



Tahmoor South Coal Project

State Significant Development (SSD 8445)

Planning Secretary's Environmental Assessment Report

December 2020



Published by the NSW Department of Planning, Industry and Environment

dpie.nsw.gov.au

Title: Tahmoor South Coal Project

Subtitle: Planning Secretary's Environmental Assessment Report

Cover image: Tahmoor Mine Surface Facilities Site

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Glossary

Abbreviation	Definition
BCA	Building Code of Australia
BCS	Biodiversity, Conservation and Science Directorate within the Department
CIV	Capital Investment Value
CCL	Consolidated Coal Lease
CHPP	Coal handling and preparation plant
CMSC Act	<i>Coal Mine Subsidence Compensation Act 2017</i>
Commission	Independent Planning Commission of NSW
DAWE	Commonwealth Department of Agriculture, Water and the Environment
Department	Department of Planning, Industry and Environment
DPI	Department of Primary Industries within the Department of Regional NSW
DPIE Water	Water Group within the Department
EIS	Environmental Impact Statement (SIMEC, January 2019)
EPA	Environment Protection Authority
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EP&A Regulation	<i>Environmental Planning and Assessment Regulation 2000</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPI	Environmental Planning Instrument
EPL	Environment Protection Licence
ESD	Ecologically Sustainable Development
GDE	Groundwater Dependent Ecosystem
ha	Hectares
Heritage	Heritage NSW, within the Department of Premier and Cabinet
HoF	Height of fracturing
IESC	Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development

Abbreviation	Definition
IEPMC	Independent Expert Panel for Mining in the Catchment
km	kilometres
LDP	Licensed Discharge Point
LGA	Local Government Area
LOP	Licensed Overflow Point
LW	Longwall
MEG	Mining, Exploration and Geoscience within the Department of Regional NSW
Minister	Minister for Planning and Public Spaces
ML	Mining Lease
Mtpa	Million tonnes per annum
NPV	Net present value
NRAR	Natural Resources Access Regulator, within the Department of Regional NSW
PAR	Project Amendment Report (SIMEC, February 2020)
PKCT	Port Kembla Coal Terminal
Planning Secretary	Secretary of the Department of Planning, Industry and Environment
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
REA	Reject emplacement area
ROM	Run-of-mine
RTA	Response to Advice (SIMEC, August 2020)
RTS	Response to Submissions (SIMEC, February 2020)
Project	The project as presented in the <i>Second Project Amendment Report</i> (SIMEC, August 2020) and subsequently further revised by the Department (refer to Section 2.2 of this report)
SA NSW	Subsidence Advisory NSW
SCA	State Conservation Area
SEARs	Planning Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SubIA	Subsidence Impact Assessment

Abbreviation	Definition
SIMEC	SIMEC (Australia) Mining Pty Ltd
SPAR	Second Project Amendment Report (SIMEC, August 2020)
SRD SEPP	<i>State Environmental Planning Policy (State and Regional Development) 2011</i>
SSA	Subsidence Study Area
SSD	State Significant Development
STP	Sewage Treatment Plant
Tahmoor Coal	Tahmoor Coal Pty Ltd
TfNSW	Transport for NSW
WM Act	<i>Water Management Act 2000</i>
Wollondilly LEP	<i>Wollondilly Local Environmental Plan 2011</i>
WSC	Wollondilly Shire Council
WTP	Water Treatment Plant

Executive Summary

Background

Tahmoor Coal Mine is an underground coal mine that has been operating since the 1970s in the Wingecarribee and Wollondilly local government areas. The mine is located between the townships of Tahmoor and Bargo, approximately 75 kilometres (km) south-west of Sydney. The mine directly employs almost 400 people and currently operates under several development consents to extract up to 3 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal using longwall mining techniques. Coal is processed at existing surface facilities and transported by rail to the Port Kembla Coal Terminal (PKCT). Approved mining operations are anticipated to be completed by 2022.

In January 2019, Tahmoor Coal Pty Ltd (Tahmoor Coal) submitted a development application for the Tahmoor South Coal Project, which seeks approval for expansion of underground longwall mining to the south of the existing workings. The existing surface infrastructure area would continue to be used.

An Environmental Impact Statement (EIS) was exhibited in early 2019 to extract up to 48 Mt of ROM coal from 9 longwall (LW) panels over a 13-year mine life. Tahmoor Coal has subsequently revised the proposed mine design and submitted amended development applications on two occasions (in February and August 2020).

The Project

In February 2020, Tahmoor Coal lodged a Project Amendment Report (PAR) which amended the mine plan to reduce subsidence impacts, with the removal of one LW panel, and the footprint of the reject emplacement area (REA) to minimise biodiversity and noise impacts.

In August 2020, Tahmoor Coal lodged a Second Project Amendment Report (SPAR) which removed a further two longwall (LW) panels from the mine plan to significantly reduce the extent and scale of subsidence impacts on built features (particularly within the township of Bargo) (**Figure E1**).

In response to issues raised by the Biodiversity, Conservation and Science Directorate (BCS) and Heritage NSW in relation undermining 3rd order watercourses, the Department has required a further amendment to the mine plan involving shortening the length of one longwall (LW103B) by 400 metres (m). The Department considers this would result in substantial reductions in the likelihood of impact to a significant number of stream features (pools), Aboriginal heritage sites, and a cliff line, without resulting in significant sterilisation of coal resources.

In summary, amendments to the project which have resulted in reduced potential impacts to both built and natural features include:

- removal of LW109 to avoid undermining a section of Dog Trap Creek;
- reduced width and height of longwalls to reduce overall level of subsidence;
- reduced disturbance footprint of the REA to minimise biodiversity impacts;
- restricted operation of the REA to minimise noise impacts;
- removal of two longwalls (LW107B and 108B) to significantly reduce subsidence impacts on houses and infrastructure in Bargo; and
- reduced length of LW103B to minimise impacts on stream features, Aboriginal heritage sites and a cliff line.

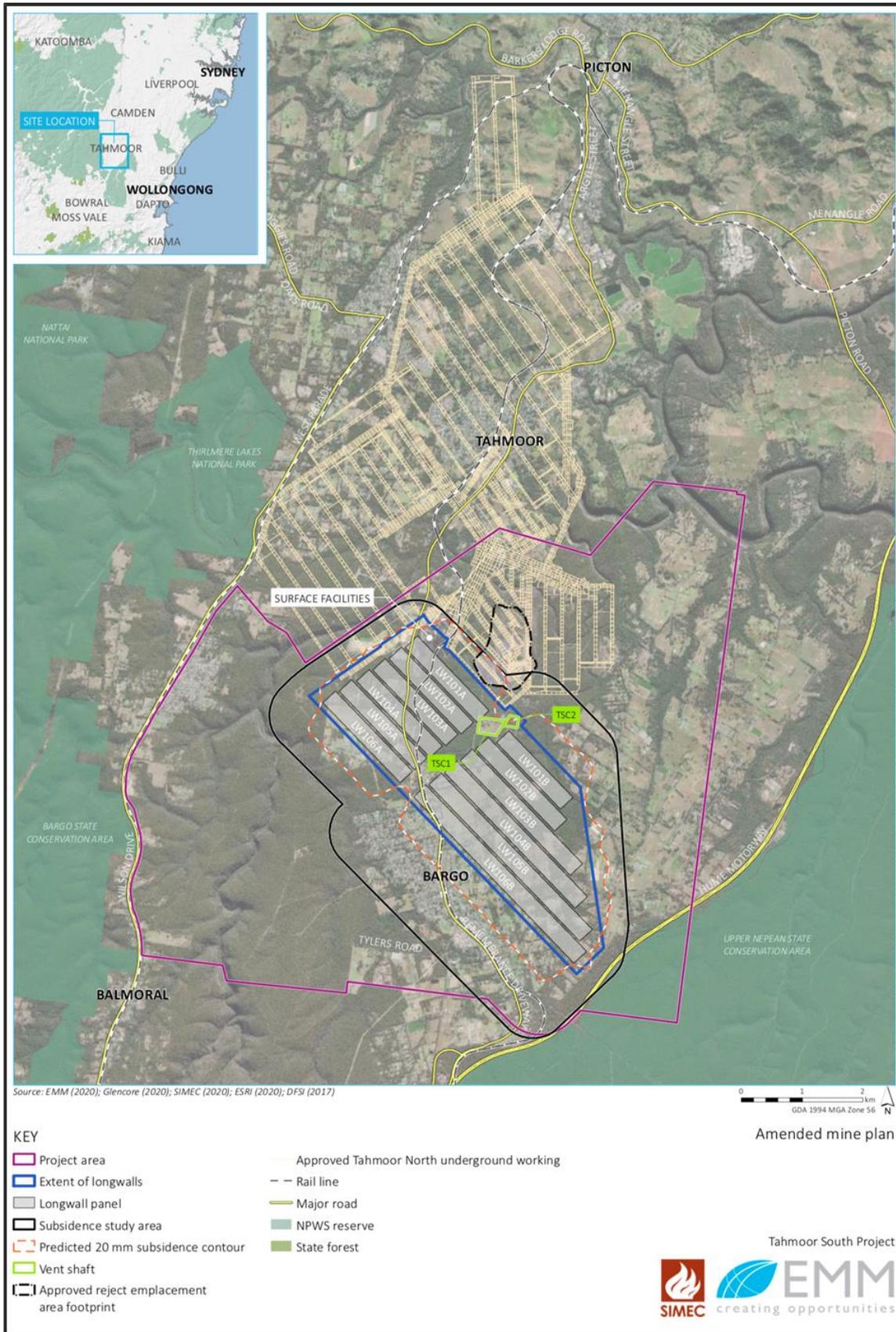


Figure E1 | Proposed Mine Plan

The Project now involves the extraction of up to 4 Mtpa of ROM coal, with a total of up to around 33 Mt of ROM coal proposed to be extracted over a 10-year period.

The Project would utilise existing and upgraded facilities at the existing surface infrastructure area for coal processing, loading and transport; reject emplacement; ventilation; sewage treatment; surface water management; and gas management. However, the proposed Project would involve the construction and operation of two new ventilation shaft sites and an associated transmission line.

This Assessment Report has been prepared by the Department of Planning, Industry and Environment (the Department) for the consideration of the Independent Planning Commission of NSW (the Commission). The report provides an environmental assessment of the Project under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This Assessment Report should be read in conjunction with the Department's Preliminary Issues Report (PIR, 2019).

Statutory Context

The Project involves coal mining and is declared to be State Significant Development (SSD) under clause 8(1)(b) of *State Environmental Planning Policy (State and Regional Development) 2011*. The Minister for Planning and Public Spaces is the consent authority for the Project as there were less than 50 duly made submissions objecting to the project during the exhibition period, neither Council objected to the project during the exhibition period, and Tahmoor Coal has not made any reportable political donations.

However, in October 2020, the Minister for Planning and Public Spaces requested that the Commission hold a public hearing into the carrying out of the Project and determine the application. The Commission is therefore the delegated consent authority.

The Project has also been declared a controlled action under section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and is being assessed by the NSW Government, in accordance with the Bilateral Agreement between the NSW and Commonwealth Governments.

Engagement

The Department publicly exhibited the EIS from 23 January 2019 until 5 March 2019 (42 days). The Department received 83 submissions from the community and special interest groups, of which 9 (11%) objected to the Project and 72 (87%) supported the Project. Advice was received from a further 14 public agencies. While none of the public agencies objected to the Project, several commented on particular aspects and proposed recommended conditions.

Following the EIS exhibition period, the Department received an additional 134 representations on the Project, mostly from members of the general public. The majority of the representations (84%) objected to the Project.

Assessment

In assessing the merits of the Project, the Department has considered the submissions and representations received; the likely environmental, social and economic impacts of the Project; the suitability of the site; relevant environmental planning instruments (EPIs); and the public interest, in accordance with the requirements of the EP&A Act. The Department has also considered advice on the Project received from the *Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development* (IESC) and independent peer reviewers of the mine plan and the groundwater and economic assessments.

Subsidence

The Project involves extraction from the Bulli Seam, which is located approximately 370 to 430 m below the surface. Coal extraction is proposed from two series (A & B) of 6 longwalls with widths up to 283 m and lengths varying between 1,515 m and 3,810 m (**Figure E1**).

The Project is located in the Wollondilly local government area (LGA), to the south of the township of Tahmoor and to the north-east of the township of Bargo. The Project would mine directly beneath the northern and north-eastern outskirts of Bargo and surrounding rural residential areas to the east, including directly beneath approximately 143 houses and rural properties, and a wide array of transport, utility and public amenity infrastructure. The Project would also mine beneath natural features, including several 1st, 2nd and 3rd order streams and forested areas covering about one third of the mine area.

The proposed mining area is located wholly within the Bargo Mine Subsidence District which was proclaimed in 1975 and 1994. A subsidence district is a land zoning tool administered by Subsidence Advisory NSW (SA NSW) under the *Coal Mine Subsidence Compensation Act 2017* (CMSC Act) to help protect homes and other structures from potential mine subsidence damage and includes provision for compensation or repairs.

The SPAR included a Subsidence Impact Assessment (SubIA) which included a sensitivity analysis using information derived from observed subsidence movements caused by historical and current mining at Tahmoor North. The SubIA indicated that the maximum total conventional subsidence from extraction of the longwalls is 1,600 mm, with maximum tilts of 10.5 mm/m and conventional strains of around approximately 2.4 mm/m tensile and 4.2 mm/m compressive. Additional non-conventional ground movement would also likely occur, due to near surface geological conditions, steep topography and valley related movements. The magnitude of predicted subsidence is similar to the range experienced at the nearby Tahmoor North and Bulli Seam Operations underground mines.

Houses

The Department acknowledges that undermining houses is a critical issue that requires careful consideration, however notes that amendments to the mine plan have resulted in an 81% reduction in the number of houses located directly above the proposed longwalls (reduced from 751 to 143 houses), and that this is significantly fewer houses than have, or would be, directly undermined at approved operations for Tahmoor North (1,259) and the nearby Bulli Seam Operations (BSO) (928).

In relation to the Project, 1,458 houses are located in the overall wider subsidence study area (SSA), which is defined as the furthest limit of either the predicted limit of vertical subsidence (ie. the 20mm subsidence contour) or a minimum of 600 m from the nearest edge of the proposed longwalls. Of these houses, 1,316 (90%) are predicted to require nil to very minor repairs, 108 (7%) to require minor cosmetic repairs, 28 (2%) to require substantial serviceability and structural repairs and 7 (0.5%) to require re-build.

The CMSC Act provides for the assessment and management of risks associated with subsidence resulting from coal mine operations and includes provisions for compensation or repair services. The owners of homes, buildings or other surface improvements damaged by mine subsidence can lodge claims for compensation through SA NSW.

The Department is satisfied that this is a well-established mechanism supported by legislation which is effective in maintaining and restoring structures to a condition equal to or better than their pre-mining state at no financial cost to owners. This statutory framework recognises the importance of being able

to safety extract coal resources on behalf of the people of NSW in areas where homes and other built features exist while ensuring that affected land and asset owners are fairly and reasonably compensated.

However, in addition to this compensation framework, and in accordance with advice received from SA NSW, the Department has recommended that additional safeguards be offered to homeowners whose houses experience significant damage and/or are damaged by more than one longwall as a result of mine subsidence movements. The safeguards would allow affected homeowners to be offered property acquisition as an option for compensation, rather than repair, in a similar manner to homeowners who may be significantly impacted by noise or dust emissions associated with an open cut coal mine under the NSW Government's *Voluntary Land Acquisition and Mitigation Policy* (VLAMP). It is estimated that the total number of houses where there could be a potential offer of acquisition to be around 22.

The Department and SA NSW believe these mechanisms would provide the homeowners confidence in the management and compensation process, coupled with additional options for acquisition if desired.

The Department is aware that the Project also has implications for future development in the area, with four current rezoning planning proposals within the proposed mining area yet to be determined, primarily due to potential future impacts due to mining. Wollondilly Shire Council's (WSC's) *Local Strategic Planning Statement – Wollondilly 2040* (LSPS) recognises that Bargo is constrained by the need to protect State significant mineral resources and is unsuitable for expansion and further intensification until mining activity is complete. The LSPS focuses on the Wilton Growth Area as a higher priority growth area in the next 20 to 30 years. The Department considers the Bargo area is unlikely to be a vital urban growth area during this time. Mining associated with the Project is forecasted to cease by 2032. After this time the area could be used for further urban development.

Other Built Features

The wide array of other built features in the SSA would collectively experience the full range of subsidence movements varying from very small movements, where longwalls do not mine directly beneath them, to maximum movements. Key public infrastructure located directly over the longwall panels includes the Main Southern Railway, the Sydney to Moomba and Gorodok Ethane gas pipelines and the Bargo Waste Management Centre (BWMC). The M31 Hume Highway is located on the edge of the SSA.

Other built features include public transport, gas, water, sewerage and telecommunication infrastructure; public amenities; agricultural facilities; and industrial, commercial and business establishments.

Potential risks to all built features are proposed be managed through early detection via monitoring and early response through implementation of a triggered action response plan (TARP). The SubIA indicates that with appropriate management plans in place, built features would remain safe and serviceable (i.e. capable of being used for its intended purpose) at all times during mining.

In accordance with standard practice, it is proposed to establish technical committees, comprising representatives from Tahmoor Coal, the asset owner(s) and engineering and geotechnical specialists, to develop risk management strategies and manage potential impacts of longwall mining on key transport and gas infrastructure, as well as the BWMC.

The Department acknowledges that there is a long history of undermining built features in NSW over a period of over 150 years. Over this time, technically feasible methods to manage potential subsidence impacts on both key and other built features have been developed and there have been no major serviceability or public safety incidents related to subsidence impacts which were not able to be managed and rectified.

To ensure this is the case, the Department has also proposed performance measures addressing safety, serviceability, repairability and compensation for all built features and the preparation and implementation of built features management plans as a component of a robust Extraction Plan.

Groundwater

The PAR included a Groundwater Assessment and an updated Sensitivity Analysis, both of which were independently peer reviewed.

Groundwater drawdown and Bores

The major groundwater aquifer in the region is the Hawkesbury Sandstone, which is a highly productive aquifer containing over 980 registered groundwater bores in the vicinity of the Project. Groundwater modelling predicts that groundwater drawdown in the lower Hawkesbury Sandstone would be approximately 30 m and drawdown in the upper Hawkesbury Sandstone would be approximately 10-14 m as a result of the Project. Cumulative drawdown due to cumulative mining activities of Tahmoor (North and South) and BSO extends across the footprint of all the mines.

It is predicted that 46 privately-owned registered bores would experience a drawdown in excess of the 2 m drawdown criterion of the *Aquifer Interference Policy* (AIP) as a result of the Project. Of these bores, 22 (48%) are predicted to experience 2-5 m drawdown, 8 (17%) are predicted to experience 5-10 m drawdown and 16 (35%) are predicted to experience >10 m drawdown.

Tahmoor Coal has proposed to continue its current practice of implementing 'make-good' provisions for any groundwater users adversely impacted by the Project. 'Make-good' measures include lowering pumps within groundwater bores, or providing an improved pump, deepening a bore or drilling a new bore, or providing an alternative water supply.

However, Tahmoor Coal contends that it is unlikely that the number of bores modelled to be impacted beyond the 2 m drawdown would result in 'make-good' provisions because most bores in the area are quite deep (i.e. >50 m) and have large available drawdowns. Consequently, a 2 m or even up to 10 m drawdown would largely go unnoticed by most bore users.

A risk analysis based on the proximity of bores to the proposed longwalls; the magnitude of predicted groundwater drawdown and subsidence; and operational history and record of 'make good' at Tahmoor North, predicted that only 10 bores have a 'high' risk of requiring 'make good' provisions. Using this risk based analysis, it is predicted that an additional 5 bores could potentially require 'make good' provisions as a result of cumulative impacts associated with BSO (although it is noted that all of these bore were classified as being at 'low' risk of requiring 'make-good' provisions).

Overall, the Department accepts that the number of bores predicted to be impacted by the Project and potentially requiring 'make-good' provisions (10 'high' risk bores) is manageable and has recommended conditions that would ensure any impacts are appropriately monitored, managed and compensated via a well understood, feasible and equitable process.

Mine Inflows

The Groundwater Assessment predicts groundwater inflows into the mine of approximately 1,600 to 1,900 megalitres per annum (ML/a), peaking at up to 2,900 ML/a toward the end of the operational life of the Project. Tahmoor Coal has confirmed that there are sufficient entitlement shares within the Groundwater *Water Sharing Plan* (WSP) to purchase the required water access licences (WALs) to account for its maximum groundwater take. DPIE Water accepts that there are sufficient entitlements to account for the predicted groundwater take.

