transport Infrastructure

The railway system utilised by the existing Tahmoor Mine comprises the Tahmoor Mine Balloon Loop, Main Southern Railway Line and the Moss Vale to Unanderra Line for rail haulage to Port Kembla. The total distance travelled from the Tahmoor Mine to Port Kembla is approximately 113 km. Tahmoor Coal also rails product coal to Newcastle Port Waratah from time to time.

The Tahmoor Mine currently uses Class 82 locomotives and coal wagons with a nominal gross load of 100 tonnes. The trains are about 796m long comprising two locomotives; one at either end, and 45 wagons. Each coal wagon currently carries 70 tonnes of product each, equating to an average loaded train capacity of 3,150 tonnes for a 45 wagon train.

Analysis undertaken as part of the Rail and Port Assessment indicates that the average travel time in each direction is about 3.5 hours. The total cycle time, including unloading of product coal at Port Kembla Coal Terminal is a minimum of eight hours.

Tahmoor Mine Balloon Loop

The Tahmoor Mine Balloon Loop is a 1.3 km long rail loop located at the Tahmoor Mine Junction and is used to load coal from the existing Tahmoor Mine onto trains for transport to Port Kembla. The coal loading process at the Tahmoor Mine Balloon Loop takes a minimum of about two hours. Trains that are used for transport of coal from the existing Tahmoor Mine travel along the Main Southern Railway Line from the south and pass the Tahmoor Mine Balloon Loop, where they then stop, reverse and travel backwards through the Tahmoor Mine Balloon Loop for loading. Product coal is loaded onto trains via the rail load out bin located between the CHPP and product coal stockpile area. Once loaded, trains enter back onto the Main Southern Railway Line and travel south along the Main Southern Railway Line.

Train movements along the Main Southern Railway Line are blocked for 12 minutes at a time as a result of the complex manoeuvres required for trains to enter and exit the Tahmoor Mine Balloon Loop. Owing to the configuration of the Tahmoor Mine Balloon Loop and the complex manoeuvres required by trains to enter and exit, the maximum train length that can be accommodated at the existing Tahmoor Mine is about 900m, limiting the opportunity for longer trains to be utilised.

The scheduled arrival and departure times for trains to the Tahmoor Mine Balloon Loop is summarised in **Table 11-82**. The actual arrival and departure times largely depend on the availability of train path segments and congestion within the network.

Table 11-82 Existing Tahmoor Mine arrival and departure schedule

Train ID	Weekday Arrival	Weekday Departure	Weekend Arrival	Weekend Departure
TM71/TM72	08:37	10:44	08:10	11:00
TM81/TM82	11:39	14:00	11:39	14:00
TM93/TM94	21:30	23:25	20:46	23:25
TM97/TM98	23:47	01:50	23:39	01:50

Main Southern Railway Line

The Main Southern Railway Line is part of the north-south rail corridor between Sydney and Melbourne. It is leased by ARTC and is utilised for both passenger and freight traffic. The rail loop at the Tahmoor Mine connects to the Main Southern Railway Line, with locomotives travelling along this route until the Moss Vale junction, where trains turn east and continue along the Moss Vale to Unanderra Line towards Port Kembla (refer to **Figure 11.34**).

Moss Vale to Unanderra Railway

The Moss Vale to Unanderra Line is an east-west rail corridor which is operated by ARTC for the purposes of freight traffic. It is a duplicated line between Unanderra and Dombarton. However, the remainder of the rail corridor is single line with four passing loops or sidings. From Unanderra, the Moss Vale to Unanderra Line is operated by NSW TrainLink. At Unanderra there is a rail junction where freight trains wait for clearance to proceed to Port Kembla (refer to **Figure 11.34**).

The Moss Vale to Unanderra Line currently has a capacity of 16 to 17 train paths per day, with a peak utilisation of about 13 paths per weekday. There are therefore three to four train paths available per day on the Moss Vale to Unanderra Line. The existing Tahmoor Mine utilises four (31%) of the available train paths per day (during peak utilisation) along the Moss Vale to Unanderra Line, with the remaining paths used for the transport of grain, flour, limestone and mineral ore. There is potential for the capacity of the Moss Vale to Unanderra Line to be enhanced in the future by extending the existing passing loops.

Alternative Rail Path – Illawarra South Coast Line

The Illawarra South Coast Line runs from Sutherland to Bomaderry via Wollongong as part of the Sydney metropolitan train network and is used by a mixture of passenger and freight trains. Passenger trains have priority over freight movements with no freight trains permitted to impact on passenger services arriving at Central station in the morning (6am to 9am) and afternoon (4pm to 6pm) peak.

There is potential for rail traffic from the Tahmoor Mine Balloon Loop to travel north along the Main Southern Railway Line towards Sydney, where trains could travel through the Metropolitan Freight Network and then from Marrickville, travel south along the Illawarra South Coast Line to Port Kembla. There is minimal capacity along the Illawarra South Coast Line as detailed in **Table 11-83**.

Table 11-83 Available train paths on the Illawarra South Coast Line

Hour	Spare Paths from Sydney towards Port Kembla	Spare paths from Port Kembla towards Sydney
00:00 – 00:59	1	0
02:00 – 02:59	1	0
03:00 – 03:59	1	0
10:00 – 10:59	2	0
11:00 – 11:59	0	1
12:00 – 12:59	1	0
13:00 – 13:59	0	1
19:00 – 19:59	0	1
22:00 – 22:59	0	1

Potential Future Rail Paths – Maldon to Dombarton Line

The proposed Maldon to Dombarton Line would potentially provide an alternative link between the Tahmoor Mine and Port Kembla if it were more economical than current arrangements. The use of the Maldon to Dombarton Line would be considered if the rail project is completed and this route provides greater economic or operational benefits than the current rail routes available.

The Maldon to Dombarton Line would connect with the Main Southern Rail Line near Picton and finish at Dombarton, about 15 km from Port Kembla. Construction of the Maldon to Dombarton Line commenced in 1983, but the proposed development was cancelled in 1988 when a significant number of coal mines that were potential users of the Maldon to Dombarton Line were closed and there was a change in government. At the time of cessation of construction of the Maldon to Dombarton Line, two thirds of earthworks and entry cuts to the tunnel portals and access roads to the tunnel area had been completed.

Port Infrastructure

Port Kembla Coal Terminal is the major coal intermodal facility in southern NSW for the transfer of coal from road and rail to ship. Port Kembla Coal Terminal enables the receipt, assembly and loading of coal from the Southern and Western NSW Coalfields for transport by ship to both Australian and international markets. It is located on the northern side of the Port Kembla Inner Harbour and has two bulk handling facilities, with Berth 102 (high capacity coal berth) utilised for the handling and loading of coal.

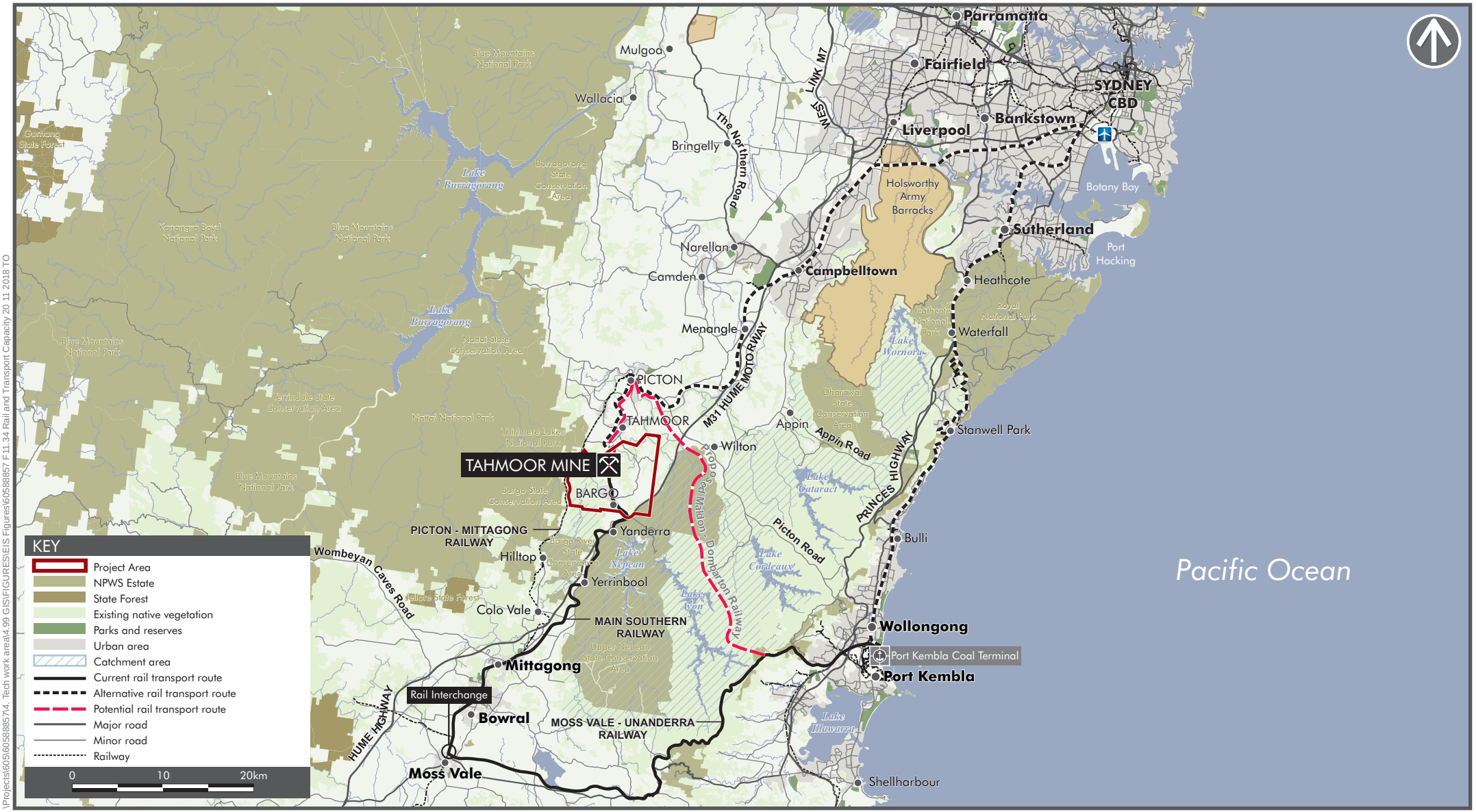
Trains enter the port from the main line at Coniston. Here the rail line branches and proceeds around a loop in a clockwise direction, unloading coal from wagons within the receival terminal before leaving the site. Coal is unloaded from the train wagons through the bottom doors while moving around a balloon rail loop at a speed of about 0.9 km per hour. Port Kembla Coal Terminal receives up to 16 trains of coal product a day, with each train taking about one hour to unload. Conveyor belts transport coal from the receival sheds to the stockyard where it is assembled in preparation for vessel loading. The stockyard has a capacity to store 850,000 tonnes of coal in two storage pads.

The capacity of the Port Kembla Coal Terminal has a rated capacity of 18 Mtpa and a throughput of around 8 Mtpa to 10.5 Mtpa in recent years (2015-2016, 2016-2017 reporting periods), indicating that there is about 7.5 Mtpa of spare capacity. About 60% of coal product transported to the Port Kembla Coal Terminal is received by rail. The terminal typically receives 23,100 tonnes of product per day at a nominal rate of 3,700 tonnes per hour. In the 2016/2017 financial year, 8,058,430 tonnes of coal was shipped through the terminal. Coking coal comprised 78% (6,311,450 tonnes) of this product, and steaming coal made up the remaining 22% (1,746,980 tonnes). Of the coal product received and transported by ship at the terminal, about 93% is exported and seven percent is transported for use in the Australian market.

Ongoing capacity of the Port Kembla Coal Terminal

As outlined in *Navigating the Future: NSW Ports' 30 Year Masterplan* (NSW Ports, 2015), Port Kembla's role in supporting NSW mining industry (as well as other industries such as agriculture, manufacturing and construction) will grow and strengthen over the next 30 years.

The Port Kembla Outer Harbour Development would provide additional land for operational facilities and future berth construction and to provide for future throughput needs. Approval for the development of Port Kembla's Outer Harbour was granted in March 2011 and Stage 1A of the development has been completed which has provided 6.9 hectares of additional port land suitable for further development to allow storage and handling and processing of bulk cargoes.



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SIMEC MINING

RAIL AND TRANSPORT CAPACITY

Tahmoor South Project
Environmental Impact Statement

FIGURE 11.34

11.14.4 Impact Assessment

Capacity of the Existing Rail Transport Path

Rail network modelling undertaken by Tahmoor Coal determined that the maximum available rail system capacity within the limit of the existing approved four train paths per day is 4.6 Mtpa. The proposed development would produce up to 4 Mtpa ROM coal and the Tahmoor Mine Balloon Loop has sufficient capacity to accommodate the expected range of annual product coal from the proposed development. To transport the anticipated 4 Mtpa of product coal by rail, four train paths per day would be required between the Tahmoor Mine and Port Kembla. This is consistent with the existing approved rail transport for the operation of Tahmoor Mine and as a result, no impact on rail transport infrastructure is anticipated.

Rail Network Modelling determined that the transport of coal product via the Main Southern Rail Line and Moss Vale to Unanderra Line (as per current arrangements) was the most efficient solution for the Tahmoor Mine to transport the anticipated amount of product to Port Kembla using the four existing train paths a day. The use of the existing Main Sothern Rail Line and Moss Vale to Unanderra Line would not require any modification of existing infrastructure and the train paths could be used immediately at the commencement of the proposed development. As the proposed development would not modify the frequency of rail movements, it is not anticipated to impact on the existing rail transport path between Tahmoor Mine and Port Kembla.

Other nearby proposed developments such as The Hume Coal Project and the Russell Vale Colliery Underground Expansion Project would not significantly impact the capacity of the rail system between the Tahmoor Mine and Port Kembla. The Hume Coal Project would transport coal via a new rail loop as part of the Berrima Rail project and would only utilise the Main Southern Rail Line during off-peak periods in the existing timetable and would have a minimal effect on the overall line capacity (EMM, 2017). The Russel Vale Colliery Underground Expansion Project would not transport coal via rail.

Use of Alternative and Potential Future Rail Paths

Following the feasibility study undertaken in 2010 to 2011 to inform decision making on the Maldon to Dombarton Rail Line proposal, the Federal Government contributed $25.5 million to the preparation of detailed design work to support future construction of the Maldon to Dombarton Rail Line. It was determined that construction of the line is not feasible for financial reasons and that the existing infrastructure is sufficient to manage rail capacity in the short to medium term. As construction of the Maldon to Dombarton Rail Line is not planned, it has not been considered as an alternative rail path to the existing movement of trains between the Tahmoor Mine and Port Kembla. However, if completed the Maldon to Dombarton Rail Line would provide a shorter route for trains. If completed, Tahmoor Coal would consider the commercial benefits of utilising the Maldon to Dombarton Rail Line as an alternative to the Moss Vale to Unanderra route.

Safety of the rail network

As the proposed development is not anticipated to modify rail path movements there would be no impact to the safety of the rail network.

Capacity of Port Kembla Coal Terminal

Between 8 Mtpa and 10.54 Mtpa of product coal has been shipped from Port Kembla Coal Terminal in recent years (2015-2016, 2016-2017 reporting periods), indicating that there is about 7.5 Mtpa of spare capacity, with the terminal having an approved throughput of about 18 Mtpa.

Port Kembla Coal Terminal has the capacity to continue to receive four train paths per day of product coal from the Tahmoor Mine. The volume of coal to be produced from the proposed development would be able to be accommodated within the 7.5 Mtpa of spare capacity that exists at the terminal. It is therefore considered the proposed development would not significantly alter the existing impacts that Tahmoor Mine has on port and rail capacity other than the prolongation of utilising this infrastructure.

Management and Mitigation Measures

As the proposed development is not anticipated to modify rail path movements and is highly unlikely to impact on the current and potential future capacity of Port Kembla Coal Terminal, no management and mitigation measures are considered necessary.

11.14.5 Conclusion

The generation of product coal from the proposed development would be accommodated within the four rail paths that are currently utilised for the operation of the existing Tahmoor Mine.

The use of the Illawarra South Coast Line as an alternative route to the Main Southern Rail Line and Moss Vale to Unanderra Line should these rail lines reach capacity is not considered favourable when considering the existing constraints for rail movements, particularly for freight purposes along this rail line. As the proposed development would not require additional rail paths or increase the frequency of pass-byes, the development is not expected to pose additional constraint on the current Main Southern Rail Line and Moss Vale to Unanderra Line route.

Port Kembla Coal Terminal has the capacity to receive four train paths of coal product per day from the proposed development, and has the capacity to store and handle the product coal that the proposed development would generate.

It is therefore considered the proposed development would not significantly alter the existing impacts that Tahmoor Mine has on port and rail capacity other than the prolongation of utilising this infrastructure.

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11.15 Social

The Social Impact Assessment (SIA) (AECOM, 2018) undertaken for the proposed development is attached as **Appendix Q**.

The social assessment addressed the SEARs relevant to social impacts. These are listed in **Table 11-84**. SEARs relevant to economic impacts are addressed in **Section 11.16**.

Table 11-84 SEARs for the assessment of social impacts

Social & Economic SEARs	Section Addressed
Social & Economic – including an assessment of the:	
• A detailed assessment of the likely social impacts of the development on the local and regional community in accordance with the *Social impact assessment guideline for State significant mining, petroleum production and extractive industry development* (2017); and; and	**Section 11.15.1** to **11.15.6** and **Appendix Q**
• an assessment of the likely economic impacts of the development, paying particular attention to: - the significance of the resource; - the costs and benefits of the development, identifying if it would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates; and - the demand for the provision of local infrastructure and services.	**Section 11.15.4**, **Section 11.16** and **Appendix R**

11.15.1 Background

The proposed development has the potential to affect various individuals and groups within the community in both positive and negative ways. The role of the SIA for the proposed development is to determine how potential adverse impacts can be addressed to minimise the effects of a proposal on the social environment and to identify how potentially beneficial impacts associated with the proposed development can be further enhanced to support the local area.

The objectives of the SIA undertaken for the proposed development were:

- to identify and assess the potential social impacts associated with the proposed development in accordance with the methodology outlined in *Social impact assessment guideline for State significant mining, petroleum production and extractive industry development* (DPE, 2017) (SIA Guideline);
- to provide an understanding of the community context within which the proposed development would be undertaken, including consideration of community perception and the recognition that the interests and values of stakeholders are diverse; and
- to develop appropriate mitigation measures to respond to the social impacts identified.

The SIA for the proposed development was completed in accordance with the SIA Guideline with consideration to the types of social impacts identified in Section 1.1 of the Guideline, as listed below:

- **way of life**, including:
  - how people live, for example, how they get around, access to adequate housing;
  - how people work, for example, access to adequate employment, working conditions and/or practices;
  - how people play, for example, access to recreation activities; and
  - how people interact with one another on a daily basis;
- **community**, including its composition, cohesion, character, how it functions and sense of place;

- **access to and use of infrastructure, services and facilities**, whether provided by local, state, or federal governments, or by for-profit or not-for-profit organisations or volunteer groups;
- **culture**, including shared beliefs, customs, values and stories, and connections to land, places, and buildings (including Aboriginal culture and connection to country);
- **health and wellbeing**, including physical and mental health;
- **surroundings**, including access to and use of ecosystem services, public safety and security, access to and use of the natural and built environment, and its aesthetic value and/or amenity;
- **personal and property rights**, including whether people's economic livelihoods are affected, and whether they experience personal disadvantage or have their civil liberties affected;
- **decision-making systems**, particularly the extent to which people can have a say in decisions that affect their lives, and have access to grievance and remedy mechanisms; and
- **fears and aspirations** related to one or a combination of the above, or about the future of their community.

11.15.2 Existing Environment

The Project Area is located on the outer south-western peri-urban fringe of Sydney primarily within the Wollondilly LGA with a small portion extending into the Wingecarribee LGA. Within the Project Area, the proposed development (including all longwall mining and surface infrastructure) would be confined to the Wollondilly LGA only. The region is characterised by a mixture of village residential, rural residential, market gardens, agricultural and conservation areas. The region is located within the Greater Sydney Basin and encompasses areas of land dedicated to conservation and the protection of drinking water catchments.

The Project Area (refer to **Figure 1.3**) is bounded by the incised gullies associated with the Bargo and Nepean Rivers. Land within the Project Area comprises forested land, rural-residential development and Crown land, Government authority or corporation owned land. Forested land is largely located in the south-eastern section of the Project Area and along the Bargo River.

Rural residential areas are generally clustered around the town centres of Bargo, Tahmoor and Buxton, and the villages of Yanderra, Pheasants Nest, Couridjah and Balmoral. These areas are separated by a semi-rural and partially forested landscape.

The Project Area is located in a region with a long history of agricultural land use which has resulted in large areas of flat and low gradient slopes in the Project Area being subject to large scale vegetation clearance for agricultural and other activities including farming practices, poultry, cattle grazing, trotting horse training, greyhound training and horse studs.

Community Identity and Profile

The population of the outer south-western region has increased over the five years between 2011 and 2016. Larger townships in the Project Area have also been subject to increased population growth. However, the, smaller villages have been experiencing a population decline. Regional and local population growth is anticipated to continue (DPE, 2016) with regional growth projected to be greater than local growth due to the development of the south-west growth centre within the Campbelltown and Liverpool LGAs. Local population growth is anticipated to reflect natural growth associated with births and deaths, as well as a net migration of people moving into the local area. The local population is ageing as a result of an increase in people aged over 65 relocating into the area's multiple new senior's living developments and outwards migration of people aged 18 to 34 as a result of limited tertiary education opportunities, for more diverse employment opportunities and to experience a 'city' lifestyle (Wollondilly Shire Council, 2011).

The local area has an above-average proportion of family households, with the number of single parent households lower than the State average. At the time of the 2016 census, the proportion of Aboriginal and Torres Strait Islander people living within the local area is higher than the State average of 3%. The number of people living in the local area that were born overseas and that speak a language other than English is significantly lower than the State average.

More than 90% of housing in the Wollondilly and Wingecarribee LGAs comprises detached houses, reflecting the primary rural-residential nature of the area, as does the lower than State average percentage of rental properties. Tahmoor has the highest proportion of rental properties (29%) which aligns with the State average. Vacancy and occupancy rates of dwellings in the local areas align with those of the remainder of the State.

The *Wollondilly Growth Management Strategy* (2011) notes that 7,500 additional dwellings are required over the next 25 years to accommodate the population growth that is projected for the local area. The Growth Management Strategy has identified a target of 4,000 dwellings across Picton, Tahmoor and Thirlmere and 2,000 in the Bargo area.

Accessibility of individuals to material and social resources, and their ability to participate in society broadly defines the socio-economic advantage or disadvantage of an area. All LGAs and suburbs in the State are provided with a socio economic indices. The lowest scoring 10% of areas are given a decile of one indicating these areas are the most disadvantaged and the highest 10% of areas are given a decile of 10, representing areas that are the least disadvantaged in the state. The Wollondilly and Wingecarribee LGAs have a decile of nine, indicating that they are not greatly disadvantaged as a whole. However, within the Project Area, Tahmoor is ranked as being relatively disadvantaged with a decile value of three, indicating that as a township Tahmoor is more disadvantaged than 70% of other suburbs in the state.

As detailed in Section 3.2.4 of **Appendix Q**, there are a number of early childhood and primary school facilities in the Project Area, whilst high schools are located at some distance from the local area. One tertiary educational facility (Illawarra TAFE Moss Vale campus) is located in the Wingecarribee LGA. A higher proportion of advanced diploma qualifications were recorded in the 2016 census in the Wollondilly and Wingecarribee LGAs compared to the rest of the State. However, the number of bachelor and post graduate degree qualifications was lower than the State average, reflecting the limited accessibility to tertiary educational facilities in the local area. This aligns with the trends in employment within the two LGAs, with the highest proportion of the labour force comprising the manufacturing, construction, retail trade, health care and social assistance sectors. The 2011 census reported that the employment rate of the two LGAs was lower than NSW as a whole.[1]

The Sydney Trains Southern Highlands Line passes through the Project Area, connecting the Project Area to the Sydney metropolitan area via Campbelltown. Weekday services generally travel through Bargo on an hourly basis, with services every one to two and a half hours on weekends. There are also two bus routes which provide public transport along Remembrance Driveway between Yanderra / Bargo and Picton on weekdays and on Saturdays.

A number of diverse sport and recreational facilities in the Project Area provide areas of open space and a sense of community and place.

The Role of Tahmoor Mine in the Community

The Tahmoor Mine has been operational for over thirty five years, during which time the mine has developed a relationship with the local community through supporting local events, making contributions to community partnerships and employing most of its staff from within the local area. In 2013, the largest proportion of personnel employed at Tahmoor Mine resided within the Wollondilly LGA (199 employees or 46%). Remaining employees travel to the Tahmoor Mine from nearby LGAs including Wollongong and Shellharbour (30%), Wingecarribee (8%), and Campbelltown (16%). The Tahmoor Mine also has an Apprentice Engagement Program which employs on average two apprentices from the local area each year.

In addition to mandatory contributions from royalties and taxes, Tahmoor Coal also contributes to community partnerships and initiatives through its Corporate Social Involvement (CSI) program. The CSI program provides for local contributions as part of the targeted Tahmoor Community Support Program and other local programs (refer to Section 3.3 of **Appendix Q** for additional detail).

[1] Data for the 2016 Census was not yet available at the time of preparation of this SIA.

Open dialogue and the dissemination of information between mine operators, management, key stakeholders and the community is facilitated by the TCCCC. Tahmoor Coal maintains a database of complaints received by the Tahmoor Mine to allow it to understand issues as they arise in the community. Tahmoor Coal actively engages with the community to resolve issues and complaints raised.

11.15.3 Methodology

SIA Guideline

The SIA Guideline applies to applications for development consent for State significant resource projects where the SEARs are issued after the date of publication of the guideline in September 2017. The SIA Guideline includes the following transitional arrangements for State significant resource projects for which SEARs have already been issued but are not expecting to lodge an EIS until six months or more following publication of the SIA guideline (i.e. after March 2018):

The Department, in consultation with the applicant, will re-issue the Secretary's Environmental Assessment Requirements (SEARs) to require the social impact assessment component of the environmental impact statement to be prepared in accordance with this guideline.

This situation applies to the Tahmoor South project for which SEARs were originally issued on 9 June 2017 prior to the publication of the SIA Guideline.

In accordance with the transitional arrangements of the SIA Guidelines, supplementary SEARs were issued for the Tahmoor South Project by DPE on 20 June 2018 as identified in **Table 11-84**.

This SIA has been prepared to meet the objectives and requirements of both the SIA Guideline and the supplementary SEARs.

Assessment Steps

The methodology for the SIA has followed the assessment steps of the SIA Guideline as outlined below. Further details of the methodology followed for the Baseline Study (Step 1) and the Identification and Evaluation of Impacts (Steps 2 and 3) are also outlined below.

- **Step 1** - Preparing a Social baseline study, which has involved:
    - identifying the area of social influence within which the proposed development may result in potential social impacts;
    - identifying the social indicators, against which social impacts will be assessed and monitored;
    - undertaking a desktop review of social indicators and other relevant data in order to create a baseline profile of the community;
    - undertaking community and stakeholder engagement to seek direct feedback on community views, concerns and social impacts; and
    - considering the overall sensitivity of different stakeholders and how they are likely to respond (based on knowledge of the community profile, their values, fears and aspirations, previous projects etc.);
- **Step 2**- Predicting and analysing the extent and nature of potential social impacts, which has involved:
    - identifying and describing project components or activities that may result in potential social impacts (against baseline conditions), both positive and negative;
    - liaising with other technical specialists to identify any potential social implications of, for example, impacts from subsidence, traffic, noise, air quality, and landscape and visual amenity; and
    - taking into consideration factors such as the spatial extent, duration, severity, and sensitivity of receptors in characterising potential social impacts;

- **Step 3** - Evaluating the significance of potential social impacts without mitigation and with mitigation (to determine residual impacts) based on likelihood and consequence ratings, as per the social risk matrix approach in the SIA Guideline. This includes consideration of potential cumulative social impacts and the timing of impacts; and
- **Steps 4 & 5** - Recommending measures for the avoidance, reduction, mitigation, management and/ or monitoring of potential social impacts and any residual impacts.

Baseline Study

Area of Social Influence

The Area of Social Influence was determined for the SIA based on the following factors:

1. the activities proposed as part of the development, comprising the surface disturbance activities and longwall mining within the Project Area. The development would utilise the existing rail loop and rail network to transport coal to Port Kembla and from time to time to Port Waratah. However, this would not involve any change to existing train movements, train loading capacity or frequencies. As there would be no change to operations or impacts along the train haulage route(s) (compared to existing), the area of social influence for the SIA does not include broader rail network haulage routes to Port Kembla or Port Waratah;
2. the likely scale and extent of impacts – the severity and spatial and temporal extent of impacts identified in other specialist assessments within this EIS has informed the area of influence of the SIA. For example economic and employment opportunities created by the proposed development are considered likely to have far-reaching effects for the south west Sydney region, and NSW more broadly. However, impacts upon amenity values are anticipated to occur largely within close proximity to the proposed development, generally limited to the Wollondilly Shire LGA;
3. cumulative impacts – the specialist studies carried out for the proposed development have included consideration and modelling (where relevant) of cumulative impacts from other mines and other known and/or proposed developments within the Southern Coalfields;
4. the natural, land use and social characteristics of the areas likely to be affected by the development, including proposed future land use and growth, based on a review of baseline and publicly available data.
5. the community and stakeholder groups most likely to be affected by the kinds of impacts predicted, based on the consultation activities carried out for the proposed development.

Based on the above, the area of social influence (referred to hereafter as the study area) for the assessment of social impacts includes a broad consideration of the statistical areas of Wollondilly, Wingecarribee, Camden, Campbelltown and Wollongong LGAs, with comparison to broader NSW provided for context.

An assessment of local level social impacts for the proposed development are provided for the localities of Tahmoor, Bargo, Yanderra, Pheasants Nest, Buxton and Couridjah within the Wollondilly Shire LGA. These localities have been chosen based on their proximity to the proposed development, the results of specialist assessments and the availability of baseline data.

Identification of Social Indicators

Social indicators were identified in terms of their potential for social change as a result of the proposed development. Social indicators were selected to be reflective of key social issues for the study area and included population demographics, health and wellbeing in the community in terms of its potential relative disadvantage, housing, educations, employment and income, availability and access to community services and community identity including the shared values and customs, as well as community cohesion.

Collection of baseline data

Statistical and other relevant data was collected and reviewed to create a baseline community profile. Baseline data collection included the following:

- database searches obtained from sources such as the Australian Bureau of Statistics (ABS) for the relevant statistical areas. Database searches are detailed in Table 2.1 of **Appendix Q**;

- a review of current Major Projects listed on the DPE website to identify major developments relevant to the proposed development in order to assess cumulative impacts on the community, particularly with regards to workforce requirements and timeframes; and
- a review of relevant government inquiries, namely the Southern Coalfields Inquiry and the Thirlmere Lakes Inquiry, as well as relevant Council and community interest submissions made as part of the inquiries to provide context for the assessment of the proposed development.

Consultation and Engagement

The results of consultation and engagement activities undertaken by Tahmoor Coal were reviewed to provide an understanding of the community perception and values about the environment, community, the operation of the existing Tahmoor Mine and the proposed development. Consultation and engagement materials that were reviewed included:

- Tahmoor Coal independent stakeholder survey 2012;
- Tahmoor community survey 2012;
- Tahmoor South Project community information days survey and feedback (2013, 2014, 2017 and 2018);
- records of complaints and enquiries received, as well as the implementation of activities guided by the CSI Plan;
- records of 15 June 2017 Tahmoor Coal Community Consultative Committee (TCCCC) meeting;
- records of meeting with Wollondilly Shire Council project update on 7 September 2017;
- records of meetings held with other specialist stakeholders and groups including: Wollondilly Anglican College, Wirrimba Flora and Fauna Sanctuary, Bargo Dingo Sanctuary, Emergency Services and the Bargo Progress Association; and
- Aboriginal heritage consultation undertaken as part of the ACHA.

Identification and Evaluation of Impacts

Negative Social Impacts

Potential negative social impacts were identified and evaluated based on the framework outlined in the SIA Guidelines as summarised in **Figure 11.35** below.

Potential negative social impacts were identified through the following means:

- impacts identified in the Tahmoor South Project SIA Scoping Report (June 2018). This report was prepared to support the seeking of supplementary SEARs for the proposal in relation to social impacts and was prepared utilising the SIA Scoping Tool component of the SIA Guideline;
- additional impacts identified in the EIS by other technical studies; and
- ongoing feedback from community engagement activities.

To determine the likely significance or ‘Social Risk Rating’ of the social impact, the ‘likelihood’ and ‘consequence’ of the identified negative social impacts were then evaluated based on the risk matrix provided in the SIA Guideline as shown in **Figure 11.36** below. Each impact was evaluated without mitigation and again with mitigation to determine any residual impacts.

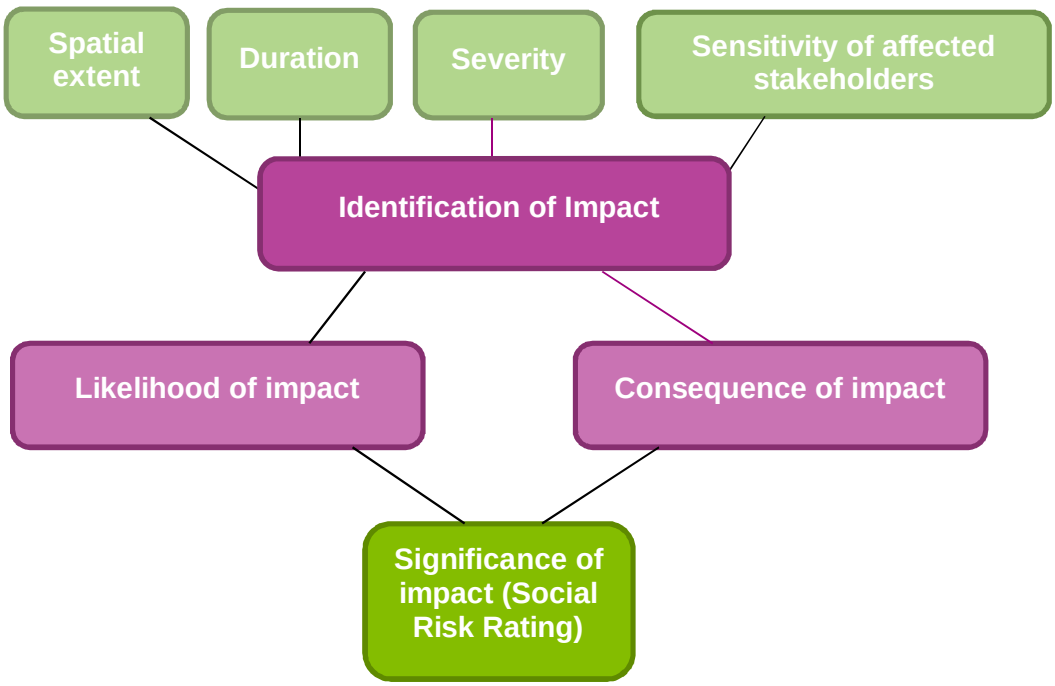

Figure 11.35 Assessment framework for determining risk rating of social impacts

			Consequence Level				
			1	2	3	4	5
			Minimal	Minor	Moderate	Major	Catastrophic
Likelihood Level	A	Almost certain	A1	A2	A3	A4	A5
	B	Likely	B1	B2	B3	B4	B5
	C	Possible	C1	C2	C3	C4	C5
	D	Unlikely	D1	D2	D3	D4	D5
	E	Rare	E1	E2	E3	E4	E5
Social Risk Rating							
	Low		Moderate		High		Extreme

Figure 11.36 Social Risk Matrix (SIA Guideline, DPE, 2017)

The evaluation criteria for "likelihood" are shown in Figure **11.36** and comprise: *almost certain, likely, possible, unlikely,* or *rare*. The evaluation criteria for "consequences" as identified in the SIA Guideline are listed below:

Minimal

- No discernible positive or negative changes caused by the impact

Minor

- small change caused by the impact;
- generally temporary or short term in duration;
- impacts confined to a small number of receivers within the proposed development locality; and
- able to be mitigated or managed such that impacts are deemed to be low.