Thirlmere Lakes

Thirlmere Lakes are the only high priority groundwater dependent ecosystem (GDE) listed in the Groundwater WSP in the vicinity of the Project. The lakes are located approximately 3.5 km to the north west of the nearest proposed longwall. The potential impacts of mining on Thirlmere Lakes have been studied extensively over the last two decades, however there is no conclusive evidence of any significant impacts to water levels of the lakes from historical or current mining operations, which are located closer to and between the lakes and the proposed Project longwalls.

The Groundwater Assessment predicted that Thirlmere Lakes would experience groundwater drawdown within the alluvium of ≤ 0.02 m due to the Project. This represents 0 to 1% of alluvial water level fluctuations and is considered very small compared to natural variability in downstream catchment conditions.

The Department considers that Project would result in relatively low risks of groundwater impact to Thirlmere Lakes. However, the Department considers it important that potential impacts continue to be monitored, reported and validated via a comprehensive Groundwater Management Plan, and has recommended conditions accordingly.

Surface Water

Subsidence-induced impacts to watercourses

The mine is located outside the Special Areas of Sydney's drinking water catchment and the layout has been designed to avoid mining directly beneath significant streams in the region, including the Bargo and Nepean Rivers. However, the Project would mine directly beneath several tributaries of the Bargo and Nepean Rivers, including Tea Tree Hollow and Dog Trap Creek which are 3rd order streams with associated 1st and 2nd order tributaries.

The SubIA predicted that where the longwalls mine directly beneath the streams, fracturing may result in surface water flow diversion, primarily via pools. This may result in loss of water holding capacity of pools, reduced frequency of pools overflowing and periodic loss of interconnection between pools during dry weather within the affected reach. Subsidence can also result in changes to the vertical and horizontal alignment of overlying watercourses and potentially change erosion and sediment deposition patterns. Surface water along watercourses may also be impacted by iron and other constituents from fractured creek beds, ferruginous springs and strata gas emissions.

Modelling based on past experience of mining beneath streams estimates that of the 62 pools located above the proposed longwalls, around 15 pools (24%) could be impacted. Isolated sections of Dog Trap Creek and Tea Tree Hollow could also experience localised increased erosion. As outlined above, the Department has recommended a reduction in the length of LW103B by 400m to further reduce the likelihood of impacts to pools and surface features along 3rd order sections of Dog Trap Creek. The Department considers that additional amendments to the mine plan to further avoid sections of Dog

Trap Creek would have significant economic implications, by sterilising substantial volumes of coal, for reduced environmental benefits.

BCS and numerous public and special interest group submissions raised concerns about potential impacts to watercourses as a result of the Project, indicating that insufficient justification had been provided to demonstrate that impacts would be repairable. In its response, Tahmoor Coal described the recent remedial works the company has completed in pools along Myrtle Creek Redbank Creeks, to remediate impacts from operations at Tahmoor North. These works have included utilising different shallow and deep grouting techniques to fill subsidence-induced fractures in pool rockbars.

The Department accepts that preliminary water level and aquatic health monitoring results suggest that these works have been effective. The Department has recommended a rehabilitation objective requiring watercourses damaged by subsidence impacts to be restored to pre-mining surface flow and pool holding capacity as soon as reasonably practicable. The Department also recommended a condition requiring Watercourse Corrective Action Management Plan(s) be prepared for any watercourses damaged by subsidence impacts associated with the Project.

Baseflows

The maximum predicted reduction in baseflow at the majority of the watercourses is very small when compared to existing mean daily flows (0.05 - 1.3%). This level of change would be imperceptible and very small compared to natural variability in catchment conditions and are therefore considered to be negligible. However, the maximum predicted reduction in baseflow at Dog Trap Creek represents a significant percentage of the average estimated baseflow (51.9%) which would be detectable, particularly during periods of low flow.

Overall, predicted maximum baseflow reductions from all watercourses are estimated to be 109 ML/a for the Project, which are considered relatively small. Tahmoor Coal has confirmed that there are sufficient entitlement shares within the Surface WSP to purchase the required WALs to account for its take, noting that the mine is not located within the Special Areas of Sydney's drinking water catchment and licences are available to trade under the Water Sharing Plan. DPIE Water accepts that there are sufficient entitlements to account for the predicted surface water take.

Mine Water Discharges

The Environment Protection Authority (EPA) has recently varied the Environment Protection Licence (EPL 1389) for the site to require the installation of a new Water Treatment Plant (WTP) and specify concentration limits for treated water discharges. The EPL requires the WTP to be operational prior to the commencement of secondary coal extraction in the Tahmoor South area, which is currently scheduled for September 2022.

The Department notes that controlled discharges associated with the proposed surface operations would be higher than existing volumes but would be treated to a high standard via a new WTP, therefore ensuring protection of the downstream receiving aquatic environment. The Department considers it important that potential surface water impacts are monitored, reported and validated via comprehensive surface water management plans, and has recommended conditions accordingly.

Noise

The Project surface facilities, including the existing surface facilities site and REA, and the proposed two new ventilation shaft sites, are near the townships of Bargo and Tahmoor, along with rural residential receivers, with a higher density of receivers located to the north and south of the sites.

A Noise Impact Assessment (NIA) was prepared in accordance with the *NSW Noise Policy for Industry 2017* (NPfI) and in consideration of the *Voluntary Land Acquisition and Mitigation Policy* (VLAMP).

As part of the Project, Tahmoor Coal proposes to implement significant noise mitigation and management measures at the surface sites which are predicted to result in substantial reductions (between 2 and 18 dBA) in noise impacts to receivers during the operational phase of the Project.

Prior to the completion of the noise mitigation works and as a result of construction of the new ventilation shafts, it is predicted that three receivers would experience noise levels that exceed the relevant project noise trigger levels (PNTL) by 3 dBA or greater.

As such, the Department has recommended that these receivers be afforded mitigation rights in accordance with the VLAMP. For all remaining receivers and for all receivers during times when construction activities are not occurring, the Department considers that Tahmoor Coal should continue to operate under existing noise limits specified in Tahmoor DA 1994, until the proposed noise mitigation measures are implemented. The Department has recommended a condition that these noise mitigation works be completed within two years from the commencement of the development, which aligns closely to the completion of mining operations at Tahmoor North and commencement of secondary extraction at Tahmoor South.

During the operational period, marginal / moderate (3-5 dBA above PNTL) and significant (>5dBA above PNTL and above amenity noise levels) exceedances are predicted to occur at 47 receivers, which the Department has recommended be managed in accordance with the VLAMP through proactive and reactive noise management on site, in combination with at-receiver mitigation treatments, upon request. One receiver predicted to be significantly impacted would be eligible for acquisition upon request.

Overall, the Department notes that there would be a significant reduction in the number and severity of PNTL exceedances in comparison to existing operations (209 exceedances) once mitigation and management measures associated with the Project are implemented.

Biodiversity

Terrestrial

The Project has been designed to avoid and minimise biodiversity impacts where possible, including avoiding extending the existing footprint of the REA. Nevertheless, the Project would still require the clearing of 24.3 hectares (ha) of native vegetation, including 10.1 ha associated with the construction of the two ventilation shafts and powerline easement and 14.2 ha of mine rehabilitated native vegetation within the current REA footprint.

This includes clearing of up to 10.1 ha of '*Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest*', which aligns with the *Shale Sandstone Transition Forest in the Sydney Basin Bioregion*' (SSTF), and is listed as a Critically Endangered Ecological Community (CEEC) under both the *Biodiversity Conservation Act 2016* (BC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Vegetation clearance is also predicted to impact 2 threatened flora species as well as 5 threatened and migratory fauna that were recorded or identified with known or potential foraging habitat in the proposed disturbance area. However, the Project has been assessed as being unlikely to lead to a long-term decrease in the population of threatened fauna species as there is extensive potential foraging habitat within the surrounding landscape and majority of these species are highly mobile (ie birds and

microbats). Whilst no Koalas were detected during field surveys, areas proposed for surface disturbance form part of a primary Koala corridor.

Observations of past subsidence events in the Southern Coalfield indicate that indirect adverse impacts on terrestrial vegetation are unlikely, but when they do occur, are localised and minor. The Department considers that this would also be the case for the Project, particularly as key watercourses are ephemeral in nature and woodland / forest vegetation communities are not solely reliant on groundwater for survival. Irrespective, the Department has recommended that indirect impacts on vegetation be carefully monitored, remediated, or offset if unexpected impacts occur that cannot be remediated.

The Department acknowledges that, as an underground mining project which utilises mostly existing mining infrastructure, the Project has a considerably smaller disturbance footprint than a comparable open cut or greenfield mining project. The Department considers that further opportunities to avoid biodiversity impacts are limited due to the location of existing surface facilities site and the coal resource. However, the has recommended a range of conditions to ensure that biodiversity impacts are minimised and appropriately mitigated, including the development of a Biodiversity Management Plan.

To offset the residual biodiversity impacts of the Project, Tahmoor Coal propose to implement a Biodiversity Offset Strategy, including the retirement of ecosystem credits and species credits, in accordance with the requirements of the BC Act. The Department has recommended that all credits are retired within two years of the commencement of the Project.

Aquatic

Watercourses within the Project area provide habitat for a range of aquatic species and have the potential to be impacted by reductions and changes in flow regimes and water quality due to subsidence and from mine water discharges. One threatened aquatic fauna species (Sydney Hawk Dragonfly) has been assessed as having potential habitat in the Project area. No threatened aquatic ecology species listed under either the *Fisheries Management Act 1994* or the EPBC Act were recorded during the surveys.

However, fracturing and the partial or total loss of water in pools could result in the loss of aquatic habitat (including Type 1 and 3 Key Fish Habitat) and impacts to aquatic flora and fauna, including native fish and macroinvertebrates, although the Project has been assessed as being unlikely to change the overall ecology of affected waterways which are already subject to highly variable flows. In accordance with the FM Act, impacts on KFH will require rehabilitation or offset to ensure that there is no net loss.

Potential impacts to aquatic ecology from mine water discharges would be minimised due to the new commissioning of the new WTP and strict water quality discharge requirements of the EPL. The Department has also recommended a range of conditions regarding monitoring, management and remediation of watercourses.

Traffic

It is predicted that the Project would result in an additional 190 vehicle movements per weekday (from an existing 766 to a proposed 956 vehicle movements per weekday), primarily due to the predicted increase in employees and haulage of materials to and from the mine.

Tahmoor Coal has committed to upgrading the main mine vehicle access intersection on Remembrance Driveway as part of the Project. Following this upgrade, the intersection was predicted to operate at an acceptable performance standard for the life of the Project. The Department has recommended that

this intersection be upgrade be prior to the commence of secondary workings associated with the Project.

Although the Department considers that the Project's contribution of traffic at other intersections (including the Avon Dam Road and Remembrance Driveway intersection) do not warrant upgrades, the Department has recommended that intersection performance is periodically monitored and the development-related traffic impacts are minimised if necessary, including scheduling heavy vehicle movements outside of peak periods. The Department has also recommended that a comprehensive Traffic Management Plan be prepared, in consultation with Transport for NSW and WSC, prior to construction.

Greenhouse Gases

It is estimated that the Project would generate a maximum of around 28 Mt of carbon dioxide-equivalent (CO₂-e) Scope 1 and 2 greenhouse gas emissions (GHGEs) over the life of the Project. This represents approximately 0.65% of total NSW emissions and 0.2% of total Australian emissions. Tahmoor Coal proposes to minimise its Scope 1 and 2 GHGEs by around 26.5% through either flaring or using the methane gas for power generation.

Scope 3 emissions from the combustion of product coal by third party consumers were modelled to be about 66 Mt CO₂-e over the life of the Project, or an average of about 8 Mt CO₂-e per annum. Scope 3 GHGEs associated with burning coal to produce coke and burning coke to produce steel are accounted for at other domestic or international steelworks where that combustion takes place. The Department notes that there is no current alternative to the use of coking coal for the large scale, economic production of steel.

As only Scope 1 and Scope 2 emissions are within the control of an entity, the Department's view is that the key areas for active management of greenhouse gases within the development assessment and approval process for new projects in NSW are reductions in direct (ie Scope 1) emissions and improved energy efficiency (ie reduction and efficiency in the use of fuels and bought-in electricity). Recommended conditions require Tahmoor Coal to prepare and implement an Air Quality and Greenhouse Gas Management Plan, which must include all reasonable and feasible measures to maximise the beneficial re-use of methane on site.

Aboriginal Heritage

Three Aboriginal heritage sites of low archaeological significance (one open camp site and two artefacts) are located within the footprint of the ventilation shaft sites and predicted to be directly impacted by the Project. The broader SSA contains an additional 29 Aboriginal sites of low (23), moderate (2) and high (4) archaeological significance, including rock shelters, art sites, axe grinding grooves and a scared tree. These sites may be indirectly impacted by subsidence impacts, however the likelihood of significant harm to these sites is considered low.

The Department notes that the mine plan was designed to avoid mining directly above the four highly significant sites located to the south east of LW102B. As discussed above, in response to concerns raised by BCS the Department has also recommended that LW103B be shortened to avoid directly undermining a two Aboriginal heritage sites and reduce the risk of impact to a further three sites along Dog Trap Creek. The Department has also recommended conditions to ensure the Project's potential impact on other Aboriginal cultural heritage sites is appropriately managed, including the preparation of a Heritage Management Plan under each Extraction Plan.

Other Impacts

The Department has also undertaken a comprehensive assessment of the full range of other potential impacts, including air quality, greenhouse gas emissions, site water balance, flooding, on-site sewage treatment, rehabilitation, Aboriginal and historic heritage, economics, social and human health. The Department accepts that these potential impacts are likely to be minor and able to be managed, mitigated or offset to achieve an acceptable level of environmental performance, subject to the recommended conditions of consent.

Evaluation

The Department has carefully weighed the environmental impacts of the Project against the significance of the Project's identified coal resource and the wider socio-economic benefits associated with extending the operation of the Tahmoor Mine for a further 10 years.

The Department considers that substantial amendments have been made to the original mine plan to significantly reduce subsidence impacts to built and natural features, while maintaining the economic viability of the Project.

The Department acknowledges the potential impacts of the Project on houses, but is satisfied that a well-established regulatory and compensatory framework exists, which has been successfully implemented at other underground mines in the region to ensure houses are appropriately maintained and restored to a condition equal to or better than their pre-mining state at no financial cost to owners.

The Department recognises the relationship of the coal resource to the existing approved operations, and the synergies this presents for utilising existing infrastructure and reducing capital costs.

The Department also recognises the importance of the Project to the domestic steelmaking industry, with a significant proportion (ie. 40%) of the high-quality metallurgical coal produced to be sold to domestic markets.

The Project would provide wide-ranging benefits for the local Wollondilly and State economies, including ongoing employment of 390 people, with an additional 50 to 175 people during construction. The Project is expected to generate net present value (NPV) benefits to NSW of over \$664.9 million, with indirect benefits of approximately \$450 million, as well as a total estimated net benefit of \$137.5 million to local suppliers and employees in the Wollondilly local area. The Department considers that, even when considering conservative assumptions, the economic benefits of the Project to the State and region would be significant.

The Department has recommended a comprehensive and precautionary suite of conditions to ensure that the Project complies with contemporary criteria and standards, and that residual impacts are effectively minimised, managed, offset and/or compensated for. The conditions were developed in consultation with government agencies and WSC.

Overall, the Department considers that the benefits of the Project outweigh its residual costs, that the Project is in the public interest and is approvable, subject to the strict conditions of consent.

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1 Introduction

1.1 Background

1. Tahmoor Coal Pty Ltd (Tahmoor Coal), a subsidiary of SIMEC (Australia) Mining Pty Ltd (SIMEC), owns and operates the Tahmoor Coal Mine, located between the townships of Tahmoor and Bargo approximately 75 kilometres (km) south-west of Sydney (**Figure 1**).
2. Tahmoor Coal Mine is an underground coal mine that has been operating since the 1970s. The mine currently operates under several existing development consents, with approved mining operations anticipated to be completed by 2022.
3. In January 2019, Tahmoor Coal submitted a State significant development (SSD) application for the Tahmoor South Coal Project for the expansion of underground longwall mining to the south of the existing workings. Primarily due to the extent and scale of subsidence impacts on built features (particularly within the township of Bargo) and surrounding watercourses, Tahmoor Coal revised the proposed mine design and submitted amended development applications on two occasions (in February and August 2020).
4. Tahmoor Coal is now seeking approval for the Second Project Amendment (the Project), which involves the extraction of up to 4 million tonnes (Mt) of run of mine (ROM) coal per annum (pa), with a total of up to 33 Mt of ROM coal proposed to be extracted over a 10 year period.
5. This Assessment Report has been prepared by the Department of Planning, Industry and Environment (the Department) for the consideration of the Independent Planning Commission of NSW (the Commission). The report provides an environmental assessment of the Project under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).
6. This Assessment Report should be read in conjunction with the Department's Preliminary Issues Report (PIR) dated June 2019, available on the Department's major projects website at: <https://www.planningportal.nsw.gov.au/major-projects/project/10966>.
7. The PIR was prepared by the Department for the consideration of the Commission for a multi-stage public hearing that was originally requested by the former Minister for Planning in January 2019. In October 2020, the Minister for Planning and Public Spaces issued a new request for the Commission to hold a single public hearing and make its determination of the development application as the consent authority under delegation (see Section 4.8 for further details).

1.2 Project Setting

8. The existing Tahmoor Coal Mine is located within the Wollondilly and Wingecarribee local government areas (LGAs) which comprise extensive underground mining lease areas (**Figure 2**). The Project application area covers 6,490 hectares (ha) within the Wollondilly LGA.
9. The existing surface facilities site covers approximately 206 ha, located to the south of the existing mining area and immediately east of Remembrance Drive. The townships of Tahmoor and Bargo are located approximately 2.5 km to the north and 4 km to the south of the surface facilities site, respectively.