Moderate

- moderate change caused by the impact;
- generally temporary or short to medium term in duration;
- spatial extent of impacts may vary across the affected LGAs; and
- able to be mitigated or managed such that impacts are deemed to be moderate.

Major

- large change caused by the impact;
- generally medium to long term in duration;
- spatial extent of impacts may vary across the affected LGAs, or the broader region or State; and
- negative impacts would require extensive mitigation and consultation with affected stakeholders.

Worst Case

- very large change caused by the impacts;
- likely to be long-term in duration;
- spatial extent of impacts may vary across the affected LGAs, or the broader region or State; and
- negative impacts would require extensive mitigation and consultation with affected stakeholders.

Positive Social impacts

Consistent with the guidance provided in the SIA Guideline, positive social impacts were evaluated qualitatively with consideration to the following factors:

- level of interest by stakeholders;
- the scale of improvement or benefit; and
- the importance placed on the benefit and the equity of distribution.

The social risk matrix approach identified in the SIA Guideline as discussed above was adopted to assess the significance of positive social impacts considering the likelihood of benefits and the scale of the improvement or benefit (replacing 'consequence level').

11.15.4 Impact Assessment

The assessment of potential impacts associated with the proposed development included consideration of direct and indirect impacts, with direct impacts being those that would cause change to the existing community as measured through the use of social indicators, and indirect as those impacts which relate to community values and sense of place. In addition the SIA considered cumulative social impacts resulting from the proposal.

Surroundings –Amenity Impacts and Natural Features

Table 11-85 summarises the potential impacts of the proposed development on amenity and natural features. The primary amenity impacts associated with the proposed development is the continuation of existing types of impacts associated with existing mining operations (such as noise, air quality, subsidence and visual impacts). However, over the life of Tahmoor Mine, Tahmoor Coal has developed an extensive understanding of the local environment which it operates within and this has informed the effective management of potential amenity impacts.

Table 11-85 Amenity Impacts of the Proposed Development

Aspect	Impacts
Noise	The noise assessment predicts exceedances of Noise Management Levels (NMLs) during standard and non-standard construction hours at nearby receivers and a range of reasonable and feasible mitigation measures are proposed to be implemented as part of a Noise Management Plan to minimise impacts. Mitigation would focus particularly on sensitive night time hours in order to minimise the potential for sleep disturbance. In addition, acquisition negotiations have commenced with the two receptors predicted to experience exceedances of noise levels outside of standard hours. Social amenity impacts from construction noise would be temporary and consistent with construction projects of a similar scale. With the implementation of mitigation measures, it is considered that impacts can be managed so as to not significantly impact on social amenity. The likelihood of construction noise impacts is considered to be *likely* and the consequence of impact is considered to be *moderate* resulting in a significance/ risk rating of *high*. With the implementation of mitigation the consequence of impact is likely to reduce to *minor* however the residual post-mitigation significance/ risk rating would remain *high*. The operational noise assessment undertaken for the proposal identifies that that with the implementation of reasonable and feasible mitigation measures as part of surface facility upgrades for the Tahmoor South Project, the Tahmoor Mine surface facilities would result in noise emission reductions compared to the existing scenario. Noise emissions are predicted to reduce compared to the existing operations at almost all noise-sensitive receptors during the day and evening periods and, importantly, most significantly during the night-time period at all noise-sensitive receptors. As such the proposed development would lead to significantly improved noise and social amenity outcomes compared to the existing situation. Tahmoor Coal would implement negotiated noise agreements and voluntary acquisition in accordance with the NSW Government VLAMP, for residual noise impacts above project specific noise levels. The likelihood of operational noise impacts is considered to be *possible* and the consequence of impact is considered to be *moderate* resulting in a significance/ risk rating of *high*. With the implementation of measures including real time noise monitoring and reactive management to trigger noise levels during surface facility and REA operations, it is considered that the consequence of impacts can be reduced to *minor* resulting in a residual post-mitigation significance/ risk rating of *moderate*. Further details regarding noise and vibration impacts are discussed in **Section 11.10**.

Aspect	Impacts
Air Quality and Odour	There are no predicted exceedances for most of the air quality criteria assessed as a result of the proposed development. Exceedances of the 24-hour average PM_{10} criteria would occur at up to seven sensitive receivers however are predicted to occur over a limited number of days per year and would be able to be managed with the implementation of on-site controls. No exceedance of odour criteria are predicted. Stakeholders in the Southern NSW Coalfields rate Tahmoor Coal's current efforts to improve air quality as below satisfactory (ACCSR, 2016) and increased air quality and odour impacts would be perceived negatively by the community. The likelihood of air quality and odour impacts is considered to be *unlikely* and the consequence of impacts is considered to be *minor*, resulting in a significance/ risk rating of *low*. With the implementation of mitigation measures, the consequence of impact is likely to reduce to *minimal*, resulting in residual post-mitigation significance/ risk rating of low. The residual risk rating is expected to remain substantially unchanged (at *low*) with the implementation of mitigation measures. Details of the impacts to sensitive receptors with regards to air quality and odour, as well as how they are managed are discussed in detail in **Section 11.11**.
Visual Impacts	The proposed development is considered as having negligible visual effects on the landscape character of the area, views from private dwellings, publicly accessible areas and community facilities, as existing and established tree cover, coupled with the gently undulating and low ridgeline landforms, provide screening of the REA and surface infrastructure facilities. The proposed development would introduce limited visual elements in addition to the existing infrastructure at the mine which has been included as part of the landscape for over 30 years. Based on this, the likelihood of visual amenity impacts is considered to be *unlikely* and of *minor* consequence, resulting in significance/ risk rating of *low*. With the implementation of mitigation measures, the consequence of impacts could be further reduced to *minimal* resulting in a residual post-mitigation significance/ risk rating of *low*. Visual impacts of the proposed development are discussed further in **Section 11.17**.
Traffic	Construction and operation of the proposed development would increase traffic movements within the local road network; however due to the local road network capacity, impacts are considered to be minor. An upgrade to the intersection of the mine access road with Remembrance Driveway would improve road safety in this area. The likelihood of traffic impacts is considered to be *possible* and the consequence of impact is considered to be *moderate,* resulting in significance/ risk rating of *high*. With the inclusion of standard traffic control measures, the consequence rating can be reduced to *minor*, resulting in a residual post-mitigation significance/ risk rating of *moderate*. Traffic impacts are discussed further in **Section 11.13**.

Aspect	Impacts
Land Use	Land use within the Project Area has been identified as predominately rural with some urban townships. There is no mapped BSAL in the Project Area. The nearest area of mapped BSAL is located between Douglas Park and Camden, approximately 20 km to the north-east of the Project Area. Approximately 43 hectares of potential agricultural land, comprising 37 hectares of Land and Soil Capability (LSC) Class 4 land, and 5.5 hectares of LSC Class 6 land, would be reduced to Class 7 land and therefore permanently removed from potential agricultural production as a result of the REA expansion. This land is not currently used for agricultural production and would be returned to bushland as part of the rehabilitation of the site following mine closure. Landholders were identified as having a low perception of the mine operator, particularly with regard to issues of land use. The likelihood of impacts to land use is considered to be *possible* and the consequences of impacts is considered to be *minimal*, resulting in a significance/ risk rating of *low*. The residual risk rating is considered unlikely to change with the inclusion of mitigation measures (landform rehabilitation). Impacts of the proposed development on land use in the proposed development are discussed further in **Section 11.19** and **Section 11.1**.
Subsidence and Groundwater	Subsidence and water resources were consistently identified as important issues for stakeholders across the Southern NSW Coalfields demonstrating the high sensitivity of affected stakeholders. The overall findings of the subsidence assessments undertaken by MSEC are that the levels of potential impact to all identified natural features and built infrastructure are able to be mitigated and can be controlled by the preparation and implementation of Extraction Plans, many of which have already been developed and are being successfully implemented as part of current mining activities at the Tahmoor Mine. Similarly, Tahmoor Coal would continue to implement its existing policy of 'making good' for any affected private bore users to mitigate impacts to groundwater quality or quantity from longwall mining. The likelihood of subsidence and groundwater bore impacts are considered to be *likely* with *major* consequences of impact without mitigation, resulting in a significance/ risk rating of *extreme*. Based on the outcomes of the specialist assessments, it is considered that with the implementation of project specific mitigation measures the consequence of impacts can be reduced to *moderate* resulting in a residual post-mitigation significance/ risk rating of *high.* Further discussion regarding subsidence and groundwater is provided in **Sections 11.1** and **11.3**.

Aspect	Impacts
Surface Water	A key community concern relates to the potential impacts of underground mining on natural water courses, and the perception that environmental effects on watercourses may affect the ecological value of the local area and the potential to recognise economic gains associated with tourism. During the mine planning process, a constraints analysis, risk assessment and preliminary fieldwork investigations were undertaken to identify sensitive natural surface features and to develop risk management zones for the proposed development. Following the risk assessment the proposed longwall layout was modified to reduce subsidence impacts to these natural features. Specifically mining is no longer proposed in the Eastern Domain and the commencement ends of longwalls have been shortened to minimise and avoid impacts to the Metropolitan Special Area including Cow Creek and the Upper Nepean State Conservation Area located within its bounds. The mine planning process has avoided direct undermining of sensitive environmental features including the Bargo and Nepean Rivers, Bargo River Gorge, Mermaid Pools and of several waterways including Eliza Creek, Dry Creek, Sugar Loaf Gully, Carters Creek and Cow Creek, which would remain outside of the SSA for the proposal. Similarly, the Thirlmere Lakes are located 3.5 km from the nearest longwalls and outside the SSA for the proposal. The surface water impact assessments undertaken for the proposal indicates that the proposed development is likely to result in minor localised changes, diversions and ponding to surface water. Management of these potential impacts would include further baseline monitoring, monitoring during mining and post-mining and Trigger Response Action Plans. Given the level of community value and concern raised relating to the potential impacts of the proposed development on local watercourses, the sensitivity of potentially affected stakeholders is considered to be high. The likelihood of impacts to waterways is considered to be *likely* with *major* consequences of impact without mitigation, resulting in a significance/ risk rating of *extreme*. Based on the outcomes of the specialist assessments, it is considered that with the implementation of project specific mitigation measures the consequence of impacts can be reduced to *moderate* resulting in a residual post-mitigation significance/ risk rating of *high*. Further discussion regarding surface water is provided in **Section 11.4**.

Way of Life

The proposed development is considered to have the following social impacts with respect to population and way of life.

Negative

- demographic change and housing shortages – As the proposal would continue its existing policy of employing locally the likelihood of an influx of workers for the proposed development is considered to be *unlikely* and the consequence of such an influx on housing shortages, would be *minor*, resulting in a *low* significance/ risk rating. With the implementation of existing mitigation (policy of employing locally), there would be no change to the significance/ risk rating post-mitigation; and

- cessation of employment at mine closure – without mitigation, the likelihood of job losses for up to 422 employees (existing plus new, post 2020) at the end of the mine life is considered *almost certain* which could lead to potential *major* impacts in relation to a portion of population leaving the local area to find alternate employment (and associated impacts to the local economy, business, community infrastructure and services). This would result in an *extreme* significance/ risk rating. With the implementation of mitigation in the form of a Social Involvement Policy including employment transitioning to help employees find alternate employment and appropriate mine closure planning, the likelihood of net employment losses can be reduced to *likely* and the consequence of impacts to the population can be reduced to *moderate*. As such, the residual significance/risk rating would be reduced post-mitigation to *high*.

Positive

- employment – the proposal would maintain employment for the existing 390 employees at the mine and employ an additional 50-175 people at peak employment. The likelihood of the proposed development generating and maintaining employment in the local and regional area during the mine life is considered *likely*. The beneficial consequences for the local and regional population (with respect to employment and associated benefits to the local economy, business, community infrastructure and services) is considered *moderate*, resulting in an overall *high* positive social impact rating. With the implementation of the existing policy of sourcing mine employment from the local area and region, there would be no change to the post-mitigation beneficial significance rating.

Community Identity and Cohesion

The proposed development is considered likely to result in the following social impacts with respect to community identity and cohesion.

Negative

- use of Existing Mine Facilities - the proposed development would not change Tahmoor Mine's existing character, function and role within the landscape and therefore have minimal impacts to community identity and sense of place in this regard. The likelihood of impact is considered *unlikely* and the consequence of impact *minor*, resulting in a *low* significance/ risk rating. No mitigation measures are proposed and the residual significance/ risk rating would remain unchanged.
- access - the proposed development would not create an access barrier or physical divide between communities. Any temporary disruptions to access during construction would be localised and mitigated with the implementation of standard construction measures. The likelihood of impact is considered *unlikely* and the consequence of impact *minor*, resulting in a *low* significance/ risk rating. The post mitigation significance/ risk rating is expected to remain the same.
- New Infrastructure – the introduction of new surface infrastructure have a *possible* likelihood of impacting on landscape character and certain receptor's sense of place with localised *minor* consequences in terms of amenity and disturbance impacts, resulting in a *moderate* significance/ risk rating. With appropriate facility design the consequence rating can be reduced to *minimal* resulting in a residual post mitigation significance/ risk rating of *low*;
- natural features – there is the potential for the project to affect local natural features, resulting in impacts upon the community's sense of place. This impact is considered *possible*, with the consequences without mitigation being *moderate*. As such the overall significance is considered to be *high*. With the implementation of mitigation measures including monitoring, Trigger action Response Plans and remediation of damage, the consequence of impacts can be reduced to *minor* resulting in a residual post mitigation significance/ risk rating of *moderate*; and
- employment and Demographics – *unlikely* likelihood and *minor* consequence to overall demographic composition and associated effects on social cohesion, as employment would be primarily sourced locally, thereby resulting in a *low* significance/ risk rating. With the implementation of existing policy to employ locally, the post mitigation significance/ risk rating is expected to remain the same; and

- consistency with the Wollondilly CSP – A *possible* likelihood and *moderate* consequence of effects to the local strategic community direction should mitigation measures not be integrated into all stages of the proposal consistent with the CSP objectives, resulting in a *high* significance/ risk rating. The measures proposed as part of the proposal (including local employment, implementation of a Social Involvement Policy, road upgrades to the mine entrance at Remembrance Driveway to improve road safety and mine planning with consideration to risk management zones) are consistent with the CSP objectives of: looking after the community and building a strong local economy, managing the road network and improving road safety and caring for the environment. With the implementation of the proposed mitigation, the consequence of impacts to the local strategic direction would reduce to *minor* resulting in a residual post mitigation significance/ risk rating of *moderate*.

Positive

- community Contributions– the ongoing operation of the mine would include the continuation of Tahmoor Coal's provision of ongoing community contributions and support for the local community as part of its Social Involvement Plan. The likelihood of this occurring would be *almost certain*, with a *moderate* beneficial consequence, resulting in an *extreme* beneficial significance rating. With the implementation of ongoing community contributions there would be no change to the post-mitigation beneficial significance rating.

Access to, and use of, infrastructure, services and facilities

The proposed development is considered to have the following social impacts on access to, and use of, infrastructure, services and facilities.

Negative

- subsidence impacts – the likelihood of subsidence impacts on infrastructure is considered to be *likely* with *moderate* consequences on disruption to services and infrastructure, resulting in a significance/ risk rating of *high* (without mitigation). With the implementation of subsidence management and remediation measures the consequence rating can be reduced to *minor*, however the residual post mitigation significance/ risk rating would remain at *high*;
- construction damage – a *possible* likelihood of damage and disruption to services/ infrastructure during construction activities with *minor* consequences as any damage would likely be localised and easily rectified resulting in a significance/ risk rating of *moderate*. With the implementation of standard construction practice and mitigation such as due diligence dial-before-you-dig searches and remediation in the case of damage, it is expected that the consequence of impact can be reduced to *minimal*. Therefore, the residual post-mitigation significance/ risk rating would be *low*;
- resources – the likelihood of requiring additional potable water supplies and construction material is considered to be *likely*, with *minimal* consequences on existing services and resource availability as these resources are considered to be readily available, resulting in a significance/ risk rating of *low*. Given the low significance of impact specific mitigation measures are not proposed and there would be no change to the residual risk rating; and
- Workforce – *unlikely* likelihood of influx of construction workforce (as employment to be sourced locally) with *minor* consequences on community facilities and services, resulting in a significance/ risk rating of *low*. With the implementation of existing policy to employ locally, the post mitigation significance/ risk rating is expected to remain the same. Currently 45% of permanent employees at Tahmoor Mine are local. Assuming a similar percentage for the Project, there would be 14-15 additional local and 16-17 additional other permanent full time equivalent workers after the transition period. It is assumed that other employees would live in the region and be able to commute to work (i.e. from the Wollongong to Sydney area). Therefore, no additional infrastructure or serviced demand is anticipated for the additional workers.

Positive

- royalties – an *almost certain* likelihood of royalties from the proposed development being available to Government with *moderate* beneficial consequences for the funding of community infrastructure and facilities resulting in an overall significance rating of *extreme benefits*. With the implementation of royalty arrangements as per government requirements there would be no change to the post-mitigation beneficial significance rating.

Culture

The ACHA (Niche, 2018) carried out for the proposed development identified that subsidence related impacts (indirect impacts) have the potential to affect 26 of the 40 Aboriginal cultural heritage sites identified within the SSA. In addition, one of the 40 heritage sites are predicted to be directly impacted by surface disturbance for surface infrastructure works. Detailed consultation with Aboriginal heritage stakeholders were conducted as part of the ACHA preparation and the cultural importance of all of the recorded sites were emphasised by the Aboriginal stakeholders. Importantly, the mine plan has been designed to avoid direct undermining of archaeological heritage sites along Dog Trap Creek, which include sand shelter sites with artwork of high significance, to avoid potential impacts and preserve the heritage values for future generations. Detailed mitigation measures have been proposed to manage, monitor and mitigate subsidence impacts to Aboriginal heritage sites.

Based on the above, the likelihood of negative impacts to Aboriginal cultural heritage have been rated as *possible* with *moderate* consequences resulting in a significance/ risk rating of *high*. With the implementation of project specific mitigation measures, the consequence of impacts can be reduced to *minor* resulting in a residual post-mitigation significance/ risk rating of *moderate*.

The Historic Heritage Assessment (Niche, 2018) carried out for the proposed development identified that potential impacts on heritage items are primarily limited to subsidence associated impacts. A total of 23 historical heritage items were identified during the assessment, with 19 located directly above the proposed longwall mining area. Impacts to historic heritage items may result in changes to the way in which the community interacts with and values heritage items and the extent to which heritage is available for future generations. The assessment concluded that there was nil to low likelihood of significant impacts to any of the built structures of heritage value identified in the project area, as such it is considered that the proposed development would have minimal impacts to historic cultural values.

Negative impacts to historical cultural heritage have been rated as *unlikely* with *moderate* consequences resulting in a significance/ risk rating of *moderate*. With the implementation heritage management and monitoring measures in relation to subsidence impacts and ongoing consultation with affected stakeholders it is considered that the consequence level can be reduced *minor* resulting in a residual post-mitigation significance/ risk rating of *low*.

Health and Wellbeing

Longwall mining related subsidence impacts to private properties and structures (including farm infrastructure such as farm dams and fences) have the potential to increase anxiety and stress in the community, including in relation to the timing, duration and process for accessing any reparations for subsidence. Tahmoor Coal has extensive experience to-date in successfully managing subsidence related impacts from the Tahmoor Mine, including in investigating and closing out subsidence claims sensitively and expeditiously in accordance with Subsidence Advisory NSW's (SA NSW) requirements. Tahmoor Coal would apply the same process for the proposed development in consultation with affected receivers with the aim of minimising stress and anxiety associated with the process as far as possible.

There is the potential for environmental emissions associated with the proposed development including air quality (particulates and odour), noise, surface water discharge and groundwater intrusion (affecting bore water quality) to raise concerns and anxiety within the community regarding health impacts (actual or perceived). Such stress and anxiety could occur at any stage of the proposed development from the development assessment stage, to construction, mine operation and closure and post-closure stages (in regards to residual impacts of the development).

Specialist technical assessments have been completed for all key impacts associated with the proposed development against current NSW assessment standards and requirements to ensure that the environmental impacts of the proposal can be managed within acceptable limits so as not to pose unacceptable risks or impacts to surrounding receivers. In addition a range of mitigation and management measures have been proposed as part of the technical assessments to manage the environmental impacts of the proposal.

Based on the above negative social impacts in relation to health and wellbeing are considered *possible* but likely to be of *minor* consequence (as impacts are likely to localised to specific receivers with concerns), resulting in a significance/ risk rating of *moderate*. It is considered that with the implementation of mitigation measures the likelihood of increased anxiety and health impacts (perceived and actual) can be reduced to *unlikely*, resulting in a residual post-mitigation significance/ risk rating of *low*.

Personal and property rights

Access to private property for the purposes of construction activities would be subject to landholder access agreements to identify access arrangements and management measures to avoid impacts to private property during project related activities. Any impacts to private bore users (groundwater quality or quality) would be subject to make good provisions by Tahmoor Coal. Similarly subsidence related property claims would be subject to reparation in accordance with SA NSW's requirements. Environmental impacts of the mine would be managed in accordance with regulatory requirements to ensure acceptable limits are met at nearest receptors. Impacts to personal and property rights are considered to be *possible* but *minimal* in consequence, resulting in a significance/ risk rating of *low*. With the implementation of mitigation measures the likelihood of impacts on personal and property rights would reduce to *unlikely*, resulting in a residual post-mitigation significance/ risk rating of *low*.

Decision making systems

Environmental regulation at the mine would be governed by its development consent and associated environmental management framework which would include complaint handling mechanisms to address and remedy issues raised by the community. Subsidence related property claims would be handled in accordance with the SA NSW's requirements and would be overseen by that agency in the case of dispute or advice. Tahmoor Coal would continue to engage with the community and affected stakeholders through its mine community consultative committee and other mechanisms to ensure affected receptors are aware of their rights under the development consent and are aware of and have the opportunity to provide feedback on the mine's activities and environmental management. Impacts to individual's decision making abilities are considered to be *possible* but *minimal* in consequence, resulting in a significance/ risk rating of *low*. With the implementation of mitigation measures the likelihood of impacts on individual's decision making abilities would reduce to *unlikely*, resulting in a residual post-mitigation significance/ risk rating of *low*.

Fears and Aspirations

Opposition to coal mining projects in general (on the basis of greenhouse gas and climate change impacts), and concern regarding the cumulative impacts of mining in the Southern Coalfields on landscape features such as Thirlmere Lakes are concerns raised by the broader public and regional receivers in submissions on similar development projects. The Tahmoor South Project has been developed with specific consideration to the recommendations of the Southern Coalfield Inquiry, and based on the precautionary and robust assessment approach of developing RMZs in the first instance to avoid and minimise impacts to significant natural features. In addition, the assessment of the proposed development has been based on significant technical studies (including the assessment of greenhouse gas emissions) and significant consultation between specialist to ensure interconnections between impacts are identified and appropriate mitigation measures developed.

Tahmoor Coal will continue to engage with community members through the mine community consultative committee and other mechanisms (including the mine website) to ensure accurate and up-to-date information on the project's impacts assessment, environmental management and monitoring results are made available for public viewing and feedback.

Impacts of the proposed development on individual's fears and aspiration are considered to be *possible* but *minimal* in consequence, resulting in a significance/ risk rating of *low*. With the implementation of mitigation measures it is considered that the risk rating would remain similar.

Cumulative Impacts

The proposed development is considered to have the following cumulative social impacts.

- workforce - The likelihood of cumulative projects generating additional employment and economic opportunity is considered to be *possible* with a likely *minor* beneficial consequence (given its temporary and localised nature), resulting in a moderate significance rating. As this would comprise a community benefit no mitigation measures are proposed and the residual significance rating would remain unchanged.
- other mining development (amenity) - Given the distance separation, the likelihood of surface amenity and traffic impacts from other mining operations in the area is considered to be *unlikely* and the consequence of impact *minor*, resulting in a significance/ risk rating of *low*. Mitigation measures implemented at the mine to manage project specific surface amenity impacts would reduce contributions to cumulative impacts, however given the distance between nearest mining operations, the risk rating is likely to remain unchanged.
- other mining development (environmental) - The likelihood of contributing to cumulative environmental impacts to receivers and the natural landscape (groundwater, surface water and subsidence) is considered *likely* and the consequences of impacts to be *moderate*, resulting in a significance/ risk rating of *high*. With the implementation of project specific mitigation measures contributions to cumulative impacts would be reduced and is likely to reduce the consequence of impact to *minor*. However, the residual post mitigation significance/ risk rating would remain *high*.

Residual Impacts

The significance of social impacts without and with mitigation (residual impacts) are summarised in **Table 11-86** below.

The assessment of social risk indicates that with the implementation of mitigation measures the likelihood and/ or consequences of impact can be reduced. Whilst a number of issues retain a residual social risk rating of 'high' under the risk matrix (subsidence, groundwater and surface water including cumulative impacts) this reflects the key nature of these issues for longwall mining projects in general and within the Southern Coalfields in particular. In recognition of the key nature of these issues, the impacts have been subject to significant technical assessment including specific consideration of the recommendations of the Southern Coalfield Inquiry, and significant consultation between specialist to ensure interconnections between impacts are identified and appropriate mitigation measures developed. Refer **Sections 11.1**, **11.3**, **11.4** and **11.5**. Construction noise has also retained a high residual risk rating, however this impact would be temporary and is consistent with impacts associated with other major construction works. Management and mitigation measures would be implemented to ensure impacts do not significantly impacts on receiver amenity during the construction period (refer **Section 11.10**)

Potential impacts to population from the loss of employment at the end of mining also retained a high residual risk rating. However the matrix indicates an expected reduction in impacts (compared to risks without mitigation) with the implementation of appropriate mitigation and contingency measures. The assessment shows that with the implementation of mitigation and management measures in the form of a Social Involvement Policy including employment transitioning to help employees find alternate employment and appropriate mine closure planning, the likelihood and consequence of impacts to the population can be reduced.

With the implementation of the proposed management, mitigation and monitoring regime, it is considered that residual social impacts of the proposed development are unlikely to be significant and would be outweighed by the social benefits of the proposed development.

The SIA has identified significant benefits of the proposal including:

- employment – the proposal would prolong the life of Tahmoor Mine, which in turn would enable the direct employment of the existing 390 employees and an additional 50 to 175 employees at peak employment. The retention of employment would enable the existing workforce (and their families) to continue to support the local economy and social and community services/ infrastructure in the area. With the development of other mining development in the area there is also the potential for cumulative beneficial employment generation.

- royalties - the economic assessment and cost-benefit analysis carried out for the proposed development (Refer **Section 11.16** and **Appendix R**) indicates net economic benefits accruing from the proposal including:
  - royalties estimated around $149.1 million to the NSW Government;
  - increase in gross regional income in the Wollondilly Region by between $3,288 million and $3,561 million (in NPV terms), depending on labour market responsiveness; and
  - increase in NSW's gross state product by between $4,692 million and $5,055 million (in NPV terms) depending on labour market responsiveness.

  The economic benefits from the proposed development represent additional public funds available to State and (indirectly) to local governments to spend on community infrastructure and facilities.

- community Contributions – the Tahmoor South Project would facilitate Tahmoor Coal's ongoing role in supporting the local community, through ongoing contributions to community partnerships and initiatives through Tahmoor Coal's Corporate Social Involvement (CSI) program, for a further 13 years.

Based on the identified impacts of the proposed development and the experience of managing such impacts over 30 years of mining in the Southern Coalfields it is considered that the proposed development would not result in significant adverse social outcomes, provided that the recommended mitigation, management and monitoring measures outlined in **Section 12.0** of the EIS are implemented. With the implementation of the identified measures, the social benefits of the proposed development are considered to outweigh the predicted residual impacts.

Table 11-86 Summary of Assessment of Significance

Impact Category		Likelihood	Consequence (Negative) or Scale of Benefit (Positive)	Rating (Before mitigation)	Likelihood	Consequence (Negative) or Scale of Benefit (Positive)	Rating (After mitigation)
Surroundings - Natural features and Amenity	Surface Water	B	4	B4 (Extreme Impact)	B	3	**B3 (High Impact)**
	Subsidence	B	4	B4 (Extreme Impact)	B	3	**B3 (High Impact)**
	Groundwater	B	4	B4 (Extreme Impact)	B	3	**B3 (High Impact)**
	Acoustic - operation	C	3	C3 (High Impact)	C	2	C2 (Moderate Impact)
	Acoustic - construction	B	3	B3 (High Impact)	B	2	**B2 (High Impact)**
	Particulate matter	D	2	D2 (Low Impact)	D	1	D1 (Low Impact)
	Odour	D	2	D2 (Low Impact)	D	1	D1 (Low Impact)
	Visual	D	2	D2 (Low Impact)	D	1	D1 (Low Impact)
	Traffic	C	3	C3 (High Impact)	C	2	C2 (Moderate Impact)
	Land use	C	1	C1 (Low Impact)	C	1	C1 (Low Impact)
Population and way of life	Housing	D	2	D2 (Low Impact)	D	2	D2 (Low Impact)
	Mine Closure	A	4	A4 (Extreme Impact)	B	3	**B3 (High Impact)**
	Employment	B	3	B3 (High Benefit)	B	3	B3 (High Benefit)

Impact Category		Likelihood	Consequence (Negative) or Scale of Benefit (Positive)	Rating (Before mitigation)	Likelihood	Consequence (Negative) or Scale of Benefit (Positive)	Rating (After mitigation)
Community (composition, cohesion, character, function, sense of place)	Use of Existing Mine facilities	D	2	D2 (Low Impact)	D	2	D2 (Low Impact)
	Barrier/ Access	D	2	D2 (Low Impact)	D	2	D2 (Low Impact)
	New Facilities	C	2	C2 (Moderate)	C	1	C1 (Low Impact)
	Natural features	C	3	C3 (High Impact)	C	2	C2 (Moderate Impact)
	Employment and Demographics	D	2	D2 (Low Impact)	D	2	D2 (Low Impact)
	Wollondilly CSP	C	3	C3 (High Impact)	C	2	C2 (Moderate Impact)
	Community contributions	A	3	A3 (Extreme Benefit)	A	3	A3 (Extreme Benefit)
Access to and use of infrastructure, services and facilities	Subsidence Impacts	B	3	B3 (High Impact)	B	2	**B2 (High Impact)**
	Construction impacts	C	2	C2 (Moderate Impact)	C	1	C1 (Low Impact)
	Natural resource use	B	1	B1 (Moderate Impact)	B	1	B1 (Moderate Impact)
	Workforce	D	2	D2 (Low Impact)	D	2	D2 (Low Impact)
	Royalties	A	3	A3 (Extreme Benefit)	A	3	A3 (Extreme Benefit)
Culture	Aboriginal cultural	C	3	C3 (High Impact)	C	2	C2 (Moderate Impact)
	Historic Heritage	D	3	D3 (Moderate Impact)	D	2	D2 (Low Impact)

Impact Category		Likelihood	Consequence (Negative) or Scale of Benefit (Positive)	Rating (Before mitigation)	Likelihood	Consequence (Negative) or Scale of Benefit (Positive)	Rating (After mitigation)
Health and Well being	Subsidence	C	2	C2 (Moderate Impact)	D	2	D2 (Low Impact)
	Other environmental impacts	C	2	C2 (Moderate Impact)	D	2	D2 (Low Impact)
Other	Fears and Aspirations	C	1	C1 (Low Impact)	C	1	C1 (Low Impact)
	Personal and property rights	C	1	C1 (Low Impact)	D	1	D1 (Low Impact)
	Decision-Making Systems	C	1	C1 (Low Impact)	D	1	D1 (Low Impact)
Cumulative Impacts	Workforce	C	2	C2 (Moderate Benefit)	C	2	C2 (Moderate Benefit)
	Other mining operations	D	2	D2 (Low Impact)	D	2	D2 (Low Impact)
	Environmental impacts	B	3	B3 (High Impact)	B	2	**(B2 (High Impact)**

11.15.5 Management and Mitigation Measures

The proposed development is anticipated to generate impacts to social amenity and surroundings including subsidence and groundwater, surface water, noise, air quality and odour, traffic, visual impacts, and land use. Tahmoor Coal has a 40 year history of working with the local community and managing social amenity impacts generated by its mining operations. Amenity impacts would be minimised in accordance with the recommended management and mitigation measures outlined in **Sections 11.1**-**11.23**.

Community engagement activities undertaken by Tahmoor Coal would be reviewed regularly to ensure that the information and mechanisms for providing information to key community and government stakeholders are appropriate. The Tahmoor Colliery Community Consultative Committee (TCCCC) would continue to facilitate open dialogue and dissemination of information between mine operators, management, key stakeholders and the community. Complaints received by Tahmoor Mine from the local community would be addressed as quickly as possible.

Tahmoor Coal would implement measures to monitor potential social impacts on the community for the duration of the project. An annual community survey would be conducted and Tahmoor Coal would continue to hold bi-annual open days which would allow feedback from the community. In addition to managing impacts associated with the proposed development, Tahmoor Coal would continue to provide ongoing community support measures, identified through consultation with the local community. The existing Social Investment Plan would be updated to allow for the continuation of mining proposed as part of the Tahmoor South Project, and would provide a framework for ongoing contributions to community partnerships and initiatives through Tahmoor Coal's Corporate Social Involvement (CSI) program. As outlined in **Table 9.1**, discussions with the Wollondilly Shire Council regarding a Voluntary Planning Agreement have commenced. Tahmoor Coal commit to continuing these discussions with the Wollondilly Shire Council, with the Voluntary Planning Agreement to be resolved before determination.

To ensure appropriate planning for eventual mine closure, Tahmoor Coal would implement its Social Involvement Policy, which requires a social impact assessment to be conducted as a component of mine closure planning, no later than five years prior to the end of the mine life. This planning would involve consultation with local and regional stakeholders to explore the employment generating potential of future land uses of the Surface Facilities Area and employment transitioning to help employees find alternate employment.

11.15.6 Conclusion

Social impacts of the proposed development have been assessed with consideration of the local and regional context of the Project Area. The proposed development is likely to continue to generate social impacts in line with those already experienced by the community, rather than to generate new impacts or significantly exacerbate social impacts within the local area and region.

The social impacts of the proposed development have been minimised as much as possible by utilising the existing surface infrastructure facilities where reasonable and feasible and through appropriate mine planning to avoid and minimise impacts to sensitive environmental, built and cultural heritage features.

Social impacts would be minimised and mitigated through the implementation of measures that have been informed by over 30 years of mining in the Southern coalfields and significant experience gained in successfully managing impacts in consultation with the community. Ongoing community consultation and engagement procedures would be implemented to keep the community informed of mine activities, respond to complaints and concerns and seek feedback. In addition, Tahmoor Coal would implement a Social Involvement Policy to provide for mine closure planning and transitioning of employment to minimise the future impacts of mine closure.

The proposed development would allow for the continued use of existing infrastructure, providing benefits by way of continuation of employment for the existing, established workforce for a further 13 years. This would provide ongoing employment for the existing 390 employees as well as generate an additional 50 to 175 jobs at peak employment. The proposed development would generate significant economic benefits, including royalties and net income to the Wollondilly region and State, and would allow for community contributions for a further 13 years.

11.16 Economic

An Economic Impact Assessment was prepared by Cadence Economics (2018) for the proposed development and is contained in **Appendix R**.

The Economic Impact Assessment addressed the SEARs relevant to economic impacts. These are listed in **Table 11.87**.

Table 11-87 Secretary's Environmental Assessment Requirements

Social & Economic SEARs
Social & Economic – including an assessment of the -likely economic impacts of the development, paying particular attention to:
• the significance of the resource;
• the costs and benefits of the development, identifying if it would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates; and
• the demand for the provision of local infrastructure and services.

11.16.1 Background

The Project Area is primarily situated within the Wollondilly LGA. Data obtained from the 2016 census (ABS, 2017) for the LGA provides a background of the social and economic conditions within the locality, and is further detailed in **Appendix R**. The economic assessment for the proposed development (**Appendix R**) presents a detailed assessment of the incremental costs and benefits of the proposed development, relative to a baseline, 'business as usual' case (with the existing Tahmoor Mine scheduled for completion in around 2022) (base case), an analysis of whether the proposed development would result in a net benefit for the NSW community, as well as a local effects analysis of economic benefits to the Wollondilly region.

The analysis has drawn on information provided by Tahmoor Coal, and the findings of this EIS and associated technical studies for the proposed development.

11.16.2 Methodology

The economic assessment for the proposed development included the following:

- A review of existing operational activity, costs and revenue for the Tahmoor Mine, as well as a review of other relevant economic information for the locality and region (refer **Appendix R**);
- A Cost-Benefit Analysis (CBA) of the proposed development. The analysis included an assessment of direct benefits, indirect benefits and indirect costs to NSW. A sensitivity analysis of the CBA was also undertaken to provide a range of possible outcomes given varying pricing scenarios (e.g. fluctuating coal price);
- A Local Effects Analysis (LEA) of the proposed development including assessment of the net economic impacts to the local community and a sensitivity analysis of the LEA; and
- A Computable General Equilibrium (CGE) modelling framework, which modelled the economic impacts of the proposed development flowing through the wider economy over the proposed development life cycle (from mine development to completion of coal extraction). Modelling was undertaking using a CGE model of the Wollondilly region ((Australian Bureau of Statistics Statistical Area 3 (SA3) - Wollondilly) and the NSW (including Wollondilly region) economies.

The economic assessment for the proposed development was prepared having consideration of the NSW Government (2015) *Guidelines for the economic assessment of mining and coal seam gas proposals* (the Guidelines).

11.16.3 Cost Benefit Analysis

For the purposes of the CBA and in accordance with the Guidelines, a baseline case and a proposed development - central case have been defined as follows to measure the net benefits to the NSW community.

Baseline case

The baseline scenario considered all costs and benefits if the proposed development does not proceed. Tahmoor currently has approval to mine resources in the Northern Domain, and therefore the economic benefits and costs associated with extraction of coal within the existing operation were excluded from the assessment.

Project case (proposed development)

The proposed development is seeking to extend mining activity at Tahmoor Mine beyond 2022 to 2035. The proposed development is detailed in **Section 4.0**, and forms the 'Project case' for the economic assessment.

The economic, environmental and social costs and benefits considered in the analysis are shown in **Appendix R** including the value assigned for each of those costs and benefits. Hard coking coal (HCC) and thermal coal price forecasts were developed by Cadence Economics, drawing on the latest coal price forecasts. In contrast, a monetary value could not always be applied to non-priced externalities including some environmental considerations. Further details on how these costs and values were derived are provided in **Appendix R**.

The findings of the CBA identified that the total net benefit of the proposed development is estimated at $699.5 million in NPV terms. This includes both direct and indirect benefits as explained further below.

Direct benefits

Based on the Guidelines, the direct benefits to NSW of the proposed development are derived from three sources:

- The net producer surplus generated by the proposed development that is attributable to NSW;
- The share of company tax payments that are attributable to NSW; and
- Other tax payments such as royalties and payroll tax that are paid to the NSW and local government.

In this case, the net producer surplus that is attributable to NSW is assumed to be zero. This is because Tahmoor Coal Pty Ltd is 100 per cent owned by SIMEC Mining, part of the Gupta Family Group Alliance (GFG Alliance) which is a private foreign-owned company based in London.

Consistent with the Guidelines, company tax is attributable to NSW based on the State's share of population which is 32 per cent.

Under the proposed development, various payments would be made to NSW Government and the Wollondilly Shire Council to extract and process coal in the State. These are made up of three types of payments: coal mining royalties and payroll tax paid to the NSW Government and council rates paid to the Wollondilly Shire Council.

The Tahmoor South Project is expected to generate an operating surplus of $916.7 million in Net Present Value (NPV) terms; of this $307.1 million in NPV terms is payable in the form of corporate taxes, leaving a net producer surplus of $609.6 million in NPV terms.

It is estimated the proposed development would generate $1,023.8 million in taxable profit in NPV terms over its operational life (this is an estimate of the accounting profit from which company taxes are calculated). At a company tax rate of 30 percent, the company tax estimate is $307.1 million in NPV terms, of which $98.3 million is attributable to NSW.

Over the life of the proposed development, a total of $177.7 million in payments would be made, in NPV terms. This is made up of $149.1 million of royalty payments and $21.7 million in payroll tax. A further $7.0 million would be paid in the form of council rates.

Indirect benefits

Based on the Guidelines, the indirect benefits to NSW of the proposed development are derived from three sources:

- The net economic benefit to workers in NSW;
- The net economic benefit to suppliers in NSW; and
- Any land owner premiums attributable to the proposed development.

Consistent with the Guidelines, a key factor in determining the benefits to workers are defined as the:

- Wages earnt in the mine;
- Minus the opportunity cost of labour for working in the mining sector, that is compared to working in non-mining sectors (or being unemployed); and
- Minus the wage difference due to skills and the disutility to work in the mining industry.

To determine the opportunity cost compared to the non-mining sector, Cadence Economics (2018) compared the average wage for mining employment to the average wage paid in NSW. This implies that should the proposed development not go ahead, those who would have been employed at Tahmoor find alternative work at the average wage paid in NSW.

In terms of supplier benefits, the producer surplus estimates were based on Type I multipliers by Cadence Economics which limit the benefit to direct value added generated by NSW suppliers. This methodology does not account for second round, nor induced consumption, effects that are captured within the CGE modelling. Using this relatively conservative technique, the total supplier benefits are estimated to be $211.4 million in NPV terms.

Indirect costs to NSW

Consistent with the Guidelines, a project's indirect costs are classified as the net public infrastructure costs, the estimated loss of surplus to other industries and the net environmental, social and transport-related costs. The proposed development's indirect costs include some costs that have been internalised by Tahmoor Coal including the biodiversity and subsidence impacts and costs that have been assessed qualitatively, such as visual amenity. In total indirect costs are estimated to be $42.3 million in NPV terms over the life of the proposed development, which includes $0.1 million of incremental costs that are not internalised by Tahmoor Coal (i.e. GHG, air quality and noise related impacts).

A summary of the net benefits of the proposed development is presented in **Table 11.88**.

A sensitivity analysis was undertaken and considered all key areas of the CBA, particularly coal prices, key costs (both capital expenditure and operating costs) and worker benefits. Where there were considered to be higher levels of uncertainty with the figures, a range of plus/minus 25 per cent was used. In areas where the figures were deemed more certain, a range of plus/minus 10 per cent was used. Variation of the CBA inputs was undertaken for the following scenarios:

- Revenue sensitivity:
  - Higher price assumptions, where coal prices are increased by 25 per cent over the central case assumptions for the life of the proposed development; and
  - Lower price assumptions, where coal prices are decreased under the central case assumptions by 25 per cent.
- Cost-base sensitivity:
  - Higher operational expenditure (increased by 10 per cent over the central case);
  - Lower operational expenditure (decreased by 10 per cent under the central case);
  - Higher capital expenditure (increased by 10 per cent over the central case); and
  - Lower capital expenditure (decreased by 10 per cent under the central case).
- Worker and supplier assumptions:

- Increased disutility of mining wage premium by 25 per cent on central case assumptions; and
- Reduced supplier benefits of 10 per cent from central case assumptions.

- Higher environmental costs (increased by 10 per cent); and
- Discount rate sensitivity, using a 4% and a 10% real discount rate.

In addition, upper and lower bound estimates were undertaken which assume:

- 'Worst-case' scenario: the coal price is reduced by 25 per cent, operational and capital expenditure are increased by 10 per cent, the disutility of the mining wage premium is set to 25 per cent and supplier benefits are lowered by 10 per cent compared with central case assumptions; and
- 'Best case' scenario: the coal price is increased by 25 per cent, operational and capital expenditure are decreased by 10 per cent, the disutility of the mining wage premium is set to zero and supplier benefits are increased by 10 per cent compared with central case assumptions.

The results are detailed in **Appendix R** and show that the estimated net benefits are robust in the sense that they remain strongly positive after testing all key assumptions underpinning the analysis. The lower bound, or worst-case, estimate of net benefits, which takes the most pessimistic assumptions around coal prices, capital expenditure, operational expenditure as well as worker, environmental impacts and supplier benefits, yields an estimated net benefit of $497.7 million in NPV terms. The upper bound, or best-case, estimate, based on the most optimistic assumptions, is $859.1 million in NPV terms.

Table 11-88 Central case – estimated net benefits of the proposed development ($ Million[1])

Benefits	NPV[2]	Costs	NPV[2]
Direct Benefits		***Direct Costs***	
1. Net producer surplus attributed to NSW	-		
2. Royalties, payroll tax and Council rates	177.7		
3. Company income tax apportioned to NSW	98.3		
Total direct benefits	**276.0**	**Total direct costs**	**-**
Indirect Benefits		***Indirect Costs***	
1. Net economic benefit to landholders	0.0	1. Air quality	-
2. Net economic benefit to NSW workers	212.2	2. Greenhouse gas emissions	0.1
3. Net economic benefit to NSW suppliers	211.4	3. Visual amenity	-
		4. Transport impact	-
		5. Net public infrastructure cost	-
		6. Surface water impact	-
		8. Residual value of land	-
		7. Biodiversity impact[3]	19.6
		8. Noise impact	10.7
		9. Loss of surplus to other industries	-
		10. Water	-
		11. Aboriginal cultural and Historical heritage	-
		12 Subsidence[3]	11.8

Benefits	NPV[2]	Costs	NPV[2]
Total indirect benefits	**423.6**	**Indirect Costs**	**42.3**
Total Project economic benefit	**699.6**	**Incremental Indirect Cost**	**0.1**
NPV of project - ($m)	**699.5**		

Source: Cadence Economics estimated based on information from various sources.
[1] Real 2017 Australian dollars
[2] NPV in 2017 Australian dollars based on a 7 per cent real discount rate
[3] Incorporated into operating costs

11.16.4 Local Effects analysis

In accordance with the Guidelines, the local effects analysis (LEA) uses a similar framework to the CBA but assesses the net economic impacts to the local community. The Guidelines refer to the local area as being consistent with the relevant Statistical Area (SA3) as defined by the Australia Bureau of Statistics. In the case of this project the Wollondilly SA3 area is used for the LEA.

The LEA accounts for the economic benefits to the Wollondilly SA3 area only. It does not include any economic benefits that may accrue to adjacent major regional centres such as the Illawarra region and Sydney.

The LEA was developed based on the following assumptions:

- no net producer surplus accrues to the region;
- no company income tax accrues to the Wollondilly SA3 region;
- 45 per cent of the workforce requirement of the proposed development and 12.9 per cent of intermediate inputs would be supplied from the SA3 region; and
- the incremental indirect costs associated with the proposed development is $674.9 million, global greenhouse gas costs apportioned to the local area.

The LEA found that the proposed development would generate indirect benefits to local suppliers of $29.5 million through increased demand for the provision of local infrastructure and services, and $95.5 million in NPV terms to local employees over the baseline case, as outlined in **Table 11.89.**

Based on these assumptions, the proposed development is estimated to confer a net benefit on the Wollondilly SA3 region of $132.0 million in NPV terms.

A sensitivity analysis was undertaken for the LEA, testing the same assumptions outlined in the CBA. The results are detailed in **Appendix R** and identify that the benefits of the proposed development exceed the costs in all scenarios, indicating that the estimated net benefits are robust. The main drivers for the regional impact are the supplier and employee benefits. Those sensitivities that change the supplier benefits through lower operational costs, lower supplier benefit or employee benefit have the greatest impact on the regional net benefit.

The lower bound, or worst-case, estimate of net benefits, which takes the most pessimistic assumptions around coal prices, capital expenditure, operational expenditure as well as worker and supplier benefits, yields an estimated net benefit of $103.4 million in NPV terms. The upper bound, or best-case, estimate, based on the most optimistic assumptions, is $139.5 million in NPV terms.

Table 11-89 Estimated Local Effects Analysis of the proposed development ($ million[1])

Benefits	NPV[2]	Costs	NPV[2]
Direct Benefits		***Direct Costs***	
1. Net producer surplus attributed to NSW	0.0		
2. Royalties, payroll tax and Council rates	7.0		
3. Company tax	0.0		
Total direct benefits	**7.0**	**Total direct costs**	**-**

Benefits	NPV[2]	Costs	NPV[2]
Indirect Benefits		***Indirect Costs***	
1. Net economic benefit to landholders	0.0	1. Air quality	-
2. Net economic benefit to NSW workers	95.5	2. Greenhouse gas emissions	-
3. Net economic benefit to NSW suppliers	29.5	3. Visual amenity	-
		4. Transport impact	-
		5. Net public infrastructure cost	-
		6. Surface water impact	-
		8. Residual value of land	-
		7. Biodiversity impact	19.7
		8. Noise impact	10.7
		9. Loss of surplus to other industries	-
		10. Water	-
		11. Aboriginal cultural and Historical heritage	-
		12 Subsidence[3]	11.8
Total indirect benefits	**125.0**	**Indirect Costs**	**42.2**
Total Project economic benefit	**132.0**	**Incremental Indirect Cost**	**0.0**
NPV of project - ($m)	**132.0**		**0.0**

Source: Cadence Economics estimated based on information from various sources.
[1] Real 2017 Australian dollars
[2] NPV in 2017 Australian dollars based on a 7 per cent real discount rate
[3] Incorporated operational costs

11.16.5 CGE Modelling Framework

The economy-wide impacts of the proposed development have been assessed using a CGE model of the regional and NSW economy. The assessment aims to estimate the net benefit of the proposed development on economic activity and the living standard of those residing within the Wollondilly SA3 and in NSW.

Modelling was based on the central case assumptions of capital expenditure of $310.8 million and coal revenue of $2,985.5 million. Flow on benefits of the proposed development outside of the Wollondilly region and the NSW economy were also factored into the modelling; for example royalty payments accrued by NSW and corporation tax to the Australian government.

The central consideration for the CGE relates to the responsiveness of the NSW labour market to the increase in expenditure (the labour supply response). Three labour market response scenarios were incorporated into the modelling:

- zero labour supply elasticity: Assumes that no new jobs would be created by the proposed development. This scenario would occur if the NSW economy was operating at full employment and no new workers were available to service the proposed development. Workers would therefore be drawn from their existing jobs to the new project via increased wages. Similarly, if a new project required very specific highly trained and skilled workers and there were none readily available, the proposed development would not create additional jobs;

- medium labour supply elasticity: Assumes the economy is operating at below capacity, as evidenced by higher unemployment and slower growth. Potential workers are therefore encouraged into the workforce, through increased wages. A labour elasticity assumption of 0.15 as per the Australian Treasury has been used, which assumes workers are slow to respond to changes in wages due to the economy being close to full employment or the proposed development under consideration requires highly skilled workers; and
- High labour supply elasticity: Assumes the economy is operating at below capacity and the labour supply elasticity is higher than the medium scenario. Therefore assumes that workers respond more readily to marginal changes in the wage rate.

The results of the projected economy-wide impacts of the proposed development generated by the CGE model are shown in **Figure 13** of **Appendix R** (Economic Impact Assessment) under the three labour market response assumptions. The results are summarised below.

Under the Zero, medium, and high labour market response assumptions the proposed development is projected to increase gross regional income (GRI) in both the Wollondilly region and NSW broadly. GRI is a measure of economic welfare. In NPV terms, the projected increase in GRI in the Wollondilly region ranges from $3,288 million under the zero labour supply response to $3,561 million under the high labour response assumption. The increase in projected economic welfare is related to the projected employment which averages 339 FTE (Full Time Equivalent) under the high labour response assumption and 183 FTE under the medium assumption.

The economic benefits of the proposed development also accrue to the broader NSW economy. In NPV terms, the projected increase in GRI in NSW ranges from $4,692 million under the zero labour supply response to $5,055 million under the high labour response assumption. The associated employment effects in NSW are 339 FTE under the high labour response assumption and 183 FTE under the medium assumption.

11.16.6 Conclusion

In accordance with the NSW Treasury guidelines, a CBA and LEA has been undertaken for the proposed development. The CBA compares the proposed development central case to a baseline case where the proposed development does not proceed, to assess the net benefits to the NSW community. The overall finding of the CBA is that the proposed development as a whole is likely to deliver net economic benefits. In the central case (which is based on a 7% discount rate) the proposed development delivers net benefits of around $699.5 million over its life, of which up to $132.0 million would flow through to the local Wollondilly region (in NPV terms).

Community benefits will be generated primarily through employment, which would average at 422 full time equivalent employees in the operational stage of the proposed development (post 2020). The proposed development is also expected to generate increased economic activity and employment within the wider NSW community, including both direct employment and employment from downstream suppliers. Systematic sensitivity analysis of the estimated net benefits has been undertaken for the CBA and LEA. The sensitivity analysis shows that the estimated net benefits are robust in the sense that they remain (strongly) positive after testing all key assumptions underpinning the analysis.

Royalties generated by this proposed development, relative to the baseline, are estimated to be worth around $149.1 million in NPV terms to the NSW Government. In addition, economy-wide modelling indicates that the proposal would accrue benefits to the Wollondilly region and the broader NSW economy under zero, medium and high labour market responses. Overall, the proposed development is expected to generate net benefits and is also expected to generate increased economic activity and employment within the NSW community.

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11.17 Visual and Landscape

This section provides an assessment of the potential visual impacts of the proposed development, and is supported by the Tahmoor South Project Visual Impact Assessment (VIA) (Green Bean Design, 2018). The VIA is provided in **Appendix S**. The objectives of the VIA were to:

- determine the likely visual significance of the proposed development on local residents and people living and working in or travelling through the landscape surrounding the Project Area;
- assess the existing visual character of the Project Area and the surrounding landscape;
- determine the extent and nature of the potential visual significance of the proposed development on surrounding areas; and
- identify measures to mitigate and minimise any potential visual impacts arising from the proposed development.

The visual and landscape assessment addresses the SEARs relevant to visual and landscape impacts. These are listed in **Table 11-90**.

Table 11-90 SEARs relating to visual amenity

Visual SEARs
Visual – including:
• an assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, and minimising the lighting impacts of the development.

11.17.1 Background

The proposed development has the potential to create a visual impact on the surrounding areas due to the expansion of the REA, construction of the two new ventilation shafts and upgrades to the Surface Facilities Area. The VIA determined the extent of these visual impacts and provided ways in which to mitigate the visual impacts of the proposed development.

11.17.2 Methodology

The VIA included the following key components:

- A desktop study to assess the visual character of the Project Area, and to identify potentially sensitive receiver locations. The desktop study involved a review of topographic maps (Land and Property Information, NSW Government), aerial photographs and satellite imagery to identify an indicative viewshed for key visible elements within the Project Area. Topographic maps and aerial photographs were also used to identify the locations and categories of potential viewpoints that could be verified during the fieldwork component of the assessment. The desktop study also helped establish the visual character of the landscape including features such as landform, elevation, land cover and the distribution of residential dwellings surrounding the proposed development;
- A field study, involving site inspections and photography to confirm the potential extent of visibility of the proposed development, including ancillary structures. The field study also included confirmation of the various view location categories and locations from which the key structures of the proposed development could potentially be visible. During the site inspections, digital photographs were taken to capture the existing views in the vicinity of a number of view locations inspected and assessed as part of the VIA. The locations where these photographs were taken are shown on Figure 6 of **Appendix S**. The digital photographs are also provided in **Appendix S**, labelled as Photo P1 to P17;
- An assessment of the visual sensitivity of the landscape and the magnitude of the proposed development using the information obtained from the desktop and field studies;
- An assessment of visual significance by determining a combination of the following factors:
  - the distance between the view location and the proposed development;

- the duration of view from view locations towards various constructed elements that form part of the proposed development;
- the predicted impact of the proposed development on the existing visual amenity;
- the nature of the predicted impacts; and
- the visual sensitivity of locations from which views towards the proposed development exist.

- Assessment of visual impact of the proposed development using the visual effect criteria and visual significance criteria outlined in **Table 11-91** and **Table 11-92** respectively; and
- Identification of mitigation measures to assist in the reduction and/or amelioration of adverse potential visual impacts of the proposed development that were identified in the VIA.

Table 11-91 Visual Effect Criteria

Criteria	Description
Nature of predicted impact	The visual impact would be either temporary (T) or permanent (P) in nature and would be considered reversible (R) or irreversible (IR).
Magnitude of impact	*High (H):* Total loss or major change to pre-development view or introduction of elements which are uncharacteristic to the existing landscape features. *Medium (M):* Partial loss or alteration to pre-development view or introduction of elements that may be prominent but not necessarily uncharacteristic with the existing landscape features. *Low (L):* Minor loss or alteration to pre-development view or introduction of elements that may not be necessarily uncharacteristic with the existing landscape features. *Negligible (N)*: Very minor loss or alteration to pre-development view or introduction of elements which are not uncharacteristic with the existing landscape (resulting in a no change situation).

Table 11-92 Visual Significance Criteria

Criteria	Description
View distance	*Long (L):* greater than 1 km *Medium (M):* 500m to 1 km *Short (S):* less than 500 m
View duration	*Long term (LT):* more than two hours *Moderate term (MT):* 30 minutes to two hours *Short term (ST):* 10 to 30 minutes
Receptor sensitivity	*High:* Residential locations *Medium:* Public recreation areas *Low:* Motorists or rail passengers

Criteria	Description
Visual significance	*High:* the proposed development would be a significant, dominant feature within the surrounding landscape and at complete variance with the landform, scale and pattern of the landscape. The proposed development would have the capacity to cause a significant deterioration in the existing view and the effects of the proposed development may not be minimised by mitigation measures. Cumulative impacts may result in an increased level of impact. *Moderate:* The proposed development would be a recognisable feature but would not dominate views within the surrounding landscape. It would be out of scale and discordant with the landform, scale and pattern of the surrounding landscape and would have the capacity to cause a noticeable deterioration in the existing view. The proposed development's visual effects may be partially alleviated by mitigation measures. *Low:* The proposed development would form a visible element within the surrounding landscape but is unlikely to constitute a marked effect on existing views. The proposed development would complement the scale, landform and pattern of the surrounding landscape and would not create a noticeable deterioration in the existing view. The proposed development's visual effects would be positively mitigated through appropriate mitigation measures. *Negligible:* The proposed development would result in no discernible deterioration in the existing view.

11.17.3 Existing Landscape

The Guidelines for Landscape and Visual Assessment (Landscape Institute, 2002) state that '*landscape effects describe the likely nature and scale of changes to individual landscape elements and characteristics, and the consequential effect on the landscape character resulting from the proposed development'.* The extent of resilience of a landscape depends on existing land use, the pattern and scale of the landscape and the visual enclosure/openness of views.

The Project Area is characterised by existing mining operations associated with Tahmoor Mine which have been present since operations commenced in 1979. Visual elements of the existing mine include pit top and surface infrastructure. The surface infrastructure of Tahmoor Mine is bounded by bushland to the north, east and south and Remembrance Driveway to the east. The existing REA is bounded on all sides by native bushland. The proposed development is located within a landscape that also includes rural residential and denser urban development associated with the townships of Tahmoor and Bargo The broader local area is characterised by national parks, bushland, WaterNSW catchment areas (MSA) and rural land.

Landscape Pattern and Scale

The landscape pattern and scale of landforms within the Project Area are defined by the existing land uses in the area. The Project Area is characterised by simple, regular and uniform landscape patterns and medium to small scale landforms, formed by the predominant land uses being mosaics of dense to moderate tree cover, rural occupation, industrial/ commercial development and urban development.

Visual Enclosure and Openness of Views

The visual environment of the Project Area is largely enclosed, being restricted by the gently undulating landform and the extensive areas of medium to dense tree cover. Along local roads and transmission line corridors, there are short distance and indirect views.

Visual Absorption Capacity

The relative ability of a landscape to absorb change without affecting landscape character is identified as the Visual Absorption Capacity. The Project Area is located within an undulating landscape with moderate to dense tree cover, providing the area with a high visual absorption capacity.

11.17.4 Impact Assessment

The key components of the proposed development were assessed in relation to visual effect and significance against the criteria outlined in **Table 11-91** and **Table 11-92** above. The results of the assessment are provided in **Table 11-93** below. The visual effect criteria outlined in **Table 11-91** is used as a guide to determine significance of visual impact. The significance of visual impact for each view location is also considered against other factors, which include the overall visibility of the proposed development from surrounding view locations.

Construction activities

Whilst construction activities would tend to be more visible than the operational stage of the proposed development, the construction activities would be temporary and transient in nature. Views toward construction activities associated with construction of the two (2) new ventilation shafts and expansion of the REA would be largely restricted by existing tree cover within the Project Area. Views of construction activities at the entry to the existing Tahmoor Mine (such as the Mine Access Road intersection upgrade) from vehicles travelling on Remembrance Driveway would be transitory in nature.

Operation

The proposed development involves the continuation of an existing underground mining operation, with minimal additional visual elements to be introduced to the landscape. New visual elements required for the proposed development would include expansion of the REA, construction of two new ventilation shafts and upgrades to the Surface Facilities Area. Operation of the proposed development would result in existing infrastructure remaining in the landscape for a longer period of time.

The landform within the Project Area and surrounds comprises a combination of sloping and ridgeline landforms and extensive areas of established, moderate to dense tree cover. As a consequence, the proposed development has been assessed to have a negligible visual effect and significance with regards to the proposed key constructed elements and associated infrastructure, including views from the majority of surrounding rural residential dwellings, roads that carry higher volumes of traffic such as Remembrance Driveway and from local road corridors (Refer **Table 11-93**).

Whilst the proposed development will require the removal of some existing tree cover (as detailed in **Section 11.6**), the VIA has considered and determined that the extent of proposed tree removal will not have an adverse impact on the overall visibility of the proposed development including views from sensitive receptors such as residential dwellings and motorists travelling along Remembrance Driveway. Overall, the magnitude of landscape effects associated with the proposed development has been determined as negligible to low, given the location, extent and purpose of the mining operations that exist in the Project Area and the existing landscape characteristics within and surrounding the proposed development. The proposed development would be of a similar nature to the operation of the existing Tahmoor Mine and is not expected to change existing land use within and surrounding the Project Area. The existing landscape character of the Project Area is considered to be robust with a High Visual Absorption Capacity that is able to absorb change without any significant alteration to the existing landscape character.

Night time lighting

The two new ventilation fan sites will include additional low-level intensity night lighting. Given the low-level intensity light to be used, and the location of these sites in areas away from residential dwellings, it is unlikely to be visible from residential dwellings. Low level night lighting at existing facilities will continue to include individual and direction spot lighting and avoid broad area or floodlighting which will minimise the potential for ‘sky glow’ above existing facilities. The majority of infrastructure areas associated with the proposed development will be unlikely to require additional lighting, or light fixtures that will create significant brightness.

Nattai National Park

The south east boundary of the Nattai National Park is located around eight km from the existing Tahmoor Mine and extends around 20 km to the north-west. The Burragorang and Wollondilly lookouts on the edges of the Nattai Reserves System are located 25 km north-west and 37 km south-west of the existing Tahmoor Mine, both offering viewpoints westward into the Nattai National Park

and the Yerranderie State Recreation Area. Views towards the existing Tahmoor Mine from these locations are obstructed by the landform and the extent of established tree cover. Given the distance, orientation, topography and intervening tree cover from these viewpoints, the proposed development would not result in any visual impact for visitors to the Park engaged in low impact bush walks or camping activities or affect the visual significance of the scenic escarpment of the Nattai National Park.

Table 11-93 Evaluation of Visual Impacts of the proposed development

Component of Project	Description of Potential Impact	Visual Effect	Visual Significance
Underground mining operations	Underground mining operations and pre mining activities would be largely confined to the existing Surface Facilities Area and below ground. As a result there would be no visual effect or significance for view locations beyond the existing Tahmoor Mine site or more broadly within the Project Area.	Negligible	Negligible
TSC1 upcast ventilation shaft	The proposed TSC1 up-cast ventilation shaft will be located on Tahmoor Coal's property at Charlies Point Road. Views from vehicles travelling along Charlies Point Road toward the upcast ventilation shaft will be partially screened and filtered by roadside tree planting. Views toward the upcast ventilation shaft from residential dwellings beyond the Tahmoor Coal mine site will be completely screened by extensive tree cover between the upcast ventilation shaft site and surrounding dwellings.	Negligible	Negligible
TSC2 downcast ventilation shaft	The proposed TSC2 down-cast ventilation shaft will be located on Crown Land opposite Tarmoor Coal's property at Charlies Point Road. Views from vehicles travelling along Charlies Point Road toward the upcast ventilation shaft will be partially screened and filtered by roadside tree planting. Views toward the upcast ventilation shaft from residential dwellings beyond the Tahmoor Coal mine site will be completely screened by extensive tree cover between the upcast ventilation shaft site and surrounding dwellings.	Negligible to low	Negligible to low
Mine access	Existing access points would be utilised for the proposed development and no additional visual effect or significance is likely to occur.	Negligible	Negligible
Coal logistics	Coal products would continue to be transported to Port Kembla via existing infrastructure and the existing rail movements would be sufficient for the proposed development. There would be no additional level of visual effect or significance.	No impact	No impact
Surface Facilities Area	Upgrades within the existing pit top area would be visually contained with the existing infrastructure and would not be visible from surrounding view locations, including Remembrance Driveway and residential dwellings	Negligible	Negligible
Electrical infrastructure works	These works would be mostly within the existing mine Surface Facilities Area and would not be visible from view locations within the Project Area beyond the existing Tahmoor Mine site. A new substation and associated 66kV power line would be constructed at the TSC2 ventilation shaft site. The substation would not be visible from surrounding dwellings and would be screened by established tree cover. The power line would be located away from existing dwellings and pass through or alongside areas of established tree cover which would provide partial or full screening from the majority of the surrounding landscape.	Negligible	Negligible to low

Component of Project	Description of Potential Impact	Visual Effect	Visual Significance
REA	The existing approved REA has a footprint of approximately 73ha with a final landform profile consists of a stable battered slope, approximately 12 m high (at approximately RL 300 m) with external batters ranging from 1:4 to 1:8. The maximum height of the REA would be increased from RL 300 m to RL 305 m in the southern section. The proposed two stage development footprint of the REA expansion is shown in **Figure 4.12**. The expansion area will cover up to an additional 43 hectares (resulting in a total REA area of 116 ha including the existing 73 ha), The two stages would be developed with a 1:5 (vertical: horizontal) batter and would each have a final design height of about RL 305.8m. The REA would be largely screened from surrounding rural dwellings by established, dense tree cover which extends up to and beyond 1 km from the REA site. The final REA landform would be visually consistent and contiguous with adjacent landforms that surround the existing REA and would not disrupt the existing distant skyline views from elevated and accessible view locations. The development of the REA would have some limited visual exposure to traffic movements along Charlies Point Road; however, the proposed REA stages would be partially screened by existing tree planting alongside the road corridor. Progressive and ongoing planting during rehabilitation and vegetation of the REA would provide further screening potential. During the design of the proposed development, Tahmoor Coal considered a third stage REA development which would expand the REA footprint further to the south. This option was not preferred due to the additional land clearing required, and proximity to additional residences. The proposed REA footprint has reduced the visual extent of the REA to the south and requires less land clearing when compared to this third stage option.	Low	Low

Cumulative impacts

A cumulative visual impact may result from elements of the proposed development being constructed concurrently with other existing or proposed developments.

Due to the abovementioned extent of visual screening surrounding the Project Area as well as the location of proposed constructed elements relative to the existing infrastructure, the proposed development is considered to have limited potential to increase the significance of cumulative visual impacts.

11.17.5 Management and Mitigation Measures

The following mitigation measures would further minimise the level of residual visual impacts associated with the proposed development:

- The colour and texture of new structures to be constructed for the proposed development would be dark in tone and would utilise non-reflective materials where possible. This would potentially minimise the visual contrast between these structures and the surrounding background to a number of view locations surrounding the Project Area;
- New lighting required for the proposed development would consist of low level night lighting designed to avoid direct line of sight from areas surrounding the site and avoid broad area or large floodlighting where practicable;
- Security lighting would be designed to minimise light spill where reasonable and feasible;
- Progressive rehabilitation and tree planting on the REA will continue to allow the REA to blend into the landscape;
- Existing tree cover would be retained and protected to the fullest extent where reasonable and feasible, particularly in the vicinity of the two ventilation shafts and along the boundary of the REA; and
- Landscaping works, including shrub and tree planting would be undertaken to increase the level of existing screening potential to proposed development infrastructure. Planting would be progressive through construction or as temporary works are rehabilitated, including along the Remembrance Driveway boundary to mitigate views from the road corridor as well as residential dwellings and the Wollondilly Anglican College to the west of the surface facility.

11.17.6 Conclusion

The proposed development is not expected to create a visual impact on existing land uses within and surrounding the Project Area. Additional visual elements associated with the proposed development would be minimal and would be limited to expansion of the REA, construction of two new ventilation shafts and upgrades to the Surface Facilities Area. Further, the high Visual Absorption Capacity of the Project Area and surrounds would likely reduce the potential magnitude of the visual impact.

The proposed development will be located in a landscape which is generally robust and has the ability to absorb any change without any significant alteration to the existing landscape character. The landscape character, coupled with the location and extent of existing mining operations has resulted in the proposed development having a low to negligible landscape effect.

The REA will be visually contained by established and dense tree cover. The final landform will not result in a disruption to existing distant skyline views where visible from elevated and accessible view locations. Views from private dwellings, community facilities (including the Wollondilly Anglican College) and publicly accessible areas beyond the proposed development would be screened by the gently undulating and low ridgeline landforms, together with the moderate to dense tree cover that is present across large portions of the landscape within and surrounding the Project Area. Existing and established tree cover beyond the road corridor will screen views towards proposed infrastructure within the existing Tahmoor Mine Surface Facilities Area from vehicles travelling along Remembrance Driveway. The proposed development will have an overall negligible visual impact on distant views from landscape areas beyond the existing Tahmoor Mine, including the scenic escarpment of the Nattai National Park.

The proposed development area is considered to have limited potential to increase the significance of cumulative visual impact due to the extent of existing visual screening within the Project Area and the location of proposed constructed elements relative to existing infrastructure within the Tahmoor Mine Surface Facilities Area.

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11.18 Soils and Land Capability

An Agricultural Impact Statement (AIS) was prepared by SLR and is provided in **Appendix T**. This involved the identification of the existing soil environment and the land capability of the Project Area, which is described in this section.

11.18.1 Background

Land capability is the physical capacity of the land to sustain a range of land uses and management practices in the long term without degradation to soil, land, air and water resources (OEH, 2012). An assessment of soils and land capability has been undertaken as part of the AIS for the proposed development. The purpose of the assessment was to outline the existing conditions with regards to soils and land capability within the Project Area as well as to inform the broader assessment of agricultural land uses and resources which is provided later in **Section 11.19**.