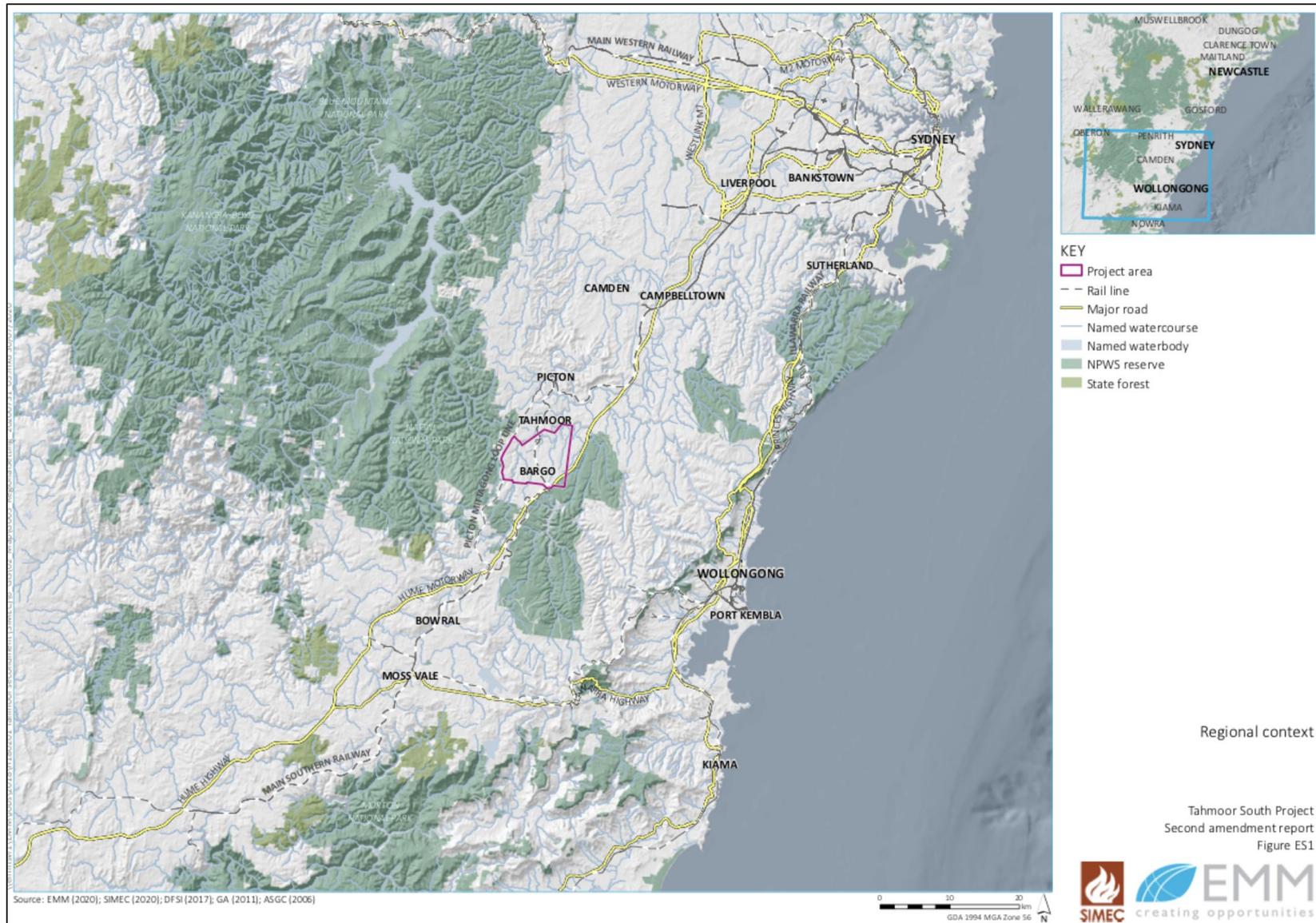


Figure 1 | Regional Location Plan



Figure 2 | Existing Tahmoor North Mining Operations

10. Approved mining operations have extended directly beneath the township of Tahmoor and surrounding rural residential areas, including mining under approximately 1,259 houses and a wide array of public transport, utility and amenity infrastructure.
11. The proposed mining area is located immediately to the south of the existing mining areas and the surface facilities. The Project would mine beneath the northern and north-eastern outskirts of the township of Bargo and surrounding rural residential areas to the east, including directly beneath approximately 143 houses.
12. The existing and proposed mining areas are located wholly within the Bargo Mine Subsidence District. A subsidence district is a land zoning tool administered by Subsidence Advisory NSW (SA NSW) under the *Coal Mine Subsidence Compensation Act 2017* (CMSC Act) to help protect homes and other structures from potential mine subsidence damage and includes provision for compensation or repairs.
13. Nearby conservation areas include the Upper Nepean State Conservation Area (SCA), the Bargo River SCA, Nattai National Park, Thirlmere Lakes National Park and Blue Mountains National Park. The three national parks form part of the Greater Blue Mountains World Heritage Area. Thirlmere Lakes are a protected wetland system located 3.5 km to the north west of the Project.
14. The major groundwater aquifer in the region is the Hawkesbury Sandstone, which is a highly productive aquifer containing over 980 registered groundwater bores in the vicinity of the Project.
15. Land use in the region is characterised by a mix of village residential, rural residential, agriculture, vacant Crown land and conservation areas. The area predominantly exhibits gently undulating slopes with steeper topography near the Bargo and Nepean river valleys, north and west of the Project, respectively. Tributaries of Bargo and Nepean Rivers, including Tea Tree Hollow and Dog Trap Creek, traverse the Project area.
16. The Project would also extend beneath semi-rural landscapes that have been affected by large scale clearing, and partly forested areas containing good quality remnant and rehabilitated vegetation, particularly to the north-east.
17. Key infrastructure assets in the area include the Main Southern Railway, which extends north-south through the Project area and supports passenger and freight services between Sydney and Melbourne; M31 Hume Highway, to the east; Sydney to Moomba and Gorodok Ethane gas pipelines; and various other transport, utility and public amenity infrastructure.
18. The majority of land in the Project area is privately-owned, with Crown land and Tahmoor Coal owned land to the north-east and north-west.

1.3 History of Mining Operations

19. Extensive underground mining has been undertaken at Tahmoor Coal Mine over the last 40 years, with the extraction of coal from the Bulli Seam using both bord and pillar and longwall mining methods.
20. The mine was originally constructed in 1975 with bord and pillar mining commencing in 1980 and the Tahmoor Washery being commissioned in 1981. In 1987, a gas extraction facility was commissioned at the surface facilities site and longwall mining commenced. Coal has since been mined from two distinct mining areas, including Tahmoor Central Longwalls (LWs) 1-21 and Tahmoor North LWs 22-37.

21. The Tahmoor Coal Mine has historically been owned and operated by numerous companies, including Clutha Development, BP Coal, Conzinc Rio Tinto Australia, Austral Coal Ltd, Centennial Coal Pty Ltd, Xstrata Coal Pty Ltd and Glencore Coal Pty Ltd. On 20 April 2018, SIMEC purchased Tahmoor Coal and is the current owner and operator of the mine.

1.4 Existing Approvals

22. Tahmoor Coal Mine consists of two Colliery Holdings under the *Mining Act 1992* (Mining Act), including the Tahmoor Colliery Holding (Consolidated Coal Lease [CCL] 716 and Mining Leases [MLs] 1308, 1376, 1539 and 1642); and the Bargo Colliery Holding (CCL 747). Although a consent for mining associated with the Bargo Colliery still exists (dating back to 1975), limited mining within the Bargo Colliery CCL has been undertaken, with historical and current mining operations predominantly being undertaken within the Tahmoor Colliery CCL and MLs under five existing consents.
23. **Table 1** provides a summary of the existing consents under which the Tahmoor Coal Mine currently operates, and the proposed approach for surrendering the consents if the Project is approved.

Table 1 | Existing development consents

Consent	Consent Authority	Scope	Proposed approach
Bargo 1975/1976 (162/76)	Wollondilly and Mittagong Shire councils	Underground mining in CCL 747 and associated surface facilities west of Bargo	Surrender consent
Tahmoor DA 1975 (7105/47)	Wollondilly Shire Council	Underground mining in CCL 716, ML1308 and ML1642, associated surface facilities and transport of ROM coal	Surrender consent; surface facilities area to be covered by new consent (if approved)
Tahmoor DA 1979	NSW Planning and Environment Commission	Operation of coal handling and preparation plant (CHPP) and reject emplacement area (REA), modifications for gas extraction, extension of washery, transport of coal to PKCT by rail and by road within Wollondilly LGA (if rail unavailable)	Surrender consent following completion of current mining activities in Tahmoor North; surface facilities area and REA to be covered by new consent (if approved)
Tahmoor Gas Extraction DA 1985 (190/85)	Wollondilly Shire Council	Surface civil and mechanical work for gas extraction	Surrender consent; surface facilities area to be covered by new consent (if approved)
Tahmoor DA 1994 (DA 57/93 MOD 1)	Land and Environment Court	Underground mining in Mining Lease Application 1 (later ML1376). Emplacement of rejects on site. Surface facilities and access shaft.	Surrender consent following completion of current mining activities and mine closure/rehabilitation in Tahmoor North
Tahmoor DA 1999 (67/98 MOD 4)	Minister for Planning	Underground mining in ML1539, infrastructure, coal processing and transport	Surrender consent following completion of current mining activities and mine closure/ rehabilitation in Tahmoor North; surface infrastructure, coal processing and transport to be covered by new consent (if approved)

24. Tahmoor Coal proposes to continue underground mining and rehabilitation/closure activities in the Tahmoor North mine area under existing Tahmoor consents issued in 1979, 1994 and 1999. Tahmoor Coal would surrender these consents once these activities are completed. However, it

is proposed that the operation of the surface facilities site, the reject emplacement area (REA) and the gas extraction activities would be governed under the new development consent for Tahmoor South, if approved.

1.5 Existing Operations

25. Tahmoor Mine uses longwall mining methods to extract up to 3 Mtpa of ROM coal from the Bulli seam in the Permian Illawarra Coal Measures, the main coal bearing sequence in the Southern Coalfield. The Bulli seam coal is predominantly a hard-coking coal used in steel making. Extraction is currently being undertaken in LWW1 of the Tahmoor North mining area (**Figure 2**).
26. Existing surface facilities at Tahmoor Coal Mine include a CHPP; a REA with a capacity for 13 Mt of reject material, coal stockpiles; surface water management infrastructure; gas drainage system; 3 ventilation shafts; a mine drift; a rail load-out facility; and a rail loop which connects to the Main Southern Railway.
27. Product coal is currently transported by rail to PKCT, or occasionally to Newcastle Port Waratah, for delivery to both Australian and International markets. Approximately 25% of the metallurgical coal produced at Tahmoor Coal Mine is currently sold to domestic steelmakers, including GFG Whyalla and Bluescope Port Kembla. Tahmoor Coal also has approval to transport up to 50,000 tpa of coal by road within the Wollondilly Shire or in circumstances where rail transport is unavailable.
28. Tahmoor Coal currently employs up to 390 permanent and contract staff.

2 The Project

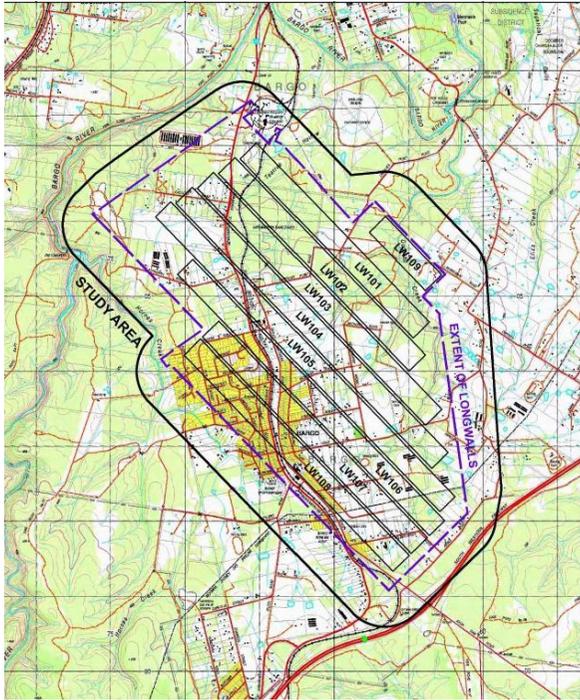
2.1 Project Amendments

29. Tahmoor Coal submitted the original Tahmoor South Coal Project application and accompanying Environmental Impact Statement (EIS) to the Department in January 2019 (refer to **Appendix A**). The original proposal involved mining from 9 longwall panels to extract up to 48 Mt of ROM coal over a 13-year mine life.
30. In response to concerns raised in submissions and agency advice on the EIS, particularly in relation to the magnitude and extent of subsidence, biodiversity and noise impacts, Tahmoor Coal amended the original proposal and submitted a Project Amendment Report (PAR) in February 2020 (refer to **Appendix B**).
31. The first amended Project removed one longwall (LW109) and reduced longwall widths and the height of extraction to reduce subsidence impacts; significantly reduced the REA footprint to minimise biodiversity impacts; and committed to restricting operations at the REA to reduce noise impacts.
32. Primarily in response to further concerns raised by the Department and SA NSW in relation to the extent and nature of subsidence related impacts on the township of Bargo, Tahmoor Coal requested a second amendment and submitted a Second Project Amendment Report (SPAR) in August 2020 (refer to **Appendix C**).

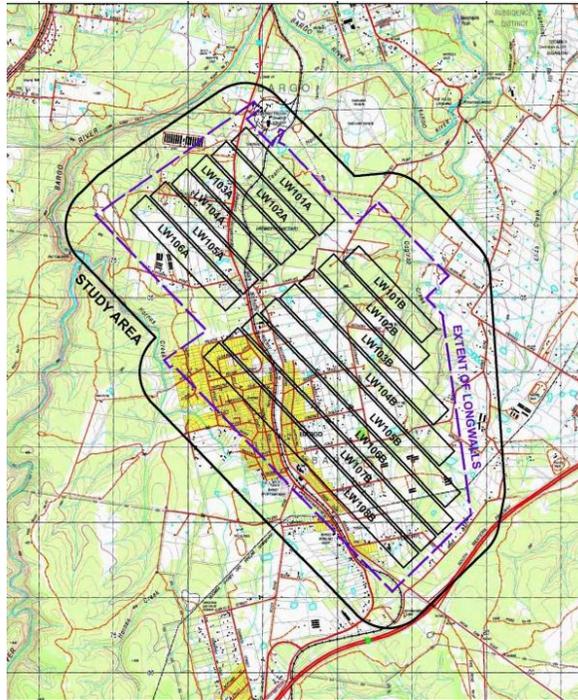
33. Key changes to the mine plan included removing the two longwall panels (LW107B and LW108B) to significantly reduce the extent of potential subsidence related impacts to houses and infrastructure in the town.
34. The Department also engaged a geotechnical expert, Mr Jeremy Busfield (MineCraft Consulting Pty Ltd), to complete an independent review of the proposed mine plan and analyse feasible alternatives to assess the opportunities and limitations (including costs and benefits) of the Project. The *Review of Tahmoor South Proposed Mine Plan* report is provided at **Appendix G**. In summary, the review indicated that:
- first workings or partial extraction methods are not economic at current prices, primarily due to the depth (400m) and the thin coal seam;
 - the amended extraction height and width is more practically suited to the existing mining equipment and would result in lower capital costs;
 - maintaining the current panel width provides the highest project value, with further reductions in widths of all panels significantly reducing net present value (NPV) of the Project (eg. reducing panel widths by 50 m would reduce the NPV in the order of \$170M to \$195M); and
 - not mining LW107B and LW108B erodes significant project value (ie. reduces NPV of the Project by \$129M).
35. Mr Busfield also considered alternatives to removing LW107B and LW108B from the mine plan, including narrowing the panel widths just within the Bargo area and angling the mains to avoid Bargo. Both these options were considered to provide better value than not extracting LW107B and LW108B, but only if some additional reserves can be added adjacent to LW108B, i.e. another small panel.
36. Overall, Mr Busfield concluded that:
- “In comparison to other Australian LW mines, Tahmoor is a low productivity, deep, gassy mine with limited upside capacity. Notwithstanding this, the proposed mine plan should enable the mine to continue operating and providing benefits to the State of NSW for the remaining mine life. However any significant restrictions in operating conditions (panel width, size of resource, etc) may negatively influence the investment decision by the owners”.*
37. The Department acknowledges that the amended mine plan, particularly the removal of LW107B and LW108B, will result in significant reductions in the Project’s NPV, however considers it necessary to avoid subsidence related impacts on the township of Bargo.
38. A summary of the amendments to the Project as described in the EIS, PAR and SPAR is provided in **Table 2**, with the changes in longwall mine layout depicted in **Figure 3**.

Table 2 | Summary of Project Amendments

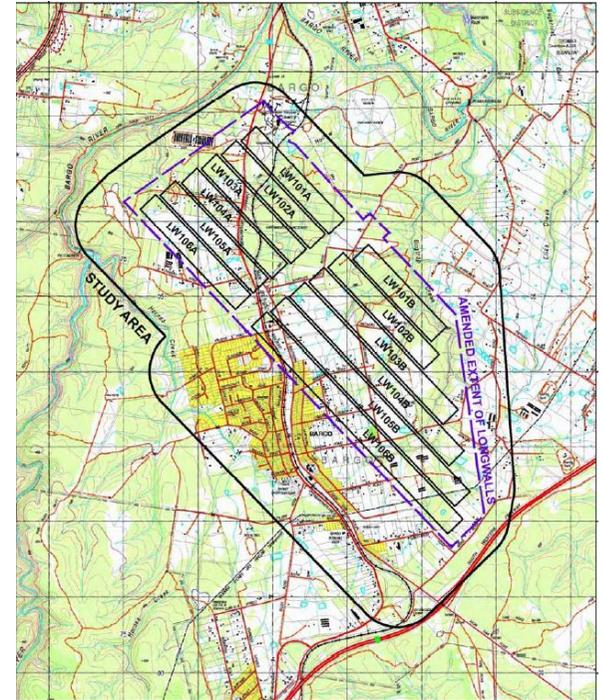
Element	EIS	PAR	SPAR (the Project)
ROM Coal Extraction	<ul style="list-style-type: none"> 48 Mt over 13 years 	<ul style="list-style-type: none"> 43 Mt over 13 years 	<ul style="list-style-type: none"> 33 Mt over 10 years
Mine Plan	<ul style="list-style-type: none"> Nine longwalls (LW101 – LW109) up to 305 m wide and 2.85 m high 	<ul style="list-style-type: none"> Removal of one longwall (LW109) beneath Dog Trap Creek Reconfigure longwall layout to comprise two series of shorter longwalls (LW101A-106A and LW101B-108B) Reduction in longwall width to 285 m and height to 2.6 m 	<ul style="list-style-type: none"> Removal of two longwalls (LW107B and LW108B) beneath Bargo
REA	<ul style="list-style-type: none"> Volume of rejects 14.3 Mt Increase in height from RL 300 m to RL 305 m Extension area (clearing) of 43 ha Operate 24 hours a day, 7 days a week 	<ul style="list-style-type: none"> Volume of rejects 11.6 Mt Increase in height from RL 305 m to RL 310 m Reduction in extension area to 11.06 ha Restrict transport of rejects via conveyor to daytime and evening hours (7 am to 10 pm) only 	<ul style="list-style-type: none"> Volume of rejects 9.7 Mt Increase in height from RL 310 m to RL 320 m No extension to approved footprint Continue restricted transport hours
Mine Ventilation	<ul style="list-style-type: none"> Use of existing mine upcast vent shaft (T2) in emergency situations only New upcast (TSC1) and downcast (TSC2) vent shafts Clearing of 9.52 ha 	<ul style="list-style-type: none"> Continued use of existing mine upcast vent shaft (T2) with reduction in use from two fans to one fan No change to new upcast (TSC1) and downcast (TSC2) vent shafts Clearing of 9.52 ha 	<ul style="list-style-type: none"> No change to use of existing vent shaft (T2) Reduction in clearing required for new upcast (TSC1) and downcast (TSC2) vent shafts Clearing of 8.84 ha
Transmission Lines	<ul style="list-style-type: none"> No changes or additional lines proposed 	<ul style="list-style-type: none"> Inclusion of easement for 66-kV overhead transmission line from surface facilities site to new vent shafts Clearing of 2.99 ha 	<ul style="list-style-type: none"> Reduction in clearing required for construction of transmission lines Clearing of 1.26 ha
Intersection with Mine Access Road	<ul style="list-style-type: none"> Proposed upgraded intersection 	<ul style="list-style-type: none"> No change 	<ul style="list-style-type: none"> No change
Carpark	<ul style="list-style-type: none"> Additional 150 parking spaces proposed 	<ul style="list-style-type: none"> Carpark not proposed 	<ul style="list-style-type: none"> Carpark not proposed



EIS Layout



PAR Layout



SPAR Layout

Figure 3 | Amendments to Longwall Panel Layout

2.1 Key Project Components

39. The key components of the Project as proposed in the SPAR are outlined in **Table 3** and shown in **Figures 4, 5, 6** and **7**.