11.18.2 Methodology

Assessment of the soils and land capability of the Project Area was undertaken primarily as a desktop assessment, with some detailed soils surveys undertaken in the areas where new mining leases will be required. The desktop assessment included:

- A review of available soils mapping to identify:
  - soil landscapes within the Project Area and their characteristics; and
  - the presence or absence of acid sulfate soils, saline soils and contaminated soils.
- Application of the rural classification method to determine the land capability of the Project Area;
- A review of the NSW *Strategic Regional Land Use Policy* (DPE, 2012) to identify the status of biophysical strategic agricultural land (BSAL) within or near the Project Area, and assessing whether land within the Project Area is likely to satisfy the classification of BSAL. This is determined by reviewing land capability and classification, in addition to other criteria (discussed below);
- Defining a disturbance assessment area (DAA) to which the impact assessment would focus, and undertaking an assessment of the proposed development on soils, land capability and BSAL for this DAA. The DDA is limited to areas of known and potential disturbance and includes three areas:
  - The Subsidence Study Area (SSA): the area of potential surface subsidence associated with underground mining, covering an area of 2,624 hectares;
  - The Ventilation Shaft Sites: the proposed two new surface ventilation shafts and associated infrastructure covering an area of approximately 13 hectares; and
  - The expansion of the REA: the area required for the expansion of the REA which would involve the disturbance of 43 hectares.

Soils

The type and condition of soils within the Project Area were determined through a review of previous studies, available online searches and mapping.

- The soil landscapes units within the Project Area were identified through a review of the *Wollongong – Port Hacking 1:100,000 Sheet* (Hazelton & Tille, 1990);
- Acid sulfate soils (ASS) within the Project Area were identified through a review of the NSW Atlas of Acid Sulfate Soils available from the Australian Soil Resource Information System (ASRIS) (CSIRO, 2013);
- Saline soils within the Project Area were identified through a review of the *Salinity Potential in Western Sydney 2002 1:100,000 sheet* (DIPNR, 2003); and

- Contaminated soils within the Project Area were identified through a search of the NSW OEH record of notices issued under the *Contaminated Land Management Act 1997* (CLM Act) for the Wingecarribee and Wollondilly LGAs. Phase I and Phase II contamination assessments previously undertaken for the Tahmoor Mine were also reviewed (refer **Section 11.22**).

Land and Soil Capability

The Land and Soil Capability (LSC) classification applied to the Project Area was according to the OEH guideline *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH, 2013a). This scheme uses the biophysical features of the land and soil to derive detailed rating tables for a range of land and soil hazards. The scheme consists of eight classes (**Table 11-94**) which classify the land based on the severity of long-term limitations according to:

- The biophysical features of the land to derive the LSC classes associated with various hazards; and
- The management of the hazards including the level of inputs, expertise and investment required to manage the land sustainably.

Table 11-94 Land and Soil Capability Classification

Class	Land and Soil Capability
Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, conservation)	
1	**Extremely high capability land**: Land has no limitations. No special land management practices required. Land capable of all rural land uses and land management practices.
2	**Very high capability land**: Land has slight limitations. These can be managed by readily available, easily implemented management practices. Land is capable of most land uses and land management practices, including intensive cropping with cultivation.
3	**High capability land**: Land has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation.
Land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)	
4	**Moderate capability land**: Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.
5	**Moderate–low capability land**: Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.
Land capable for a limited set of land uses (grazing, forestry and nature conservation, some horticulture)	
6	**Low capability land**: Land has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation.

Class	Land and Soil Capability
Land generally incapable of agricultural land use (selective forestry and nature conservation)	
7	**Very low capability land**: Land has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation.
8	**Extremely low capability land**: Limitations are so severe that the land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation.

Biophysical Strategic Agricultural Land Assessment

An initial desktop assessment was undertaken to determine if any mapped BSAL (as identified in *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 - Strategic Agricultural Land Map - Sheet STA_41* (DPE, 2013)) occurred in the Project Area. There is no mapped BSAL in the Project Area. The nearest area of mapped BSAL is located between Douglas Park and Camden, approximately 20 km to the north-east of the Project Area.

Further assessment was required due to the need to apply for a Site Verification Certificate (refer to **Section 8.1.3**) to certify that that the land on which the proposed development is to be carried out is not BSAL. A Site Verification Certificate for the proposed development was issued during October 2018 to confirm there is no BSAL in areas where new mining leases are required for the proposed development.

Disturbance Assessment Area

For the purposes of the assessment, the AIS considered both the Project Area and a DAA, which comprises the area within the Project Area that would be subject to known and potential disturbance of LSC classified land, including the SSA, Ventilation Shaft Sites and the REA (refer **Figure 11.37**).

11.18.3 Existing Environment

The soil landscapes units within the Project Area include the Blacktown, Gymea, Hawkesbury, Lucas Heights, Luddenham, Volcanic and Disturbed Terrain soil types (refer **Figure 2.2**). The characteristics and limitations of the soil types are shown in **Table 11-95** and have been used to determine the land capability of the Project Area.

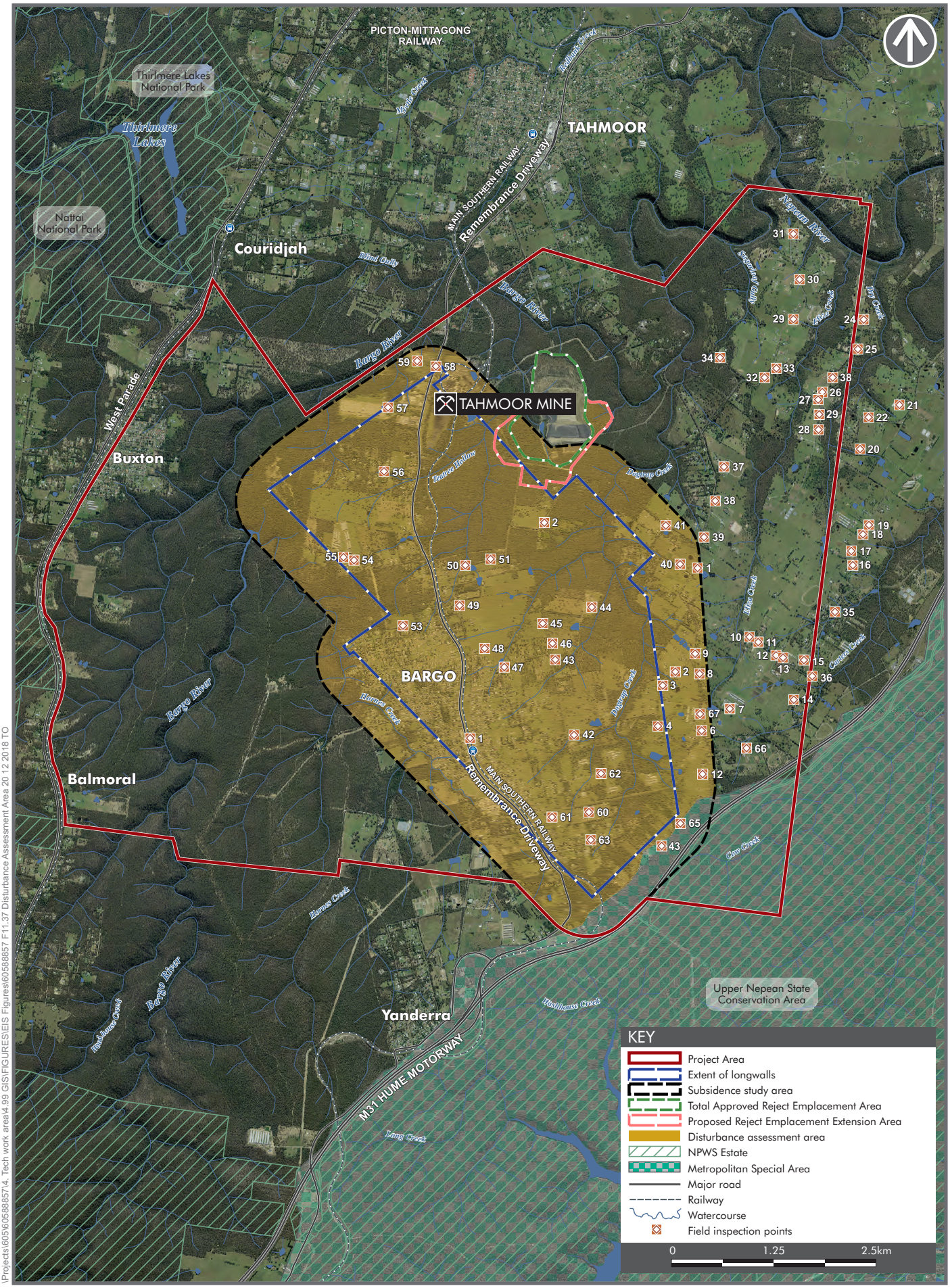
Table 11-95 Soil Landscapes within the Project Area

Soil Landscape Unit	Description / Characteristics
Blacktown (residual)	• The landscape is described as gentle undulating with the general fertility of the soils low; • Limitations are moderately reactive soil and seasonal waterlogging; • Vegetation is described as extensively cleared eucalypt low open-forest and eucalypt low woodland with sclerophyllous shrub understorey; • Erosion hazard for non-concentrated flows is generally moderate and may range from slight to extreme; and • This soil landscape unit is suitable for cropping (requiring intensive management practices) and grazing.
Gymea (erosional)	• The landscape is described as undulating to rolling rises and low hills with the general fertility of the soils very low; • Limitations are localised steep slopes, high soil erosion hazard and rock outcrops; and • This soil landscape is not suitable for any agricultural practices (designated as MSA).

Soil Landscape Unit	Description / Characteristics
Hawkesbury (colluvial)	• The landscape is described as rugged, rolling to very steep hills with the general fertility of the soils low; • Limitations of the soil landscape unit are extreme erosion hazard, mass movement, steep slopes, and rock outcrop; and • This soil landscape is not suitable for any agricultural enterprises.
Lucas Heights (residual)	• The landscape is described as gently undulating crests, ridges and plateau surfaces with the general fertility of the soils low; • Limitations to this soil landscape unit are stoniness, and localised surface movement potential; and • This soil landscape is predominately suited to grazing enterprises.
Luddenham	• Landscape is described as undulating to rolling low hills on Wianamatta Group shales, often associated with Minchinbury sandstone; • The general fertility of the soils is low to moderate; • Vegetation is described as extensively cleared dry sclerophyll open forest; • Limitations associated with this soil type include high soil erosion hazard, mass movement and moderate surface swelling potential; and • This soil landscape unit is suitable to grazing enterprises.
Volcanic	• Landscape generally covers gently inclined valley floors surrounded by steep side slopes; • Limitations associated with this soil type include localised erosion hazard, including mass movement on steep slopes; and • This soil landscape is predominately suited to grazing enterprises on localised areas on valley floors.
Disturbed Terrain	• Disturbed terrain has been highly modified by human activity. The original soil has often been removed, greatly disturbed or buried; and • This soil landscape unit is generally not suitable for agricultural production.

Five Australian Soil Classification soil types are present within the Project Area including Dermosols, Ferrosols, Kurosols, Rudosols and Tenosols. The soil types are described below:

- Kurosols are the major soil type within the Project Area and the DAA. Kurosols are soils with a strong texture contrast between the topsoil layer and lower acidic layers. Kurosols generally have moderately low inherent fertility;
- Tenosols are soils characterised by sandy to sandy loam textures. Tenosols generally have moderately low inherent fertility;
- Rudosols are generally young soils which have not had time to form structurally. Rudosols generally have moderately low inherent fertility;
- Ferrosols are soils which are derived from volcanics, are high in iron oxide. Ferrosols have moderately high inherent fertility; and
- Dermosols are soils with a structured secondary soil layer with a concentration of clay, minerals, or organics. Dermosols generally have moderately high inherent fertility.



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SIMEC MINING

DISTURBANCE ASSESSMENT AREA

Tahmoor South Project
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FIGURE 11.37

Acid Sulfate Soils

Soils can contain iron pyrite in an unoxidised state and when air comes in contact with them they oxidise forming ASS. When water passes through the ASS, sulphuric acid leaches out and passes into waterways. ASS were formed in locations where marine sediment was deposited during the Holocene geological period (<11,000 years before present). These soils generally occur below and up to 5 m AHD in estuaries, rivers, floodplains, back swamps and sand dunes and are therefore typically associated with low-lying coastal areas, including estuarine flood plains, rivers and creeks.

The elevation of the Project Area is greater than 5 m AHD and it is not located in a coastal area. Therefore the likelihood of ASS occurring is considered to be low. A review of the NSW Atlas of ASS mapping identifies the Project Area as having a low to very low probability of occurrence for ASS.

Saline Soils

Areas that are underlain by shale with a shallow water table are generally classified as having a high probability of containing saline soils. In the Southern Coalfields, salinity is generally associated with the Wianamatta Group shales, in particular, with drainage systems within soil types that include the Blacktown Soil Landscape (DNR, 2006). Within the Blacktown Soil Landscape, localised recordings of saline soils have been recorded. Reference to the *Salinity Potential in Western Sydney 1:100,000 sheet* (DIPNR, 2003), indicates that the Project Area has a very low to moderate salinity potential.

Salinity can result in the deterioration of road and concrete surfaces and the disturbance of saline soils can result in an increased saline load in surface water runoff from land. Salinity may also result in the deterioration of rural and agricultural land use.

Contaminated Soils

Construction of the additional surface infrastructure associated with the proposed development would be largely located on land within the existing Tahmoor Mine Surface Facilities Area. Potential for contamination from the existing Tahmoor Mine surface facilities was investigated through a previous Phase I and Phase II Contamination Assessment (ENSR, 2009; AECOM, 2011) as discussed in **Section 11.22**. It identified contaminating activities which had historically occurred at Tahmoor Mine but concluded that soil contamination was limited, generally in the vicinity of waste oil and underground tanks, and did not represent a significant risk of harm to the environment.

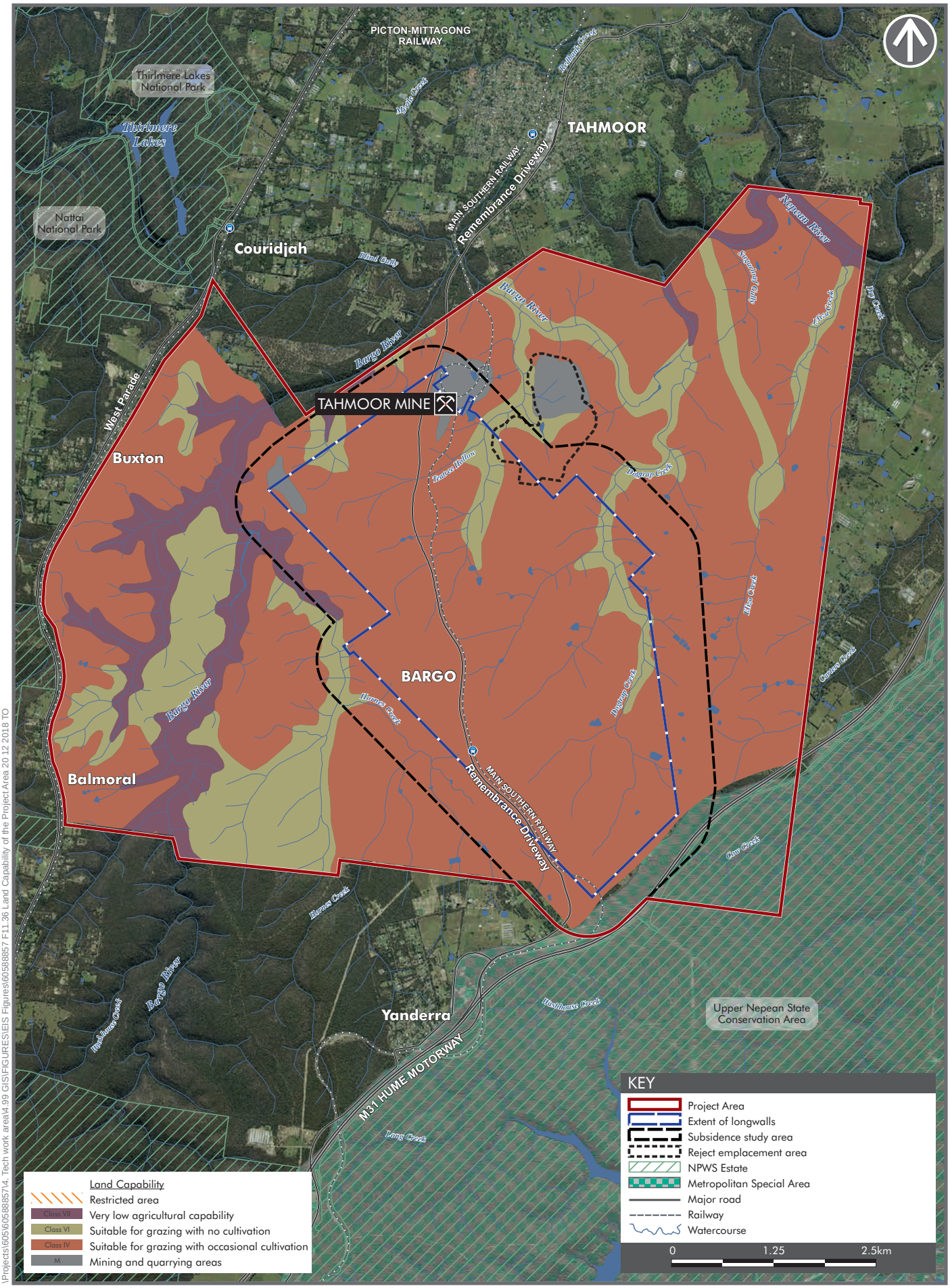
Further, surrounding land uses (primarily agricultural) are unlikely to have been impacted by these activities. Should ground excavation works during the construction of surface infrastructure associated with the proposed development encounter contaminated land or soil suspected to be contaminated, appropriate mitigation measures would be implemented consistent with existing Tahmoor Mine soil management procedures including the testing, containment, and removal of the material to an approved waste facility, to ensure protection of workers and the environment.

There is potential for historic land uses within the Project Area, such as livestock intensive industries to result in soil contamination. The extension of the REA is located on land not currently utilised for agricultural or other pastoral uses and is therefore unlikely to contain contaminated soils. The extension of longwall mining would undermine land used for agricultural land purposes, therefore there is potential for contaminated land to exist in these areas. However, infrastructure that would be established in these areas would be limited to additional ventilation and gas drainage works, and would be subject to the management procedures identified above, should contaminated land be encountered.

An investigation of the OEH record of notices issued under the CLM Act for the Wingecarribee and Wollondilly LGAs identified one record existing within the Wollondilly LGA. This site is the Maldon Works located on Wilton Park Road which is located outside of the Project Area and would not be impacted by the proposed development. Four sites were identified within the Wingecarribee LGA which were the Former Gasworks Site (Bowral), Former Shale Oil Refinery (Joadja), Former Shale Oil Plant (Mittagong) and Moss Vale North Deport (Moss Vale). None of these sites are within the Project Area and therefore would not be impacted.

Land Capability

Land capability of the Project Area was determined using the methods described in **Section 11.18.2**. The results of the assessment are shown on **Figure 11.38** and detailed in **Table 11-96**.



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SIMEC MINING

LAND CAPABILITY OF THE PROJECT AREA

Tahmoor South Project
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FIGURE 11.38

Table 11-96 Land and Soil Capability Classes

Land & Soil Capability	Project Area		DAA		Agricultural Capability
Class	**Hectares**	**%**	**Hectares**	**%**	
4	4,615	71	2,254	86	Moderate capability land
6	11,000	15	200	8	Low capability land
7	509	8	37	1	Very low capability land
Metropolitan Special Area	271	4	78	3	No classification for agricultural use
Mine Disturbed	103	2	55	2	
Total	**6,498**	**100**	**2,624**	**100**	

Three LSC classes are present within the Project Area and DAA: class 4, 6 and 7. Some areas within the Project Area are not classed under the LSC system and include the Metropolitan Special Area and the existing disturbed areas of the Tahmoor Mine.

Biophysical Strategic Agricultural Land

As discussed in **Section 11.18.2**, there is no BSAL within the Project Area. The nearest mapped BSAL is located between Douglas Park and Camden, approximately 20 km to the north-east of the Project Area. Due to the absence of BSAL in the project area, no impacts to BSAL would occur as a result of the proposed development.

11.18.4 Impact Assessment

Potential impacts on soils and land capability are largely associated with soil erosion of hardstand areas and surface infrastructure, as well as surface impacts as a result of subsidence.

Soils

Activities likely to disturb soils within the Project Area include:

- Construction activities associated with the upgrade of the Surface Infrastructure Area;
- Extension, operation and progressive rehabilitation of the REA;
- Construction of ventilation shafts;
- Access road upgrade; and
- Surface subsidence effects from the mining of longwalls, and the rehabilitation of these surface impacts.

Disturbance of soils during these activities could temporarily increase potential erosion and sediment loads within the vicinity of the activity with the potential to impact on nearby waterways. Soil disturbance would also occur where stripping is required to rehabilitate surface cracking and impacts during rehabilitation of the proposed development as part of mine closure (which would be addressed as part of the Mine Closure Plan, refer **Section 11.23**).

ASS and saline soils are not likely to be present within the Project Area. As such, impacts from the proposed development on soils are expected to be negligible. However, the potential exists for soils to be contaminated through fuel, chemical and oil spillages from vehicles and machinery working on site.

Potential subsidence impacts associated with longwall mining have been detailed in **Section 11.1** and include ground deformations such as surface cracking, heaving, buckling, humping and stepping of land at the surface. These ground deformations may result in land degradation at the surface and the potential for increased erosion.

Impacts on soil are expected to be minimal given the limited ground surface disturbance associated with the proposed development and given the continued implementation of mitigation measures successfully and currently implemented at Tahmoor Mine.

Land Capability

The only surface impacts likely to impact on the classification of potential land productivity include land clearing associated with surface works (i.e. ventilation shafts and REA expansion). Based on the mapped areas of rural land capability within the DAA (**Figure 11.38**), the following potential impacts to land capability were identified:

- Temporary removal of 13 hectares of Class 4 land from potential agricultural production during the life of the proposed development as a result of ventilation shaft site development. These areas will be rehabilitated to conditions that are generally consistent with pre-mining conditions in accordance with the *Conceptual Mine Closure Plan* (Appendix V) and therefore would not result in a permanent loss of agricultural potential.
- Permanent removal of 43 hectares of land with potential agricultural production as a result of the expansion of the REA: 37 hectares of Class 4 (moderate capability) land; and 6 hectares of Class 6 (low capability) land.

  This area would ultimately be rehabilitated to native bushland as part of the establishment of the final landform during mine closure. Following rehabilitation, the land would have a lower land capability than pre-mining and as such has been assessed as a permanent loss of potential agricultural value.

The permanent removal of potential agricultural land represents approximately 1% of the DAA.

11.18.5 Management and Mitigation Measures

Mitigation measures are currently employed as part of the existing Tahmoor Mine in order to manage potential impacts on soil. The current overarching environmental management system at Tahmoor Mine includes a Soil and Water Management Plan which mitigates potential impacts on soils of the area through stipulating requirements for regular inspections of the surface features for soil erosion and surface cracking due to longwall mining (refer to **Section 11.1** for subsidence management).

An approved SMP for Tahmoor Mine also contains a series of TARPs, which provide for corrective action and ongoing mitigation and management of subsidence impacts affecting the Project Area. A similar TARP would be prepared for the proposed development.

In addition, the Conceptual Mine Closure Plan provided in **Appendix V** and summarised in **Section 11.23** provides details on the progressive rehabilitation of disturbed land and the management of soil impacts during rehabilitation and ultimately during mine closure.

The successful rehabilitation of disturbed land to the target LSC classification is a critical component of mining operations that has been previously demonstrated by Tahmoor Coal through successful rehabilitation of disturbed lands at the Tahmoor Mine.

11.18.6 Conclusion

The soils and land capability of the Project Area have been identified as moderate to low capability land with generally poor fertility soils. No ASS or saline soils are expected to be present within the Project Area.

A total of 43 hectares of current bushland that is classified as potential agricultural land will be permanently removed as part of the REA expansion. Importantly however; this land is not currently used for agricultural purposes. Further discussion on the potential for impacts to agricultural land use is provided in **Section 11.19**.

The potential for impacts resulting from the proposed development include the disturbance of soil during surface works and surface impacts from subsidence. However, these impacts are expected to be manageable through erosion and sediment controls and subsidence management measures contained within the existing SMP. The SMP would be updated for the proposed development.

Rehabilitation is proposed and would be undertaken in accordance with the existing SMP and as detailed in the Conceptual Mine Closure Plan (**Appendix V**). Provided the existing mitigation measures and proposed rehabilitation measures are implemented, the proposed development is unlikely to significantly alter the land capability of the Project Area.

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11.19 Land Use, Agriculture and Resources

An Agricultural Impact Statement was prepared by SLR (2018) and is provided in **Appendix T**. This section identifies land use within the Project Area, as well as identifying key agricultural land and water resources and enterprises in the local area.

11.19.1 Background

The NSW *Strategic Regional Land Use Policy* (DPE, 2012) applies to areas within NSW where there is high value agricultural land and mining activity. Part of this policy requires all State-significant mining development proposals with the potential to affect agricultural resources, whether or not they are located on land mapped as biophysical strategic agricultural land, to prepare an Agricultural Impact Statement.

The purpose of the Agricultural Impact Statement prepared for the proposed development was to conduct a detailed assessment of the potential impacts of the proposed development on:

- soil and land capability (which has been detailed previously in **Section 11.18**);
- land use, including forestry, conservation and recreational use, with particular reference to the Thirlmere Lakes and Nattai National Parks, and the Upper Nepean and Bargo River State Conservation Area; and
- agricultural resources and/or enterprises in the local area including any change in land use or resources as a result of the proposed development.

11.19.2 Methodology

Assessment of land use and agricultural resources of the Project Area involved:

- A desktop review of available information to characterise the Project Area and to identify mapped and described land uses, including a review of State and local strategic and planning documents;
- A land capability assessment which identified the potential for agricultural land within the Project Area (refer **Section 11.18**);
- A field visit and site inspection, which was undertaken in June 2013, December 2017 and October 2018 by SLR's Associate Agronomist to validate the desktop review and to identify specific agricultural enterprises within the Project Area; and
- Utilising the findings of the land capability assessment and desktop review to inform assessment for the potential of agricultural and other land uses that may be impacted by the proposed development. The assessment identified potential impacts on agricultural resources and industry, and recommended mitigation measures for identified impacts.

Potential impacts to land use and agricultural resources were anticipated to be limited to a defined DAA which includes the SSA, ventilation shaft sites and the REA expansion area (refer to **Section 11.18.2**). The DAA is located entirely within the Wollondilly LGA. As described in **Section 11.19.4**, impacts to land use and agricultural resources within the SSA would be limited to temporary, indirect impacts compared to impacts associated with the ventilation shaft sites and REA expansion area which would consist of direct temporary and permanent impacts.

11.19.3 Existing Environment

Regional Land Use

The Project Area is located primarily within the Wollondilly LGA, and partially within the Wingecarribee LGA. Land use in the region is characterised by a mix of village residential, rural residential, market gardens, agricultural and conservation areas. Most of the rural land is used for agricultural purposes, including market gardens, orchards, dairy farms, poultry farms and grazing (Wollondilly profile.id, 2013).

The Project Area traverses semi-rural and partly forested landscapes, along with a mix of rural and environmental land uses. Townships, villages and rural residences dot the landscape, the nearest of which include the township of Tahmoor and villages of Bargo, Yanderra, Pheasants Nest, Couridjah, Balmoral and Buxton.

The Project Area is located in a region with a long history of agricultural use. Rural uses within the Project Area include small-scale agricultural activities such as horticulture, poultry, cattle grazing, trotting horse training, greyhound training and several horse studs. While incised gullies and plateaux have largely remained undisturbed, large areas of flat and low gradient slopes have undergone moderate landscape disturbances as a result of large-scale native vegetation clearing to allow agricultural production.

Agricultural Land and Resources

Agriculture is a minor land use for the regional area, accounting for 11% of land use within the Wollondilly LGA (SLR, 2018). Of the agricultural land within the LGA, the vast majority is utilised for grazing activities, primarily for cattle and sheep. A small portion of land is utilised for cropping activities primarily for vegetable and fruit production. Poultry accounts for a large proportion of livestock numbers within the LGA.

The land capability assessment (**Section 11.18**) generally supports the LGA profile and identified that the majority of agricultural land within the Project Area and DAA (as defined in **Section 11.19**) is best suited to grazing enterprises and is highly to severely constrained for cultivation (cropping) enterprises. Smaller portions of agricultural land within the Project Area and DAA were considered suited to cultivation enterprises using intensive soil management practices.

The site inspection undertaken for the proposed development to ground-truth desktop information identified a number of differing agricultural land uses within the DAA. The various land uses at each site were recorded and are described in **Table 11-97**. Land uses within the Project Area are shown in **Figure 11.39**. Approximately 26% (or 677 hectares) of the DAA is considered to be available for agricultural production in its current form. Using a precautionary assessment and assuming this total area is LSC Class 4, this area has the potential to generate a gross margin of $200,392 per annum from beef cattle production.

The main income generating enterprises in the DAA relating to agriculture are poultry hatching and growing-out operations (Ingham's and Cordina), vegetables grown in market gardens and greenhouses, pacing horse (standard bred trotters) and greyhound breeding and training facilities (SLR, 2018).

Table 11-97 Observed Land Use (SLR, 2018)

Site	Land Use	Site	Land Use
1	Cattle grazing	35	Pleasure horses
2	Irrigated olives	36	Hydroponic lettuce
3	Alpacas 2013, rural residential 2017	37	Standard bred (pacing) horses
4	Cattle and horse grazing	38	Pleasure horses
5	Market garden	39	Pleasure horses
6	Boarding kennels	40	Tomato greenhouses & irrigated vegetables
7	Inghams poultry sheds & cattle grazing	41	Horse pre-training complex
8	Pleasure horses	42	Pleasure horses
9	Sheep grazing	43	Pleasure horses
10	Rural residential	44	Bargo waste facility
11	Standard bred (pacing) horses	45	Cattle grazing 2013, rural residential 2017
12	Cattle grazing	46	Pleasure horses
13	Markey garden	47	Pleasure horses
14	Market garden & Fresian horse stud	48	Cattle grazing 2013, rural residential 2017

Site	Land Use	Site	Land Use
15	Oat crop	49	Pleasure horses
16	Hard rock quarry	50	Cattle grazing
17	Cattle grazing	51	Disused cattle feedlot
18	Cordina poultry sheds	52	Pleasure horses
19	Draught horses	53	Rural residential
20	Cattle grazing	54	Hydroponic lettuce
21	Disused poultry sheds	55	Poultry sheds
22	Pleasure horses	56	Disused cut flower greenhouses
23	Sheep grazing	57	Inghams poultry sheds
24	Sheep grazing	58	Olives & sheep grazing
25	Pleasure horses	59	Irrigated olives & alpaca stud
26	Pleasure horses	60	Rural residential
27	Pleasure horses	61	Pleasure horses
28	Pleasure horses	62	Inghams poultry sheds
29	Standard bred (pacing) horses	63	Disused cut flower greenhouses
30	Pleasure horses	64	Boarding kennels
31	Rural residential	65	Critter Bits rural produce store
32	Rural residential	66	Greenhouses & market garden
33	Cattle grazing 2013, rural residential 2017	67	Poultry sheds
34	Horse pre-training complex		

Water Resources

The Project Area is covered by the Greater Metropolitan Groundwater Sources Water Sharing Plan. 791 privately-owned groundwater extraction bores have been identified within, and surrounding the Project Area. Most of the groundwater usage in the area is from the Hawkesbury Sandstone or from surficial alluvium and basalt aquifers (about 89% of the total), with about 10% from the Bulgo Sandstone (Hydrosimulations 2018).

Tahmoor Mine holds three groundwater licences with a total volume of 1,642 ML per annum, and a 5 ML per year surface water extraction licence.

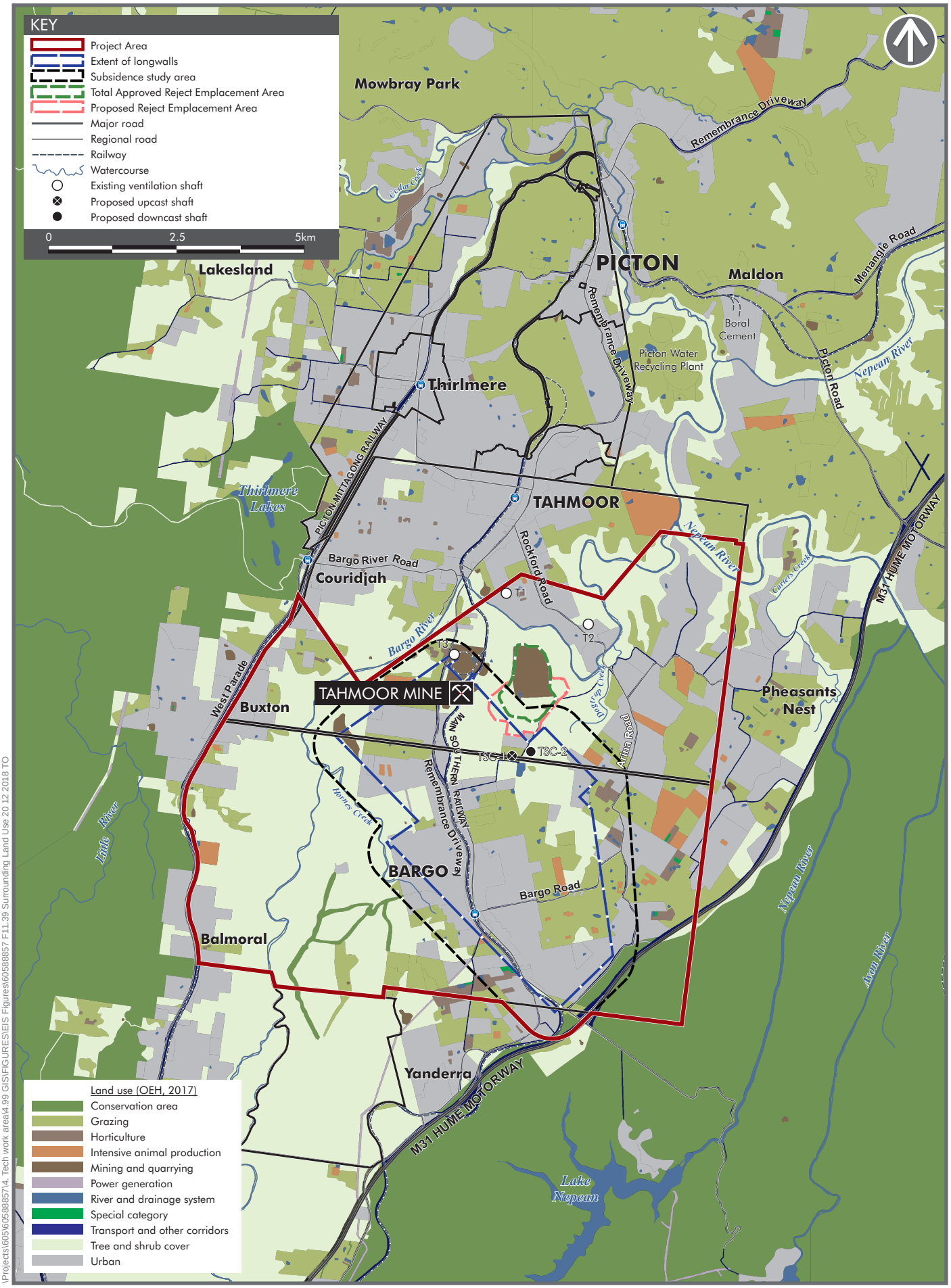
National Parks and State Conservation Areas

The region surrounding the Project Area encompasses large areas dedicated to conservation and the protection of drinking water catchments, referred to as the Metropolitan Special Area. These are the Upper Nepean State Conservation Area, Bargo River State Conservation Area, Thirlmere Lakes National Park and Nattai National Park as described in **Table 11-98** and shown in **Figure 2.3**. The principal difference between the management, objectives and principles of National Parks and State Conservation Areas is that mineral and petroleum exploration and mining may be permitted in State Conservation Areas (OEH, 2014).

Table 11-98 National Parks and State Conservation Areas in proximity to the Project Area

Name	Description / Land Use Values	Location
Upper Nepean State Conservation Area	Upper Nepean State Conservation Area protects the Nepean dam and the upper catchment area.	East of the M31 Hume Motorway, within the south eastern portion of the Project Area (but not within proposed development)
Bargo River State Conservation Area	Bargo River State Conservation Area is a smaller conservation area (1,970 ha), protecting a section of the upper Bargo River catchment.	South of the Project Area
Bargo State Conservation Area	Bargo State Conservation Area is known to contain several Aboriginal sites and contains several items of European history. It also provides undisturbed bushland areas popular with bushwalkers.	Adjacent to the western boundary of the Project Area, west of the Southern Railway (Picton to Colo Vale spur line)
Thirlmere Lakes National Park	Thirlmere Lakes National Park is known for natural wetlands, bushland and the five freshwater lakes which make up the Park. This National Park is also part of the Greater Blue Mountains World Heritage Area.	North-west of the Project Area, west of the Southern Railway (Picton to Colo Vale spur line)
Nattai National Park	The Nattai National Park encompasses the Warragamba dam catchment and provides bushland and wilderness qualities popular with bushwalkers. This National Park is also part of the Greater Blue Mountains World Heritage Area.	West of the Project Are, joining the Thirlmere Lakes National Park and Bargo State Conservation Area.

The Upper Nepean State Conservation Area is the largest of the State Conservation Areas surrounding the Project Area. It was established in 2007 and covers a total area of 25,869 ha. Approximately 171 hectares of this area (2%) lies within the Project Area although the proposed development itself does not extend within its land. The majority of the State Conservation Area encompassed within the Project Area is designated within the Fire Management Strategy (OEH, 2008) as Strategic Fire Advantage Zones or Land Management Zones.



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SIMEC MINING

SURROUNDING LAND USE

Tahmoor South Project
Environmental Impact Statement

FIGURE 11.39

11.19.4 Impact Assessment

Agricultural Land and Resources

As discussed in **Section 11.18** there is no BSAL within the Project Area. The nearest mapped BSAL is located between Douglas Park and Camden, approximately 20 km to the north-east of the Project Area. Due to the absence of BSAL in the project area, no impacts to BSAL would occur as a result of the proposed development.

LSC classified land within the DDA included: the SSA, the ventilation shaft sites and the REA expansion area, but did not include existing disturbed areas of the mine (i.e. Surface Facilities Area). The agricultural assessment has focused on LSC classified land.

It is considered that potential impacts would consist of:

- Temporary impacts related to:
  - direct surface disturbance of LSC classified land at ventilation shaft sites that can be rehabilitated back to the same land capability post mining; and
  - indirect surface disturbance at the SSA resulting from subsidence following the mining of longwalls.
- Permanent impacts related to direct disturbance at the REA where construction, use and subsequent rehabilitation following mine closure results in a permanent change of land use and loss of land that is classified as having potential for agricultural production.

Temporary Impacts

Approximately 13 hectares of potential agricultural land would be temporarily removed during the proposed development for the construction of the ventilation shaft sites and associated services (approximately 6 hectares at each site). These 13 hectares are LSC Class 4 land that are currently used for grazing pleasure horses in the case of TSC1 and comprises bushland on Crown Reserve that has not historically been used for agricultural production in the case of TSC2. The areas would be rehabilitated to a native bushland area generally consistent with pre-mining conditions upon the cessation of mining.

In relation to the potential impacts from subsidence, no change to the LSC Class across the SSA is predicted as a result of subsidence resulting from the proposed development (MSEC, 2018). Notwithstanding, a number of agricultural structures were identified during the field inspection that may be subject to impacts resulting from subsidence. These structures include:

- Rural structures – which are more susceptible to impacts when in poor existing condition. However, risk to public safety is considered low and minor expected impacts are readily remediated;
- Water tanks – which are unlikely to experience impacts as a result of ground strains. However, associated underground pipework to these tanks may experience minor impacts such as leaking joints which are readily remediated;
- Gas and fuel storages– which are unlikely to experience impacts as a result of ground strains. However, associated underground pipework to these tanks may experience minor impacts such as minor gas leaks which are readily remediated;
- Poultry sheds – which are expected to remain in safe and serviceable condition. Any potential impacts would be minor in nature and readily remediated;
- Greenhouses and hothouses – which are unlikely to experience impacts as a result of subsidence. Any potential impacts would be minor in nature and readily remediated;
- Irrigation systems – which are usually constructed of polyethylene pipe which are resilient to predicted subsidence impacts. Any potential impacts would be minor in nature (such as minor pipe leaks) and readily remediated;

- Farm fences – which can be affected by tilting of the fence posts and changes of tension in the fence wire as a result of subsidence strains. Impacts to fences are anticipated to be minor in nature and readily remediated; and
- Farm dams – which can experience changes in water levels, capacity and stability as a result of subsidence tilt. It is unlikely the majority of farm dams would experience adverse impacts. However, remedial measures are readily available where impacts to storage capacity or levels are experienced such as increasing the heights of impacted dam walls. There is extensive experience of mining underneath farm dams within the Southern Coalfields and there have been minimal claims of significant adverse impacts. As such, the likelihood of expected impacts for the proposed development is considered low and is considered manageable.

It is considered that potential subsidence impacts to agricultural enterprises within the Project Area during the life of the proposed development will be temporary, involving relatively minor subsidence related damage to farm infrastructure, which are readily manageable through appropriate repair measures. Direct impacts to agricultural land (LSC Class 4) would be temporary subject to post-mining rehabilitation back to existing land capability. Based on the above impacts are not anticipated to be significant.

Permanent Impacts

There is no land within the DAA that is currently used for agricultural purposes that will permanently be removed from production. However, there is approximately 43 hectares of land within the DAA that is classified as having potential for agricultural production that would be removed as a result of the REA expansion. This consists of 37 hectares of Class 4 (moderate capability) land and 6 hectares of Class 6 (low potential) land, and is estimated as having potential to provide a gross margin of $11,840 per annum were it utilised for agricultural production.

The REA will be rehabilitated to LSC Class 6 or 7 land. Conservatively assuming it will be returned to Class 7 land, the rehabilitated area would have a potential gross margin of $3,182 per annum. Therefore, the total calculated loss as a result of the reduction in LSC Class from Class 4 and 6 to Class 7, is $8,658 per annum calculated over 43 hectares. When compared to the gross annual value of agricultural production for the Wollondilly LGA ($61.3 million) this amount is considered a negligible impact on agricultural enterprises, agricultural employment and related industries. Also, none of the 43 hectares has been used for agricultural production currently or in the past. Further, a loss of $8,658 per annum is considered acceptable given the significant economic benefits of the proposed development (refer **Section 11.16**).

Water Resources

An assessment of impacts to water resources has been undertaken for both surface water and groundwater resources and has been presented previously in **Section 11.4** and **Section 11.3**, respectively. Based on the findings of these assessments, predicted changes in flood inundation, water flow velocity and stream profile are not considered likely to significantly impact agricultural resources or enterprises within the Project Area.

With respect to groundwater impacts, a total of 30 registered bores and three unregistered bores are predicted to experience drawdown of greater than 2 m as a result of the proposed development (Hydro Simulations, 2018). Due to changes in hydraulic properties and depressurisation of the strata there is potential for mixing of groundwater between different units, however it is considered unlikely to result in changes to beneficial uses of groundwater (refer **Section 11.3**). Tahmoor Coal would implement make good measures in relation to all bores identified to be impacted by water drawdown and/ or quality. Make good measures have been routinely and successfully implemented as part of existing Tahmoor Mine operations and would continue to be applied for the Tahmoor South Project. With the implementation of these measures, it is considered that impacts to groundwater bores can be managed. Make good measures and other groundwater mitigation and management measures are further discussed in **Section 11.3**.

Offsets

A Biodiversity Offset Strategy has been proposed by Tahmoor Coal to offset the loss of vegetation from clearing associated with the construction of the new surface facilities required to support the proposed development (refer to **Section 11.6**). The Biodiversity Assessment Report (Niche, 2018) identifies five biodiversity offset sites for the Biodiversity Offset Strategy:

- Rockford Road BioBank Site;
- Pit Top BioBank Site;
- Ventilation Shaft No. 2 Site;
- Bargo Colliery BioBank Site; and
- Anthony Road BioBank Site.

One of these is potentially considered to be an agricultural resource (Anthony Road BioBank Site) and is currently used to graze pleasure horses. The remainder are heavily timbered with native bushland. Therefore, the Biodiversity Offset Strategy will have a minor impact upon an agricultural resource or enterprise.

State Conservation Areas

The Subsidence Impact Assessment (**Appendix F**) for the proposed development identified that subsidence within the Upper Nepean State Conservation Area is expected to be negligible.

11.19.5 Management and Mitigation Measures

Management of land use for the proposed development include measures prior to, during and post mining activities. These measures include:

- Minimising disturbance to agricultural lands through minimising land clearing activities during mine planning and ensuring prompt rehabilitation following impacts.
- In accordance with existing practice at Tahmoor Mine, a Surface, Safety and Serviceability Management Plan would be developed for each asset expected to experience impacts from subsidence. This would include impacts on rural structures, tanks, sheds, fencing and farm dams.
- Development of a Land Management Plan or equivalent to manage land use and agricultural land within the Project Area. The plan would complement or include other management plans which cover impacts to land use such as surface and groundwater management, weed control, and rehabilitation. Regular inspection would be undertaken under this Plan to identify and remediate subsidence impacts such as cracking or other surface deformations.
- Re-establishing agricultural lands following mine closure in accordance with the Conceptual Mine Closure Plan (refer **Section 11.23**) to ensure acceptable post-disturbance land use and stability of the post-disturbance landform. This includes ensuring the successful restoration of agricultural land to target LSC Classifications.

11.19.6 Conclusion

Land use within the Project Area and DAA has been identified as predominately rural with some urban townships. There is no mapped BSAL in the Project Area. The nearest area of mapped BSAL is located between Douglas Park and Camden, approximately 20 km to the north-east of the Project Area. Conservation Areas surround the Project Area; however a small portion of only one, the Upper Nepean State Conservation Area, is located within the Project Area (though not within the proposed development). Subsidence impacts to the Upper Nepean State Conservation Area are considered to be negligible.

Rural land use in the Project Area includes existing agricultural land and land identified as having agricultural potential or availability. Temporary impacts to this land are anticipated as a result of ventilation shaft construction (which would be restored as part of post-mining rehabilitation), as well as subsidence related impacts to agriculture structures. However, these impacts are expected to be minor and readily managed through the SMP and/or the Extraction Plan.

Land disturbed for surface infrastructure (ventilation shafts) would be rehabilitated consistent with pre-mining conditions, following the cessation of mining. As such there would be no permanent loss of potential agricultural land use (post-mining) as a result of surface facility development associated with the Tahmoor South Project.

However, approximately 43 hectares of potential agricultural land, comprising 37 hectares of LSC Class 4 and 6 hectares Class 6 land, would be reduced to Class 7 land and therefore permanently removed from potential agricultural production as a result of the REA expansion. This land is not currently used for agricultural production and would be returned to bushland as part of the rehabilitation of the site following mine closure. It is considered that the economic benefits of the proposed development would exceed the economic loss of the 43 hectares of potential agricultural land.

The Anthony Road BioBank Site is considered potentially agriculturally productive land and is currently used to graze horses. Therefore the Biodiversity Offset Strategy would have a minor impact on agricultural resources or enterprises. All other BioBank sites are heavily timbered with native bushland.

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11.20 Rejects Disposal

This section addresses the SEARs relevant to rejects emplacement for the proposed developed. Relevant SEARs are listed in **Table 11-99**.

Table 11-99 SEARs for the assessment of rejects emplacement

Rejects SEARs	Section Addressed
Waste – including a waste management strategy;	**Section 11.21**
Rehabilitation and Final Landform – including an assessment of the likely impacts of the development on existing landforms and topography, including justification of the final landform design of the rejects emplacement area expansion and its long term geotechnical stability.	**Section 11.20**

Environmental assessment requirements for key agencies, including the EPA and OEH also requested investigation of alternative methods for reject disposal and use, including underground emplacement. Alternatives considered for rejects disposal are outlined in **Section 6.2.6.**

11.20.1 Existing Environment

Coal Rejects Material

Coal rejects generally comprise a mixture of carbonaceous shale and mudstone, with minor quantities of sandstone and small quantities of low quality coal. There are four types of coal rejects generated at the Tahmoor Mine, including:

- oversize rejects, comprised of small quantities of larger ROM oversize reject material and coal produced occasionally during screen or belt maintenance;
- coarse rejects, which are by-products from the coal washing process;
- fine rejects produced from the washery filter and belt equipment and generally have a higher moisture content; and
- coal sludge and yard clean-up spoil, comprising small quantities of sediment from site water treatment ponds and sumps.

Typical moisture content of coarse rejects is 4% to 8%, and 20% to 30% for fine rejects. When combined on the conveyor, the overall combined reject product has a moisture content of about 6% to 12%. **Table 11-100** below details the typical size faction and moisture content of coal rejects from the CHPP.

Table 11-100 Typical size faction and moisture content of all coal rejects from the CHPP

Size Fraction (mm)		Cumulative Mass (%)	
		Passing	Retained
	+ 100.0		Nil
- 100.0	+ 75.0	100.0	0.2
- 75.0	+ 50.0	99.8	1.4
- 50.0	+ 31.5	98.6	29.3
- 31.5	+ 16.0	70.7	55.7
- 16.0	+ 8.0	44.3	73.7
- 8.0	+ 4.0	26.3	83.6
- 4.0	+ 2.0	16.4	89.5

Size Fraction (mm)		Cumulative Mass (%)	
		Passing	Retained
- 2.0	+ 1.0	10.5	94.1
- 1.0	+ 0.5	5.9	96.1
- 0.5	+ 0.250	3.9	96.7
- 0.250	+ 0.150	3.3	97.1
- 0.150	+ 0.075	2.9	97.7
- 0.075		2.3	100

Tahmoor Mine REA

Historically, up to 50,000t of rejects material per annum from the Tahmoor Mine were used as select fill for a range of local community and construction projects within the Southern Coalfields, including residential developments and commercial applications. Currently, all coal rejects material is disposed of within the REA.

The existing Tahmoor Mine REA was approved as part of the 1979 Tahmoor development consent and subsequently modified by the 1994 development consent. The use of the existing Tahmoor Mine REA commenced in 1980 and currently occupies an area of about 89 ha, measuring about 1,300 m long from north to south, and 650 m wide in an east-west direction. The existing approved REA has a capacity of about 13Mt and average depth of fill to about 12 m. The REA was designed with a maximum height of about 300 m AHD. There is about 4 Mt of capacity remaining, which is expected to be used by 2022, aligning with the completion of the Tahmoor North operations.

A condition of the 1994 development consent was the development of a management, rehabilitation and monitoring plan for the REA. Operation of the REA is generally carried out in accordance with this plan which was developed in 1995. The management plan outlines design criteria, operational procedures, stormwater management, rehabilitation criteria and water monitoring requirements.

Oversize rejects, coal sludge and yard clean up spoil is transported to the REA by truck. The fine stream is dewatered using belt press and drum filter before being combined with the coarse stream, and transported by the 3R conveyor to the reject bin, for loading into rear-dump haul trucks. The rejects are transported by haul trucks, on private roads within the site, and emplaced at the REA. Rejects are dumped, compacted, shaped, topsoiled and progressively rehabilitated. The general deposition principles for the REA are outlined in Tahmoor Coal's *Reject Emplacement Area Plan* and are as follows:

- The active REA is not to exceed 4.5 ha under normal circumstances.
- All slopes are contour ploughed to reduce the potential for erosion to occur. The maximum batter slopes are:
  - external batters – 1 in 8;
  - maximum external batters – 1 in 4;
  - internal batters – 1 in 4; and
  - maximum internal batters – 1 in 3.

Rejects deposition is undertaken with the aim of minimising the area of disturbance as much as possible, with rehabilitation of disturbed surfaces commencing as soon as practical following the completion of rejects disposal within each area. Mobile equipment used to service the REA includes haul trucks, dozers, excavators, scrapers, graders and water trucks.

11.20.2 Impact Assessment

Reject Disposal

It is predicted that the proposed development would produce 15 Mt of coal reject material. Options considered for reject disposal and the configuration of the REA are described in **Section 6.2.6**. An

indicative annual breakdown of the generation of this material based on a 70% yield is provided in **Table 11-101**. The total coal reject quantities shown in the table below are based on maximum production. However, the actual quantity produced in any one year will be dependent on localised geological features, detailed mine design, the actual mine development sequence and operational factors. The preferred disposal strategy consists of two new areas adjoining the existing REA, using a staged fill plan approach. The REA will be progressively rehabilitated over the life of the mine.

The volume summary for the proposed expanded portion of the Tahmoor Mine REA is summarised in **Table 11-102** below.

Final shaping of the REA will occur in line with mine closure planning and will be managed within the footprint shown in **Figure 4.13**.

Table 11-101 Indicative schedule of annual coal reject material production

Year	Coal Reject Production (tonnes)	Cumulative Coal Reject Production (tonnes)
2019	30,000	30,000
2020	94,000	124,000
2021	322,000	446,000
2022	825,000	1,271,000
2023	1,066,000	2,337,000
2024	1,041,000	3,378,000
2025	1,061,000	4,439,000
2026	1,081,000	5,520,000
2027	1,171,000	6,691,000
2028	1,099,000	7,790,000
2029	1,014,000	8,804,000
2030	1,136,000	9,940,000
2031	1,053,000	10,993,000
2032	1,056,000	12,049,000
2033	1,186,000	13,235,000
2034	780,000	14,015,000
2035	335,000	14,350,000

Table 11-102 REA Volume Summary

Description	Area (m^2)	Fill (m^3)	Compaction Level (t/m^3)	Storage capacity (t)
Area 1	592,989 m^2	5,693,000 m^3	2.002 t/m^3	11,500,000
Area 2	210,677 m^2	1,750,000 m^3	2.002 t/m^3	3,500,000
Total	803,666 m^2	7,443,000 m^3		15,000,000

Construction

Construction works to accommodate the expansion of the REA would include construction of new internal haul roads around and within the REA and would potentially have a range of minor biophysical and social impacts. These include impacts on the amenity of local residents and visitors to the area, with regards to noise, air and visual impacts, as well as impacts to local ecological values and surface water quality.

The expansion of the REA will result in the clearance of a total of 39.7 ha of native vegetation, mainly comprising Shale Sandstone Transition Forest (SSTF) (34 ha). Construction activities for the expansion of the REA, have the potential to increase dust generation, erosion and sedimentation which may impact air quality, surface water quality, and surrounding habitat quality.

Construction impacts from the expansion of the REA with regards to surface water, ecology, noise and vibration, air quality and visual amenity are further discussed in **Section 11.4.4**, **11.6.4**, **11.10.4**, **11.11.5** and **11.17.4** respectively.

Operation

As described in **Section 4.3.2**, the expanded REA would cover up to an additional 43 hectares, providing an additional emplacement capacity of approximately 15 million tonnes for the rejects generated during the operation of the proposed development (refer to **Plate 1**). The maximum height of the REA would be increased from RL 300 m to RL 305 m in the southern section of the REA (refer to **Plate 2**). The REA will operate during the daytime and evening noise periods, that is from 7am to 10pm per day. Operational activities will typically include:

- removing existing vegetation, including all trees and shrubs;
- stripping and stockpiling of topsoil, typically the top 150 mm of soil;
- transporting of reject material, including minimisation of dust through the use of water carts;
- placing of the reject material, including spreading and compacting of the reject in layers to a density of 95 per cent standard;
- trimming and shaping to achieve the planned landform; and
- covering the reject material with the stockpiled topsoil when the landform has reached its planned shape.

These operational activities will require the use of haul trucks, dozers, front end loaders, excavators, water carts and scrapers. The proposed operation of the REA will adopt a staged reject emplacement approach progressing from the existing REA to the approved design surface and into REA Areas 1 and 2 (as shown in **Figure 4.13**).

The operational activities and the plant and equipment required to undertake these would generate a range of impacts. These would include impacts to:

- Terrestrial ecology, comprising the direct removal of 39.7 ha of native vegetation including 34 ha of SSTF. The REA expansion also has the potential to impact on connectivity of habitat in the Project Area due to fragmentation and edge effects as a result of the proposed vegetation clearance. Impacts to terrestrial ecology would be offset through the implementation of a biodiversity offset strategy as further described in **Section 11.6**;
- Operational noise. The noise assessment for the proposed development predicts noise reductions compared to existing mine levels at all receivers during the night time, evening and day time periods with the exception of two receivers at Charlies Point Road (south of the REA) where day time noise levels are predicted to increase by 3 dB compared to existing mine levels as a result of the southern extension to the REA. Tahmoor Coal has committed to implementing negotiated noise agreements or voluntary acquisition in accordance with the NSW VLAMP for receivers predicted to experience residual noise above PSNLs. Noise management measures and voluntary acquisition requirements are further discussed in **Section 11.10**;
- Operational dust. The air quality impact assessment indicates compliance with annual average $PM_{2.5}$, annual average PM_{10}, annual average TSP, annual average deposited dust and 24-hour $PM_{2.5}$ criterion, however predicts exceedances of the maximum 24 hour PM_{10} criterion at some receptors. Receptor R10 located in close proximity to the REA is predicted to experience the highest estimated number of days exceeding the 24-hour average PM_{10} criterion (up to 9 days per year). Comprehensive TARP and other dust management practices would be implemented to manage exceedances and this is further discussed in **Section 11.11**;
- Surface water impacts would primarily involve reductions to catchment flow from the expansion of the REA potentially affecting dry weather flows at Tea Tree Hollow and Bargo River. The

expansion of the REA would represent an up to 0.5% reduction of the Bargo River catchment area at its confluence with the Nepean River (HEC, 2018). However it is expected that any reductions in flow at Tea Tree Hollow would likely be offset by ongoing mine water discharge from LDP1. Surface water impacts are further discussed in **Section 11.4**; and

- Visual and landscape which are expected to be minor, as the REA Stages would be significantly visually contained by established and dense tree cover, which extends up to and beyond 1 km from the proposed REA boundary. It is therefore highly unlikely that views of the proposed REA would exist from the small number of rural receptors that are located within and immediately beyond the REA site. Visual impacts are further discussed in **Section 11.17**.

11.20.3 Management and Mitigation Measures

Potential impacts associated with the REA relating to noise, air quality, biodiversity, surface water and visual amenity would be minimised in accordance with the recommended management and mitigation measures outlined in **Section 11.10**, **11.11**, **11.6**, **11.4** and **11.17**.

Key mitigation measures relevant to management of the REA include:

- The REA will be progressively rehabilitated to minimise fragmentation of vegetation;
- A biodiversity offset strategy will be developed to compensate for the removal of native vegetation;
- Impacts to threatened species within the Project Area will be mitigated and managed through the implementation of a Biodiversity Management Plan and an on-going monitoring program;
- A Noise Management Plan (NMP) will be developed and implemented outlining a noise monitoring program which would include attended and continuous use of the existing real time noise monitoring system;
- Negotiated noise agreements and/ or voluntary acquisition would be implemented in accordance with the NSW Government VLAMP at affected receivers; and
- The existing Soil and Water Management Plan for Tahmoor mine would continue to be implemented during operation of the proposed development.

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11.21 Waste

11.21.1 Background

Waste management for both the existing operations and the proposed development is largely guided by the *Protection of the Environment (Waste) Regulation 2014*, NSW *Waste Avoidance and Resource Recovery Strategy* (WARR Strategy) and the NSW Waste Classification Guidelines (NSW EPA, 2014), as described below.

NSW Waste Classification Guidelines

The Waste Classification Guidelines (NSW EPA, 2014) describe a number of pre-classified wastes and provides specific direction on the classification of waste, based on chemical composition and associated environmental impacts. Waste streams require different management, transportation and disposal depending on their classification. The six waste categories outlined in the guidelines are:

- special waste (e.g. clinical, asbestos and tyres);
- liquid waste (e.g. human waste);
- hazardous waste (e.g. waste with a pH ≤2, coal tar, lead paint waste);
- restricted solid waste;
- general solid waste (putrescibles) (e.g. household waste, manure, food waste); and
- general solid waste (non-putrescibles) (e.g. glass, plastic, rubber, garden waste).

NSW Waste Avoidance and Resource Recovery Strategy

The WARR Strategy (NSW EPA, 2014) sets out principles incorporating the adoption of measures which avoid unnecessary resource consumption and promotes resource recovery, including reuse, reprocessing, recycling and energy recovery. The WARR Strategy identifies six key areas where outcomes must be achieved in order to avoid and manage waste, as follows:

- avoiding and reducing waste generation;
- increasing recycling;
- diverting more waste from landfill;
- managing problem wastes better;
- reduce litter; and
- reduce illegal dumping.

11.21.2 Methodology

A desktop assessment was carried out to consider the potential waste streams likely to be generated as part of the construction, operation and decommissioning stages of the proposed development. Management and mitigation measures were then considered with respect to the WARR Strategy.

Construction waste streams were identified through a review of the proposed construction methodology of the proposed development.

The waste streams of the operation of the proposed development are not anticipated to differ from the waste streams currently generated by the existing operations. Consequently, in order to assess the future waste streams of the proposed development, the waste streams and volumes of the existing operations were investigated and reported on below.

11.21.3 Existing Environment

Wastes generated

The existing operations of the Tahmoor Mine generate a number of types of waste, as summarised in **Table 11-103.** Wastes generated at the existing Tahmoor Mine are classified and separated in accordance with the Waste Classification Guidelines and managed in accordance with the existing Tahmoor Waste Management Plan.

The longwall mining at Tahmoor Mine results in groundwater seeping into the underground mine, which is collected and pumped to the onsite water treatment plant.

In the 12 month period between 1 January 2016 and 31 December 2016, the existing Tahmoor Mine produced 603,245 tonnes of rejects material from the coal washing process. The 2017 Annual Review Report for the Tahmoor Mine predicted that 476,228 tonnes of coarse rejects material would be produced in 2017.

Table 11-103 Waste register for operation of the existing Tahmoor Mine

Waste Type*	Source	Description	Management
Hazardous Waste	Batteries	Small batteries in non-commercial quantities (e.g. AAA and 9 volt batteries)	Waste contractor collects and disposes of batteries at an appropriate off site licensed facility.
		Used car and truck batteries Computer wet cell batteries	Tracked and transported to an approved metals recycling facility by waste contractor. The weight of all batteries is recorded and reported on a monthly basis.
		Underground cap lamps	Waste contractor collects and disposes of lamps at an appropriate off site licensed facility.
	Oil Drums	Not cleaned and containing hydrocarbon residues	Disposal at a licensed facility by waste contractor. Waste data is recorded and maintained on site for four years.
	Oil filters and oily rags	Containing free oil	
Special waste	Medical and hygiene waste	From the first aid room	Waste is placed within appropriately labelled storage bins at the Tahmoor Mine and collected on an as required basis by waste contractor. Weight of medical and hygiene waste is recorded on a monthly basis. All waste is incinerated at an appropriately licensed facility.
	Tyres	Used, rejected or unwanted tyres (includes shredded tyres or tyre pieces)	Disposed of on mine site in quantities less than 5,000 tonnes per annum. Any excess tyres are removed by waste contractor to a licensed waste facility that is licensed for the treatment or disposal of tyres.
Liquid waste	Grease in 205L grease drums	Grease	Full drums are relocated to secure bunded area and transported and tracked to an appropriately licensed waste facility for recycling.
	Oily water/ hydrocarbon spillages	From washdown bay, workshop floors and lube bay floor, hydraulic fluid spills etc.	Collected from site by waste contractor and disposed of at an appropriately licensed facility.
	Parts, washers, liquid waste	Parts, washers, liquid waste	Disposed to a licensed facility by waste contractor. Waste data is recorded and maintained on site for four years.
	Sewage	Generated from bathhouses and office toilets	Treated by onsite sewage treatment plant.
	Engine Coolant	Generated from equipment and site vehicles	Transported and tracked to an approved recycling facility where water and glycol are separated and recycled. Waste recorded in litres on a monthly basis.
	Waste oil	Black oil – a mixture of a range of oils	Pumped into storage tanks onsite and pumped into approved waste oil tankers when required. Transported and tracked to a waste oil refinery for processing.

Waste Type*	Source	Description	Management
General waste (non-putrescible)	Municipal waste	Domestic office waste	Disposed of within general waste bins on site.
	Paper and cardboard	Paper and cardboard from administration building	Placed in onsite recycling bins.
	Scrap metal	Scrap metal	Transported to an approved scrap metal recycling facility. Types and weights of metals are recorded and reported monthly.
	Toner cartridges	From printers and photocopiers	Disposed using cartridges.
Non-applicable	Dredged sediment	From surface sediment dams, sumps etc.	Disposal onsite at the REA.
	Coal washery rejects	Generated during the coal processing process at the CHPP	Disposal within the REA.

**As defined by the NSW Waste Classification Guidelines (NSW EPA, 2014)*

11.21.4 Impact Assessment

Construction

Waste generated throughout construction will primarily be from civil works associated with site preparation, construction of ventilation shafts and development of the REA. Waste generating activities will include:

- preparation and construction of ventilation shaft sites and the development of the REA:
  - vegetation clearance, generating green wastes;
  - excavation and construction of hardstand areas, generating soils and gravel stockpiles;
  - installation of environmental controls, fencing, silt fences, lockable gates, generating material off-cuts;
- drilling activities for the construction of the ventilation shafts;
- general construction activities;
- construction of new and modification of existing infrastructure; and
- construction of internal haul roads and a stormwater management system to facilitate the development and expansion of the REA.

Table 11-104 lists the waste streams that are anticipated to be generated throughout the construction phase of the proposed development.

Table 11-104 Wastes Generated during the Construction Phase of the Proposed Development

Waste Type*	Description
General Waste (putrescible)	Waste from litter bins and food waste
General waste (non-putrescible)	Glass, plastic, rubber, concrete, metal, paper, cardboard, dewatered sediment from sediment treatment devices, general building wastes, asphalt waste, garden waste and wood waste
Special waste	Tyres and medical and hygiene waste
Hazardous waste	Oil filters and oily rags, oil drums, and batteries
Liquid waste	Grease, oily water and hydrocarbon, sewage, engine coolant and waste oil
Restricted solid waste	Used erosion and sediment control materials
	Spoil from construction of ventilation shafts
	Groundwater from ventilation shaft construction. The management of groundwater generated through the ventilation of the ventilation shafts is described in **Section 11.3**

Inappropriate management of construction waste has the potential to impact on visual amenity, and/or result in water and soils contamination, as well as the infestation of feral and pest populations and weeds.

With the exception of the construction of the ventilation shafts, construction waste streams will be similar to those generated from the operation of the existing Tahmoor Mine. It is therefore considered that construction waste will be able to be managed appropriately by adopting the practices and procedure prescribed by the existing Waste Management Plan. Management and mitigation measures to avoid and minimise impacts of inappropriate construction waste management are detailed in **Section 11.21.5**.

Spoil from the construction of ventilation shafts TSC1 and TSC2 would be temporary stockpiled at the ventilation shaft sites or at the REA. Sediment from sedimentation ponds within this area would be removed from ponds and placed in drying areas adjacent to the water reticulation ponds. Once drained, this spoil would be added to the dry spoil stockpile from the construction of ventilation shaft TSC1 and TSC2.

Operation

Coal rejects

The largest waste generating activity that will be undertaken throughout the operational life of the proposed development would be coal washery rejects from the coal washing process, with the proposed development anticipated to generate an average of about 0.700 Mt of rejects material per annum.

The existing REA would be expanded onto 43 ha of adjacent land to accommodate the disposal of this reject material, providing an additional emplacement capacity of 12 Mt of rejects material. The maximum height of the REA would be increased from RL 300 m to RL 305 m in the southern section of the REA. The development of the REA to accommodate coal rejects would require vegetation clearance. The impact of this clearance on visual amenity and terrestrial ecology is considered a construction impact and has been assessed in **Sections 11.6** and **11.17**. Green waste generated from the development of the REA would be utilised where possible (e.g. harvestable timber or fence posts), otherwise, green waste would mulched on site and stored within the REA where practicable. The mulch would be reused onsite for landscaping works.

General Operational Waste

Over the 12 month period between 1 January 2016 and 31 December 2016 79% or 1,557 tonnes of the waste generated was disposed of offsite to landfill by licensed waste contractors and 21% or 414 tonnes of waste was reused or recycled.

It is anticipated that the proposed development would generate the same waste streams as those described in **Table 11-104.** However, as the operations would be larger than existing, with periods of increased numbers of employees, quantities of wastes generated would be slightly greater for waste disposed of offsite to landfill (i.e. ≥1,557 tonnes per 12 month period) and for waste reused or recycled onsite (i.e. ≥414 tonnes per 12 month period).

Inappropriate management of operational waste generated by the proposed development has the potential to impact on visual amenity and result in water and soils contamination. Potential impacts of the proposed development on visual amenity, surface water, terrestrial ecology, aquatic ecology and soils are outlined in **Section 11.17, 11.4**, **11.6**, **11.7** and **11.18** respectively.

The Waste Management Plan for the existing Tahmoor Mine would be amended to reflect the operation of the proposed development. The updated Waste Management Plan would be implemented throughout the operational life of the proposed development to ensure that operational waste is managed appropriately. It is therefore considered unlikely that waste generated throughout the development would impact on visual amenity, local waterbodies and soils.

11.21.5 Management and Mitigation Measures

To manage waste generated by the proposed development throughout construction and operation, the existing Waste Management Plan would be updated to reflect the proposed development. The existing Waste Management Plan has been prepared based on the principles of the WARR Strategy and in accordance with the NSW Waste Classification Guidelines. The updated Waste Management Strategy would include measures to be implemented throughout construction and operation of the proposed development to avoid or minimise waste generation where practicable, followed by reuse and recycling where reasonable and feasible. Waste avoidance and reuse strategies employed by Tahmoor Mine would include:

- purchase and use of products that generate minimal waste (including packaging) and pollution;
- purchase and use materials that may be less toxic or hazardous, or that can be reused, recycled or more readily disposed of; and

- consideration of opportunities for material reuse when purchasing resources from suppliers and during equipment procurement.

The following mitigation measures will be continued at Tahmoor Mine under the updated Waste Management Strategy:

- confirm that waste that cannot be reused or recycled would be disposed of at an appropriate licensed facility by waste contractors;
- avoid unnecessary resource consumption by making realistic and accurate predictions on the required quantities of resources such as construction materials;
- separate wastes generated by the proposed development prior to disposal by licensed contractors;
- where practicable, mulch green wastes onsite and reuse for landscaping in the absence of a more beneficial use being identified (such as harvestable timber or fence posts);
- store hazardous wastes in secure areas on site within areas that have adequate bunding and containment measure to minimise the potential for spillages and leakages which could affect surface water quality or cause soil contamination;
- store waste oil and other flammable waste streams at locations away from any likely ignition sources to minimise the risk of fire; and
- track wastes and confirm that these are being transported and disposed of in accordance with the *Protection of the Environment (Waste) Regulation 2014* and the POEO Act.