Table 3 | Key Components of the Project

Aspect	Description
Project Life	<ul style="list-style-type: none"> Approximately 2032 (2 years construction and 10 years coal extraction)
Coal Extraction	<ul style="list-style-type: none"> Estimated 33 Mt of recoverable ROM coal at a rate of up to 4 Mtpa
Coal Products	<ul style="list-style-type: none"> Coking coal (90-95%) and thermal coal (5-10%)
Mine Method	<ul style="list-style-type: none"> Underground longwall mining
Mine Schedule	<ul style="list-style-type: none"> LW101A-103A – 2022 to 2024 LW101B-106B – 2025 to 2030 LW104A-106A – 2031 to 2032
Coal Processing	<ul style="list-style-type: none"> Continued use of existing on-site CHPP, upgraded to include a new coarse rejects screen, additional belt filter capacity and increased thickener capacity
Ventilation	<ul style="list-style-type: none"> Continued use of existing upcast vent (T2) Construction and operation of an upcast (TSC1) and a downcast (TSC2) vent at two new sites along Charlies Point Road to the south of the REA (clearing of 8.84 ha)
Transmission Line	<ul style="list-style-type: none"> Construction of new 66 kV electrical power line to vent shaft sites (clearing of 1.26 ha)
REA	<ul style="list-style-type: none"> Continued use of existing REA, with increased height from RL 300 m to RL 320 m to accommodate up to 9.7 Mt of additional coal rejects (no extension to approved footprint)
Water Management	<ul style="list-style-type: none"> Surface water runoff: continue to be reused on-site (dust suppression, coal processing) with wet weather discharges from existing sediment basins regulated by the EPA. Two new sediment basins (S11 and S12) to be construction to collect runoff from the REA. Mine water: commissioning of a new Water Treatment Plan (WTP) required under special conditions issued by the Environment Protection Authority (EPA). Treated water (up to 2,030 ML/year) to continue to be discharged via Licenced Discharge Point (LDP) 1 into Tea Tree Hollow under new water quality limits Excess mine water: transfer and return of excess mine water to and from the proposed underground storage areas within goaf areas of Tahmoor North using existing mine infrastructure (around 242 ML/year excess mine water with underground storage capacity of 4,725 ML). Note: Tahmoor Coal must modify the existing development consent for the Tahmoor North Mine (67/98) dated 1999, or any other relevant consent, to obtain approval.
Sewage Treatment	<ul style="list-style-type: none"> Upgrade of the existing Sewage Treatment Plant (STP) (peak capacity of 61 kL/day) to produce effluent of a suitable quality to enable discharge via LDP 1 or to be used in future for irrigation of the REA
Gas Management	<ul style="list-style-type: none"> New gas drainage system from underground mine area to surface facilities site Continued use of existing on-site gas infrastructure including the Gas Plant, Gas Vent, Gas Flare Plant and Waste Coal Mine Gas Power Plant
Product Transportation	<ul style="list-style-type: none"> Continue to transport up to 4 laden trains from the mine to PKCT via the existing mine rail load out, rail loop, the Main Southern Railway and the Moss Vale to Unanderra Railway, with occasional transport of product to Newcastle (Port Waratah) Road transport (receipt of ROM coal and dispatch of product coal and reject) of up to 200,000 tpa and 3,000 t per day, with a maximum of 16 truck movements per hour
Mine Site Access	<ul style="list-style-type: none"> Continued use of existing vehicular access to the surface facilities site via Remembrance Drive. Upgrade of intersection to provide dedicated right-hand turning bay from the south and extended acceleration and deceleration lanes
Rehabilitation and Closure	<ul style="list-style-type: none"> Rehabilitate and make safe all surface facilities following completion of mining to a condition suitable for a range of future land uses

Aspect	Description
Workforce	<ul style="list-style-type: none"> Ongoing employment of 390 permanent and contract staff, with an additional 50 to 175 staff prior to completion of Tahmoor North and start of secondary extraction at Tahmoor South
Hours of Operation	<ul style="list-style-type: none"> Operational activities (underground mining, rail transport, surface facilities site, vent shaft sites): 24 hours a day, 7 days a week Road transport (coal product and reject): 7 am to 6 pm Monday to Saturday REA haulage: 7 am to 10 pm, 7 days a week (following commencement of second workings) Construction activities: 7 am to 6 pm Monday to Friday, and 8 am to 1 pm Saturday, with no construction activities on Sundays or public holidays Drilling activities at vent shaft sites: 24 hours a day, 7 days a week
Capital Investment Value (CIV)	<ul style="list-style-type: none"> \$342 million

2.2 Department's Recommended Project Amendment

40. In its submissions on the PAR and SPAR, BCS and Heritage NSW recommended that the southern ends of LWs 101B, 103B and 104B be shortened to avoid directly undermining 3rd order¹ sections of Dog Trap Creek and reduce risks of impact to the streams (including pools) and Aboriginal heritage sites. In response, the Department requested that Tahmoor Coal provide an analysis of the economic and environmental implications of reducing the lengths of these longwalls. The key outcomes of this analysis are summarised in **Table 4**.

Table 4 | Implications of Reducing Longwall Lengths

Longwall	Reduced Length (m)*	Implications	
		Economic	Environmental
LW101B	450	<ul style="list-style-type: none"> Cost of developing the remaining short length of the longwall compared to the revenue generation from the coal extraction would render it economically unviable Removing entire length of LW from mine plan would sterilise 1.3 Mt of product coal valued at \$250 million 	<ul style="list-style-type: none"> Avoid directly undermining 6 stream pools and reduced likelihood of impact to a further 4 pools Avoid directly undermining 2 Aboriginal heritage sites and reduced risk of impact to a further 2 sites
LW103B	400	<ul style="list-style-type: none"> Sterilise 0.35 Mt of product coal valued at \$64 million 	<ul style="list-style-type: none"> Avoid directly undermining 9 stream pools and reduced likelihood of impact to a further 8 pools Avoid directly undermining 2 Aboriginal heritage sites and reduced risk of impact to a further 3 sites Avoid directly undermining one cliff (C_0228)
LW104B	700	<ul style="list-style-type: none"> sterilise 0.6 Mt of product coal valued at \$106 million 	<ul style="list-style-type: none"> Avoid directly undermining 8 stream pools and reduced likelihood of impact to a further 2 pools

* Length of longwall that would need to be reduced to avoid directly undermining Dog Trap Creek (including setbacks of approximately 90 m)

¹ Classification of streams in accordance with Strahler stream order system.

41. As discussed in detail in Section 6 of this Assessment Report, the Department considers that setting back the commencement end of LW103B by a relatively short length (i.e. 400m) would result in a clear material environmental benefit without compromising the economic viability of the Project. The 3rd order section of Dog Trap Creek is a well-defined valley and incised part of the landform that is predicted to experience the greatest non-conventional subsidence effects and subsidence impacts. The Department considers that substantial reductions in the likelihood of impact to a significant number of pools (17) and Aboriginal heritage sites (5), as well as a cliff line, along Dog Trap Creek would be achieved by shortening the longwall.
42. Based on this analysis, the Department has recommended a condition requiring Tahmoor Coal to setback the commencement end of LW103B to avoid mining directly under Dog Trap Creek. If requested by Tahmoor Coal, the Planning Secretary would review the commencement position of LW103B, subject to further stream/riparian features assessment along Dog Trap Creek, including:
 - (a) significance assessment of key stream and riparian features including pool volumes and water holding capacity, pool ecological attributes, groundwater dependent ecosystems and Aboriginal heritage sites;
 - (b) updated subsidence effects, impact and consequence assessment comparing the shortened longwall commencement position and the commencement position originally proposed;
 - (c) details of likely remediation required on the predictions for each of the commencement positions, and considering any watercourse damage from previously extracted longwalls; and
 - (d) costs and benefits of the commencement positions, including consideration of costs of any predicted remediation.
43. The Department accepts that avoiding undermining sections of Dog Trap Creek above LW101B and LW104B would have significant economic implications, by sterilising substantial volumes of coal, for reduced environmental benefits (i.e. a reduced likelihood and risk of impacts to fewer pools and Aboriginal heritage sites). The Department has therefore recommended the lengths of these longwalls remain unchanged.

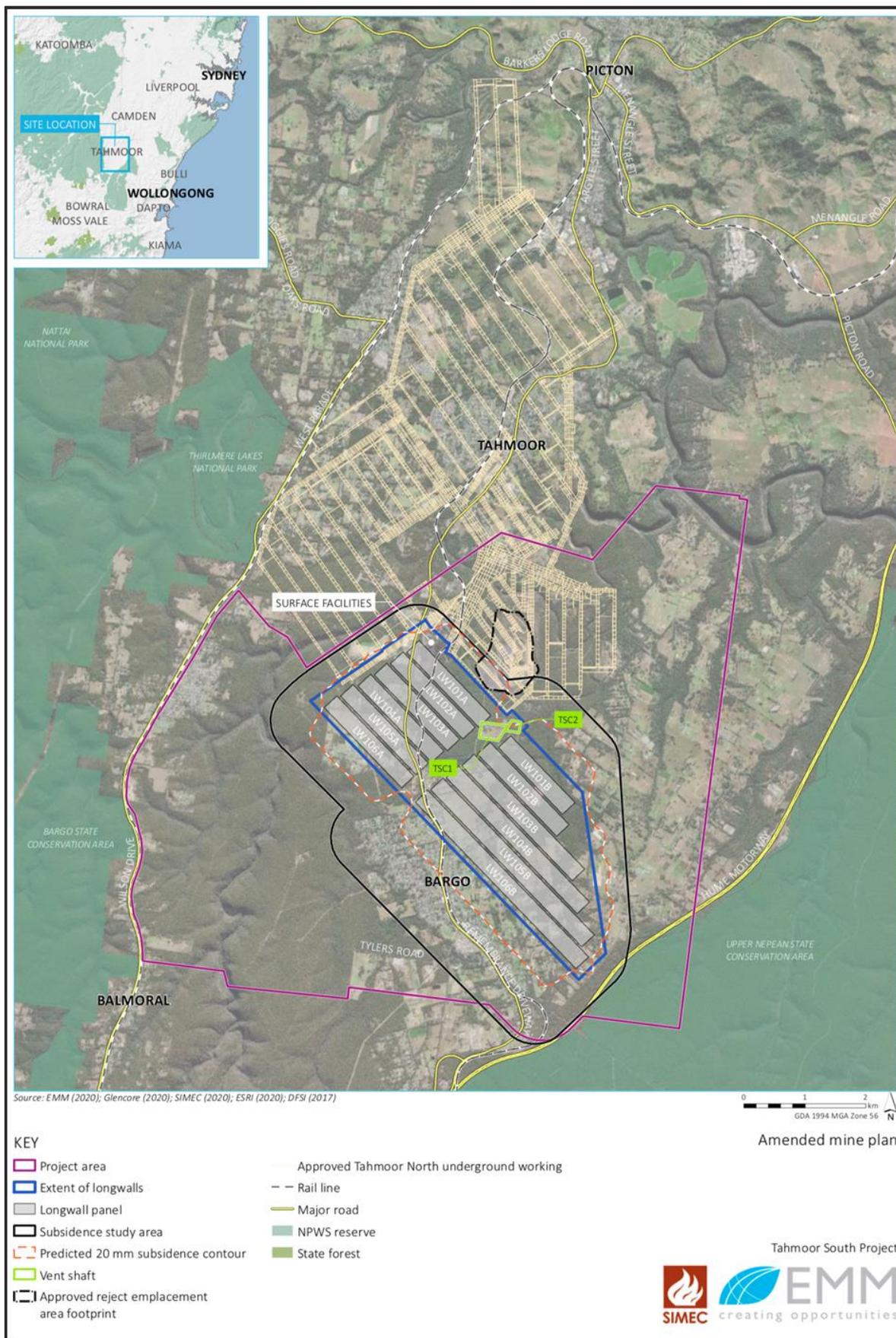


Figure 4 | Proposed Mine Plan



Figure 5 | Existing and Proposed Surface Facilities Site

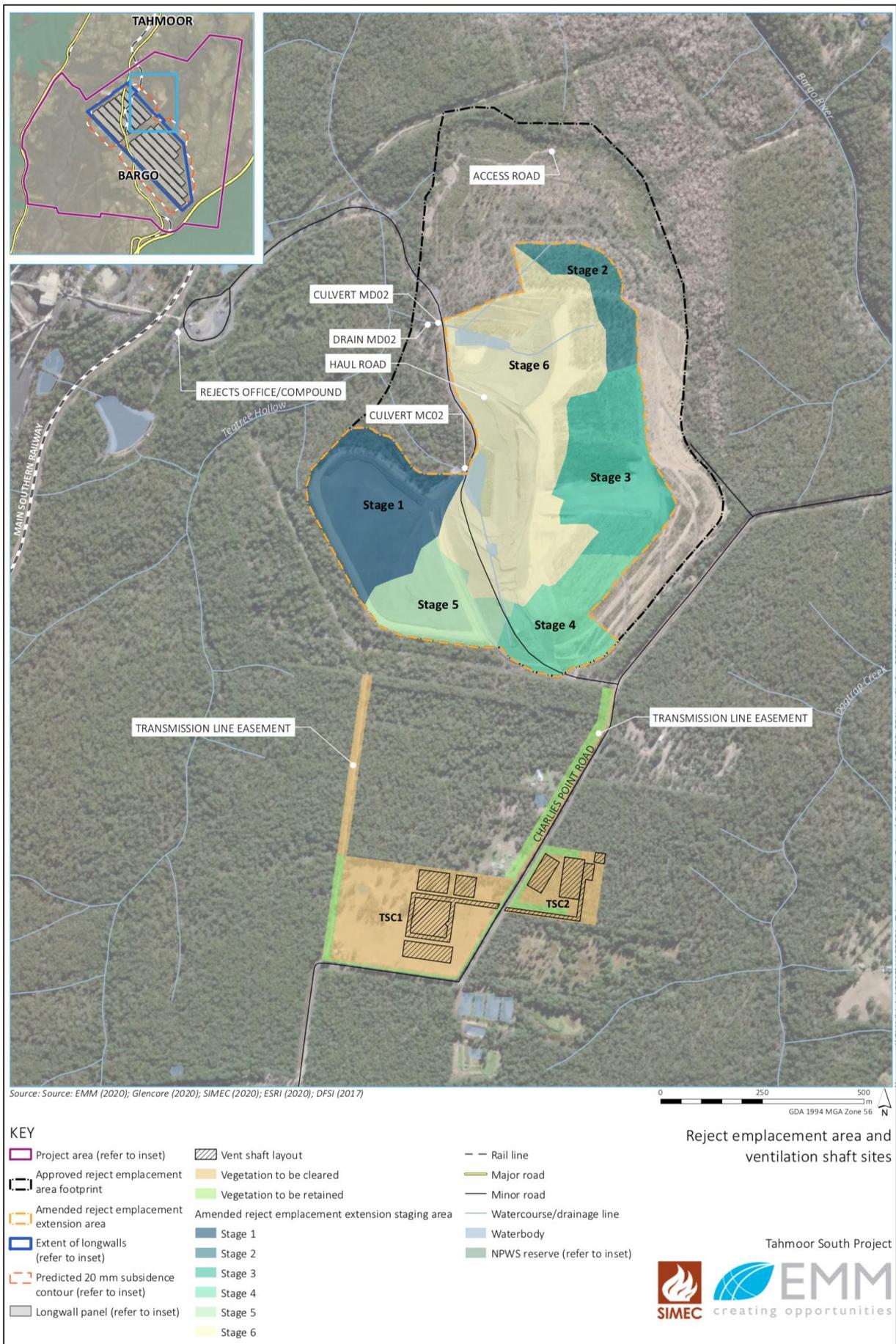


Figure 6 | Existing and Proposed REA and Ventilation Shaft Sites



Figure 7 | Proposed Conceptual Final Landform

2.3 Chronology of Events

A chronology of the key events for the Project is presented in **Table 5**. Documentation referred to in this table can be accessed on the Department's website at: <https://www.planningportal.nsw.gov.au/major-projects/project/10966>.

Table 5 | Chronology of Key Events

Date	Event
January 2019	<ul style="list-style-type: none">Lodgement of the Environmental Impact Statement (EIS, 2019) for the proposed extraction 48 Mt of coal over 13 yearsReferral of the Project to the Independent Expert Scientific Committee (IESC) for advice
January –March 2019	<ul style="list-style-type: none">The Department publicly exhibited the EIS (2019)
March 2020	<ul style="list-style-type: none">The IESC provided advice on the Project to the Department (refer to Section 5.6)
June 2019	<ul style="list-style-type: none">The Department completed its preliminary review of the development application, the EIS, community submissions and government agency advice on the Project and submitted a Preliminary Issues Report (PIR, 2019) to the Commission for consideration during public hearings
July 2019	<ul style="list-style-type: none">Tahmoor Coal advised the Department it proposed to amend the Project
February 2020	<ul style="list-style-type: none">Tahmoor Coal submitted a Project Amendment Report (PAR, 2020) and Response to Submissions (RTS, 2020)The PAR and RTS were made publicly available on the Department's website and sent to key government agencies for further comment
August 2020	<ul style="list-style-type: none">Tahmoor Coal submitted a Second Project Amendment Report (SPAR, 2020) and Response to Advice (RTA, 2020) for the second amended Project, which proposed extracting 33 Mt of coal over 10 yearsThe SPAR and RTA were made publicly available on the Department's website and sent to key government agencies for further comment
October 2020	<ul style="list-style-type: none">Minister for Planning and Public Spaces issues new request for the Commission to carry out a public hearing on the Project and to make a determination of the project as delegated consent authority.

3 Strategic Context

3.1 Southern Coalfield

44. The Project is located in the Southern Coalfield of NSW. The Southern Coalfield is one of the five major coalfields located within the Sydney-Gunnedah Basin. It is located around 70 km south-west of Sydney and around 35 km north-west of Wollongong, with topography that is defined by the Illawarra and Woronora Plateau.
45. The Southern Coalfield has a long history of coal exploration and mining, with underground mining being undertaken in the area for over 200 years. In addition to the Tahmoor Coal Mine, there are

nine nearby mining operations which are in various phases of operation (Bulli Seam Operations incorporating Appin, Appin West and West Cliff Collieries, Dendrobium Colliery, Metropolitan Colliery); care and maintenance (Russell Vale Colliery, Wongawilli Colliery, North Cliff Colliery and Berrima Colliery); or are proposed (Hume Coal Project).

46. The Southern Coalfield has historically been a major source of high-quality hard coking coal used for steel making, both in Australia and internationally. The unique nature of this coal resource within NSW makes it a very important contributor to the local, regional and NSW economies. The proximity of the Southern Coalfield to the coast and the PKCT is a major factor supporting export of coal from the region. Coal from the Southern Coalfields also supports local industry, such as BlueScope Steelworks at Port Kembla which employs around 3,000 people.
47. SIMEC is a subsidiary of GFG Alliance, an international group of businesses founded and owned by the British Gupta family. GFG Alliance's main operating businesses are Liberty House and SIMEC Group. Liberty House operates commodities, recycling, steel, aluminium and engineering divisions. SIMEC Group operates shipping, infrastructure (ports, railway stock, marine fleets and storage facilities), mining, energy and commodities assets.
48. Tahmoor Coal is an operating business within the SIMEC Mining Division of the GFG Alliance. Approximately 25% of metallurgical coal currently produced at Tahmoor Coal Mine is sold to domestic steelmakers (i.e. GFG Whyalla and Bluescope Port Kembla). If the Project is approved, it is expected that the proportion of product coal sold to GFG Whyalla would increase to approximately 40% of domestic sales. The remaining coal would continue to supply demand for metallurgical coal within international markets.
49. The Project would also result in the continued employment of approximately 390 persons and an additional 50 to 175 persons in the initial stages of the Project for construction and mine development. It is expected that a large proportion of Tahmoor Coal's employees would continue to reside within the Wollondilly LGA, with subsequent benefits for the local and regional economies (noting that 46% of the current Tahmoor Coal workforce resides in the LGA). The Project is estimated to result in a net economic benefit to the local and state economies, as well as royalty revenue to the state.
50. The Department therefore considers the Project both economically and socially important for the state and the regional economy in the medium term.

3.2 Strategic Statement on Coal Exploration and Mining in NSW

51. In June 2020, the NSW Government released its *Strategic Statement on Coal Exploration and Mining in NSW*. The key objective of the strategic statement is to provide greater certainty to explorers, investors, industry stakeholders and communities about the future of coal mining in the state. The statement recognises the significance of coal to NSW, indicating that the industry provides over 22,000 direct jobs and around 89,000 indirect jobs. In 2018–2019, royalties from coal generated around \$2 billion in government revenue.
52. The statement also recognises that while many countries are beginning to transition from fossil fuels to low carbon energy sources, the demand for coking coal is likely to continue well beyond 2040 as coal-free steel making technologies are unlikely to be commercially available for some time.

53. The statement identifies the benefits of extensions to existing mining proposals as a means of delivering economic returns to the state while minimising environmental impacts. The Department notes that the proposed continuation of mining into the Tahmoor South area would facilitate the supply of premium grade metallurgical coal through utilising existing facilities rather than establishing a separate, new mine to access this resource. The use of an operating mine is considered preferable to the construction of a new mine from an environmental, economic and social perspective to maximise production and supply product coal into established export markets.
54. Overall, the Department considers that the Project, being an extension to an existing underground coal mine primarily targeting coking coal resources for steel making, aligns with the objectives of the strategic statement. The Project would also enable reuse of rehabilitated mining land at the surface facilities sites for future development, including rural residential growth areas (see Section 3.3 below).

3.3 Local Strategic Planning Statement

55. In March 2020, Wollondilly Shire Council (WSC) released its *Local Strategic Planning Statement – Wollondilly 2040* (LSPS) which outlines the land use planning vision for Wollondilly LGA over the next 20 years. The LSPS recognises that there are significant mineral resources in the LGA and that primary industries are essential to the area's economy.
56. The LSPS also recognises that land use conflicts with current and proposed mining activities would limit the areas suitable for local housing in the medium to long term, including in Bargo. The LSPS states that "*Bargo is constrained by the need to protect State significant mineral resources and is unsuitable for expansion and further intensification until mining activity is complete*". The LSPS focuses on the Wilton Growth Area as a higher priority growth area in the next 20 to 30 years, and is forecast to provide 15,000 new homes and space for 15,000 jobs. As well as mining constraints in the Bargo area, the LSPS identifies that significant servicing and infrastructure issues also constrains urban development, including restrictions from the Picton Wastewater Scheme and Water Recycling Plant.
57. The Department accepts that the Wilton Growth Area would cater for housing in the region in the next 20 to 30 years and that the Bargo area is unlikely to be a vital urban growth area during this time. Mining associated with the Project is forecast to cease by 2032. After this time the area could be used for further urban development. The Department considers this situation and timing is in line with WSC's strategic planning vision for the area.

3.4 Bargo Mine Subsidence District

58. A key strategic issue for the Project is the predicted subsidence impacts on urban and rural residences and the potential for prolonged subsidence impacts over the proposed life of the Project. As outlined in Section 2.1, a key reason for project amendments was to reduce potential subsidence induced impacts to residences. As a result of Tahmoor Coal's amendments to the mine plan, the number of houses located directly above the proposed longwalls has reduced by approximately 81% (i.e. from 751 in the EIS, to 571 in the PAR to 143 identified in the SPAR).
59. The Department acknowledges that the mine is located within the Bargo Mine Subsidence District. A Subsidence District is a land zoning tool administered by SA NSW under the CMSC Act to help protect existing homes and other structures from potential mine subsidence damage. SA NSW also regulates building and subdivision works within districts to ensure new homes and structures

are built to an appropriate standard that reduces the risk of damage should subsidence effects occur. Applications to construct buildings in Subsidence Districts must be approved by SA NSW.

60. The CMSC Act also provides for the assessment and management of risks associated with subsidence resulting from coal mining operations and includes provision for compensation or repairs required to mitigate the damage caused by mine subsidence.
61. The Bargo Mine Subsidence District was declared in 1975. Since this time, the township of Bargo has expanded steadily, such that 83% of houses in the area have been built following the declaration. Therefore, it is important to note that the majority of the houses in Bargo were constructed on the understanding that they may be subsided by underground mining in the future.

3.5 Thirlmere Lakes Inquiry

62. Thirlmere Lakes are a protected wetland system consisting of five lakes (Lake Gandagarra, Lake Werri Berri, Lake Couridjah, Lake Baraba and Lake Nerringong) that form the basis of the Thirlmere Lakes National Park. The lakes are located approximately 3.5 km north-west of the Project's nearest proposed longwall.
63. Water levels in the Thirlmere Lakes have been declining since 1992. However, the cause(s) of these declines are not straightforward, with some members of the community suggesting that the declines were related to longwall coal mining that had taken place to the east of the lakes, principally between 1995 and 2004.
64. The Thirlmere Lakes Inquiry was undertaken in 2011 in response to community concerns about declining water levels in the lakes. The Inquiry and subsequent review by the NSW Chief Scientist and Engineer (2013) found that, while there is evidence to suggest that mining had contributed to changes in groundwater tables and hydraulic gradients in the Hawkesbury Sandstone, it is not possible to conclude whether this is temporary or long-lasting.
65. Further, it was found that it is not possible to differentiate groundwater changes due to mining from those due to private bores, natural climate change (droughts), and anthropogenic climate change. Both the Inquiry and review recommended that substantial further research be undertaken to better understand lake levels and groundwater interactions.
66. The NSW Government has subsequently established several monitoring and research programs to expand the scientific data and knowledge into the causes of changes in water levels in Thirlmere Lakes. The most recent of these is the Office of Environment and Heritage (OEH) (now Biodiversity, Conservation and Science Directorate of the Department) led Thirlmere Lakes Research Program, commissioned in 2017 to investigate the sensitivity of these wetland systems to external influences, including mining. This program is due to be completed in late 2021.
67. As discussed in Section 6.3 of this report, existing information and data from the Thirlmere Lakes Inquiry and associated research programs have been used to model potential impacts to Thirlmere Lakes as a result of groundwater drawdown associated with the Project. The Department has recommended that the relevant findings of the Thirlmere Lakes Research Program be represented within the future groundwater conceptual and numerical model reviews.

3.6 Special Areas

68. The Southern Coalfield is unique in NSW, as much of it is located beneath high-value native vegetation and streams set aside for Sydney's drinking water supply. This water catchment is

divided between the Special Areas (Warragamba, Metropolitan and Woronora) and the outer broader catchment.

69. The Project area is located adjacent to the Metropolitan Special Area (MSA). Although no proposed longwall panels extend into the Special Area, one watercourse (Cows Creek) is located immediately outside the eastern boundary of the Project area and drains into the MSA.
70. The *Independent Expert Panel for Mining in the Catchment* (IEPMC) was established in February 2018 to provide informed expert advice to the Department on the impact of mining activities in the Greater Sydney Water Catchment Special Areas.
71. In November 2018, the IEPMC released its *Initial Report (Part 1)* which focused on the two active mines in the Special Areas, Dendrobium and Metropolitan. In October 2018, the IEPMC released a *Final Report (Part 2)* which includes a review of current coal mining in the Greater Sydney Water Catchment Special Areas with a focus on risks to water supply, the environmental consequences for swamps, and cumulative impacts.
72. The IEPMC made 27 recommendations in its *Final Report* to inform mine design and approvals, monitoring and performance. Although the Project is located outside of the Special Areas, the Department has considered these recommendations in relation to the Project. In summary, the Department considers that specific actions and commitments made by Tahmoor Coal align with recommendations made by the IEPMC, specifically in relation to:
 - the assessment of regional groundwater impacts and consequences;
 - the completion of an uncertainty analysis for groundwater predictions; and
 - peer review of the Groundwater Assessment.
73. As well as commissioning a separate independent peer review of the Groundwater Assessment, the Department has recommended conditions to further address specific recommendations made by the IEPMC, including:
 - Extraction Plan monitoring that requires early detection and control of any elevated risks of variance between predicted and measured subsidence effects;
 - stream and riparian vegetation health and channel stability (geomorphology) monitoring along watercourses;
 - requirements to remediate physical impacts to watercourses damaged by subsidence impacts; and
 - inclusion of trigger-action-response plans (TARPs) in management plans to provide a clear basis to decide whether or not the performance measures are being met, and certainty in determining the appropriate management response to exceedances and breaches.

4 Statutory Context

4.1 State Significance

74. The Project involves coal mining and is declared to be SSD under clause 8(1)(b) of *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP).

4.2 Permissibility

75. Development associated with the Project would be located within the Wollondilly LGA, on land subject to the *Wollondilly Local Environmental Plan 2011* (Wollondilly LEP).
76. The surface facilities area and REA are on land zoned RU2 Rural Landscape. The proposed extraction area extends beneath land zoned primarily E2 Environmental Conservation, E4 Environmental Living, RU1 Primary Production, RU2 Rural Landscape and RU4 Rural Small Holdings. The footprint of the mine plan also includes areas of Low and Medium Density and Large Lot Residential (R2, R3 and R5, respectively) and SP2 Infrastructure (Road and Railway). As discussed in **Appendix H**, the Project would not result in any clearing or direct surface impacts to land zoned E2 Environmental Conservation and the Department considers that the Project would allow WSC to maintain the land use objectives of this and other zones in the extraction area.
77. Under the Wollondilly LEP, the Project is permissible with consent in some land zones and prohibited in other zones. However, the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (the Mining SEPP) ensures that the Project is fully permissible with consent. Under the Mining SEPP, development for the purposes of underground mining is permissible on any land in NSW.

4.3 Surrender of Development Consents

78. Section 4.63 of the EP&A Act (relating to voluntary surrender of development consents) provides that if a development consent(s) is surrendered as a condition of a new development consent and the new consent includes continuation of development that was authorised, then the consent authority:
 - is not required to re-assess the likely impact of the continued development to the extent that it could have been carried out but for the surrender of the consent;
 - is not required to re-determine whether to authorise that continued development under the new development consent (or the manner in which it is to be carried out); and
 - may modify the manner in which that continued development is to be carried out for the purpose of the consolidation of the development consents applying to the land concerned.
79. As discussed in Section 1.4, if the Project is approved, Tahmoor Coal would surrender the existing development consents for mining and rehabilitation/closure activities in the Tahmoor North mine area once these activities are completed. The mining at Tahmoor South, as well as the operation of the surface facilities site, the REA and the gas extraction activities, would be regulated under a single consolidated contemporary development consent. While the consent authority is not required to re-assess the impacts of the ongoing activities of an approved project, both the SPAR and the Department's assessment have considered worst-case impact scenarios to ensure the full range of impacts are considered, including in regard to:
 - water resources – the assessment incorporates the potential impacts of the Tahmoor South mining operations, previous mining at Tahmoor North and other mining operations in the region;
 - amenity – noise and air assessments were based on maximum production rates and worst-case operational scenarios, and the visual assessment considered existing and proposed infrastructure at the surface facilities site and REA landforms; and

- other matters – traffic, social, economic and land use impacts.
80. This approach has been reflected in the recommended conditions of consent which incorporate the relevant requirements of the approved operations, including existing obligations to upgrade the WTP at the surface facilities site.

4.4 Integrated and Other NSW Approvals

81. Under Section 4.41 of the EP&A Act, several approvals are integrated into the SSD approval process and consequently are not required to be separately obtained for the proposal. These include:
- approvals relating to heritage required under the *National Parks and Wildlife Act 1974* and the *Heritage Act 1977*; and
 - certain water approvals under the *Water Management Act 2000* (WM Act).
82. Under Section 4.42 of the EP&A Act, several other approvals are required but must be substantially consistent with any consent granted for the project. These include:
- a mining lease under the *Mining Act 1992*;
 - approval under the *Coal Mine Subsidence Compensation Act 2017* (CMSC Act);
 - consents under the *Roads Act 1993*;
 - an EPL under the *Protection of the Environment Operations Act 1997*;
 - notification under the *Work Health and Safety (Mines) Act 2013* for high risk activities, including emplacement of reject materials; and
 - water access licences under the *Water Act 1912* and/or the WM Act.
83. Tahmoor Coal currently holds most relevant leases and licences under these Acts and can obtain any other licences required for the Project where required. The Department has consulted with the relevant government authorities responsible for these other approvals (see Section 5), and considered the relevant issues relating to these approvals in its assessment of the development (see Section 7). None of the relevant authorities object to the Project.

4.5 Mandatory Matters for Consideration

84. The Department of Planning, Industry and Environment's (the Department's) assessment of the Project has given careful consideration to all necessary statutory requirements. These include the:
- objects of the EP&A Act, set out in section 1.3 of the Act; and
 - matters listed under section 4.15(1) of the EP&A Act, including applicable Environmental Planning Instruments (EPIs) and regulations.
85. Apart from considering the statutory requirements in their own right, the Department has carefully considered Section 8 of the EIS, where Tahmoor Coal has considered applicable legislation and environmental planning instruments in detail.
86. The Department has considered all statutory requirements in its assessment of the Project and has provided a summary of this consideration in respect of the objects of the EP&A Act and a general overview of the applicable EPIs below. Further consideration of particular provisions of applicable EPIs can be found in **Appendix H**.

Objects of the EP&A Act

87. The objects of the EP&A Act are the underpinning principles for all decision making under the Act. They must be considered by the consent authority when determining a development application under the Act. The Department has assessed the Project against the objects found in section 1.3 of the EP&A Act. **Table 6** summarises how the Department considers that the Project can be undertaken in a manner that is consistent with these objectives, including Ecologically Sustainable Development (ESD).

Table 6 | Consideration of the proposal against relevant objects of the EP&A Act

Objects of the EP&A Act	Consideration
(a) <i>to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources;</i>	<p>The Project meets this object because it:</p> <ul style="list-style-type: none"> • represents a continuation of a long-standing historical land use; • would involve substantial improvements to the surface facilities operations to minimise noise and air impacts on the community; • would provide substantial royalties of up \$131.5 million NPV ; and • would provide considerable employment and economic benefits to the State and region. <p>While the Project has the potential to result in both positive and negative social impacts, overall, the Department considers that any negative social impacts can be appropriately managed under recommended conditions.</p>
(b) <i>to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment;</i>	<p>The Department's assessment has sought to integrate all significant environmental, social and economic considerations. The Department considers that the Project can be carried out in a manner that is consistent with the principles of ecologically sustainable development.</p>
(c) <i>to promote the orderly and economic use and development of land;</i>	<p>The surface components of the Project represent a continuation of a long-standing historical land use. The Project would use existing rail infrastructure to transport coal to the PKCT. The proposed surface facilities site and REA would be operated within the current boundaries, and would require minimal clearing of native vegetation. The subsidence impacts associated with underground mining areas would be monitored, repaired, remediated or offset, as required. The Department considers this represents an orderly and economic use of the land.</p>
(e) <i>to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats;</i>	<p>The Department has assessed the biodiversity impacts of the Project in accordance with relevant State and Commonwealth legislation, policies and guidelines. The Department considers that the Project avoids and minimises, to the greatest extent practicable, impacts on threatened species and communities and key habitats. The Department has recommended conditions to ensure that the residual biodiversity impacts of the Project would be appropriately managed and offset.</p>
(f) <i>to promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage);</i>	<p>The Department has assessed the likely impacts of the Project on Aboriginal cultural heritage and historic heritage. The Department recognises that the Project has the potential to impact a number of Aboriginal and historic heritage sites however considers that these impacts can be appropriately managed and mitigated subject to the recommended conditions.</p>
(i) <i>to promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State; and</i>	<p>The Department has assessed the Project application in consultation with WSC and other relevant NSW government authorities, and given consideration to the issues raised by these agencies in its assessment.</p>
(j) <i>to provide increased opportunity for community participation in environmental planning and assessment.</i>	<p>The Department publicly exhibited the Project application and considered all submissions in its assessment.</p>

Environmental Planning Instruments

88. The consent authority must take into consideration the provisions of EPIs (including draft instruments) when determining a development application. A number of EPIs apply to the Project, including the:
- Mining SEPP;
 - *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011*;
 - *State Environmental Planning Policy (Infrastructure) 2007*;
 - *State Environmental Planning Policy No 33 – Hazardous and Offensive Development*;
 - *State Environmental Planning Policy No 44 (Koala Habitat Protection) (SEPP 44)*;
 - *State Environmental Planning Policy No 55 – Remediation of Land*; and
 - Wollondilly LEP.
89. The Department notes that on 1 March 2020, SEPP 44 was replaced by the *SEPP (Koala Habitat Protection) 2019*. Under savings and transitional provisions, a development application made, but not finally determined, before the commencement of this policy must be determined as if this policy had not commenced.
90. The Department has considered the Project against the relevant provisions of these instruments (see **Appendix H**). Based on this assessment, the Department considers that the Project can be carried out in a manner that is consistent with the aims, objectives and provisions of these instruments.
91. In particular, in accordance with the Infrastructure SEPP, the Department confirms that it notified all relevant public infrastructure providers about the Project and has carefully considered the advice from these authorities in its assessment of this application.

4.6 Biodiversity Assessment

92. Section 7.9(2) of the *Biodiversity Conservation Act 2016* (BC Act) generally requires all applications for SSD to be accompanied by a Biodiversity Development Assessment Report (BDAR). However, clause 28(1) of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* provides that *‘The former planning provisions continue to apply ... to the determination of a pending or interim planning application.’*
93. The Project is a ‘pending or interim planning application’ under this Regulation. As a result, although the *Threatened Species Conservation Act 1995* (TSC Act) was repealed by the BC Act, some provisions of the TSC Act that would be in force if it had not been repealed (such as assessment guidelines) continue to apply to the Project.
94. For this reason, the EIS contains a Biodiversity Assessment Report (BAR) and Biodiversity Offset Strategy (BOS) prepared in accordance with the 2014 *Framework for Biodiversity Assessment – NSW Biodiversity Offsets Policy for Major Projects* (FBA), rather than a BDAR.

4.7 Commonwealth matters

95. On 12 January 2018, a delegate of the Commonwealth Minister for the Environment determined that the original project was a ‘controlled action’ under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) due to its potential impacts on Matters of National Significance (MNES), specifically listed threatened species and communities (sections 18 & 18A

of the EPBC Act) and a water resource (section 24D & 24E of the EPBC Act) (EPBC Ref 2017/8084).

96. Under the Bilateral Agreement between the Commonwealth and NSW governments, the Commonwealth has accredited the NSW assessment process under the EP&A Act, to enable an integrated assessment of the Project. However, the Commonwealth's decision-maker maintains a separate approval role, which would be exercised following the Commission's determination of the development application (if approved).
97. On 12 October 2020, Tahmoor Coal submitted a variation request to the Commonwealth Minister for the Environment based on the SPAR. A decision on the variation request was made on 17 November 2020 which confirmed no change to the original controlling provisions.
98. Due to the timing of the variation referral process, the Department will provide a separate assessment for the Commonwealth Minister of the Project's potential impacts on Commonwealth matters not considered in this report (ie listed threatened species and communities) in accordance with any relevant agreement, policies or guidelines.

4.8 Public Hearings and Consent Authority

99. On 15 January 2019, the then Minister for Planning requested the Commission conduct a multi-stage public hearing including an initial public hearing into the Project, as soon as practicable after the public exhibition of the EIS.
100. The Minister asked that the Commission to consider the EIS, submissions on the Project, and any relevant expert advice and other information. The Minister also asked that the Commission to publish a report on the hearing findings including, amongst other things, identification of the key issues requiring detailed consideration by the Department.
101. On 7 June 2020, the Department referred its Preliminary Issues Report (PIR) to the Commission to assist in conducting the public hearing.
102. The Commission proposed to hold the public hearing for the Project on 18 July 2019, however following advice from Tahmoor Coal that it proposed to amend the project in response to public submissions and advice from government agencies, on 9 July 2019, the Commission released a statement that the public hearing would no longer go ahead.
103. The Minister for Planning and Public Spaces is the consent authority for the Project as there were less than 50 duly made submissions objecting to the project during the exhibition period, neither Council objected to the project during the exhibition period, and Tahmoor Coal has not made any reportable political donations.
104. On 27 October 2020, the Minister for Planning and Public Spaces rescinded the earlier request for a public hearing and requested that the Commission hold a public hearing into the carrying out of the Project and make a determination of the application. The Commission is the delegated consent authority under the Minister's delegation of September 2011. The terms of the public hearing are provided below.

**Request to the Independent Planning Commission
Tahmoor South Project
Section 2.9 (1) (d) of the Environmental Planning and Assessment Act 1979**

On 15 January 2019, the former Minister for Planning requested the Independent Planning Commission conduct a public hearing in multiple stages into the carrying out of the Tahmoor South Coal Project. A public hearing was scheduled in response to the request but was cancelled due to modifications proposed to be made to the application for consent for the Project. Additionally, multi-stage public hearings are no longer conducted by the Commission.

Noting the above, I, the Minister for Planning and Public Spaces, rescind the request made on 15 January 2019 for the Independent Planning Commission to conduct a public hearing in multiple stages and instead request the Independent Planning Commission to:

1. Conduct a public hearing into the carrying out of the Tahmoor South Coal Project (SSD 8445) prior to determining the development application for the Project under the *Environmental Planning and Assessment Act 1979*, paying particular attention to:
 - a) the Department of Planning, Industry and Environment's assessment report, including any recommended conditions of consent;
 - b) key issues raised in public submissions during the public hearing; and
 - c) any other documents or information relevant to the determination of the development application.
2. Complete the public hearing and make its determination of the development application within 12 weeks of receiving the Department's assessment report in respect of the project, unless the Planning Secretary agrees otherwise

5 Engagement

5.1 Department's Engagement

105. The Department publicly exhibited the EIS from 23 January 2019 until 5 March 2019 (42 days) and advertised the exhibition in the Sydney Morning Herald, Daily Telegraph, The Australian, Southern Highlands News, Macarthur Chronicle and Wollondilly Advertiser. The EIS was also made available at the Wollondilly and Wingecarribee council offices and the Wollondilly and Bowral central libraries. In addition, the Department notified Wollondilly and Wingecarribee councils and relevant government agencies and utilities.
106. Following exhibition, the Department met with numerous government agencies, including WSC, to discuss specific issues in relation to the Project.

5.2 Summary of Submissions

107. During the exhibition period for the EIS, the Department received 97 submissions, including 14 from state and local government agencies, 6 from special interest groups (SIGs) and 77 from the general public (including individuals and businesses). Of the submissions from SIGs and the general public, 9 (11%) objected to the Project and 72 (87%) supported the Project. Seventeen (17) submissions were received from community members in the Tahmoor, Thirlmere, Bargo and Picton post codes, with the majority (14) of these supporting the Project.
108. A summary of the submissions and advice from Government agencies is provided in **Table 7**. A copy of all submissions received from the general public and SIGs is provided in **Appendix D**.