11.21.6 Conclusion

Construction waste from the proposed development would largely be from civil works associated with site preparation, construction of ventilation shafts and development of the REA. Construction waste would be managed in accordance with the Waste Management Strategy for the proposed development, and is not considered to have a significant impact.

With the exception of additional coal washery rejects, the proposed development once fully operational would not result in a significant change in the amount or type of wastes generated on site. As a result, the existing waste management practices are considered to be adequate for the proposed development.

The Waste Management Plan for the existing Tahmoor Mine would be amended to reflect the operation of the proposed development, ensuring that waste is recycled and reused where possible and that minimal general waste is disposed to landfill.

Waste management measures to be implemented for the proposed development would encourage efficient resource use alternatives, reuse and recycling. Wastes that cannot be reused or recycled would be disposed of in an appropriate manner.

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11.22 Hazard and Risk

11.22.1 Background

The proposed development is subject to risks associated with the storage of hazardous goods, underground fire/explosion, spontaneous combustion, contamination and bushfire. This section outlines the risks present as part of the operation of the existing Tahmoor Mine and risks associated with the proposed development, and is supported by an *Acid and Metalliferous Drainage and Spontaneous Combustion Assessment* (GeoTerra, 2014), which is provided in **Appendix W**.

11.22.2 Existing Environment

There are several potential hazards and risks associated with the operation of the existing Tahmoor Mine, including the storage of hazardous goods, the potential for underground fire and/or explosion and the generation of contamination. Additionally, the Tahmoor Mine is located in an area which comprises extensive stands of vegetation that pose a bushfire risk.

Storage of hazardous goods

The proposed development requires the storage of hazardous materials on-site. An initial screening was undertaken using *Hazardous and Offensive Development Application Guidelines: Applying SEPP 33* (NSW Department of Planning, 2011) to identify whether the type and quantity of hazardous materials exceed the screening thresholds for potentially hazardous developments. The initial screening identified that the existing and the proposed development are likely to fall below the relevant thresholds, and therefore would not constitute a potentially hazardous development.

As part of the operation of the existing Tahmoor Mine, fuels, hydraulic fluid and oils are supplied to machinery and equipment around the mine. These materials are stored in appropriately contained and/or bunded depots around the mine to ensure compliance with the relevant codes, standards and regulations. The locations of the depots within the surface infrastructure facilities area are shown in **Figure 11.40**.

Hazardous materials are managed in accordance with Tahmoor Coal's Sustainable Development Procedure Health and Safety Management System Document *TAH SD PRO 0034 – Hazardous Materials Management*. In accordance with this procedure, bulk fuel storage areas are contained within bunded areas in accordance with *Australian Standard AS 1940 – The Storage and Handling of Flammable and Combustible Liquid*.

In line with the *Explosives Act 2003* and the *Explosives Regulation 2013,* the existing Tahmoor Mine has developed and submitted a site security plan and has also notified WorkCover NSW of the dangerous goods kept onsite, detailed in **Table 11-105** below. Operation of the proposed development is unlikely to result in greater volumes of these materials being stored at the existing Tahmoor Mine.

Table 11-105 Hazardous or Dangerous Goods Stored on the Premises of the Existing Tahmoor Mine

Dangerous Goods Class	Type of Storage	Product Name	Quantity	Distance from Boundary	Screening Method*	Assessment
3PGIII	Underground tank	Ethyl Hexanol	11,000L (approximately 8.9 tonnes)	>10 m	Figure 9	Below the threshold
3PGIII	Underground tank	Diesel Fuel	11,000L (approximately 9.7 tonnes)	>10 m	Figure 9	Below the threshold
3PGIII	Two above ground tanks	Diesel Fuel	27,500L (approximately 24.3 tonnes)	>10 m	Figure 9	Below the threshold
3PGIII	Underground tanks (above ground use)	Reagent (similar properties to Diesel Fuel)	9,000L (approximately 8 tonnes)	>10 m	Figure 9	Below the threshold

Dangerous Goods Class	Type of Storage	Product Name	Quantity	Distance from Boundary	Screening Method*	Assessment
3PGIII	Ground tank (underground use)	Reagent (similar properties to Diesel Fuel)	15,000L (approximately 13.3 tonnes)	>10 m	Figure 9	Below the threshold
1.1D	Above ground magazine	Explosive: Blasting Type E	900kg (0.9 tonnes)	200 m	Figure 5	Below the threshold
1.4B	Above ground magazine	Detonators: Electric for blasting	2,000 units	200 m	Figure 5	Below the threshold
8PGII	Above ground tank housed and separately bunded inside the water recycling plant	Sodium Hydroxide Solution	5,000L (approximately 10.65 t)	NA	Table 3	Below the threshold
8PGII	Above ground tank housed and separately bunded inside the water recycling plant	Sulphuric Acid	5,000L (approximately 9.2 t)	NA	Table 3	Below the threshold
8PGII	Above ground tank housed and separately bunded inside the water recycling plant	Hypochlorite Solution	5,000L (approximately 5.55 tonnes)	NA	Table 3	Below the threshold

* Figure and table numbers refer to the figures and tables within *Hazardous and Offensive Development Application Guidelines: Applying SEPP 33* (NSW Department of Planning, 2011). Data source: Tahmoor Coal

Other hazardous goods stored on the site include:

- Aerosols: Class 2.1 used for minor spraying works, lubrication, marking paints and similar activities. Stored within a steel cage in the stores warehouse;
- Various types of oils: used for lubrication of equipment and machinery. About 6,000L stored in 20L drums on pallets within a dedicated oil storage shed. An additional oil store is located at the rear of the CHPP. The CHPP oil stores comprises a steel frame shed with sheet steel cladding and holds about 500L of oil in 20L drums fitted with hand pumps for decanting into containers;
- Flammable liquids – including aerosols, paint and other flammable liquid containers within a AS1940: 2004 compliant cabinet;
- A 14,000L quintolubric hydraulic oil tank is located within depot two;
- A 12,000L capacity Diesel Fuel tank is located within the REA adjacent to the rejects store bin;

- A mixture of lubricating oil and flammable liquids is located in a steel framed storage shed adjacent to the rejects area office; and
- A 5,000L capacity aboveground Diesel Fuel tank is located at the northern edge of the coal stockpile for the refuelling of bulldozers and front end loaders.

Underground Fire/Explosion

Outbursts are ejections of gas and coal from the working coal face. The potential for outbursts is managed primarily via gas drainage of the coal seam prior to mining to lower the gas content of the seam. Details regarding gas drainage are provided in **Section 4.2.4**.

REA Spontaneous Combustion

Coal naturally undergoes a continuous oxidising reaction when exposed to air which results in the release of heat. When the rate of heat produced by this exothermic reaction exceeds the rate at which the coal is cooled, there is a gradual build-up of heat and the temperature reaches the ignition point of coal thereby causing it to combust.

The process of spontaneous combustion is complex and is subject to a number of influencing factors, including but not limited to gas and water content, particle size, oxygen supply, and the rate of exposure of coal to oxygen. The Bulli seam has a low tendency to spontaneously combust. The Bulli seam has been mined for more than 120 years, during which there has been no reports of spontaneous combustion events.

Although the risk of spontaneous combustion at the Tahmoor Mine is considered to be remote, a Spontaneous Combustion Management Plan is currently in place which includes specific provisions for managing surface stockpile spontaneous combustion risks.

Fire and explosion (other)

Mining operations have the potential to provide sources of:

- flammable, combustible and explosive substances and materials, both natural and introduced, including gas, dust, ores, fuels, solvents and timber;
- ignition, fire or explosion, including plant, electricity, static electricity, spontaneous combustion, lightning, light metal alloys, hot work and other work practices; and
- flammable material with a flash point of less than 61° Celsius, including materials on the top of any shaft, outlet or well at the mine or petroleum site.

Tahmoor's *Fire and Explosion Principal Mining Hazard Management Plan* identifies potential sources of fire and explosions and details requirements for managing the risk of fire or explosion. The plan also details requirements for controlled materials and plant such as flame resistant and anti-static materials, lasers, overhead power lines and diesel particulate matter.

Contamination

The potential for contamination to exist at the Tahmoor Mine has been considered through the following assessments:

- Phase I Environmental Site Assessment and Targeted Underground Storage Tank Investigation;
- Phase II Environmental Site Assessment; and
- Underground Petroleum Storage Systems (UPSS) Assessment.

Phase I Environmental Site Assessment and Targeted Underground Storage Tank Investigation

A Phase I Environmental Site Assessment (ESA) was undertaken in 2009 for the existing surface infrastructure facilities area. The Phase I ESA assessed the contamination status of the pit top area for ongoing use. **Table 11-106** summarises the potential contaminating activities and land uses of the surface infrastructure facilities area and the resultant potential contaminants of concern.

Table 11-106 Historical Potential Contaminating Activities and Contaminants of Concern

Potential Past Contaminating Activities/Land Use	Potential Contaminants of Concern
Underground Storage Tanks (USTs) and Above Ground Storage Tanks (ASTs), bowsers and associated fill points, pipelines and vents.	TPH, Monocyclic Aromatic Hydrocarbons (MAH), Polycyclic Aromatic Hydrocarbons (PAH), phenols and lead
Oil/water separators and associated infrastructure	TPH, MAH, PAH, phenols and lead.
Coal Washery and Site Dams – Polymers, frothers, flocculants and conditioners used in the coal washing process and in the on-site dams for settlement purposes.	Ethyl Hexanol, Hexanedioic acid, Acrylic acid, Poly aluminium, chloride.
Workshop operations	TPH, MAH, PAH, VOC, phenols and lead.
Potential for imported fill material at the site.	Metals, MAH, PAH, VOC, phenols and lead.
Storage and use of explosives.	Nitrated compounds.
Former agricultural use of the site.	Organochlorides and Organophosphorous pesticides and asbestos .
Sewage Treatment Plant.	Heavy metals, Major cations, anions, phosphate, nitrate, ammonia, alkalinity, Total cyanide, Phosphorus.
Electrical transformers in the substation.	Polychlorinated biphenyls (PCBs), asbestos.
Hazardous Waste Storage.	Metals, PCBs, TPH, MAH, VOC, PAH and phenols.
General rubbish, scrap and dilapidated machine parts and machinery.	Metals, PCBs, TPH, MAH, PAH, asbestos.

A subsequent targeted UST investigation was undertaken to assess the potential for contamination associated with these facilities to have impacted on surrounding groundwater. Groundwater sampling identified concentrations of TPH and benzene, toluene, ethylbenzene and xylenes (BTEX) in five of six monitoring wells commissioned as part of the assessment.

Phase II Environmental Site Assessment

The findings of the Phase I and UST investigation assessments were submitted to the EPA, who issued Pollution Reduction Program 19 (PRP 19) for the site which required that the Tahmoor Mine undertake the following:

- assess the full nature and extent of contamination in soils and groundwater in the vicinity of the waste oil tank and USTs; and
- assess the potential for off-site migration of the contamination and the risk of harm to human health and the environment posed by such contamination.

The additional assessments undertaken with regards to PRP 19 included the advancement of 14 boreholes to assess the groundwater conditions in the vicinity of the waste oil tank, ASTs and USTs as well as the potential for migration of groundwater contamination from these areas.

Widespread soil contamination was not detected in the vicinity of the USTs or the waste oil tank area. Hydrocarbon impacted soil was considered likely to be a result of localised minor spills/leakages of fuels and the extent of soil impact was identified as being limited in extent.

Hydrocarbon contamination, likely to be diesel from historical storage, was identified in groundwater north, northwest and northeast of USTs in shallow and deep monitoring wells, indicating likely horizontal and vertical migration of groundwater. The extent of migration was considered to be minor given that there was limited hydraulic connectivity and the source of the contamination (diesel) is no longer stored in USTs in this area.

Other hydrocarbon contamination was detected in the vicinity of the USTs; however the nature, source and extent of contamination could not be inferred. In the vicinity of the waste oil tank and ASTs, other TPH was also identified as well as in deeper wells indicating potential vertical migration.

Offsite migration of diesel or other TPH is considered unlikely given the slow recharge of groundwater wells and low hydraulic connectivity. Existing soil and groundwater contamination is considered unlikely to present a risk of harm to human health or the environment. At the time of the Phase II ESA, a remediation action plan was not required to be prepared.

Underground Petroleum Storage Systems (UPSS) Assessment

In 2013, a UPSS Assessment was completed to comply with the requirements of the Protection of the Environment (Operations) (POEO) UPSS Regulation (2008). The UPSS Assessment comprised a groundwater monitoring event (GME) utilising existing groundwater monitoring wells at the site, in the vicinity of the USTs and in the waste oil tank area.

Light non-aqueous phase liquid (LNAPL) was detected in three monitoring wells near the USTs and in one monitoring well near the waste oil tank, and total recoverable hydrocarbons (TRH) were reported at concentrations greater than the adopted assessment criteria in groundwater samples collected at a number of locations in both areas. Volatile halogenated compounds (VHCs) were also reported in groundwater samples collected in both areas of assessment, at a concentration greater than the assessment criteria in one location.

The UPSS Assessment concluded that contamination sources in each area of the site were likely to be different. Near the USTs, reported leaks from underground fuel lines between the USTs and the CHPP were considered to be the primary source of contamination, while near the waste oil tank, a reported spill of diesel during refilling of a generator was considered to have caused the highest concentrations of TRH and the LNAPL detected.

Minor contamination was discovered and the EPA has been notified in accordance with section 60 of CLM Act (notification in 2009 and 2014). The underground tanks remain operational and will continue to be monitored.

UST Validation Report

In 2017 two 11,000 L USTs at the Tahmoor Colliery Facilities were decommissioned by excavation and offsite disposal. Soil validation sampling was undertaken to assess the suitability of the soil following removal of the USTs. Potential contaminants of concern identified included aliphatic hydrocarbons (total recoverable hydrocarbons (TRH)), benzene, toluene, ethylbenzene, xylenes (BTEX), heavy metals (lead) and polycyclic aromatic hydrocarbons (PAHs).

Analysis of the soil samples showed that concentrations of TRH, BTEX, PAHs and heavy metals were below the EPA endorsed site assessment criteria for commercial and industrial sites. One sample, collected from near a 15 KvA underground electrical cable, reported concentrations above the NEPM management limited; however the report noted that given the industrial setting the exceedance represents an isolated and inaccessible area of residual hydrocarbons. The report recommend that should future works enable access to this area, further soil removal and validation sampling should be undertaken.

Stage 1 Preliminary Contamination Investigation

A Stage 1 Preliminary Contamination Investigation of the operational area of Tahmoor Coal was undertaken by GHD Pty Ltd in 2017. The investigation includes a review of historical information, NSW WorkCover and EPA information and a site inspection.

The investigation reported that the site was used for agricultural activities until the 1970's when construction of the mine began. The overall likelihood of significant contamination to be present at the site was considered to be low, with the exception of hydrocarbon contamination around waste oil, fuel and diesel tanks and groundwater. The report recommended monitoring in these areas to determine the extent of these impacts. Other areas identified with the potential for soil contamination included:

- laydown/hardstand areas;
- USTs and aboveground storage tanks (ASTs), delivery lines and refuelling areas;

- waste oil tanks and waste oil water separator units/sumps;
- septic tanks and waste water treatment plant;
- truck wash areas;
- electrical transformers/substations;
- leaking conveyor gearbox/motor plant;
- stormwater retention ponds;
- historical areas of filling and waste disposal;
- buildings that may potentially contain hazardous building materials; and
- areas where aqueous film forming foam (AFFF) product have been stored or used.

The investigation concluded that the site is considered to be suitable for on-going use as underground mining operations provided the following measures are undertaken:

- assessment of soils around areas where spills/leaks of fuels, oils and/or other chemicals have been identified and remediated of any impacts including:
  - hardstand/laydown areas;
  - AST/refuelling points; and
  - electrical transformers;
- the assessment should provide information regarding possible health and ecological impacts from potential surface contamination;
- repair of leaking equipment and remediation of any impacts;
- review of the use of AFFF products on site and completion of sampling to assess potential impacts. The assessment should provide information regarding possible health and ecological impacts from potential contamination;
- engage competent person such as a licenced asbestos assessor to undertake a hazardous buildings materials/asbestos survey of structures present on site;
- continue to monitor groundwater impacts around the former USTs and waste oil/diesel AST areas; and
- document known areas of contamination within site management plans such as those associated with former UST and waste oil tank.

Bushfire

The proposed development is located in a basin dominated by undulating to very steep hills along the westerly aspect with an effective south to north orientated ridgeline within the local topography. In the central region of the Project Area, the topography broadens out to flatter and more gently undulating lands with generally south-west to north-east ridge-like features.

The bushfire season within and surrounding the Project Area coincides with seasonal strong south-west to north-west winds and is influenced by drought and rainfall conditions. The main sources of ignition in the Project Area are lightning strikes, arson and pile burns escaping from private residential properties. The most recent bushfire was the Hall Road Fire, which encroached into the southern portion of CCL 747. The Hall Road Fire was ignited by power lines after strong winds caused a branch to fall across the power line at Balmoral during a period where the Rural Fire Service had rated the fire danger as severe. The fire burnt 17,657 ha of land, comprising national park, Sydney catchment land and private land.

Tahmoor Coal works closely with the local Rural Fire Service, and the State Property Authority, providing and maintaining an open communication network that is emergency ready should the need arise. Firefighting equipment caches are situated at various strategic locations around the existing Tahmoor Mine, including a fire hydrant network that forms part of the mine safety system. Problematic bushfires associated with land surrounding the existing Tahmoor Mine have not previously been reported. However, Tahmoor Coal is alert to the dangers and risks associated with bushfires in this location (Tahmoor Coal, 2011).

Areas of land under the control of the Tahmoor Mine are routinely inspected and subject to controlled burning if recommended by the local bush fire brigade.

Bushfire management for the Tahmoor Mine is undertaken in accordance with Tahmoor Coal's Bushfire Management Plan, which applies to all assets owned by Tahmoor Coal within the following landholdings. The bushfire behaviour rating for these sites is detailed in **Table 11-107**.

The Bushfire Management Plan details measures to prevent the occurrence of unplanned bushfire, to suppress unplanned bushfire and to minimise the potential for the spread of bushfire in, from, or into lands under the care and control of Tahmoor Coal.

Table 11-107 Fire Behaviour Potential of Tahmoor Coal Assets in the Project Area

Fire Behaviour Potential	Tahmoor Coal Assets	Description
Low	Charlies Point Road, Tahmoor Innes Street Thirlmere Bridge Street, Thirlmere	Areas of managed grassland and vegetation and the managed curtilage to the Colliery assets.
High	Tahmoor Colliery site Ventilation Shaft TSC1 Ventilation Shaft TSC2 Rockford Road Areas of unmanaged woodland/forest vegetation	Unmanaged woodland and forest vegetation has a high fire potential due in part to the exposure to the predominant hot, dry fire winds from the northwest and west, as well as the extent of unmanaged vegetation and topography of the land on or adjoining the sites.
Very High	Forested vegetation within Bargo Colliery	Very high risk as a result of the aspect, exposure, topography, vegetation structure and unmanaged fuel loads present within and surrounding the sites.

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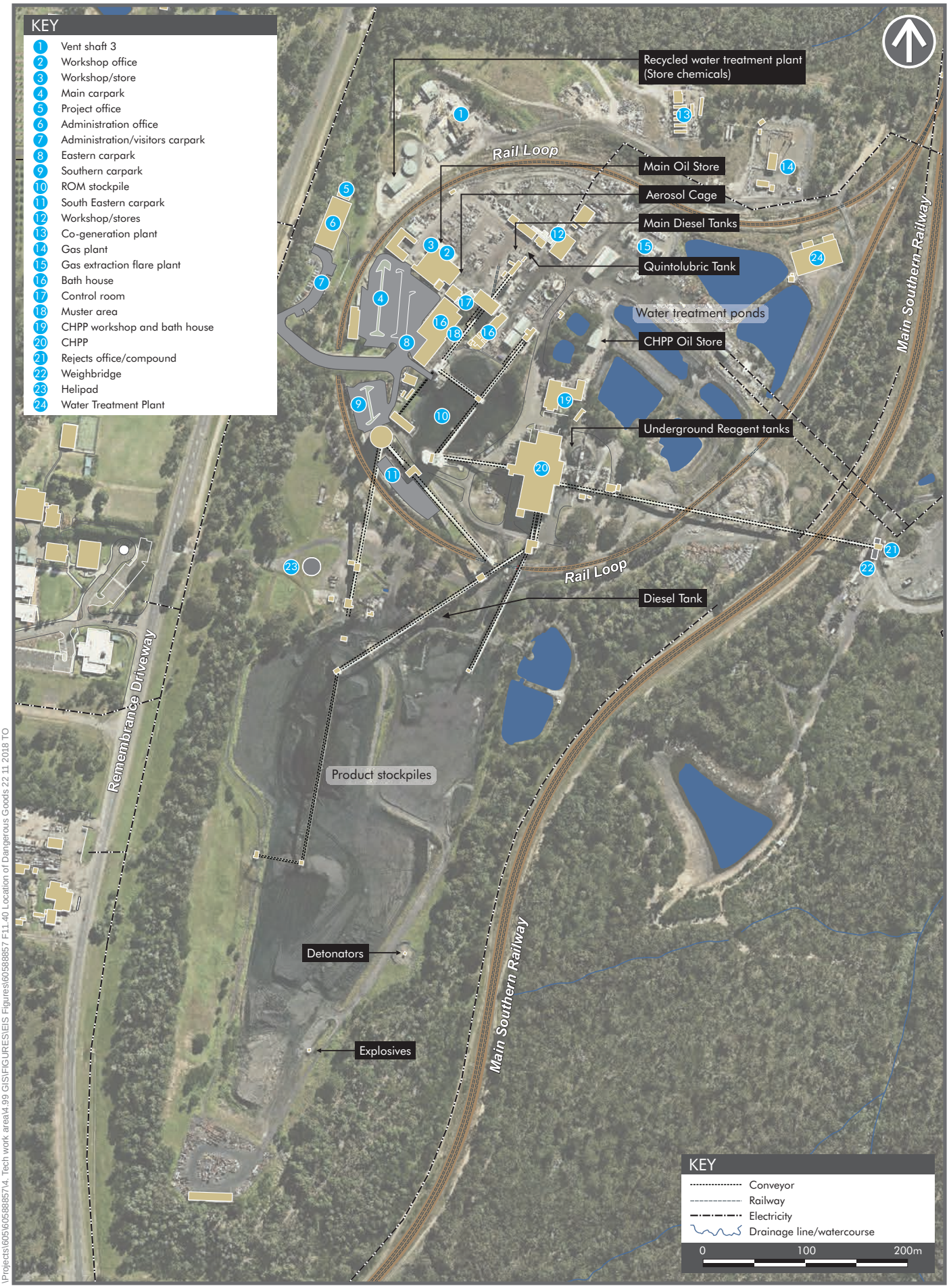

\Projects\605\605885714. Tech work area\4.99 GIS\FIGURES\EIS Figures\605885857 F11.40 Location of Dangerous Goods 22 11 2018 TO

SIMEC MINING

LOCATION OF DANGEROUS GOODS WITHIN THE SURFACE INFRASTRUCTURE FACILITIES AREA

Tahmoor South Project
Environmental Impact Statement

FIGURE 11.40

11.22.3 Methodology

Desktop Review

Hazards and risks associated with the existing Tahmoor Mine and the proposed development with regards to the storage and handling of dangerous goods, contamination and bushfire were identified by undertaking a desktop review of existing available information including:

- Tahmoor Coal Annual Environmental Monitoring Reports;
- Tahmoor Underground Annual Review Reports;
- The *Tahmoor Underground Bushfire Management Plan*;
- *Tahmoor Colliery Phase 1 Environmental Site Assessment* (AECOM, 2009);
- *Tahmoor Colliery Additional Site Investigations Report* (AECOM, 2011);
- UST Validation Report (ENRS, 2016); and
- Stage 1 Preliminary Contamination Investigation (GHD, 2017).

Acid Metalliferous Drainage and Spontaneous Combustion Assessment

An assessment was undertaken by GeoTerra (2013) to understand the potential acid and metalliferous drainage and spontaneous combustion characteristics of the proposed REA waste materials, the existing physical and chemical baseline status of the shallow regional groundwater up and down gradient of the existing REA and to identify the existing and potential acid and metalliferous drainage and spontaneous combustion nature of the REA.

The assessment comprised sampling, laboratory assessment and interpretation of the following:

- selected laboratory washery recovery tests at core intervals from the Bulli seam within the Project Area;
- an Adiabatic Self Heating Test on coal samples from the Bulli seam within the proposed development area;
- leachate and runoff samples from the existing Tahmoor Mine REA that contains in excess of 10 million tonnes of reject material from the existing Tahmoor Mine Bulli seam, roof and floor material; and
- installation of an upslope and a downslope piezometers which were used to measure the standing water level and water chemistry of groundwater within the Hawkesbury Sandstone that underlies the existing and proposed extension to the REA.

Additional detail regarding the *Acid and Metalliferous Drainage and Spontaneous Combustion Assessment* is provided in **Appendix W**.

11.22.4 Impact Assessment

Storage of hazardous goods

The Tahmoor Mine operates in accordance with a Hazardous Materials Management Procedure, which provides a framework for the management of hazards and risks associated with the operation of the mine. Operation of the proposed development would not be significantly different to the operations of the existing Tahmoor mine. Hazardous goods would continue to be contained within bunded facilities in accordance with *Australian Standard AS 1940 – The Storage and Handling of Flammable and Combustible Liquid*.

As the hazardous goods required for the proposed development would be the same as those required for the operation of the existing Tahmoor Mine, the storage of hazardous goods and combustible liquids would continue to be managed under the existing *Hazardous Materials Management Procedure* and *Fire and Explosion Principal Hazard Management Plan*.

Underground fire/explosion

The risk of outburst occurring during the operation of the proposed development is not expected to increase from the level of risk that is currently managed for the existing operations at Tahmoor North. The potential for outburst during operation of the proposed development would be managed via pre and post gas drainage of the coal seam prior to mining to lower the gas content of the seam as described in **Section 4.2.4**.

Spontaneous Combustion within the REA

It is generally observed that;

- reshaping batters allows the movement of air over the surface rather than penetrating through the unshaped steep batters into rock voids and lowers the likelihood of spontaneous combustion outbreaks; and
- compaction can assist in controlling and managing spontaneous combustion as areas that experience higher compaction, such as roads, exhibit less spontaneous combustion than batter areas.

Monitoring of the existing REA, as it has been sequentially constructed, shaped and revegetated since the early 1980's, indicates there has been no observed occurrence of spontaneous combustion. The Adiabatic Self-Heating Test conducted on the Bulli seam rejects materials from the Project Area indicated that the rate of self-heating from 40°C to 70°C was 0.003°C per hour. This data indicates that spontaneous combustion of carbonaceous material is unlikely.

Regular monitoring of the existing REA indicates that there has been no observed occurrence of spontaneous combustion, which supports laboratory test results that the occurrence of spontaneous combustion from CHPP rejects from the Bulli seam extraction associated with the proposed development is unlikely.

Fire and explosion (other)

Operation of the proposed development would not be significantly different to the operations of the existing Tahmoor mine which would be undertaken in line with the requirements set out in the Fire and Explosion Principal Hazard Management Plan.

Contamination

Existing contamination has been identified or has the potential to be present at the site, as stated in the previous contamination investigation undertaken for the site. Construction works have the potential to encounter contamination when occurring in known or potentially contaminated areas, as outlined in **Section 11.18**.

When metalliferous material is excavated from below the groundwater table and exposed to air and water, it may undergo natural oxidation of sulphide materials. The drainage produced from this oxidation process, termed acid and metalliferous drainage always contains sulphate, may be acidic or neutral, and could potentially contain dissolved heavy metals. The discharge of acid and metalliferous drainage impacted water has the potential to impact on surface water and groundwater quality, and can potentially affect ecological processes and water supply. The generation of acid and metalliferous drainage can continue after the cessation of mining operations and is difficult to ameliorate once local waterways have been impacted.

Analysis of the potential rejects from the CHPP after extraction of the Bulli seam within the Project Area indicates that the REA should be non-acid forming due to the low pyrite (chromium reducible sulfur) levels in all samples. Acid and metalliferous drainage is not anticipated as a result of these materials. The analysis of water chemistry from leachate samples from the CHPP rejects samples indicated no potential acid generation and a low potential salinity for the CHPP rejects from the proposed development. The analysis of leachate samples identified that the major ions and metals present were generally below the ANZECC/ARMCANZ (2000) trigger values for freshwater upland streams and protection of 95% of aquatic species, with the exception of pH, total dissolved solids, Copper and total Nitrogen.

Bushfire

Bushfire risk is currently managed in accordance with Tahmoor Mine's Bushfire Management Plan which forms part of the Tahmoor Coal Health and Safety Management System. The Bushfire Management plan addresses the risk of bushfire and has in place procedures and management measures to mitigate the impact of bushfire on land within and surrounding the Tahmoor Coal landholdings. The proposed development would not alter the potential risk of bushfire or the behaviour of bushfires with regards to Tahmoor Coal's assets. The existing Bushfire Management Plan is considered to be adequate to manage bushfire risks associated with the proposed development.

11.22.5 Management and Mitigation Measures

The management and mitigation of hazards and risks associated with the proposed development with regards to the storage of dangerous goods, contamination, spontaneous combustion and bushfire would be in accordance with Tahmoor Coal's, Health and Safety Management System. Management and mitigation measures for the proposed development include the following:

Storage of hazardous goods

The storage of dangerous goods during construction and operation of the proposed development would be managed using Tahmoor Coal's Health and Safety Management System Document *TAH SD PRO 0034 – Hazardous Materials Management*. Storage of combustible liquids would be managed using Tahmoor Underground *Fire and Explosion Principal Hazard Management Plan.*

Fire and explosion (other)

The management of fire and explosion would continue to be managed by the *Fire and Explosion Principal Hazard Management Plan.*

Contamination

- Tahmoor Coal would undertake ongoing acid and metalliferous drainage testing during the REA construction process;
- Tahmoor Coal would continue to routinely monitor water quality during active placement of rejects at the REA to identify any variation in acid and metalliferous drainage;
- Should contaminated land be uncovered during construction appropriate identification, containment and disposal measures would be carried out to minimise exposure risk to the environment and personnel; and
- Construction and maintenance workers who may be exposed to contaminated soil and groundwater in the vicinity of the USTs, ASTs and waste oil tank should adopt appropriate protective measures, including Personal Protective Equipment.

Spontaneous combustion

- Tahmoor Coal would undertake Adiabatic Self Heating testing throughout the REA construction process;
- the existing Spontaneous Combustion Management Plan would be updated to reflect the operation of the proposed development; and
- regular visual inspections of the REA would be undertaken for the presence of spontaneous combustion. Inspections would involve observing stockpiles for any visible signs of smoke or other obvious signs of heat production.

Bushfire

- Preventative measures for potential ignition sources would be enforced as per the preventative measures detailed in Table 11 of the existing Bushfire Management Plan. This would include discussion of bushfire and ignition prevention measures during toolbox talks and in relevant health and safety plans.
- Tahmoor Coal would continue to enforce a cigarette ban at all landholdings.
- A monitoring program would be conducted to reduce the risk of bushfire occurring.

- Fuel reduction activities would be undertaken to limit the speed and spread of potential unscheduled fires. This would include thinning or removal of undergrowth.
- Hazard reduction burning would not be undertaken during periods of declared total fire bans.
- Fire trail and access roads to, from and within Tahmoor Coals landholdings would continue to be maintained to provide access for Rural Fire Service Tankers.
- The responsibility for fire management would continue to be implemented in accordance with the Tahmoor Emergency and Management Plan, which forms part of the Health and Safety Management System.
- In the instance of a bushfire event, the existing Emergency Response Procedures for the Colliery and REA, and other landholdings would be followed.

11.22.6 Conclusion

The field and laboratory studies undertaken as part of the *Acid and Metalliferous Drainage and Spontaneous Combustion Assessment* for both potential and existing REA materials determined that there is not anticipated to be any significant observable acid and metalliferous drainage, metalliferous discharge, elevated salinity or spontaneous combustion associated with the proposed placement of rejects material on the proposed extension to the REA. The REA is not anticipated to generate acid and metalliferous drainage, and the tested samples of rejects material were classified as Non Acid Forming with a low spontaneous combustion potential. It is not anticipated that any monitoring or lime treatment would be required, nor would management measures for the capture of runoff and/or leachate be implemented.

The risks associated with the storage of dangerous goods, underground fire and explosion and bushfire on the proposed development would not differ to that which is present for the operation of the existing Tahmoor Mine. These risks would be managed through the continued implementation of the existing *Hazardous Materials Management Procedure*, *Bushfire Management Plan* and pre and post gas drainage.

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11.23 Mine Closure and Rehabilitation

This section summarises the Conceptual Mine Closure Plan SLR (2018) for the proposed development, identifies the strategies for the Surface Facilities Area with regard to the proposed final land use and considers key principles for mine closure. Proposed rehabilitation measures for the proposed development during construction, operation and closure are provided. The Conceptual Mine Closure Plan for the proposed development has been prepared by SLR (2018) and is provided in **Appendix V**.

This section addresses the SEARs for rehabilitation and final landform as shown in **Table 11-108** below.

Table 11-108 SEARs for the assessment of final landform

Rehabilitation and Landform SEARs
Rehabilitation and Final Landform – including:
• an assessment of the likely impacts of the development on existing landforms and topography, including justification of the final landform design of the rejects emplacement area expansion and its long term geotechnical stability;
• a detailed description of the progressive rehabilitation measures that would be implemented for the development;
• a detailed description of the proposed rehabilitation and mine closure strategies for the proposed development, having regard to DRG's requirements (see Attachment 2) and the key principles in Strategic Framework for Mine Closure, and the: - rehabilitation objectives, methodology, monitoring programs, performance standards and proposed completion criteria; - decommissioning and management of surface infrastructure; - nominated final land uses, having regard to any relevant strategic land use planning or resource management plans or policies; and - potential for integrating the rehabilitation strategy with offset strategies proposed for the development.
• the measures which would be put in place for the long-term protection and management of the site, any biodiversity offset areas following the cessation of mining, and
• measures to avoid the propagation of acid sulphate soils.

11.23.1 Background

The proposed development is anticipated to extend the life of the Tahmoor Mine until 2035. Following completion of mining at Tahmoor South, the land would be rehabilitated and returned to a nominated final land use. It is anticipated that closure and rehabilitation of the proposed development would be undertaken in four stages:

- closure planning (five years before closure);
- decommissioning and rehabilitation (within four years of closure);
- monitoring and maintenance (within eight years of closure); and
- relinquishment and post-relinquishment activities (within ten years of closure).

It is acknowledged that Tahmoor Mine is over a decade from closure and therefore there is potential for legislation and guidelines relating to mine closure obligations to change. For this reason, the closure plan prepared for the proposed development is considered to be conceptual and would be reviewed in more detail at the detailed closure planning stage (no later than five years prior to permanent mine closure). During the detailed phase of closure planning, Tahmoor Coal will consider applicable legislation, policy and strategic land use options for the area under the relevant planning instruments, as well as undertake further stakeholder consultation to finalise the most suitable post closure land-use.

The conceptual closure plan for this EIS has been prepared on the basis that at closure, all existing mine related infrastructure and associated aspects will be entirely removed and the affected land returned to as close to pre-mining land use as possible. The purpose of preparing this plan during the EIS is to identify a viable rehabilitation strategy for the site post-mining in order to demonstrate that the land would be rehabilitated to an appropriate land use, in accordance with the SEARs for the proposed development. In particular, the purpose of the plan is to:

- nominate final land use for the site;
- provide objectives, performance standards and completion criteria to be achieved through the rehabilitation strategy for the proposed development;
- identify rehabilitation methods to be implemented during closure; and
- nominate timeframes for rehabilitation and closure activities.