Table 7 | Summary of Submissions / government agency advice

Area	Submissions	Support	Object	Comment
Public authority	14	-	-	14
Special Interest Groups	6	1	3	2
General Public	77	71	6	-
within project boundary	17	14	3	-
within 30 km of project boundary	36	35	1	-
> 30 km of project boundary	24	22	2	-
Total	97	72	9	16

5.3 Agency Advice

109. While none of the agencies objected to the Project, several commented on particular aspects and proposed recommended conditions. As discussed in Section 5.7, both the PAR and SPAR were also forwarded to agencies for comment. A copy of advice received from agencies at the different stages of the Project is attached at **Appendix E**. These comments and recommendations are summarised in **Table 8** below and considered in more detail in Section 7 of the report.

Table 8 | Agency Advice

Agency	Advice	Consideration and Conditions
Department of Planning, Industry and Environment		
Water Group	<ul style="list-style-type: none"> Requested that the groundwater model be revised and the predictive scenarios re-run to confirm the magnitude of potential impacts, including further sensitivity and uncertainty analysis. The groundwater model was revised. The model was subsequently independently peer reviewed by Hugh Middlemis, a highly qualified and experienced expert in the fields of hydrology, hydrogeology and groundwater modelling. Accepted the analysis and predictions in the revised groundwater model and Tahmoor Coal's ability to obtain additional water licence entitlement to account for the Project's groundwater and surface water take. Recommended that the groundwater model be re-built and re-calibrated within 2 years of project determination and that a Groundwater Modelling Plan be prepared prior to determination. Recommended a rigorous bore census (including for bores impacted cumulatively), make good provisions and TARPs for groundwater impacts to bores. In relation to cumulatively impacted bores, DPIE-Water recommended that the responsibility of the impact be placed on the latest applicant. Recommended a geomorphology survey (baseline and post mining) of watercourses overlying the subsidence area. Recommended monitoring of streamflow, pool water levels and water quality should continue for a minimum period of two years following the cessation of subsidence movements. 	<ul style="list-style-type: none"> The Department has recommended conditions addressing DPIE-Water's recommendations, including requiring Tahmoor Coal to: <ul style="list-style-type: none"> - obtain all necessary water licences for the project under the <i>Water Act 1912</i> and/or the WM Act; - rebuild and recalibrate the groundwater model within 2 years of commencement of the development; - prepare a Groundwater Modelling Plan prior to commencing construction activities; - complete a bore census and provide compensatory water supply to any landowner whose water supply is adversely impacted by the Project (including cumulatively impacted bores); - complete a geomorphic survey and ongoing watercourse monitoring as part of the Extraction Plan; and - conduct streamflow, pool and water level monitoring; and - remediate any watercourses damaged by subsidence impacts. The Department adopted all DPIE Water's suggested amendments to the draft conditions.
Biodiversity Conservation and Science Directorate (BCS)	<p>In relation to biodiversity:</p> <ul style="list-style-type: none"> Supportive of the revised mine plan to retain the current footprint of the REA to reduce vegetation clearing. Recommended further amendments to the mine plan to reduce impacts on 3rd order streams and sites of Aboriginal cultural heritage, particularly along Dog Trap Creek. Suggested reducing length of LWs 101B and 103B. Noted the project would likely have a significant impact on the Commonwealth listed Shale Sandstone Transition Forest (SSTF) Critically Endangered Ecological Community (CEEC) and would require assessment under the bilateral agreement process. 	<ul style="list-style-type: none"> The Department has recommended LW103B to be shortened by 400m to reduce impacts to watercourse features and Aboriginal heritage sites. The Department notes that the Framework for Biodiversity Assessment (FBA) allows biodiversity credit to be satisfied after impacts occur. The Department considers Tahmoor Coal can retire biodiversity credits through various mechanisms, including payment into the Biodiversity Conservation Fund, and that a formal BOS is therefore not required.

Agency	Advice	Consideration and Conditions
	<ul style="list-style-type: none"> Recommend that conditions of consent be imposed relating to submission of a final Biodiversity Offset Strategy (BOS) detailing the proposed staged offset approach, submission of a Biodiversity Management Plan (BMP), and micro-siting of surface infrastructure to further minimise clearing impacts on SSTF CEEC and threatened species. Recommended conditions of approval require that impacts must be offset prior to impact. <p>In relation to Aboriginal heritage (refer to advice from Heritage NSW below).</p>	<ul style="list-style-type: none"> The Department has recommended conditions addressing BCS's recommendations, including requiring Tahmoor Coal to: <ul style="list-style-type: none"> retire all biodiversity credits within two years of development consent; prepare and implement a BMP including measures to minimise vegetation clearing by micro-siting surface infrastructure and minimise impacts on fauna habitat resources.
Environment Protection Authority	<p>In relation to noise:</p> <ul style="list-style-type: none"> Requested that the noise impact assessment (NIA) be revised to further assess low frequency noise (LFN) and apply the <i>Noise Policy for Industry (NPII)</i> and the <i>Voluntary Land Acquisition and Mitigation Policy (VLAMP)</i>. The NIA was revised in the PAR (Appendix B). Accepted the revised NIA. Recommended that the goal for LFN mitigation design should seek a 10 dB reduction and that all feasible and reasonable mitigation, including any negotiation with affected receivers, be included in approval conditions. Noted that proposed mitigation measures would be implemented over a 3-year period and recommended that approval conditions should consider residual noise impacts in the interim. <p>In relation to air quality:</p> <ul style="list-style-type: none"> Recommended that a construction Air Quality Management Plan and an updated Air Quality and Greenhouse Gas Management Plan be prepared, including a TARP relating to meteorological triggers. Recommended additional real-time PM₁₀ monitors be installed to target the most sensitive receivers. <p>In relation to Bargo Waste Management Centre (BWMC):</p> <ul style="list-style-type: none"> Recommended that further study is undertaken to fully assess and consider the potential subsidence impacts on the BWMC, given its proximity to Dog Trap Creek. <p>Other matters:</p> <ul style="list-style-type: none"> Satisfied with information provided in relation to the underground emplacement of coal wash reject material, wastewater storage liners, sediment basin discharges and sewage treatment. Advised that Special Conditions have been included in the existing EPL to require a new Water Treatment Plant be installed to meet specific water quality discharge limits, with a requirement to be commissioned prior to the commencement of any secondary workings associated with the Project. 	<ul style="list-style-type: none"> The EPA recently varied EPL 1389 to require installation of a Water Treatment Plant (WTP), undertake a toxicity monitoring program, an aquatic health monitoring program, a Tea Tree Hollow sediment investigation and include water treatment concentration limits. The Department considers this would ensure that adverse impacts to the downstream environment from controlled water discharges are minimised to acceptable levels. The Department has recommended conditions addressing the EPA's recommendations, including requiring Tahmoor Coal to: <ul style="list-style-type: none"> comply with strict noise and air criteria, including noise criteria during the interim period when noise mitigation is being implemented; install additional air quality monitors at sensitive receivers; prepare and implement a Noise Management Plan and Air Quality and Greenhouse Gas Management Plan; and establish a Technical Committee for the BWMC and comply with built feature subsidence performances. The EPA supports the recommended conditions.

Agency	Advice	Consideration and Conditions
SA NSW	<ul style="list-style-type: none"> • Satisfied that the revised mine plan (particularly the removal of LWs 107 and 108) significantly reduces the potential subsidence related impacts, particularly to houses in Bargo. • Confirmed that property owners whose homes are damaged as a result of mine subsidence associated with the Project can claim compensation through SA NSW under the CMSC Act. • Recommended additional protection (acquisition rights) for homeowners who may be required to live in damaged hoses for a number of years before their claims can be resolved and/or in situations where a house has sustained significant damage. • Recommended the application of performance measures for built features similar to those applied at Tahmoor North. • Advised that applications to rezone and subdivide land for urban development within the proposed mining area are likely to be refused by SA NSW, should the Project be approved. 	<ul style="list-style-type: none"> • The Department has recommended conditions addressing SA NSW's recommendations, including requiring Tahmoor Coal to: <ul style="list-style-type: none"> - offer property acquisition when houses reach certain damage categories, levels of tilt and/or has/would be impacted by more than two longwalls; and - comply with a wide range of subsidence impact performance measures for natural and built features. • SA NSW supports the recommended conditions.
Department of Regional NSW		
Mining, Exploration & Geoscience	<ul style="list-style-type: none"> • Considered that the proposed project satisfies section 3A objects of the <i>Mining Act 1992</i> and the requirements of clause 15 of the Mining SEPP. • Considered the project to be an efficient development and utilisation of coal resources which would foster significant social and economic benefits. • Advised it would consider the requirements needed to satisfy section 81 of the <i>Mining Act 1992</i> in respect of gas drainage and ventilation surface activities. 	<ul style="list-style-type: none"> • Comments noted.
Resources Regulator	<ul style="list-style-type: none"> • Considered that there is an opportunity to emplace reject material on the northern part of the existing REA to improve current rehabilitation outcomes. • Sought further information on the rehabilitation strategy including target vegetation communities, design of surface water drainage networks, make-up of the reject material and quantity and source of capping material for REA. • Tahmoor Coal committed to include detailed information as part of a Rehabilitation Strategy which would be prepared post-approval. 	<ul style="list-style-type: none"> • The Department accepts that detailed information on rehabilitation strategies can be prepared post-determination. • The Department has recommended conditions requiring Tahmoor Coal to: <ul style="list-style-type: none"> - prepare and implement a detailed Rehabilitation Strategy within 6 months of the commencement of development, including specific requirements to address RR's information request; - prepare and implement a Rehabilitation Management Plan; - comply with a range of detailed rehabilitation objectives. • RR supports the recommended objectives.

Agency	Advice	Consideration and Conditions
Water NSW	<ul style="list-style-type: none"> Acknowledged that the mining area is no longer within the Sydney Drinking Water Catchment (SDWC), however assessed whether the potential impacts extend to the catchment. Considered that groundwater drawdown and baseflow reduction from the project would pose a low risk to water quantity in the SDWC. Recommended that cumulative impacts associated with future mining at Dendrobium coal mine be considered. This information was included in the PAR (Appendix B). 	<ul style="list-style-type: none"> The Department has recommended performance measures requiring negligible impact or environmental consequences for watercourses outside the subsidence area.
DPI Fisheries	<ul style="list-style-type: none"> Required the monitoring program for water quality to include baseflow monitoring in the creeks and monitoring of iron floc entering the Bargo River. This information was included in the PAR (Appendix B). 	<ul style="list-style-type: none"> The Department has recommended conditions requiring baseline and ongoing water quality monitoring as part of a comprehensive Surface Water Management Plan, including a new water quality monitoring site in the Bargo River.
Transport for NSW	<ul style="list-style-type: none"> RMS (now Transport for NSW) did not object to the proposed Project subject to a condition requiring Tahmoor Coal to review, update and implementation of the subsidence management plan/extraction plan to ensure mine subsidence does not compromise any RMS infrastructure. 	<ul style="list-style-type: none"> Incorporated in the recommended conditions.
DPIE Crown Lands	<ul style="list-style-type: none"> Advised that approximately one third of the Project area is Crown Land. Indicated that all Crown Land and Crown Roads within a Mining Lease must be subject to a compensation agreement issued under Section 265 of the <i>Mining Act 1992</i>, to be agreed and executed prior to any mining activity taking place and within 12 months of project approval. Advised that any compensation agreement may include conditions requiring the Mining Lease Holder to purchase Crown land impacted by mining activity. Prior to the commencement of any works on Crown Land and/ or Crown Roads Tahmoor Coal committed to obtain all relevant compensation and/ or access agreements under the <i>Mining Act 1992</i> to enable works within Crown Lands/ Roads. 	<ul style="list-style-type: none"> Incorporated in the recommended conditions.
NSW Rural Fire Service	<ul style="list-style-type: none"> Recommended that a Fire Management Plan be prepared. 	<ul style="list-style-type: none"> Incorporated in the recommended conditions.
Heritage NSW	<p>In relation to Historic Heritage:</p> <ul style="list-style-type: none"> Requested additional assessment of the condition, significance and associations of all historic items within the Wurrumbirra Sanctuary, and further consideration of refinement and mitigation measures to ensure adverse subsidence and other impacts to the Sanctuary are avoided or minimised. 	<ul style="list-style-type: none"> The Wurrumbirra Sanctuary is located directly above LWs 102A, 103A, 104A and refinements to the mine plan in this location would have significant implications for the project's overall operation and viability.

Agency	Advice	Consideration and Conditions
	<ul style="list-style-type: none"> A Statement of Heritage Impact (SoHI) for the Wurrimbirra Sanctuary was included in the PAR (Appendix B). Remained concerned that the Project would result in long-term impacts to the Wurrimbirra Sanctuary and recommended that the proposed longwalls be relocated outside the SHR curtilage and an adequate buffer zone be identified around the curtilage. Also recommended a number of mitigation measures, including a site-specific management plan for the Wurrimbirra Sanctuary, as well as groundwater and vibration monitoring within and proximal to the Sanctuary. 	<ul style="list-style-type: none"> The Department considers historic items within the sanctuary would be unlikely to be significantly impacted by the project subject to the implementation of comprehensive management, monitoring and mitigation measures. The Department has recommended a comprehensive Heritage Management Plan be prepared as part of the Extraction Plan.
	<p>In relation to Aboriginal heritage:</p> <ul style="list-style-type: none"> Supported further reduction in the length of LWs 101B and 103B as per previous BCD advice to provide stronger protection of the Dog Trap Creek sites of Aboriginal cultural heritage. Recommended developing a Heritage Management Plan (HMP) in consultation with the Aboriginal community and the Department, and that it includes a range of specific actions to avoid and limit harm to specific sites. 	<ul style="list-style-type: none"> The Department has recommended LW103B to be shortened by 400m to reduce impacts to watercourse features and Aboriginal heritage sites. The Department has recommended conditions addressing Heritage NSW's recommendations, including requiring Tahmoor Coal to: <ul style="list-style-type: none"> prepare a HMP in consultation with Heritage NSW and Aboriginal stakeholders, for each Extraction plan; and ensure that the development does not cause any direct or indirect impact on any identified heritage item, beyond those predicted in the EIS.
NSW Health	<ul style="list-style-type: none"> Recommended a Health Impact Assessment (HIA) be prepared to assess potential impacts to human health in relation to air quality, noise, water and social wellbeing. A HIA and an updated Social Impact Assessment were included as part of the PAR (Appendix B). Accepted the potential for adverse health impacts within the off-site community as a result of the project are low to negligible and emphasised the importance of ongoing community consultation with the local community. 	<ul style="list-style-type: none"> The Department has recommended conditions requiring Tahmoor Coal to: <ul style="list-style-type: none"> comply with strict noise and air criteria; prepare and implement management plans air, noise and social impacts.
Councils		
Wingecarribee Shire Council	<ul style="list-style-type: none"> Acknowledged that although the project area extends into the Shire, no component of the mine or subsidence zone occur in its region. Requested that mining activity in its region is restricted into the future. Requested for covered rail wagons to be considered for the project to minimise the effect of coal dust on the growing populations of Mittagong, Bowral and Moss Vale. 	<ul style="list-style-type: none"> The Department accepts that assessed levels of dust from coal wagons is minor. The Department has recommended conditions requiring Tahmoor Coal to comply with strict air quality criteria.

Agency	Advice	Consideration and Conditions
	<ul style="list-style-type: none"> Tahmoor Coal has confirmed that no mining or mining activity is proposed in the Wingecarribee LGA. Tahmoor Coal committed to water spraying of the coal services during train loading, as well as best proactive load profiling to ensure fugitive dust emission are minimised. 	
Wollondilly Shire Council (WSC)	<ul style="list-style-type: none"> Recognised the economic benefits of the project to the local and broader economy, including employment. Strongly welcomed and supported the modifications to the project, including the 80% reduction in the number of dwellings directly above longwalls and retaining the existing footprint of the REA. Disappointed that the community was not given the opportunity to provide comment on the PAR. Remained concerned about the potential implications to the operation of the BWMC operated by WSC, including concerns that the impacts may cause a breach of its EPA EPL by causing discharge and in turn pollution of waters or air. Recommended: <ul style="list-style-type: none"> conditions requiring ongoing monitoring of impacts to private bores and that any impacted bore be rehabilitated to its former pre mining condition; potential impacts to watercourses are further investigated in consultation with research based agencies; continued investigation of reusing reject material as a means of enhancing sustainability of the project; obtaining further feedback from IESC on the Project and that further modelling is completed as part of the Extraction Plan; investigate the merits of a utilising risk management zones for watercourses; obtain strong and scientific based subsidence assessment and triggers as part of an Extraction Plan; investigate scientific based triggers and measures to protect the ecological health of watercourses and identification of measures to protect watercourses; investigate a suitable framework that would achieve full restoration of watercourses impacted by mining; investigate additional measures to reduce impact to SSFT CEEC; consider retiring biodiversity credits within the Wollondilly LGA; and investigate the movements of koalas as well as the presence of other threatened species. 	<ul style="list-style-type: none"> The Department has recommended conditions requiring Tahmoor Coal to: <ul style="list-style-type: none"> the establish a Technical Committee for the BWMC and comply with built feature subsidence performances specific to the BWMC; complete a bore census (including ongoing consultation with impacted landowners) and provide compensatory water supply to any landowner whose water supply is adversely impacted by the Project; complete further groundwater modelling as part of the Extraction Plan process; monitor watercourses and remediate any watercourses damaged by subsidence impacts; investigate options for beneficial reuse of coal rejects; retire all biodiversity credits within two years of development consent; and require any damage to public infrastructure to be investigated and fully repaired at the cost of Tahmoor Coal.

5.4 Key Issues – Special Interest Groups and Community

110. The key issues raised in public submissions that supported to the Project considered that it would:

- provide continued employment for existing staff both at Tahmoor North and the steelworks;
- generate additional employment opportunities, including flow-on employment in the local area;
- provide benefits to NSW through the generation of royalties, tax and export revenues; and
- be managed to minimise social and environmental impacts to the community.

111. The key issues raised in public submissions objecting to the Project related to:

- anthropogenic climate change and greenhouse gas emissions;
- property damage and the impacts of subsidence;
- groundwater impacts, particularly in relation to Thirlmere Lakes;
- potential damage to a UNESCO world heritage site (Thirlmere Lakes National Park); and
- biodiversity impacts.

5.5 Representations

112. Following the EIS exhibition period, the Department received an additional 134 representations on the Project, mostly from members of the general public. Most representations (84%) objected to the Project, raising issues in relation to subsidence impacts, water pollution, climate change, property values, koalas and other biodiversity impacts, groundwater bores, agriculture, community health impacts and bushfire risks.

113. The key issues raised in representations that supported the Project were similar to those raised in submissions on the EIS relating to employment and stimulation of the local economy, but also highlighted the global demand for metallurgical coal.

114. The Department has considered the issues raised in representations in its assessment of the merits of the Project.

5.6 IESC Advice

115. On 21 January 2019, the Department requested that the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) provide advice on the Project, specifically in relation to:

- accuracy of modelled and assessed far-field non-conventional groundwater impacts, including impacts on Thirlmere Lakes and the MSA;
- accuracy of modelled and assessed impacts to groundwater supply bores;
- accuracy of modelled and assessed impacts on surface water resources;
- compliance with the neutral or beneficial effect of the Project on water quality within the MSA;
- reasonableness of strategies to avoid, mitigate or reduce the likelihood of impact to water-related resources; and

- any recommended additional monitoring or management measures to address residual impacts on water-related resources.

116. The IESC advice was received on 18 March 2019 (see **Appendix F**). A summary of the advice received from the IESC and the sections of this report where the relevant issues are considered is provided in **Table 9** below.