The Conceptual Mine Closure Plan considers the *Strategic Framework for Mine Closure* (Minerals Council of Australia, 2000).

11.23.2 Rehabilitation and Closure Domains

In order to effectively address the complexity of various land uses at Tahmoor Mine, the Project Area has been divided into six management domains. These domains are shown in **Figure 11.41** and are summarised below.

- Domain1: Surface Facilities Area, which includes existing surface infrastructure and T3 ventilation shaft in addition to proposed infrastructure such as upgrades to the CHPP.
- Domain 2: Stockpiles, which include the ROM coal stockpile and reclaim tunnel, product coal stockpile and reclaim tunnel, and associated water management infrastructure (including dams S2, S3 and S4).
- Domain 3: REA, which includes the REA and water management infrastructure.
- Domain 4: Mine Ventilation, which includes the discontinued Bargo ventilation shaft, existing ventilation shafts T1 and T2 and proposed ventilation shafts TSC1 and TSC2.
- Domain 5: Roads, which includes haul roads within the Surface Facilities Area.
- Domain 6: Other Lands, which includes subsidence areas, extension of overhead power line from the REA to the Charlies Point Road property ventilation shafts, gas drainage and management infrastructure, exploration boreholes, light vehicle access tracks and Biodiversity Offset Areas.

A preliminary assessment was undertaken to identify a number of potential post-mining land use options for each of the rehabilitation and closure domains. As discussed above, the conceptual closure plan has assumed that all infrastructure would (as far as practicable) be removed from the site in each of the domains, details of which are provided in **Appendix V** and summarised in **Table 11-109**.

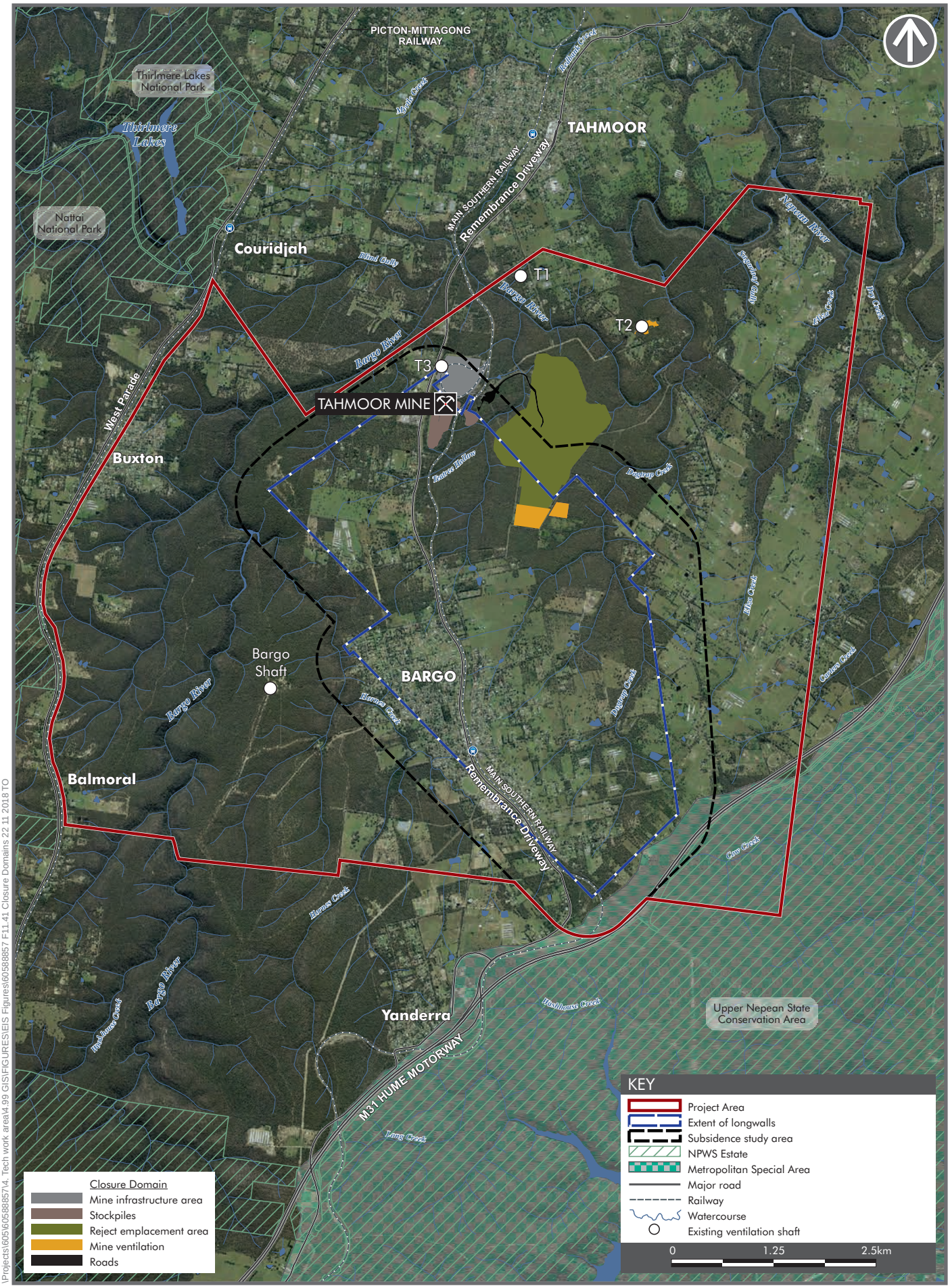
At the time of closure, there may be opportunities for infrastructure such as roads and buildings to remain to service future industries on-site and/or neighbouring industries subject to agreement with relevant stakeholders and landowners. In addition, where practicable, pipelines and cables with a diameter of approximately 200 mm or less would be capped and remain in-situ where they are located greater than 1.5 m below ground level, to reduce the risk of disturbing re-established vegetation by excavation and removal. A number of other opportunities for re-use and/or recycling (e.g. the reuse of crushed concrete footings and pads as road base for track stabilisation) may also be available and these opportunities will be considered during the detailed closure planning phase, which will include extensive stakeholder consultation.

The preliminary post-mining final land use options identified for the six domains as part of the Conceptual Mine Closure Plan are also shown in **Table 11-109**. The Conceptual Mine Closure Plan has been prepared on the basis that all existing and proposed mine related infrastructure and associated aspects will be entirely removed and the Project Area will be returned to as close to pre-mining land use as possible (predominantly native bushland) consistent with best practice mine rehabilitation. All key areas would be reshaped, deep ripped, topsoiled and seeded in accordance with the Rehabilitation and Revegetation Strategy for the proposed development (refer **Appendix V**). The post mining land use will be reviewed during preparation of the detailed closure plan five years from closure.

Table 11-109 Closure and Preliminary Post-Mining Land Use Options (SLR, 2017)

Key Area	Infrastructure and assets to be decommissioned and rehabilitated	Preliminary Final Land Use options
Domain 1: MIA	• Site services • Power lines • Equipment and buildings • Conveyors • Personnel and materials drift and ventilation shaft • Fuel farms and chemical storage areas • Roads and tracks • Sewerage and water treatment plant • Gas plant, WCMG Power Plant and on-site flare • Rail load out and rail loop • Water management infrastructure	a. Access to future mining areas (additional reserves, subject to potential future approvals) b. Re-development of the pit top area for industrial use (coal related)where compatible with end use c. Re-development of the site for some other industrial use d. Re-development of the site for a commercial use e. Re-development of the site for residential use f. Return to native bushland
Domain 2: Stockpiles	• Site services • Stockpile areas • Reclaim tunnels • Conveyors, transfer stations and gantries • Water management infrastructure • Roads and tracks	a. Access to future mining areas (additional reserves, subject to potential future approvals) b. Re-development of the stockpile area for industrial use (coal related) c. Re-development of the site for some other industrial use d. Re-development of the site for a commercial use e. Re-development of the site for residential use f. Environmental value (biodiversity) g. Grazing or other agricultural use h. Return to native bushland
Domain 3: REA	• REA • Water management infrastructure	a. Return to native bushland
Domain 4: Mine Ventilation	• Security (fencing and signage) • Site services • Ventilation shafts • Gas drainage infrastructure • Associated infrastructure	a. Return to native bushland
Domain 5: Roads	• Haul roads • Roads and tracks	a. Return to native bushland b. Retain for access to existing properties

Key Area	Infrastructure and assets to be decommissioned and rehabilitated	Preliminary Final Land Use options
Domain 6: Other lands	• Subsidence areas • Subsidence marker pegs • Gas drainage and management infrastructure • Power lines • Exploration boreholes • Roads and tracks • Associated infrastructure	a. Commensurate with the surrounding land use b. Protection for biodiversity offsets



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SIMEC MINING

REHABILITATION AND CLOSURE DOMAINS

Tahmoor South Project
Environmental Impact Statement

Source: SLR Consulting (2018)

FIGURE 11.41

11.23.3 Rehabilitation and Revegetation Measures

The rehabilitation of disturbed land for the proposed development will be conducted so that:

- Suitable vegetation species are used to achieve the nominated post-mine land uses;
- The potential for water and wind induced erosion is minimised, including the likelihood of environmental impacts being caused by the release of dust;
- The quality of surface water released from the site is such that releases of contaminants are not likely to cause environmental harm;
- The water quality of any residual water bodies is suitable for the nominated use and does not have the potential to cause environmental harm; and
- The final landform is stable and not subject to slumping or erosion which would result in the agreed post mining landform not being achieved.

The general rehabilitation measures to be implemented following the removal of infrastructure within closure domains are detailed in the Rehabilitation and Revegetation Strategy (refer **Appendix V**) and summarised below for relevant aspects.

Discussion regarding potential temporary and permanent impacts to LSC Class is provided in **Section 11.19**.

Landform Design and Planning

Rehabilitation planning at the Project Area will aid in minimising the total area of disturbance at any one time, to reduce the potential for wind-blown dust, visual impacts and sediment-laden run-off.

Rehabilitation will be designed to achieve a stable final landform compatible with the surrounding environment. This will involve the reshaping of the majority of REA to 10° or less. Should slopes exceed 10° an assessment will be made as to whether additional drainage and revegetation works are required. These control measures will help to prevent erosion and aid in groundcover establishment.

Progressive Rehabilitation

As the proposed development proposes to continue underground mining activities utilising existing surface infrastructure there would be limited opportunities for progressive rehabilitation of surface facility areas (with the exception of the REA). However, to the extent practicable where surface areas cease to be used for mining or mine-related activities, rehabilitation will be progressively undertaken as soon as reasonably practicable. The proposed progressive rehabilitation of the REA is discussed below.

Rehabilitation of REA

The REA is proposed to be progressed in approximately 15 stages over the life of the proposed development. Where practicable, each stage would be progressively rehabilitated once that section of the REA is no longer in use. Rehabilitation would commence once the portion of the REA to be rehabilitated is sufficiently dry to allow the placement of permanent capping material. Given that the remaining portions of the REA will still be in use while initial rehabilitation is completed, rehabilitation of the REA would be designed to consider:

- Capping of the rejects with a layer of compacted clay or similar impermeable substance over which a layer of free draining material would be placed;
- Use of topsoil to resurface the area to provide a suitable base for revegetation. Revegetation would be undertaken in order to inhibit ponding and infiltration of surface water and to minimise the potential for leachate;
- Rock armouring (if required) to prevent excessive slope erosion;
- Suitable clean fill and top soil will be imported on-site as required to enable progressive rehabilitation; and
- Ongoing monitoring and maintenance of the final landform to assess the rate of ongoing settlement and surface integrity.

The REA will be rehabilitated to be LSC Class 6 or 7 land (refer to **Section 11.19**). A more detailed closure strategy for the REA would also be developed in consultation with regulators as part of the detailed closure and rehabilitation planning to ensure a stable final landform.

Topsoil management

Topsoil management would be undertaken through the updating and implementation of the existing Soil and Water Management Plan, including measures such as topsoil stripping, stockpiling and the development of topsoil inventories, handling, re-spreading, amelioration and seedbed preparation. These measures are further detailed in **Appendix V**.

An assessment of the topsoil quality across the Project Area was undertaken to determine the suitability of the soil for revegetation. The assessment determined that while the topsoils are generally suitable to facilitate germination and revegetation, they will require appropriate amelioration with gypsum or lime due to the presence of strong acidity (SLR, 2018).

Erosion and sediment control

Erosion and sediment control during rehabilitation would be undertaken through the update and implementation of the existing Erosion and Sediment Control Plan.

Acid Sulfate Soils

The site is not considered at risk of acid sulfate soil or acid generation as a result of disturbance, due to the distance and elevation from the low lying coastal soils, as well as the soil types identified on site. In the event acid generation is observed measurements of soil acidity will be taken and remedial action in accordance with NSW OEH Acid Sulfate Soil Manual (1998).

Revegetation

Revegetation for the Project Area would seek to compliment the desirable post-mining land-use objectives (**Table 11-111**). Plant species would therefore be selected for each area to be rehabilitated based on their ability to successfully establish on the existing soil type and meet final land-use objectives. A list of species proposed for rehabilitation is contained in **Appendix V** and include trees, shrubs, grasses and ground covers.

Monitoring and Maintenance

Regular monitoring of rehabilitation activities would be undertaken to demonstrate whether the objectives of the Rehabilitation and Revegetation Strategy are being met and whether a sustainable landform has been achieved. Monitoring and maintenance activities would include:

- Monitoring of rehabilitation compared against reference sites (reference sites would be located in un-mined areas to indicate the pre-mining condition to be met).
- Weed monitoring and management (including regular inspection and remedial actions such as weed spraying).
- Maintenance of rehabilitated areas as required including re-seeding or planting of tube stock, application of fertiliser, and implementation of erosion protection measures.

11.23.4 Final Landform and Rehabilitation Completion Criteria

A conceptual final landform for the proposed development has been developed. Conceptual rehabilitation success criteria have been developed to provide long-term performance goals for rehabilitation activities and landform and are provided in **Table 11-110**. It is anticipated that these criteria would be further developed following consultation on the final land use with the relevant stakeholders.

Table 11-110 Preliminary Rehabilitation Success Criteria

Rehabilitation Element	Domain	Indicator	Criteria
Phase 1 – Decommissioning			
Infrastructure	Domains 1 and 2	Land use (proposed industrial)	All buildings, water storage, roads and other infrastructure (except those used by the public) have been removed unless agreed with stakeholders for their retention.
	Domains 3 and 4	Land use (Native Bushland)	All infrastructure within areas to be returned to native bushland has been removed, and disposed appropriately, for example to an appropriate waste management facility. Infrastructure may remain if the relevant stakeholders agree to their retention.
	Domain 5 and 6	Land use	Roads (except those used by the public) and other infrastructure have been removed unless stakeholders have entered into formal written agreements for their retention. Minor dozer reshaping work will be undertaken to ensure surface level consistency with the surrounding areas. Any creek crossings (i.e. culverts, etc.) will be removed and the pre-existing drainage line re-instated where applicable. If required the area will be deep ripped to loosen compacted material. A light vehicle access road is to be maintained to enable inspections of the site following closure of the mine. Fertiliser and pasture/tree seed will be applied to assist establishment of pasture post-mine land use.
	Domain 6	Boreholes	All boreholes (except those retained for monitoring purposes) have been shut down, bore casings near the surface are removed and holes plugged or capped to comply with relevant regulatory standards.
	All Domains	No contamination	All sites have been assessed by a suitably qualified expert as not containing contaminants above the relevant criteria for the proposed final land use.
Safety	All Domains	Physical	Excavations to be rendered safe. All holes/pits and other openings are to be securely capped, filled or otherwise made safe. Access to members of the public and livestock is restricted as appropriate to site conditions. No waste should remain at the surface, or at risk of being exposed through erosion. Risk assessment has been undertaken in accordance with relevant guidelines and Australian Standards and risks reduced to levels agreed with the stakeholders. Closure documentation includes the contaminated sites register which identifies contaminated sites and the treatment applied.
Phase 2 – Landform Establishment			
Landform Stability	Domains 1 and 2	Slope Gradient	Area has gradient less than 2 degrees.
	Domain 3	Capping	The REA is capped to a depth to be defined in field trials, which includes a minimum of 200 mm of topsoil. No water is observed leaching from the facility.
	Domains 1, 2, 3, 4 and 5	Surface water drainage	The landform is stable and contour banks and diversion drains are installed to direct water into stable areas or sediment control basins.

Rehabilitation Element	Domain	Indicator	Criteria
	Domains 1, 2, 3, 4 and 5	Erosion control	Erosion control structures are installed at intervals commensurate with the slope of the landform.
	Domain 6	Erosion control	Erosion mitigation measures have been applied.
	Domain 6	Subsidence impacts	Perform regular inspections over subsidence areas to identify any surface cracks and/or sinkholes. Undertake minimal clearing, if required, of areas around cracks and/or sinkholes to allow for ripping and seeding. Carry out ripping and seeding of areas where required. Following initial ripping and seeding, if trees are to be planted, they will not be planted until enough rain has fallen. Seed and/or plant appropriate species of vegetation to achieve a post-subsidence land use the same as that pre-subsidence (i.e. low intensity cattle grazing). Regrade subsidence areas and where necessary backfill with mine spoil to control surface water flow and minimise erosion and sedimentation. If ripping is not feasible due to the width of the cracks, topsoil will be stripped and stockpiled. Clay material will be imported to fill and seal cracks and the topsoil will be respread once the cracks have sealed. The area will then be reseeded with appropriate plant species.
	Domain 6	Surface water drainage	Design local drainage works to prevent the uncontrolled flow of runoff from the subsided floodplain area over the channel banks. Small diversion bunds directing floodplain runoff to properly engineered rock chute structures will be installed to minimise bank erosion.
Water Storage	Domains 3, 4 and 5	Stable landform	Water storages to be rehabilitated to a stable non-polluting condition.

Rehabilitation Element	Domain	Indicator	Criteria
Water Storage and Waterways	Domain 6	Surface water management	Provide a cover of topsoil in a weathered rock matrix to create a stable substrate for revegetation of channel banks. Weathered rock provides temporary erosion protection by covering erodible soils and minimising topsoil loss. Replace sand across the channel bed, including higher sand deposits suitable for re-creation of in-channel benches. Install timber groynes/pile field retards at the base of the channel banks (extending into the channel) to mitigate erosion undercutting the channel banks and to facilitate creation of in-channel benches. The structures will be built between each of the subsided panels affecting the river before subsidence occurs. In areas where less active bank erosion develops, large woody debris will be placed in-stream to encourage the deposition of sediment and revegetation over time. Local drainage works will be designed to prevent the uncontrolled flow of runoff from the subsided floodplain area over the channel banks. Small diversion bunds directing floodplain runoff to properly engineered rock chute structures will be installed to minimise bank erosion. Topsoil will be placed on banks and banks will be revegetated. Stock will be excluded to a width of at least 30 m from the top of bank and subsided floodplain areas in order to minimise further impacts on vegetation cover and land condition. A targeted revegetation will be undertaken in areas where surface water patterns have been affected.
Phase 3 – Growth Media Development			
Top soil	Domains 1 and 2	Physical and chemical parameters	Where practical, previously stockpiled topsoil will be used to sustain the proposed post-mining land use. Where it is assessed as not being suitable an alternative top-soil substitute will be considered (for example bio-solids, organics, etc.)
	Domains 3, 4, 5 and 6	Physical and chemical parameters	Soil salinity content is <0.6 dS/m. Soil pH is between 5.5 and 8.5. Soil Exchange Sodium Percentage is >15%. Nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts. Adequate macro and micro-nutrients are present. Where practical, previously stockpiled topsoil will be used to sustain the proposed post-mining land use. Where it is assessed as not being suitable an alternative top-soil substitute will be considered (for example bio-solids, organics, etc.)
Phase 4 – Ecosystem Establishment			
Vegetation	Domains 3, 4, 5 and 6	Species composition	Where relevant, for example areas where the post-mining land use is native bush, vegetation present is commensurate with the pre-mining environment and/or nearby undisturbed reference sites.

Rehabilitation Element	Domain	Indicator	Criteria
Phase 5 – Ecosystem Development			
Vegetation	Domains 3, 4, 5 and 6	Surface cover	Minimum of 70% vegetative cover is present (or 50% if rocks, logs or other features of cover are present). No bare surfaces >20 m^2 in area or >10 m in length down slope.
	Domains 3, 4, 5 and 6	Community structure	That the community structure is commensurate with pre-mining conditions and/or nearby undisturbed reference sites.
	Domains 3, 4, 5 and 6	Resilience to disturbance	Established species survive and/or regenerate after disturbance. Weeds do not dominate native species after disturbance or after rain. Pests do not occur in substantial numbers or visibly affect the development of native plant species.
	Domains 3, 4, 5 and 6	Sustainability	Species are capable of setting viable seed, flowering or otherwise reproducing. Evidence of second generation of tree/shrub species.
Fauna	Domains 3, 4, 5 and 6	Vertebrate Species	The number of vertebrate species does not decrease by more than 25% in the successive seasons prior to mine lease relinquishment or by more than 40% over the two successive seasons prior to mine lease relinquishment.
	Domains 3, 4, 5 and 6	Invertebrate species	Presence of representatives of a broad range of functional indicator groups involved in different ecological processes.
	Domains 3, 4, 5 and 6	Habitat structure	Typical food and water sources required by the majority of vertebrate and invertebrate inhabitants of that ecosystem type are present, including a variety of food plants and signs of natural generation of shelter sources including leaf litter.
Land Use	Domains 3, 4 and 5	Land use	The site can be managed for its designated land use without any greater management inputs than other land in the area being used for a similar purpose.

11.23.5 Conclusion

The proposed development is anticipated to extend the life of the Tahmoor Mine until 2035. Following completion of mining at Tahmoor South, the land would be rehabilitated and returned to a nominated final land use. A conceptual final landform for the proposed development has been developed and is contained within the Conceptual Mine Closure Plan (**Appendix V**). The Conceptual Mine Closure Plan has been prepared on the basis that all existing and proposed mine related infrastructure and associated aspects will be entirely removed and the Project Area will be returned to as close to pre-mining land use as possible (predominantly native bushland) consistent with best practice mine rehabilitation. The post mining land use will be reviewed during preparation of the detailed closure plan five years from closure. Conceptual rehabilitation success criteria have been developed to provide long-term performance goals for rehabilitation activities and landform.

Six management domains have been identified and the conceptual assessment has been undertaken on the basis that all infrastructure would be removed from the site in each of the domains. Preliminary final land use options for each domain were identified based on previous use, current use and the ability to rehabilitate that land following decommissioning.

The general rehabilitation measures to be implemented following the removal of infrastructure within closure domains include rehabilitation of the REA, rehabilitation of subsidence impacts, topsoil management, erosion and sediment control, revegetation and monitoring and maintenance requirements.

It is anticipated that detailed mine closure planning would be undertaken at least five years from closure, and would build upon the concept outlined in this EIS.

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11.24 Cumulative Impacts

11.24.1 Overview

Cumulative impacts result from the aggregation and interaction of impacts on a receptor and may be the product of past, present or future activities (Franks, et al. 2010). Cumulative impacts of the proposed development have been considered for the relevant environmental issues in **Section 11.0** of this EIS. There are two separate levels of cumulative impacts considered:

- Localised cumulative impacts of the proposed development on the Project Area. This includes the interaction of project impacts that in combination can cause increased effects on the environment or sensitive receptors.
- Regional interaction with other mining developments (including the existing Tahmoor Mine) in the Southern Coalfields. This includes the contribution of the proposed development to other impacts occurring at a regional scale.

Cumulative impacts have been identified and assessed across the lifecycle of the Tahmoor Mine, including activities from exploration, construction, operation and through to closure and post-closure.

11.24.2 Existing Environment and Baseline

The cumulative impact assessment has considered the key environmental issues discussed in **Section 11.0** and the existing and baseline conditions are described in the relevant sections.

The method for subsidence prediction for the proposed development used observed monitoring data from previous mining at Tahmoor Mine, as well as data from the Southern Coalfields of NSW. Subsidence predictions were used to inform assessments of natural and built features, and were also compared to observed subsidence and impacts at neighbouring collieries.

Cumulative local impacts on groundwater, surface water, terrestrial and aquatic ecology have been assessed by utilising two years' worth of baseline data. Regional impacts were assessed through analysis of observed data from the existing Tahmoor Mine, other collieries in the Southern Coalfields, and other available data sources relevant to the environmental issue.

Other mining developments identified in the region and considered in the assessment include:

- Appin and Appin West Colliery;
- West Cliff Colliery and North Cliff Colliery (non-operational);
- Metropolitan Colliery;
- Russell Vale Colliery (care and maintenance);
- Dendrobium Colliery; and
- Wongawilli Colliery.
- Berrima Colliery (closure, care and maintenance).

11.24.3 Approved and Committed Development

The following section considers approved and committed developments which are not yet fully operational, which could give rise to potential cumulative impacts in combination with the proposed development. A review of the current Major Projects, listed on the DPE website, identified several major developments relevant to the proposed development in order to assess cumulative impacts. **Table 11-111** lists these developments and identifies the anticipated timeframes.

Table 11-111 Review of Surrounding Developments

ID	Project	Status	Proponent	Anticipated Timeframe/ Project Life
09_0013	Russell Vale Colliery Underground Expansion Project	More information requested	Wollongong Coal Limited	Currently in care and maintenance mode Expansion proposes to extend mine life by 18 years
SSD 15_7172	Hume Coal Project	Project is currently being assessed by Department of Planning	Hume Coal Pty Ltd	23 years
SSD 16_8194	Dendrobium Mine Expansion Project	SEARs Issued	Illawarra Coal Holdings Pty limited	Existing operation extended for an additional 18 year timeframe.
SSD 13_6334	Sutton Forest Quarry Project	Proponent reviewing submissions	Sutton Forest Quarries Pty Ltd	30 years

The Russell Vale Colliery is located approximately 30 km south east of the proposed development. The mine was placed into care and maintenance mode in 2015 pending approval of the Russell Vale Colliery Underground Expansion Project. The proposed development seeks to extend mining operations at the site, establish new domains, and upgrade associated surface infrastructure. An EIS was submitted for review for the proposed development in 2014 and more information was requested. The proposed development was referred to the Planning Assessment Commission (PAC) and an addendum report was submitted to the PAC. In March 2016 the PAC requested additional information from the proponent.

Access to the existing Russell Vale Colliery pit top is provided via the Princess Highway and therefore traffic for the Russell Vale Colliery Underground Expansion Project and the proposed development is not expected to interact. Due to the location of the Russell Vale Colliery and site access arrangements no cumulative impacts are expected should the proposed Tahmoor South project proceed.

The Hume Coal Project is a proposed new underground coal mine and associated rail infrastructure located approximately 40 km south west of the proposed development. An EIS has been prepared for the proposed development and is currently being assessed by the Department of Planning and Environment. Due to the distance of the Hume Coal Project no cumulative impacts are expected should the proposed Tahmoor South project proceed.

The Dendrobium Mine Expansion Project proposes to expand the Dendrobium Coal Mine, located approximately 30 km south east of the proposed development. SEARs for the proposed development were issued in February 2017. Access to the existing Dendrobium Coal Mine pit top is provided via the Princess Highway and therefore traffic for the Dendrobium Coal Mine Expansion Project and the proposed development is not expected to interact. Due to the location of the Dendrobium Colliery and site access arrangements no cumulative impacts are expected should the proposed Tahmoor South project proceed.

In addition to the above projects the cumulative impact assessment also considered specific elements of the Tahmoor North operations that were not already integrated into the demolition works assessment.

11.24.4 Cumulative Impact Assessment

Tahmoor North

Coal mining operations are currently being undertaken within the Tahmoor North mining area and are scheduled for completion in 2022. While longwall mining for the proposed development would not occur until completion of Tahmoor North, the proposed development would commence pre-mining activities prior to this completion. This means there will be a period of ramping down of the existing Tahmoor North operations and the ramping up of the proposed development in order to replace current production. It is important to note that this would not increase cumulative impacts, but would rather transfer some impacts from one mining area to the other. These impacts include issues such as noise, air quality, greenhouse gas, waste and mine rejects, traffic, rail and port capacity, housing and infrastructure, social and hazard and risk.

While there will be a period of overlap between the completion of mining at Tahmoor North and the commencement of operation of the proposed development, it is considered there will be no regional net change in cumulative impacts for these issues. Further, the gradual transfer of output from Tahmoor North to the proposed development presents net beneficial outcome when compared to a scenario where both mining areas are operating concurrently at full capacity.

Subsidence

As previously discussed, subsidence predictions were modelled and compared to observed data from the existing Tahmoor Mine and other mining developments in the Southern Coalfields, therefore relying on a cumulative data set. Regional impacts are likely to result from far-field subsidence movements. Far-field subsidence movements are known to occur regularly within the Southern Coalfields but are difficult to predict by a model or prediction method. However, as no adverse impacts have been recorded as a result of such movements, cumulative impacts at a regional scale are considered unlikely.

The Subsidence Impact Assessment identified houses, amenities and infrastructure that would be impacted by subsidence movements over the life of the proposed development. As subsidence movements that have the potential to damage infrastructure are primarily limited to the SSA (i.e. excludes far-field movements), impacts to houses and structures located outside of this area are not anticipated. Further, future residential development within affected townships will be subject to the same predicted subsidence.

Cumulative impacts on infrastructure have the potential to occur where large scale linear infrastructure such as the Main Southern Railway, M31 Hume Motorway or the high pressure gas pipelines experience greater than predicted subsidence resulting in cracking or other damage. As these infrastructure link regional areas, impacts can have flow on effects. However, predictions for these infrastructure items are unlikely to result in significant impacts or deformation and therefore cumulative impacts are considered unlikely.

Groundwater

The cumulative impacts of groundwater relate to localised drawdown and impacts on water quality, volume and baseflow. The cumulative impacts were assessed through numerical modelling and included review of data from several mines in the regional area. The assessment considered impacts to sensitive water features in the region such as Thirlmere Lakes, baseflow changes to significant watercourses and drawdown impacts on private bores.

Given the simulated potential cumulative impact on the water table at Thirlmere Lakes as well as on existing groundwater users' bores within the Permian and Triassic strata, the proposed development falls within the *NSW Aquifer Interference Policy,* Level 2 classification of the minimal impact considerations.

An ongoing commitment to manage groundwater through monitoring and trigger action response and make-good measures is anticipated to minimise cumulative impacts to groundwater.

Geomorphology

The proposed development is not anticipated to cause cumulative impacts to geomorphology. The qualitative assessment of geomorphology found that the overall risk of geomorphic change as a result of mining-induced subsidence was minor. Further, as geomorphology is limited to surface water catchments, impacts are unlikely to be experienced outside these catchments. The waterways within the Project Area are described as resilient and would recover with appropriate monitoring and management should there be changes that result from the proposed development.

Surface Water

The surface water assessment considered long-term averages for rainfall data, stream flow and water quality data for the local surrounding area and included observed data for Tahmoor North. The modelling was limited to the relevant catchments within the Project Area. Due to the nature of the surface water environment, impacts are limited to these catchments and therefore other regional catchments were not assessed. No other mining developments lie within these catchments (other than Tahmoor North which was assessed) and as such the regional cumulative impact on surface water is considered minimal. Surface water has been considered cumulatively in relation to other environmental issues assessed in this EIS, such as aquatic ecology.

The impacts on both water quality and quantity are likely to be small. With consideration to the combined effects of the proposed development, consumptive groundwater extraction and the effects of other existing mining projects in Tahmoor, the cumulative impacts to baseflow reductions are assessed to be relatively small as a percentage of average flow. The largest change in baseflow is predicted to be at Dog Trap Creek where baseflow reductions would likely be distinguishable from natural variability in creek flow.

Terrestrial Ecology

Land use within and surrounding the Project Area comprises a mix of agriculture, residential development, and conservation areas. Similar land use characteristics exist for the Southern Coalfields. In a regional ecological context, the Project Area is located within the Sydney Basin Bioregion.

With the exception of existing conservation areas, land use pressures on natural systems in the Project Area have increased over time for housing, agriculture and other land uses. The proposed development has the potential to increase pressures on the natural system when combined with the existing modification and degradation of the area.

Direct impacts to terrestrial ecology will be primarily limited to surface disturbance as a result of the expansion of the REA, upgrade of the Surface Facilities Area and to a lesser extent, subsidence. The proposed development would result in the clearance of a total of 49.2 ha of native vegetation, including about 43.4 ha of Shale Sandstone Transition Forest (SSTF) EEC as well as 5.7 ha of Upper Georges River Sandstone Woodland, and impacts to individuals of threatened flora *Persoonia bargoensis* and *Grevillea parviflora* subsp. *parviflora*. While predominately localised impacts, the removal of this endangered community and species would further reduce the already limited distribution.

It is proposed that impacts will be offset through the protection of other sites within the Sydney Basin Bioregion as identified in the Biodiversity Offset Strategy for the proposed development (**Appendix K**). It is considered that the adoption of offset lands will contribute to conservation within the greater Sydney Basin Bioregion.

Aquatic Ecology

The Aquatic Ecology Assessment for the proposed development identified that cumulative impacts on aquatic ecology include the combined influence of water quality, stream connectivity and habitat loss. In addition to potential impacts from the proposed development, these can increase as a result of other land use activities such as agriculture which may contribute to sources of pollution.

Potential cumulative impacts include localised (e.g. to a pool), transient (e.g. occur in prolonged low flow condition only), or gradational impacts (e.g. downstream from a point source). Impacts to stream and biological processes may alter aquatic communities through localised reduced abundances of sensitive flora and fauna, increased abundance on tolerant flora and fauna, reduction of abundances of all aquatic flora and fauna, and a reduction of fauna richness. It is considered that the majority of stream fauna are able to recover or partially recover naturally, or through the implementation of mitigation measures (such as PRPs to control water quality).

Aboriginal Heritage

The Aboriginal Cultural Heritage Assessment involved a desktop review, field survey and consultation with Aboriginal representatives to determine local and regional cultural heritage values that may be impacted by the proposed development. One archaeological site was predicted to be impacted by direct surface disturbance and 26 archaeological sites were predicted to be impacted by indirect subsidence impacts. As a result, it was identified that the proposed development would cause a minor increase to the cumulative development impact on the Aboriginal cultural heritage of the region and local area. However, the mine plan has been designed to avoid direct undermining of rock shelter sites with art along Dog Trap Creek and archaeological heritage sites in the south east section of the Project Area south of the Hume Highway to minimise impacts to cultural heritage values in the area.

Non-Aboriginal Heritage

The Historic Heritage Assessment involved a desktop review and field survey to determine local and State items of heritage significance that may be impacted by the proposed development. The assessment considered subsidence impacts which may negatively impact heritage values. As the heritage sites identified are discrete locations, and significant impacts are not anticipated, it is considered the proposed development would not have a cumulative effect on Non-Aboriginal heritage.

Noise and Vibration

The NVIA undertaken for the proposed development considered background data for the affected area and considered meteorological effects to provide more accurate predictions. The assessment considered surrounding receptors as categorised into nine noise catchment areas. Noise modelling was undertaken for construction noise, operational noise, and road traffic noise impacts. Acoustic mitigation measures were identified that can be implemented to reduce noise levels generated at source from the proposed development. There are no other major noise sources (such as other mine developments) close enough to the proposed development that would further contribute to overall noise impacts.

While there will be some overlap in the cessation of the Tahmoor North mining area and commencement of the proposed development cumulative noise impacts are not likely to increase as a result. While there will be a period of overlap of activities to maintain coal production, activities at Tahmoor North will be ramped down as the proposed development ramps up, therefore providing no net change to regional noise emissions predicted in the NVIA.