Table 9 | Summary of IESC Advice

IESC Advice	Where Considered
<i>Groundwater</i>	
<ul style="list-style-type: none"> • The groundwater modelling should reflect the observations of vertical flow losses that occur above the height of complete groundwater drainage above the longwall. • The IESC does not have a high level of confidence in the modelled water balance and predicted drawdown, particularly for shallow model layers because extraction from non-mining bores is unknown and so was not modelled. • The groundwater model does not incorporate the impacts of surface cracking and near-surface fracturing. • To assist in providing more confidence in impact predictions, further investigations and monitoring, supported by the further analysis of existing data should be focused on quantifying losses of surface water into near-surface fracture zones and the possibility of partial or complete returns of these flows to surface water at some point and time to support GDEs. • An uncertainty analysis must rigorously test and quantify uncertainties in model conceptualisation, parameters, physics and assumptions. • The findings of ongoing studies at Thirlmere Lakes (NSW OEH, 2019) should be used to revise and update future models. 	Section 6.3
<i>Surface Water</i>	
<ul style="list-style-type: none"> • The IESC does not have confidence in the predictions of impacts on surface water resources that are modelled and assessed in the EIS because of: <ul style="list-style-type: none"> - inconsistencies between modelled and observed subsidence and mining-induced ground movements near watercourses and the Nepean Fault; - limitations in the ability of the groundwater model to adequately consider the effects of fracturing, particularly in the near-surface zone; - a paucity of baseline data to substantiate assumptions regarding impacts of existing mining activities; and - a general lack of information about the influence of modelling assumptions on the likely upper and lower bounds of estimates on surface and water impacts. • Consideration should be given to reducing impacts of connective fracturing above the longwall and reducing surface cracking and near-surface fracturing on creeks and associated GDEs by additional alterations to the mine plan. • Further analysis and modelling of existing baseline data are needed to better inform estimates of the upper and lower bounds of potential impacts on surface water losses to near-surface fracture zones. New model-independent data on the extent of near-surface fracturing should be obtained and used to develop a modelling approach that is capable of incorporating the hydrological effects of near-surface fracturing. 	Section 6.4
<i>Wastewater Management and Discharge</i>	
<ul style="list-style-type: none"> • More recent monitoring data should be used to confirm that the contaminant concentrations have been reduced with improvements to the WTP. • The existing operations facilities for water should be improved by ensuring: <ul style="list-style-type: none"> - the WTP is operating as intended to mitigate metal concentrations in water prior to discharge; and - the water treatment system has the capacity to store and treat contaminated mine water during storm events or during periods of high groundwater inflows. • Potential impacts to the surface water receiving environment from overflow discharges should be considered. 	Section 6.4 and 6.8

- If it is intended to store the waste water from coal washing and groundwater from dewatering activities in the goafed areas, further information is needed on the underground storage proposal.
- Development of a Receiving Environment Management Plan which includes management and monitoring measures to effectively protect the environment from discharges.

Additional Monitoring

- | | |
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| <ul style="list-style-type: none"> • Subsidence monitoring should: <ul style="list-style-type: none"> - include a 5-yearly catchment-wide geomorphology survey; - be installed before any mining of second workings for all longwalls in each Extraction Plan; - be used to provide better calibrated predictions of subsidence within each consecutive Extraction Plan, particularly within fault zones; - be undertaken to determine if leakage from shallow near-surface fractures is occurring and if the flows through fractures are returning to the watercourses. • Groundwater monitoring should: <ul style="list-style-type: none"> - include a review of vibrating-wire piezometers to identify piezometers that have ceased to function or are providing suspect data; - include installations of multi-level piezometers and open rock holes; - seek to include reliable groundwater head data from all public and private bores. • Surface water monitoring should include: <ul style="list-style-type: none"> - re-installation of gauging stations and monitoring at surface-water sites; - be expanded to include high-risk and ecologically sensitive sites; - provide an explanation for the source of high contaminant concentrations at reference sites; - increase spatial representation of water quality sites, particularly downstream of LDP1. | Sections 6.2,
6.3 and 6.4 |
|--|------------------------------|

5.7 Response to Submissions

117. On 21 February 2020, Tahmoor Coal provided its RTS report responding to the issues raised in submissions on the EIS (see **Appendix B**). As discussed in Section 2.1, the RTS also included the PAR which described the first amendments to the Project made based on submissions received. The RTS and PAR were sent to government agencies that provided advice on the EIS.
118. On 3 August 2020, Tahmoor Coal provided its response to advice received from several agencies in relation to the RTS report (see **Appendix C**). The response included the SPAR describing the second round of amendments to the Project. The response to agency advice and SPAR were sent to key government agencies which had identified residual issues following review of the RTS.

5.8 Additional Information Requests

119. During the assessment process, the Department requested that Tahmoor Coal provide additional clarification and information, specifically in relation to:
- issues raised by NSW Heritage and the Heritage Council of NSW in relation to further mine plan amendments to reduce the risks of impact to Aboriginal sites and the Wurrimbirra Sanctuary;
 - issues raised by BCS in relation to finalising and submitting the Biodiversity Offset Strategy and submission of a Biodiversity Management Plan; additional justification to demonstrate that impacts to undermined streams and watercourses, notably 3rd order streams of Dog

- Trap Creek, would be repairable; and further assessment of the impacts of wastewater on the receiving environment;
- issues raised by the RR in relation to the revegetation strategy target vegetation communities; the design of the water drainage network; and characterisation of the reject material in relation to rehabilitation;
 - issues raised by WSC in relation to potential subsidence impacts on the Bargo Waste Management Centre, including potential breach of the EPL;
 - provision of a 'make good strategy' for the predicted impacts to bores and confirmation of the number of bores predicted to be impacted by cumulative groundwater drawdown;
 - analysis of the economic and environmental implications of reducing the lengths of LWs 101B, 103B and 104B to avoid directly undermining 3rd order sections of Dog Trap Creek and reduce risks of impact to the streams (including pools) and Aboriginal heritage sites;
 - clarification of the predicted impacts and repair categories for houses;
 - additional noise modelling to determine worst-case construction, operational and road noise predictions;
 - issues raised by the APA Group regarding the Moomba to Sydney Ethane and Moomba to Wilton Natural Gas pipelines;
 - provision of updates on the shortfall of Biobanking credits for specific communities;
 - clarification of specific greenhouse gas emissions and mine related traffic impacts; and
 - confirmation of the general terms of the voluntary planning agreement.
120. This information was provided in three *Response to Request for Information* reports which were submitted to the Department on 14 September 2020, 23 October 2020 and 4 November 2020 (see **Appendix G**). The Department has considered this information in its assessment of the merits of the Project.

6 Assessment

6.1 Key Assessment Issues

121. In assessing the merits of the Project, the Department has considered all the requirements of the EP&A Act and EP&A Regulation, and all relevant information including:
- the EIS and accompanying development application;
 - all submissions received from the IESC, State agencies and local councils;
 - all submissions received from special interest groups and the general community;
 - Tahmoor Coal's PAR, SPAR and accompanying responses to submissions, and other information provided in response to the Department's requests; and
 - independent expert reports commissioned by the Department in respect of the Project's proposed mine plan, and groundwater and economic assessments; and
 - relevant EPIs, policies and guidelines.
122. The Department has assessed the full range of potential impacts of the Project, but considers that the key assessment issues relate to:

- potential subsidence impacts on houses and built features in Bargo and the surrounding rural residential areas;
- groundwater drawdown and potential impacts to water supply levels, yield and quality of privately-owned bores;
- subsidence induced impacts to watercourses including impacts to key stream features such as pools; and
- potential noise impacts to residential receivers in the vicinity of the surface operations.

These issues are fully assessed in the Sections 6.2 to 6.5 of this report. Assessment of the remaining issues and impacts is provided in in Sections 6.6 to 6.8.

6.2 Subsidence

Underground Mining Environment

123. Tahmoor Mine lies in the southern part of the Permo-Triassic Sydney Basin, within which the main coal bearing sequence is the Illawarra Coal Measures. The Project involves extraction from the Bulli Seam, which is the upper most seam in the Illawarra Coal Measures and is the seam currently mined at the Tahmoor Mine. In the Project area, the Bulli coal seam is located approximately 370 to 430 m below the surface and is approximately 1.8 to 3.3 m thick.
124. Coal extraction is proposed from two series (A & B) of 6 longwalls which would be orientated in a south-east / north-west direction (refer to **Figure 4**). Longwall widths would be up to 283 m and lengths would vary between 1,515 m (LW 101B) and 3,810 m (LW 106B). Overburden depth would range from a minimum of 365 m above proposed LW 105A to a maximum of 410 m above proposed LWs 101A, 101B and 102B. The proposed extraction heights vary from a minimum of 2.1 m to a maximum of 2.6 m.
125. Two major fault zones exist in the Project area: the Nepean Fault and the Central Fault zones (refer to **Figure 8**). The presence of these fault zones has constrained the extent of longwalls and defined the mining domain for the proposed development. The Nepean Fault zone is the most significant geological feature. This fault is approximately 350 m wide and trends north-south along the eastern boundary of the area. The Central Fault zone is a smaller fault and trends along the western and southern boundaries.

Subsidence Assessments

126. The EIS included a Subsidence Impact Assessment (SubIA) (Appendix F), prepared by Mine Subsidence Engineering Consultants Pty Ltd (MSEC), to predict subsidence effects and subsidence impacts of the original proposed longwall mine plan. This SubIA (MSEC, 2018) has been updated and revised on two occasions to reflect the amended mine plans. The predicted subsidence effects and assessed potential subsidence impacts discussed in this section relate to those presented in the SubIA included in the SPAR.

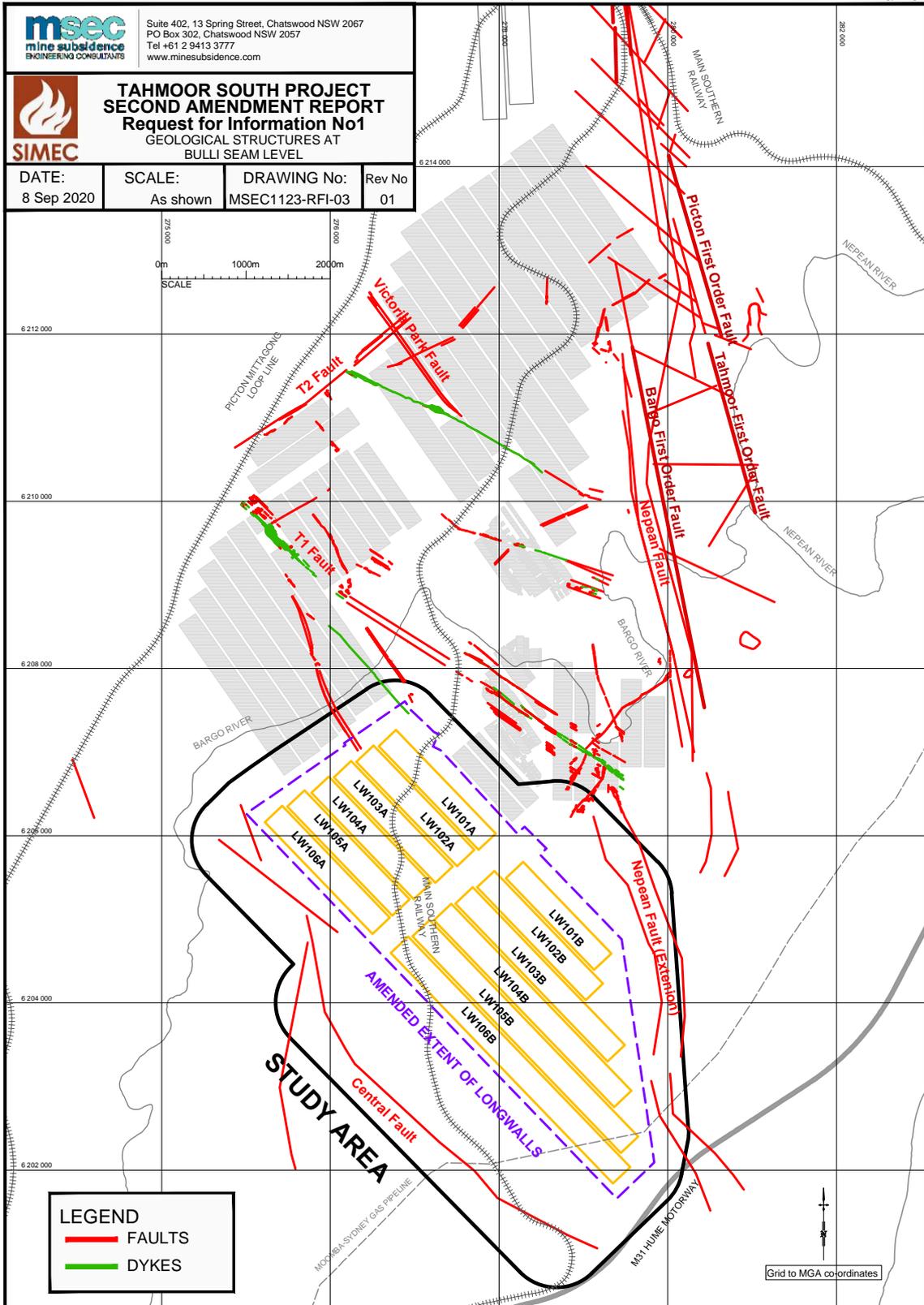


Figure 8 | Geological Structures

127. The SubIA defined the subsidence study area² (SSA); quantified the predicted subsidence impacts using the Incremental Profile Method (IPM) and the empirical method outlined in the Australian Coal Association Research Programme (ACARP); assessed impacts of the proposed mining on natural and built features; and provided information on measures that can be implemented to manage potential impacts. Importantly, the SubIA also included a sensitivity analysis using information derived from observed subsidence movements caused by historical and current mining at Tahmoor North.

Subsidence Predictive Modelling

128. The IESC advice on the original Project questioned the accuracy of the subsidence IPM modelling presented in the SIA (2018), particularly in predicting ground movements and impacts within watercourses near the Nepean Fault.
129. In its response, Tahmoor Coal acknowledged that the IPM model is not designed to predict non-conventional ground movements, such as valley closure and upsidence that typically affect watercourses. Tahmoor Coal confirmed that the ACARP valley closure prediction model was used in conjunction with the IPM model to predict both non-conventional (irregular) and conventional (smooth) subsidence and assess potential impacts on watercourses.
130. 'Conventional subsidence' behaviour refers to the manner in which the surface responds to subsidence effects when the topography is typically flat, the coal seam is level and the geology is uniform and free of structural disturbances. Conventional components of subsidence include vertical displacement, tilt and tensile and compressive strains.
131. As discussed in the Tahmoor Coal's RTS, the IPM method has been used to predict conventional subsidence behaviour. This method is an empirical model based on a large database of observed subsidence monitoring data from previous mining within the Southern, Newcastle, Hunter and Western Coalfields of NSW and the Bowen Basin in QLD. Accuracy of the IPM model is dependent on calibration to a database of existing results representative of the site.
132. MSEC indicated that the IPM for the Project has been based on the Southern Coalfield predictive curves with calibrations for the local conditions, based on the extensive ground monitoring data from previous mining at Tahmoor Mine (Longwalls 1-19, 22-25 and 27-30). MSEC indicated that the IPM subsidence prediction model provides reasonable, if not, slightly conservative predictions of conventional subsidence associated with the Project.
133. Where the surface topography is steep and varying, the seam dips at a high rate, or the geology of the overburden varies greatly, the surface subsidence behaviour is typically irregular and is referred to as 'non-conventional'. Non-conventional components of subsidence include valley closure, upsidence and far-field horizontal movements.
134. Of all subsidence effects, it is valley closure and upsidence which cause the greatest impacts on streams and watercourses in the Southern Coalfields. Valley closure is a phenomenon whereby one or both walls of a valley move horizontally towards the valley centreline, due to changed horizontal stress conditions. Upsidence is a relative upward movement or uplift, created by the horizontal compression and buckling behaviour of rock strata in the vicinity of a valley.

² The Subsidence study area was defined by MSEC as the furthest limit of either (a) the predicted limit of vertical subsidence (ie. 20mm subsidence contour resulting from extraction of the proposed longwalls); or (b) a minimum of 600 m from the nearest edge of the proposed longwalls.

135. MSEC confirmed that the ACARP model was used to predict non-conventional valley closure and upsidence along the watercourses within the longwall mining area. This modelling method was developed using empirical data from the Southern Coalfield, including from the Nepean and Cataract River Valleys, which are large and steeply incised. It is expected, therefore, that the subsidence predictions generated using the ACARP method provided conservative results for smaller, less incised creek and river valleys within the SSA.
136. The Department accepts that both IPM and ACARP modelling methods are appropriate and provide an appropriate basis for conventional and non-conventional subsidence predictions associated with the Project, particularly considering the models are based on extensive subsidence monitoring data from other mines in the Southern Coalfields and have been calibrated using local data from previous mining at Tahmoor Mine.
137. SA NSW has confirmed that MSEC has extensive expertise in subsidence predictions and that it is confident the predictions in relation to the Project are informed by data gained from Tahmoor North and their knowledge of the Southern Coalfield geology.
138. However, localised anomalies in subsidence behaviour due to geological structures such as the Nepean Fault and other effects in the natural system are not fully predictable by empirical models. Subsidence levels greater than predictions have previously been observed in parts of Tahmoor Mine (i.e. during mining of Longwalls 8, 13, 24A-27 and 32), which are thought to be due to the presence of faults and dykes near river valleys and gorges.
139. MSEC has confirmed that additional geological characterisation has been undertaken as part of the revised SubIAs to better understand the influence of fault zones and lineaments in the SSA. The effect of geological structures on subsidence predictions and impacts are discussed in the following sections of this report.

Built and Natural Features

140. Built and natural features identified within the SSA and surrounds are listed in **Table 10** and shown in **Figures 9** and **10**.
141. In addition to the built features list below, WSC's *Growth Management Strategy 2011* indicated a long-term target of 2,000 additional houses in and around the township of Bargo by 2036, with the majority of urban growth planned to occur to the east of Bargo township and above the proposed longwalls.

Table 10 | Built and Natural Features

Feature	Description
<i>Built Features</i>	
Residential houses and improvements	1,458 residential houses (143 located directly above proposed longwalls), the majority of which are located on the outskirts of Bargo, and associated improvements such as pools, garages and tennis courts
Transport infrastructure	M31 Hume Motorway, Remembrance Driveway, Main Southern Railway, local roads and associated structures such as culverts, bridges and viaducts
Gas infrastructure	Moomba to Sydney Gas Pipeline and the Gorodok Ethane Pipeline (high pressure pipelines) and local gas reticulation network
Water infrastructure	Potable water rising mains, water storage reservoirs, distribution network, groundwater bores, dams and associated works (including Picton Weir)
Electrical infrastructure	66 kV, 11 kV and low voltage power lines
Sewerage infrastructure	Bargo sewerage scheme including a pressure main and a consumer reticulation network
Telecommunications infrastructure	Copper cables, optical fibre cables and a mobile phone tower
Public amenity infrastructure	Schools, churches, Wirrimbirra Sanctuary, Bargo Waste Management Centre (BWMC), Bargo cemetery, shops, community centre and ovals survey control marks
Industrial, commercial and business establishments	58 structures including the Bargo Hotel, Post Office, petrol stations, automotive repair workshops, grocery stores, restaurants and a variety of retail businesses
Agricultural farmland and facilities	4,232 rural structures (sheds, garages), 299 tanks, 206 farm dams, irrigation systems and fences
<i>Natural Features</i>	
Special Areas	A small part of the Metropolitan Special Area (MSA) to the east but outside of the SSA and the Warragamba Special Area 2.4 km to the north west of the SSA
Watercourses	2 nd , 3 rd and 4 th order tributaries of the Bargo and Nepean rivers, including Tea Tree Hollow, Dog Trap Creek, Hornes Creek and associated tributaries which traverse the SSA
Forested Areas	Covering approximately one-third of the SSA, primarily to the west of the mine
Conservation Areas	Upper Nepean State Conservation Area to the east, Bargo State Conservation Area to the west and Bargo River State Conservation Area to the south (all outside of the SSA)
Cliffs and Steep Slopes	Cliffs (10-20 m in height and <100 m in length) and steep slopes, primarily located within the valleys and along the banks of rivers and creeks
Thirlmere Lakes	Unique wetland systems protected within the Thirlmere Lakes National Park, located approximately 3.5 km to the northwest of the SSA

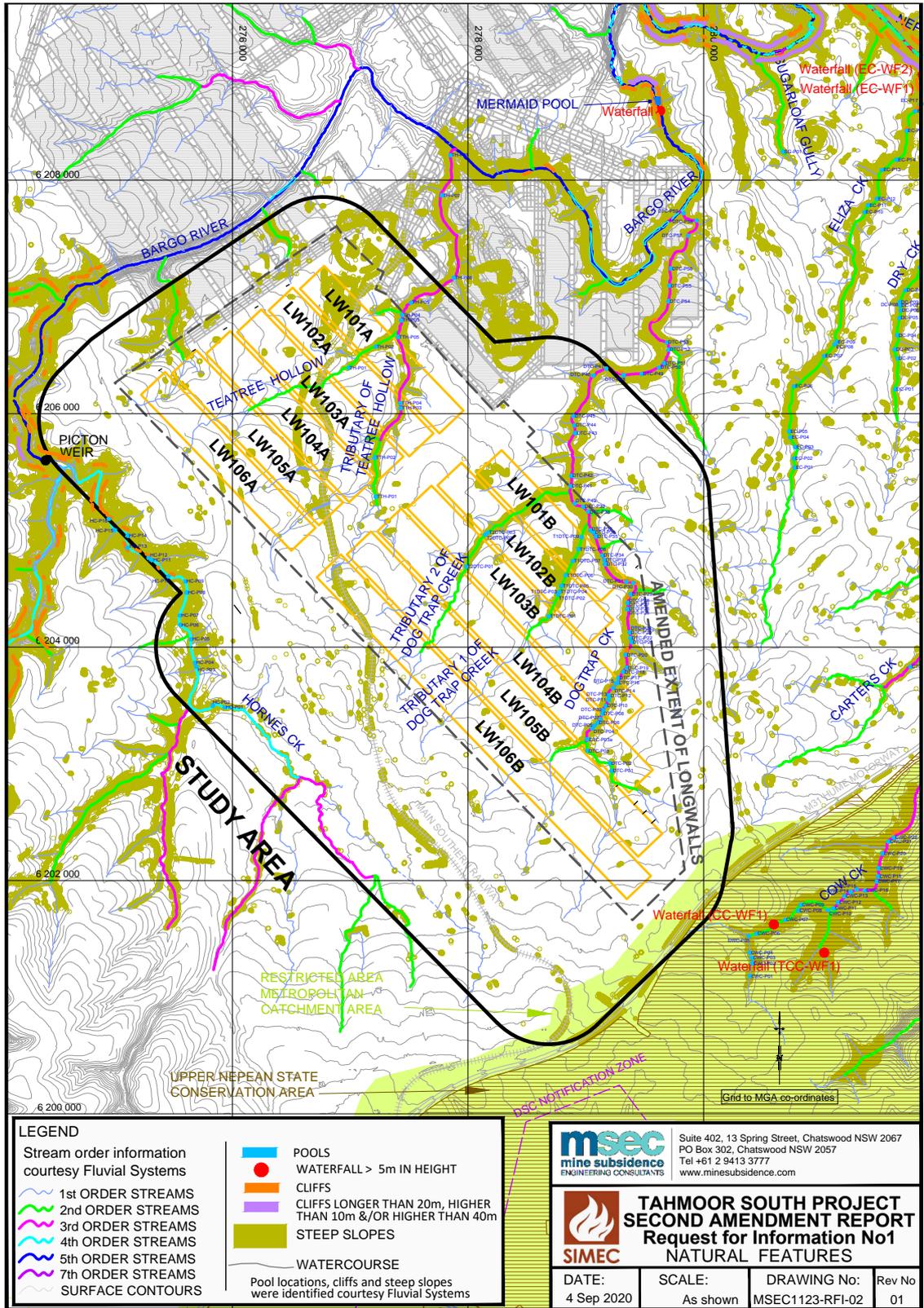


Figure 10 | Natural Surface Features

Predicted Subsidence Effects

142. 'Subsidence effects' refer to deformation of the groundmass due to mining, including all mining-induced ground movements. As described above, subsidence effects are typically characterised as either 'conventional' or 'non-conventional'.