Air Quality

Cumulative air quality impacts, including dust generation have been assessed against background concentrations of pollutants within the local region. A Monte Carlo Simulation was completed to assess PM_{10} 24-hour impacts at the most affected receptor locations. The analysis concluded that there was a probability that the selected receptors may exceed the EPA criterion of 50 $\mu g/m^3$ when impacts are considered cumulatively.

The probability of exceedances occurring are dependent on actual mine activities, other nearby dust generating activities, weather conditions as well as the implementation of real-time controls.. There are no receptors that are predicted to experience annual average PM_{10}, annual average TSP or annual average dust deposition levels above the EPA assessment criteria, either from the proposed development alone or cumulatively.

While there will be some overlap in the cessation of the Tahmoor North mining area and commencement of the proposed development cumulative air quality impacts are not likely to increase as a result. While there will be a period of overlap of activities to maintain coal production, activities at Tahmoor North will be ramped down as the proposed development ramps up, therefore providing no net change to regional air emissions predicted in the AQIA.

Greenhouse Gas

The proposed development will result in a cumulative impact in GHG emissions, with increases in Scope 1 GHG emissions representing approximately 0.19% of Australia's Paris Agreement target. The assessment of GHG emissions considered ROM and coal product values projected for years 2019 to 2035.

While there will be some overlap in the cessation of the Tahmoor North mining area and commencement of the proposed development cumulative greenhouse gas emissions are not likely to increase as a result. While there will be a period of overlap of activities to maintain coal production, activities at Tahmoor North will be ramped down as the proposed development ramps up, therefore providing no net change to regional greenhouse gas emissions predicted in the GHG assessment.

Traffic

The proposed development will result in a marginal incremental increase in traffic movements associated with employee vehicle movements travelling to and from Tahmoor Mine over its extended life, with traffic impacts peaking in 2020. The TIA considered the existing and future road network capacity and concluded that impacts would be minor. The cumulative increase in traffic is not anticipated to result in significant traffic delays or safety issues.

While there will be some overlap in the cessation of the Tahmoor North mining area and commencement of the proposed development cumulative traffic impacts are not likely to increase as a result. While there will be a period of overlap of activities to maintain coal production, activities at Tahmoor North will be ramped down as the proposed development ramps up, therefore providing no net change to regional traffic impacts predicted in the TIA.

Rail and Port Capacity

The Rail and Port Capacity study provided a cumulative assessment of the proposed development's main export route. The study identified that there is existing capacity, and included potential future growth from other sources received at Port Kembla. The transition between Tahmoor North and the proposed development is unlikely to result in a change to net cumulative impacts on rail and port capacity assessed in the study.

Social

The SIA for the proposed development considered cumulative social impacts with other environmental issues, as well as impacts from the presence and further development of mines within the Southern Coalfields. It also identified the benefits of the proposed development as a result of ongoing and increased employment within the local community, and regional benefits to the economy. Tahmoor Coal provides community contributions in accordance with a Corporate Social Involvement Plan which was developed to accommodate local and regional planning strategies. The transition between Tahmoor North and the proposed development is unlikely to result in a change to net cumulative impacts on social impacts as the social investments by Tahmoor Coal would continue to be undertaken.

Economic

A net benefit of around $699.5 million in NPV terms is expected to be generated by the proposed development over its life, of which up to $423.6 million would flow through to the NSW economy through both the labour market and suppliers. The employment benefits of the project would peak at approximately 565 employees during the transition period between ongoing mine operations at Tahmoor North and pre-mining development at Tahmoor South. Operational employment at Tahmoor South would peak at 510 employees in 2020 and involve a long term operational workforce of approximately 422 employees (post 2020).

Visual

The proposed development is not expected to create a visual impact on existing land use within and surrounding the Project Area. The existing landscape character of the Project Area is considered to be robust with a High Visual Absorption Capacity that is able to absorb change without any significant alteration to the existing landscape character. No cumulative impacts are expected.

Soils and Land Capability

Soil disturbance will occur for the expansion of the REA and upgrade of the Surface Facilities Area. The land disturbed for ventilation shaft sites (approximately 13 ha) would be rehabilitated consistent with pre-mining conditions following the cessation of mining and therefore would not result in the permanent loss of potential agricultural land. The land required for the REA expansion (approximately 43 ha) is classified as Class 4 moderate capability land (37 ha) and Class 6 low capability land (6 ha). This land would be reduced to Class 7 land (upon post-mining rehabilitation) and therefore permanently removed from potential agricultural production as a result of the REA expansion. As the land has not been historically or currently used for agricultural purposes, the impact on cumulative land capability would be low. Minor cumulative impacts could occur during construction where potential erosion and sedimentation may affect water quality in local watercourses. However, surface areas are managed by existing and proposed environmental management plans.

Land Use, Agriculture and Resources

Land use within the Project Area is primarily rural but also includes residential development, agricultural developments and conservation areas. As discussed above, around 43 ha of potential agricultural land will be reduced to Class 7 agricultural land and thereby permanently removed from potential agricultural production as a result of the REA expansion. This land is not currently used for agricultural production and would be returned to bushland as part of the rehabilitation of the site following mine closure. The rehabilitation of this land is anticipated to re-link native vegetation previously impacted by the REA.

The Conceptual Mine Closure Plan for the proposed development has identified that where possible, post-rehabilitation land use options include returning suitable land to agricultural use. A review of future rehabilitation plans of other developments (e.g. Appin Mine) identified that post-rehabilitation land-use goals would similarly aim to ensure land is returned to a quality suitable for rural agriculture.

Waste

The proposed development will generate construction and operational waste. While waste will be minimised or recycled where possible, some waste materials will require off-site disposal by a licensed contractor. The majority of off-site disposal will be required during construction, as operational waste is primarily limited to the disposal of rejects to the REA.

The transition between Tahmoor North and the proposed development is unlikely to result in a change to net cumulative impacts on waste as existing disposal methods would continue. There are no other major waste generating developments in the area and it has been assumed that other mining developments in the Southern Coalfields generate comparable waste types and volumes. Neighbouring mines also adopt an on-site reject disposal approach therefore cumulative impacts would be relatively minor.

Hazard and Risk

The proposed development will need to manage hazard and risks associated with storage of dangerous goods, underground fire and explosion and bushfire. However, the risks and management of those risks would not differ from the existing Tahmoor Mine. Cumulative impacts on hazard and risk are unlikely.

Mine Closure and Rehabilitation

The Conceptual Mine Closure Plan for the proposed development identifies suitable final land-use options following decommissioning of infrastructure. Rehabilitation of Tahmoor Mine would provide positive cumulative impacts as impact sources such as noise and dust generating activities would be removed from the area.

11.24.5 Management Measures

Cumulative impacts would be mitigated and managed by the measures presented in **Section 11.0** for each environmental issue. The commitment to ongoing groundwater and surface water monitoring programs would provide an accurate and contemporary baseline for further assessments and management as needed.

12.0 Environmental Management Commitments

12.1 Environmental Management

12.1.1 Environmental Management System

Tahmoor Coal currently operates Tahmoor Mine under an existing EMS, although the EMS is not accredited or externally audited under ISO14001. Tahmoor Coal also operates under several key EMPs as described in **Table 12-1**. Management plans that form the base of the EMS have been developed to identify, analyse, evaluate and manage all significant potential and actual risks and impacts of activities and operations in the environment and the community. The existing EMS would continue to be adopted for the proposed development but would be updated and augmented where required to incorporate additional environmental management requirements.

Table 12-1 Tahmoor Coal Environmental Management System Document Directory

Tahmoor Coal Existing Environmental Management Plans	
Title	**Purpose**
Cultural Heritage Management Plan	Protect, maintain and mitigate any impacts to items of indigenous and non-indigenous heritage as a result of Tahmoor Mine's operations.
Biodiversity and Land Management Plan	Documents land management practices and control measures to be implemented by Tahmoor Coal to minimise the impact of operations on the surrounding area.
Air Quality and Greenhouse Gas Management Plan	Documents the management practices and control measures which have been implemented at Tahmoor Mine to maintain compliance with all relevant approval conditions related to air quality. Identifies control measures aimed at minimising the release of fugitive greenhouse gas emissions from the operation.
Waste Management Plan	Documents the management measures to be implemented at Tahmoor Mine in accordance with the conditions of development consent, EPL No.1389 and legislative requirements pertaining to waste management.
Noise Management Plan	Provides a framework for site personnel to ensure that compliance is achieved with relevant internal and external regulatory requirements related to noise management at the site.
Conceptual Mine Closure Plan	Provides an overall framework for the mine closure process. The document will form the basis for the development of a detailed mine closure plan within 5 years of the planned completion of mining.
Environmental Monitoring Program	Details the environmental monitoring requirements of Tahmoor Mine and ensure that the environmental monitoring methods are appropriate to assess the environmental performance of the operation, and comply with the relevant regulatory conditions.
Social Involvement Plan	To continually improve and maintain Tahmoor Mine's role as a responsible corporate citizen and to assist with the implementation of appropriate communication strategies to promote positive and long-term relationships with our community
Pollution Incident Response Management Plan	Addresses the legislative Pollution Incident Response Management Plan requirements. This document also details the procedures for notification of pollution incidents resulting in or having the potential to cause material harm to the environment.
Soil and Water Management Plan	Provides a framework for the management of soil and water on-site at Tahmoor Mine.

Tahmoor Coal Existing Environmental Management Plans	
Title	**Purpose**
Groundwater Management Plan	Provides a framework for the operation of Tahmoor Mine so that surface and subsurface mining operations will be conducted in a manner which minimises the potential impacts on groundwater flow and quality, aquifer integrity, groundwater dependent ecosystems and other off-site groundwater related impacts.

12.1.2 Environmental Monitoring and Reporting

Tahmoor Coal is committed to continuous improvement of its environmental management of the existing Tahmoor Mine and would continue this process for the proposed development. Tahmoor Coal would continue to record all complaints received in a database and would respond to complaints received as quickly as possible. Throughout construction and operation of the proposed development, environmental reporting would include the following:

- annual reporting including a summary of the following over the reporting period:
  - compliance with all relevant approvals and licenses;
  - mining operations;
  - environmental performance;
  - water management;
  - rehabilitation works; and
  - community engagement and complaints.
- compliance reports;
- incident reports;
- remedial actions undertaken should an incident occur;
- checklists to address operational compliance;
- details of stakeholder consultation and meetings;
- outcomes of any auditing that is carried out; and
- the findings of any monitoring that is conducted.

Tahmoor Coal would ensure that all reporting that is undertaken in relation to environment and OHS issues would be in compliance with the relevant licence conditions and regulatory requirements.

12.2 Summary of Management and Mitigation Measures

Management and mitigation measures outlined in this section would be implemented throughout the detailed planning, construction and operational phases of the proposed development, should it proceed. These safeguards would minimise any potential adverse impacts arising from the proposed development on the surrounding environment. The management and mitigation measures recommended for the proposed development are summarised in **Table 12-2**.

Table 12-2 Summary of Management and Mitigation Measures for the Proposed Development

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
Subsidence				
S-1	Subsidence impacts to natural and built features	Prepare an Extraction Plan for the proposed development that includes: • Requirements for pre-mining subsidence assessment and ongoing monitoring. • Preparation of subsidence management sub-plans for natural and built feature categories that will be impacted by subsidence. Each subsidence sub-plan would detail subsidence performance measures, criteria, predictions and descriptions for each feature as well as monitoring requirements, risk controls and a TARP. • Consideration of the potential for increased subsidence impacts to occur.	Proposed	Pre-construction
Geomorphology				
GE-1	Impacts to geomorphological features in the Project Area from mining-induced subsidence	Undertake pre-, during- and post-mining photographic surveys and visual inspections of geomorphological features for each longwall. Results would be documented in the EP and end of panel report.	Proposed	Operation
GE-2		Undertake an annual catchment survey at 10 headwater photographic sampling locations to monitor mining-induced subsidence impacts of the proposed development over time. Monitoring results reported annually within the Annual Environmental Monitoring Report.	Proposed	Operation
GE-3		For each longwall monitor risk of knickpoint formation and implement appropriate controls to prevent knickpoint formation. Monitoring and controls to be reported within the longwall's end of panel report.	Existing	Operation
Groundwater				
GW-1	Impacts to groundwater as a result of mining-induced subsidence	Develop and implement a Groundwater Management Plan.	Existing	Pre-construction
GW-2		Develop and maintain regional groundwater monitoring network, with monitoring results reported annually within the Annual Environmental Monitoring Reports and/ or longwall end of panel reports.	Existing	Ongoing

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
GW-3	Impacts to groundwater as a result of longwall mining and mining-induced subsidence	Monitoring of inflows to the mine using the total mine inflow metering method, with volumes reported within the Annual Environmental Monitoring Report.	Existing	Operation
GW-4	Impacts of mining-induced subsidence on groundwater bore users	Remediation of impacts to groundwater bores to a 'make good' standard, which would involve deepening and/or replacing bores and wells and/or providing an alternative water source to affected users.	Proposed	Operation
Surface Water				
SW-1	Impacts to surface water from mining-induced subsidence	Undertake monitoring of potentially impacted streams for flow and water quality. Monitoring results reported within the Annual Environmental Monitoring Reports	Existing	Ongoing
SW-2		Install an additional gauging station at Tea Tree Hollow, downstream of the edge of the longwall and upstream of LDP1. Establish continuous pool water level monitoring network within representative sites along Dog Trap Creek, and Tea Tree Hollow. Monitoring results reported within the Annual Environmental Monitoring Reports	Proposed	Pre-construction
SW-3		Develop an adaptive monitoring program and TARP which includes triggers for water quality exceedances, unexpected flow loss based on analysis of baseline (pre-subsidence) streamflow data and unexpected loss of pool water holding capacity based on analysis of baseline (pre-subsidence) pool water level data. TARP to be documented in the longwall's EP and outcomes reported within the end of panel report.	Proposed	Pre-construction
SW-4		Monitoring of waterways within 200m of active longwall mining, including weekly photographic recording and monthly water quality sampling upstream and downstream of potentially affected areas. Results would be analysed in relation to action response triggers. Monitoring to be reported within the longwall's end of panel report.	Existing	Pre-construction

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
SW-5		In accordance with the Extraction Plan following the cessation of longwall mining, monitor streamflow, pool water levels and water quality of waterways in the Project Area. Monitoring to be reported within the Annual Environmental Monitoring Report.	Existing	Post-operation
Terrestrial Ecology				
TE-1	Impacts to terrestrial ecology from surface impacts of the proposed development	Monitor site disturbance works to, where possible, avoid or minimise impacts to terrestrial ecology.	Existing	Ongoing
TE-2		Revise and update the existing Biodiversity Management Plan.	Proposed	Construction and operation
TE-3		Undertake on-going monitoring of potential flora and fauna impacts, including ongoing amphibian monitoring. Monitoring to be reported annually within the Annual Environmental Monitoring Report.	Existing	Ongoing
TE-4		Implement the Tahmoor South Project Biodiversity Offset Strategy.	Proposed	Ongoing
Aquatic Ecology				
AE-1	Impacts to aquatic ecology as a result of longwall mining and mining-induced subsidence	Monitor site disturbance works to, where possible, avoid or minimise impacts to aquatic ecology. Monitoring to be reported within the Annual Environmental Monitoring Report.	Existing	Ongoing
AE-2		Undertake monitoring of macroinvertebrates for a baseline period prior to longwall extraction. The monitoring program may require adding or relocating sites according to the final mine plan, and using the same sampling methods as used in the aquatic monitoring conducted to date.	Existing	Pre-construction
AE-3		Implement a BACI (Before After Control Impact) designed monitoring program to compliment the baseline information collected and to assess monitoring impacts in an adaptive management framework.	Existing	Ongoing
Aboriginal Heritage				
AH-1	Impacts to items and/or places of Aboriginal Cultural Heritage Significance as a	Prepare a Heritage Management Plan in consultation with Aboriginal stakeholders	Proposed	Construction and operation
AH-3		Develop site-specific management strategies in consultation with Aboriginal stakeholders should any monitored rock shelters be impacted by mining-induced subsidence associated with the proposed development.	Proposed	Operation

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
AH-4	result of longwall mining and mining-induced subsidence.	Expand the Tahmoor Aboriginal Heritage Monitoring Program to include AHIMS sites. Undertake monitoring prior, during and after longwall mining, with monitoring results reported annually within the Annual Environmental Monitoring Report	Proposed	Ongoing
AH-5		Complete subsurface test excavation at TSC 2 Ventilation shaft and fan site location, after the confirmation of its final location.	Proposed	Construction
Non-Aboriginal Heritage				
HH-1	Impacts to items of non-Aboriginal Cultural Heritage Significance as a result of longwall mining and mining-induced subsidence.	Update the existing Cultural Heritage Management Plan to include relevant information from the Historic Heritage Assessment for the proposed development.	Proposed	Construction
HH-2		Develop a site specific Heritage Management Plan for each heritage site of local and/or State significance identified within the SSA including Wirrimbirra Sanctuary, Bargo Railway Station and Toilet Block, Bargo Cemetery, Bargo Railway Bridges (South and North) and Tahmoor Mine. Each Heritage Management Plan would form part of the Extraction Plan for the longwalls relevant to each item, and would be developed in consultation with property owners/managers and the Wollondilly Shire Council prior to commencement of mining within one year of mining.	Proposed	Construction
HH-3		Develop a site specific Heritage Management Plan for Wirrimbirra Sanctuary prior to commencement of mining, including a detailed site inspection. The outcomes of the assessment would be provided in an addition Statement of Heritage Impact in consultation with the National Trust and NSW Heritage Council, or its delegate.	Proposed	Operation
Noise and Vibration				
NV-1	Impacts of construction noise on sensitive receivers	Update the Noise Management Plan to include regular site operator education about best practice work methods to minimise construction noise as part of site inductions. Delivery of site operator education to be reported within the Annual Environmental Monitoring Report.	Proposed	Construction
NV-2		Develop and implement a Construction Noise and Vibration Management Plan. Monitoring to be reported within the Annual Environmental Monitoring Report.	Proposed	Construction
NV-3	Impacts of operational noise on sensitive	Implement all mitigation measures determined to be reasonable and feasible which were modelled in the proposed development operational mine scenario.	Proposed	Operation

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
NV-4	receivers	Update the Noise Management Plan, including a noise monitoring program for the proposed development, including attended and continuous real time noise monitoring. Monitoring to be reported annually within the Annual Environmental Monitoring Report.	Proposed	Operation
NV-5		Continue the existing noise monitoring program.	Proposed	Operation
Air Quality				
AQ-1	Impacts of construction of the proposed development on air quality sensitive receptors	Develop and implement an Air Quality Management Plan for inclusion in the CEMP. The Air Quality Management Plan would include management and mitigation measures to minimise dust generation.	Proposed	Construction
AQ-2	Impacts of the operation of the proposed development on air quality sensitive receptors	Update the Air Quality and GHG Management Plan to align with the operation of the proposed development. Monitoring to be reported annually within the AEMR.	Proposed	Operation
AQ-3		Continue to implement the reactive and predictive Air Quality Control System to manage dust impacts. Monitoring to be reported annually within the AEMR.	Existing	Operation
AQ-3		Implement a Target Action Response Plan relating to meteorological triggers for dust generation.	Existing	Operation
Greenhouse Gas				
GHG-1	Generation of GHG from operation of the proposed development	Implement fugitive emissions abatement measures.	Proposed	Operation
GHG-2		Continue use of an electric winder as the primary method of materials transport for the mine rather than diesel transport	Existing	Pre-construction
GHG-3		Monitor the upcast ventilation shaft sites to enable accurate measurements of ventilation emissions. Monitoring to be reported within the AEMR.	Proposed	Operation
GHG-4		Prepare an Energy Savings Action Plan in accordance with the NSW Energy Administration Amendment (Water and Energy Savings) Act, 2005 and the Guidelines for Energy Savings Action Plans (DEUS, 2005). The plan will include standards to minimise energy use and GHG emissions from the proposed development's operations.	Proposed	Operation

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
GHG-5		Ensuring maintenance, calibration and record keeping is undertaken on the main ventilation shafts and fans to enable GHG emission calculations. Maintaining records for monthly electricity use and monthly ROM coal production to allow calculation of greenhouse gas emissions. Monitoring to be reported annually within the AEMR.	Proposed	Operation
Traffic				
T-1	Impacts of construction traffic on the local road network	Prepare and implement a Construction Traffic Management Plan in consultation with RMS and the Wollondilly Shire Council.	Proposed	Pre-construction
T-2		Staging of construction of the proposed ventilation shafts, with one ventilation shaft constructed at a time. A benefit of this approach is that it will reduce the cumulative impact of heavy and light vehicle movements on the local road network and reduce the overall traffic volume generated by the proposed development.	Proposed	Construction
T-3	Impacts of the proposed development on road safety and traffic efficiency along the local road network	Upgrade the Remembrance Driveway/Mine Access Road intersection to improve the performance and safety of the intersection.	Proposed	Construction
T-4		Construct a new carpark at the Surface Facilities Area to accommodate the increased number employees and contractors.	Proposed	Construction
T-5	Impacts of operational traffic on the local road network	Update the existing Tahmoor Mine Traffic Management Plan	Proposed	Operation
Social Impacts				
SI-1	Impacts of the proposed development on the social environment of the Project Area	Manage amenity impacts in accordance with the measures outlined in the relevant sections outlined in this table and in **Section 11.11**, **11.13**, **11.15** and **11.17.**	Proposed	Construction and Operation
SI-2		Review community engagement activities regularly to ensure the information and mechanisms for providing key community and government stakeholders are appropriate.	Proposed	Ongoing
SI-3		Update the existing Social Investment Plan to would provide a framework for ongoing contributions to community partnerships and initiatives through Tahmoor Coal's Corporate Social Involvement (CSI) program.	Proposed	Operation

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
SI-4		Continuing discussions with the Wollondilly Shire Council regarding a Voluntary Planning Agreement	Proposed	Prior to determination
Visual Impacts				
V-1	Impacts of the surface development of the proposed development on visual amenity.	New structures would be dark in tone and utilise non-reflective materials where possible.	Proposed	Pre-construction
V-2		Design new lighting to consist of low level night lighting and avoid direct line of sight from surrounding areas where possible.	Proposed	Pre-construction
V-3		Design security lighting to minimise light spill where reasonable and feasible.	Proposed	Pre-construction
V-4		Retain and protect tree cover to the fullest extent possible where reasonable and feasible.	Proposed	Construction
V-5		Implement landscaping which is progressive and increases the level of existing screening potential	Proposed	Construction
V-6		Implement progressive rehabilitation and tree planting on the REA to allow the REA to blend into the landscape.	Proposed	Operation
Soils and Land Capability				
SLC-1	Impacts of mining induced subsidence from the proposed development on soil and land capability.	Update existing Soil and Water Management Plan. Monitoring to be reported within the AEMR.	Existing	Ongoing
SLC-2		Prepare and implement a TARP as part of the revised Soil and Water Management Plan.	Proposed	Operation
Land Use and Resources				
LUR-1	impacts of the surface aspects of the proposed development on land use	Limit land clearing to minimise disturbance to agricultural land.	Proposed	Construction
LUR-2		Develop a Surface, Safety and Serviceability Management Plan for each asset expected to experience impacts from subsidence.	Proposed	Pre-construction
LUR-3		Develop a Land Management Plan to manage land use and agricultural land within the Project Area.	Proposed	Pre-construction
LUR-4		Re-establishing agricultural lands following mine closure in accordance with the Conceptual Mine Closure Plan to ensure successful restoration of agricultural land to target Rural Land Capability Classification.	Proposed	Post-operation

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
Rejects disposal				
RD1	Impacts associated with improper management of the REA	Update the existing management, rehabilitation and monitoring plan for the REA.	Proposed	Operation
Waste				
W-1	Inappropriate waste management throughout construction and operation of the proposed development	Update the existing Waste Management Plan. Monitoring to be reported annually within the AEMR.	Proposed	Construction and Operation.
Mine Closure and Rehabilitation				
MCR-1	Inappropriate rehabilitation and revegetation of the Project Area	Undertake rehabilitation in accordance with the Rehabilitation and Revegetation Strategy. Monitoring to be reported within the AEMR.	Existing	Operation and post-mining
MCR-2	Surface cracking and impacts to waterways and drainage lines from mining-induced subsidence	Undertake rehabilitation as soon as practical following subsidence.	Proposed	Operation.

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
Hazard and Risk				
HR-1	The generation of contamination from the proposed development.	Undertake ongoing acid and metalliferous drainage monitoring. Monitoring to be reported within the AEMR.	Existing	Construction
HR-2	Spontaneous combustion as a result of rejects emplacement	Update the existing Spontaneous Combustion Management Plan.	Proposed	Operation
HR-3		Undertake regular visual inspections of the REA for the presence of spontaneous combustion	Existing	Ongoing
HR-4	Impacts of bushfire	Enforce a cigarette ban at all landholdings	Existing	Ongoing
HR-5		Undertake fuel reduction activities to limit the speed and spread of potential unscheduled fires	Existing	Ongoing
HR-6		Maintain Fire trail and access roads to, from and within Tahmoor Coals landholdings	Existing	Ongoing
HR-7		Continued implementation of the Tahmoor Emergency and Management Plan	Existing	Ongoing
HR-8		Follow the existing Emergency Response Procedures.	Existing	Ongoing
Environmental Risk				
EHR-1	Potential impact of diesel emissions on the health of individuals	Undertake reactive monitoring programs and regular maintenance and servicing of diesel vehicles on site to reduce risks to the exposed community.	Existing	Ongoing
Cumulative Impacts				
N/A	Cumulative impacts of the proposed development	Cumulative impacts would be mitigated and managed by the measures presented in **Section 11.0** for each environmental issue.	Proposed	Ongoing

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13.0 Project Justification

13.1 Net Project Benefits

The proposed development will provide a range of benefits to local, Regional and State economies, including continued provision of employment for Tahmoor Mine's existing workforce of approximately 390 employees, as well as providing employment for additional employees (up to around 175 additional staff at peak employment), until 2035. Additional wages, royalties and flow-on effects with a net benefit of a total of $699.5 million will be injected into regional and State economies as a result of the additional 13 year life of mining activities at Tahmoor resulting from the proposed development.

From an environmental perspective, the proposed development utilises the existing Surface Facilities Area of Tahmoor North therefore alleviating the need to develop undisturbed areas. Similarly, as the Tahmoor Mine has been operating in the region since the 1970s, the geology and environmental conditions are well known and therefore allow informed impact predictions and identification of suitable and proven mitigation and management measures.

Based on the identified environmental effects of the proposed development, the ability to confidently manage those effects to minimise harm to the environment, and the gradual transition of mining activities from Tahmoor North to Tahmoor South, the proposed development will present an overall minimal residual consequence, provided that the recommended mitigation, management and monitoring measures outlined in **Section 11.0** and the Statement of Commitments in **Section 12.0** are implemented. On balance, the benefits of the proposed development with identified management, mitigation and offset measures in place, are considered to outweigh the predicted residual consequences.

13.2 Economic Benefits

The proposed development will create the following economic benefits:

- net benefits of around $699.5 million over its life;
- royalties estimated to be worth around $149.1 million to the NSW Government;
- lower bound estimate of net benefits to the Wollondilly region of $103.4 million and upper bound estimate of $139.5 million in NPV terms;
- increase in gross regional income ranging from $3,288 million under the zero labour supply response to $3,561 million under the high labour response assumption (in NPV terms).

13.3 Ecologically Sustainable Development

13.3.1 Precautionary Principle

The Precautionary Principle, in summary, holds that where there are threats of serious or irreversible environmental damage, the lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

A precautionary and conservative approach to mine plan development has been employed to avoid or minimise potential subsidence impacts to natural and built features, including the following:

- Identification of sensitive features within the Project Area and amending the mine plan to avoid or minimise impacts to those features. These features include the Nepean Fault, Nepean River and Bargo River and the WaterNSW Metropolitan Special Area.
- A risk-based approach to subsidence impact assessment and management including specialist environmental studies for key environmental aspects as outlined in **Section 11.0**. This approach involved the establishment of RMZs as described in **Section 5.3.6**.

A detailed understanding of the issues and potential impacts associated with the proposed development has been obtained through consultation and assessment to a level commensurate with the scale of the proposed development, industry standards, the level of environmental risk and the legislative framework under which the proposed development is permitted. Specialist assessments, including the use of engineering and scientific modelling, have been undertaken to aid the design of the mine and for impacts relating to subsidence, groundwater, surface water, terrestrial ecology, aquatic ecology, Aboriginal heritage, European heritage, noise, air quality (including GHG) and traffic, to be understood and for appropriate mitigation and management measures to be developed. Assessment has also been undertaken for other issues, including social, economic, waste, hazards and land capability and land use considerations. To this end, there has been careful and thorough evaluation undertaken in order to recognise the potential for and then avoid where possible, serious or irreversible damage to the environment.

13.3.2 Intergenerational Equity

Intergenerational Equity is centred on the concept that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations. There is a moral obligation to ensure that today's economic progress, which will benefit both current and future generations, is not offset by environmental deterioration.

The primary objective of the proposed development is to allow continued operation of mining at Tahmoor and maintain the continuity of coal production from existing and proposed mining areas, optimising resource recovery for the life of mining in an environmentally and socially responsible manner. The engagement of suitably qualified and experienced consultants has ensured that the planning, design and environmental assessment phases of the proposed development have been transparent. The contents of this EIS (including appendices) has enabled the potential implications of the proposed development to be understood, and the management strategies, mitigation measures and monitoring activities required to ensure potential impacts are appropriately minimised, to be identified.

The management strategies, mitigation measures and monitoring programs have been identified to minimise short and long term potential impacts on the local environment and nearby communities. The development of the Conceptual Mine Closure Plan well in advance of mine closure demonstrates Tahmoor Coal's commitment to the future rehabilitation and goals of identifying final land-uses commensurate with the surrounding and future environment.

13.3.3 Conservation of Biological Diversity and Ecological Integrity

The principle of Conservation of Biological Diversity and Ecological Integrity holds that the conservation of biological diversity and ecological integrity should be a fundamental consideration for development proposals. The potential environmental impacts of the proposed development, including impacts upon ecological communities and habitat values, and measures to ameliorate these potential impacts are described within this EIS.

The proposed development has initially aimed to avoid and minimise potential impacts on ecological values during mine planning, and through the identification of RMZs within the Project Area. Specialist ecological assessments were undertaken for the proposed development for both terrestrial and aquatic ecology. The assessments identified that a significant impact will occur to SSTF EEC, and threatened flora species *Persoonia bargoensis*. A Biodiversity Offset Strategy has been prepared for the proposed development.

In accordance with obligations under the EPBC Act, the proposed development has been referred to the DOEE to determine if the Project was a controlled action under the EPBC Act. The proposed development was determined to be a Controlled Action under the EPBC Act on 12 January 2018. It is noted that the DoEE Controlled Action determination was based on an earlier mine plan layout. As discussed in **Section 6.2.4,** subsequent mine planning has led to a revised mine plan involving mining in the Central Domain only (proposed development) which would result in significantly less native vegetation clearing and associated habitat loss and reduced impacts to water resources.

13.3.4 Improved Valuation and Pricing of Environmental Resources

The principle of Improved Valuation and Pricing of Environmental Resources is based on environmental factors being included in the valuation of assets and services. The cost associated with using or impacting upon an environmental resource is seen as a cost incurred to utilise that resource.

Whilst clear, consistent and widely accepted standards have not yet been established for the application of this principle (to date there are few widely accepted methods by which monetary values are attributed to environmental factors), Tahmoor Coal acknowledges and accepts the financial costs associated with all the measures required to avoid, minimise, mitigate and manage potential environmental and social impacts for the proposed development.

13.3.5 Decision Making Process

The proposed development requires approval under Division 4.1, Part 4 of the EP&A Act. An assessment of the short, medium and long term impacts of the proposed development, taking into account the principles of ESD is provided in this EIS. The mitigation measures described in **Section 11.0**, the existing Tahmoor Coal EMS, and the Statement of Commitments, provided in **Section 12.0**, form the environmental mitigation, management and monitoring requirements for the proposed development.

The development consent process prescribed under Division 4.1, Part 4 of the EP&A Act and subsequent environmental management frameworks ensure that decision making and monitoring of the proposed development will be undertaken in an integrated and transparent manner, having regard to relevant issues associated with the proposed development.

Additionally, transparency throughout the decision making process for the design, impact assessment and development of management measures has been carried out through consultation with regulatory authorities, Indigenous stakeholders, and other stakeholders during the preparation of the EIS (see **Section 9.0**). This has allowed coordinated understanding and discussion regarding potential environmental impacts and proposed mitigation and management procedures.

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14.0 Conclusion

Development consent is sought for the extension of an existing underground coal mine and use of an existing Surface Facilities Area within an existing mining lease area. Tahmoor Mine is an established underground coal mine which has operated since 1979. As a result of historical and current operations, Tahmoor Coal has a strong understanding of mine design principles and requirements for the protection of surface features, and the appropriate management of potential environmental impacts.

From an environmental perspective, the proposed development utilises the existing Surface Facilities Area of Tahmoor North therefore alleviating the need to develop undisturbed areas. Similarly, as the Tahmoor Mine has been operating in the region since the 1970s, the geology and environmental conditions are well known and therefore allow informed impact predictions and identification of suitable and proven mitigation and management measures.

The proposed Mine Plan was developed by Tahmoor Coal following consultation and included consideration of predicted subsidence impacts on the MSA and associated built and natural features. Tahmoor Coal made a number of revisions to the original Mine Plan, including shortening Longwall 105 to 108 from the commencing ends of the longwalls such that they do not encroach into the MSA and impact on a number of built and natural features.

Underground mining for the existing operations at Tahmoor Mine is anticipated to be completed by 2022, depending upon geological and mining conditions. Cessation of mining at Tahmoor Mine would result in the early mine closure in 2022, the loss of employment for the existing mine employees and loss of revenue from the extraction of up to 4 Mtpa run of mine coal until 2035.

Tahmoor Coal is seeking approval for the proposed development, being the extension of underground coal mining at Tahmoor Mine, to the south and east of Tahmoor Coal's existing Tahmoor Mine Surface Facilities Area. The proposed development would extend mining at Tahmoor Mine within the Project Area, using longwall mining methods, mining the Bulli seam with the continued use of ancillary infrastructure at the existing Tahmoor Mine Surface Facilities Area.

Approval of the proposed development is required to allow Tahmoor Mine to operate beyond 2022 and to ensure that coal extraction is maximised from within CCL 747 and CCL 716. The objectives of the proposed development are to allow continued operations of the existing Tahmoor Mine and maintain continuity of coal production from existing and proposed mining areas, optimising resource recovery for the life of mine in an environmentally and socially responsible manner.

The proposed development will provide a range of benefits to local, Regional and State economies, including continued provision of employment for Tahmoor Mine's existing workforce of approximately 390 employees, as well as providing employment for additional employees (up to around 175 additional staff at peak employment), until 2035. Additional wages, royalties and flow-on effects with a net benefit of a total of $699.5 million will be injected into regional and State economies as a result of the additional 13 year life of mining activities at Tahmoor resulting from the proposed development.

The proposed development has been assessed utilising a risk-based approach to appropriately identify the potential environmental impacts of the proposed development. The identified potential environmental impacts were then the subject of an environmental assessment using:

- an assessment of existing site characteristics (the existing environment);
- consultation with relevant government agencies;
- engagement with Aboriginal and community stakeholders;
- environmental risk analysis;
- application or the principles of ecologically sustainable development;
- redesign of the proposed development where possible to avoid potential environmental impacts; and

- identification of management strategies, mitigation measures and monitoring programs to minimise adverse impact upon the local environment and nearby communities.

The proposed development meets environmental performance requirements, will result in direct and indirect economic benefits to the local community, and has been considered in accordance with the principles of ESD in order for the proposed development to be considered for approval.

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