Conventional Subsidence

143. **Table 11** provides a summary of the maximum predicted total conventional subsidence, tilt and curvature after the extraction of each of the proposed longwall series. **Figure 11** illustrates the predicted total subsidence contours after extraction of LW106A.

Table 11 | Maximum Total Conventional Subsidence, Tilt and Curvature

Longwalls	Maximum Predicted Conventional Subsidence (mm)	Maximum Predicted Conventional Tilt (mm/m)	Maximum Predicted Conventional Hogging Curvature (km ⁻¹)	Maximum Predicted Conventional Sagging Curvature (km ⁻¹)
LW101A - LW106A	1,350	8.7	0.13	0.23
LW101B – LW106B	1,600	10.5	0.18	0.28

144. MSEC predicted that the maximum total conventional subsidence, after the completion of the proposed longwalls, is 1,600 mm which represents around 62 % of the extraction height. The maximum predicted total conventional tilt is 10.5 mm/m (i.e. 1.05 %), which represents a change in grade of 1 in 95. The maximum predicted total conventional curvatures are 0.18 km⁻¹ hogging and 0.28 km⁻¹ sagging, which represent minimum radii of curvature of 5.6 km and 3.6 km, respectively.

145. The predicted maximum total conventional subsidence due to the extraction of the second amended mine layout is less than the predicted maxima from the EIS layout by approximately 300 mm and from the PAR layout by a further 50 mm, with comparable reductions in tilts and curvatures.

146. The magnitude of predicted subsidence is similar to the range experienced at the Tahmoor North and nearby Bulli Seam Operations underground mines.

147. Based on the predicted maximum curvatures presented in **Table 11** above, MSEC predicted the maximum conventional strains for the proposed LWs 101A to 106B, are approximately 2.4 mm/m tensile and 4.2 mm/m compressive.

148. Specific subsidence predictions for individual built and natural features are discussed in the following sections of this report.

Non-conventional Subsidence

149. MSEC indicated that non-conventional ground movements would likely occur within and around the SSA, due to near surface geological conditions, steep topography and valley related movements. MSEC indicated that these non-conventional movements are often accompanied by elevated tilts, curvatures and strains, which are likely to exceed the conventional predictions.

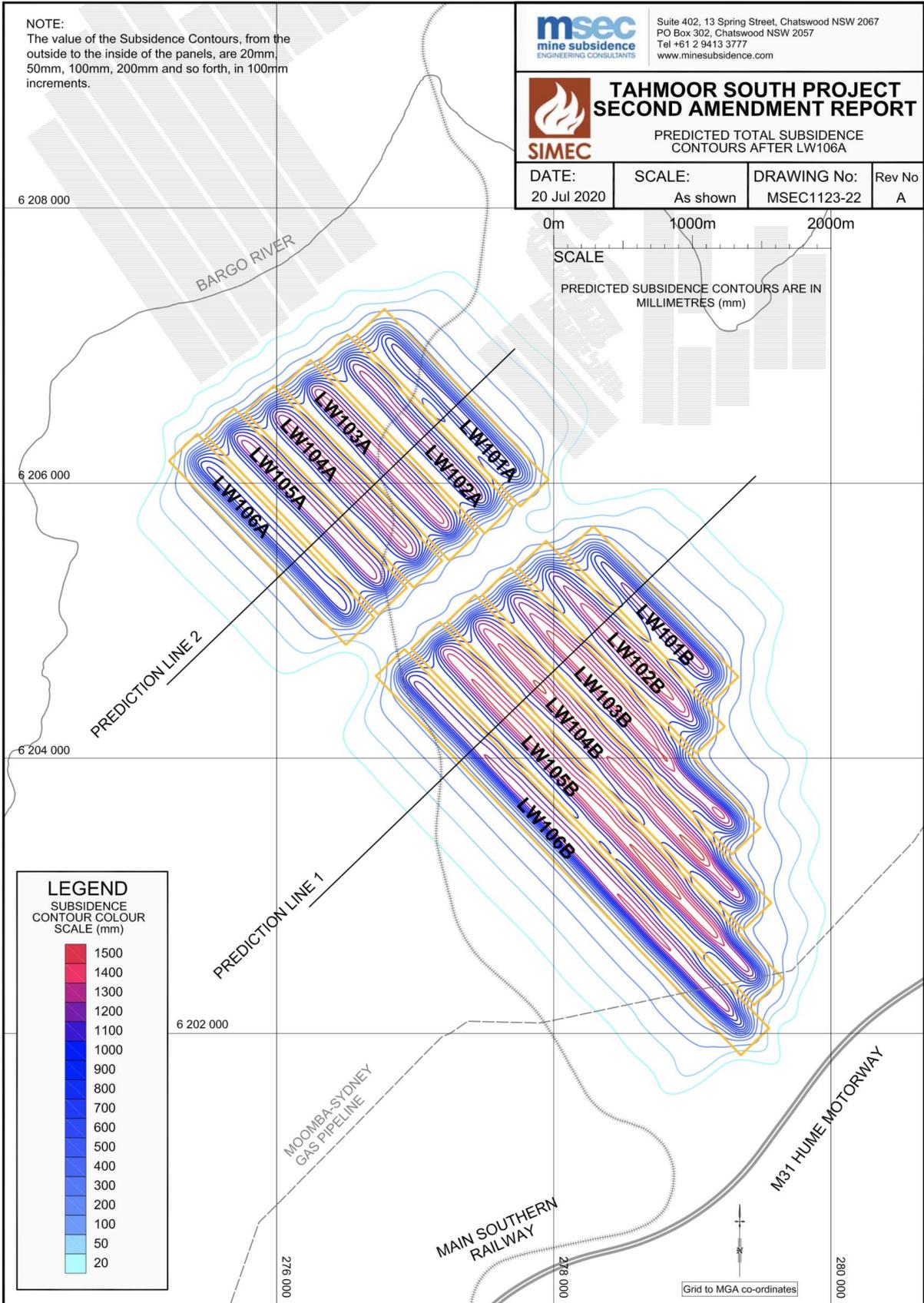


Figure 11 | Predicted Total Subsidence Contours after Extraction of LW106A

150. The SubIA included an analysis of increased conventional subsidence which was observed above several previously extracted longwalls at the Tahmoor Mine, including LWs 8, 13, 24A-27 and 32. In the case of LWs 24A and 25, the observed maximum total subsidence was greater than predictions by between 2 to 2.3 times. The analysis identified that the location of zones of increased subsidence was linked to both the close proximity to and the alignment of the Nepean Fault, and the close proximity to the deep Bargo River Gorge.
151. Based on this analysis, MSEC identified that there are several areas for potential increased subsidence within the SSA. These include areas near the commencement (south-eastern) ends of proposed LWs 101B to 106B which run adjacent to the Nepean Fault zone on the western side (the same high side as previously extracted longwalls at Tahmoor Mine). However, MSEC stated that it is unlikely that the magnitude of this increased subsidence would be much greater than the predictions presented in **Table 11**.
152. MSEC notes that this is because the Nepean Fault is less defined in the vicinity of these proposed longwalls and they are positioned further away from major regional streams such as the Bargo River. Further, MSEC indicates that the maximum predicted incremental subsidence associated with the proposed longwalls represents lower portions of proposed extraction heights compared to the previously extracted longwalls (45-52% compared to 55%).
153. MSEC predicted that any far-field horizontal ground movements resulting from the extraction of the proposed longwalls would be very small and could only be detected by precise surveys. The potential impacts of differential far-field horizontal movements on the natural and built features within the vicinity of the proposed longwalls are not expected to be measurable, with possibly the exception of the road and railway bridges. As a comparison, no measurable differential movements were observed during the far field monitoring program conducted during extraction of the Tahmoor North LW32 at key civil structures.
154. Non-conventional ground movements, such as valley closure and upsidence, typically affect watercourses. A detailed discussion of the predicted values of total subsidence, upsidence and closure for the watercourses within the SSA and associated potential impacts is provided in Section 6.4 of this report.

Predicted Subsidence Impacts

155. MSEC assessed the potential subsidence impacts on natural and built features as a result of mining associated with the Project. Potential subsidence impacts on built features, including houses; road and railways and associated infrastructure; utility infrastructure and services (water, sewerage, waste, gas, electrical and telecommunication); public amenities; and agricultural lands and facilities are discussed below.
156. Subsidence impacts on natural features, including impacts on cliffs and steep slopes are also discussed below. Subsidence impacts on other natural features are discussed in detail in subsequent sections of this report, as follows:
 - groundwater, including potential impacts to bores and Thirlmere Lakes in Section 6.3;
 - surface water and flooding, including potential impacts on watercourses in the development area and the MSA in Sections 6.4 and 6.8;
 - biodiversity, including potential impacts to threatened species and communities and aquatic ecology in Section 6.6; and
 - Aboriginal and historical heritage items in Section 6.8.

Impacts on Residences

157. The SubIA indicates that there are 1,458 houses within the SSA, with 143 (10%) of these located directly above the proposed longwalls (**Figure 9**). The majority of these houses are located in the northern and north-western outskirts of the township of Bargo above proposed LWs 104A-105A and 104B-106B.
158. As a result of Tahmoor Coal's amendments to the mine plan, the number of houses located directly above the proposed longwalls has reduced by approximately 81% (i.e. from 751 in the EIS, to 571 in the PAR to 143 identified in the SPAR).
159. MSEC predicted that the maximum predicted conventional subsidence that would be experienced at houses in the SSA is up to 1,450 mm, with tilts up to 10.0 mm/m and curvatures up to 0.13 km⁻¹ hogging and 0.28 km⁻¹ sagging.
160. The Department acknowledges that undermining houses is a critical issue that requires careful consideration. In comparison with the existing operations at Tahmoor North, significantly fewer houses would be directly undermined by the proposed amended mine plan. Tahmoor North has or would directly undermine 1,259 houses, with 1,891 houses being in the overall subsidence affectation zone. Similarly, the nearby Bulli Seam Operations (BSO) mine has or would directly undermine 928 houses, with 1,294 houses being in the subsidence affectation zone. Other underground mines in NSW also regularly undermine smaller numbers of houses and other built features.
161. The methods for predicting and assessing impacts on houses have improved over time as more empirical data has informed subsidence impact assessments. Previous impact classification methods were based on conventional subsidence related crack width as the main factor for determining the extent of impacts, therefore classifying impacts from a structural stability perspective only.
162. More recent methods have been developed based on research and studies, including an ACARP research project in 2009³ and a SA NSW commissioned study in 2016⁴, combined with experience and substantial additional information gained during mining at Tahmoor and longwalls at other collieries in the Southern and Newcastle Coalfields. The revised method of impact classification is more closely aligned with all potential impacts to a building including cosmetic, serviceability as well as stability related impacts, and includes predicted impacts from both conventional and non-conventional subsidence.
163. As detailed in **Table 12**, the revised R0-R5 classification system is based on the extent of repairs required to houses, ranging from no claim (R0); very minor to minor cosmetic repairs (R1 and R2); serviceability and structural issues requiring substantial repairs (R3); to structural stability issues requiring extensive repair or re-build (R4 and R5).

³ Waddington (2009). *The Prediction of Mining Induced Movements in Building Structures and the Development of Improved Methods of Subsidence Impact Assessment*. Australian Coal Association Research Program (ACARP) Project C12015. Report No. MSEC276 dated March 2009.

⁴ MESC, 2016, *The Mine Subsidence Board: Study into the Co-existence of Urban Development and Longwall Mining at Tahmoor Colliery*, report produced for the Mine Subsidence Board (now SA NSW).

Table 12 | Repair Category Classifications

Repair Category	Extent of Repairs
Nil/No claim	No repairs required
R0 - Adjustment	Where the damage does not require the removal or replacement of any external or internal claddings or linings
R1 - Very minor repair	Where the damage can be repaired by filling, patching or painting without the removal or replacement of any external or internal brickwork, claddings or linings
R2 - Minor repair	Where the damage affects a small proportion of external or internal claddings or linings, but does not affect the integrity of external brickwork or structural elements
R3- Substantial repair	Where the damage requires the removal or replacement of a large proportion of external brickwork, or affects the stability of isolated structural elements.
R4 - Extensive repair	Where the damage requires the removal or replacement of a large proportion of external brickwork, or the replacement or repair of several structural elements
R5 - Re-build	Extensive damage to house where SA NSW and the owner have agreed to rebuild as the cost of repair is greater than the cost of replacement

164. MSEC confirmed that the most recent repair category classification method, which has been endorsed and applied by SA NSW, has been used for the Project.
165. In response to an additional request from SA NSW, MSEC further extended the impact predictions to incorporate final tilts, which often result in ongoing issues to a property's serviceability. It has been found from past longwall mining experience that tilts of less than 7 mm/m can result in minor serviceability impacts such as door swings and issues with roof gutter and wet area drainage. Tilts greater than 7 mm/m can result in greater serviceability impacts which may require more substantial remediation measures, including the releveling of wet areas or, in some cases, the releveling of the building structure.
166. The number of houses predicted to be impacted by the proposed project is included in **Table 13**. MSEC predicted that of the 1,458 houses in the overall SSA, 1316 (90%) are expected to require nil to very minor repairs (Nil-R0), 108 (7%) to required minor cosmetic repairs (R1 to R2), 28 (2%) to require substantial serviceability and structural repairs (R3 to R4) and 7 (0.5%) to require re-build (R5).
167. The Department notes that these predictions have been made on a probabilistic approach based on experience at Tahmoor North, associated with impacts from both conventional and non-conventional subsidence. It does not provide information on specific impacts to individual houses, rather likely outcomes based on empirical data. This is particularly the case for potential impacts associated with non-conventional subsidence.

Table 13 | Predicted Impacts to Houses in the Subsidence Study Area

Group	Repair Category				Tilt (mm/m)	
	No Claim or RO	R1 or R2	R3 or R4	R5	<7	7-10
All houses (total of 1,458)	1316 (90%)	108 (7%)	28 (2%)	7 (<0.5%)	1421 (97%)	37 (3%)
Directly above proposed longwalls (total of 143)	76 (53%)	43 (30%)	19 (13%)	5 (4%)	-	-
Directly above solid coal (total of 1,315)	1240 (94%)	64 (5%)	9 (1%)	2 (<0.5%)	-	-

168. MSEC predicted maximum tilts to be less than 7 mm/m at 1421 (97%) of houses in the SSA. It is expected that only minor serviceability impacts, which could be remediated using normal building techniques, would occur at these houses as a result of tilts. The predicted maximum tilts are between 7 mm/m and 10 mm/m at 37 (3%) houses, which may require more substantial remediation measures such as releveling of the building structure.
169. The predictions for houses directly above the proposed longwalls and directly above solid coal are comparable to those previously experienced during mining of LWs 22 to 29 which experienced subsidence of up to 1,260 mm. However, MSEC indicated that the comparison is only partly applicable because many houses within the SSA are located beside the proposed LW106B and therefore unlikely to be impacted.
170. A SA NSW commissioned study⁵ completed in 2016 indicated that extraction of the Tahmoor North LWs 22 to 29 resulted in subsidence damage to approximately 40% of properties located directly above the longwalls and 30% of properties in the subsidence affectation zone, but not directly mined beneath, with an average repair cost of \$75,000 per house. For houses directly mined beneath, Tahmoor North had more houses requiring nil to very minor repairs (ie. 67% in Nil-R0) compared to the Tahmoor South predictions. However, for houses not directly undermined, Tahmoor North had more house requiring minor cosmetic repairs (ie. 17% in R1 to R2 category) and substantial serviceability and structural repairs (ie. 6% in R3 to R4) compared to the Tahmoor South predictions.
171. MSEC indicated that there are 299 privately owned swimming pools within the SSA. The relevant standards for swimming pools⁶ require that pools be constructed with a tilt of 3 mm/m or less. There are 18 swimming pools (i.e. 6% of the total) predicted to experience final tilts between 3 mm/m and 7 mm/m and 14 pools (i.e. 5 % of the total) predicted to experience final tilts greater

⁵ MESC, 2016, *The Mine Subsidence Board: Study into the Co-existence of Urban Development and Longwall Mining at Tahmoor Colliery*, report produced for the Mine Subsidence Board (now SA NSW).

⁶ Australian Standard AS2783-1992 (Use of reinforced concrete for small swimming pools) and Australian Standard AS/NZS 1839:1994 (Swimming pools – Pre-moulded fibre-reinforced plastics – Installation)

than 7 mm/m. Based on experience of impacts to pools during mining of Tahmoor North, MSEC indicated that a number of these impacted pools would require some form of remediation, and some pools would need to be completely replaced.

172. The Department considers that the primary risk associated with mining beneath houses is public safety. Residents have not been known to be exposed to 'immediate' and 'sudden' safety hazards as a result of impacts that occur due to mine subsidence movements in the NSW Coalfields, where the depths of cover were greater than 350 m, such as the case above the proposed longwalls. This includes the recent experience at Tahmoor North, which has resulted in mining above or in the vicinity of 1,890 houses, and the experiences at Appin, Teralba, West Cliff and West Wallsend Collieries, which have mined above or in the vicinity of around 500 houses.
173. MSEC confirmed that, based on previous experience, it would be expected that the houses would remain in a safe condition. The impacts would develop gradually such that they can be detected early and repairs can be undertaken incrementally to ensure that the houses remain safe and serviceable during mining. MSEC acknowledged that in some rare cases, houses experienced more severe impacts, but the impacts did not present an immediate risk to public safety as they developed gradually with ample time to temporarily relocate residents.
174. However, SA NSW has identified that the proposed mine scheduling would mean that some houses would be impacted by more than one longwall and could therefore experience subsidence impacts for extended periods of time. In particular, houses located above LWs 103A and 104A could experience subsidence impacts for up to 7 years (i.e. from 2023 when mining commences in LW 103A until 2030 when mining commences in LW 104A). Therefore, several homeowners could be living in damaged properties for a number of years, or may require relocation on several occasions (where their properties require extensive repairs or rebuilding).
175. The Department and SA NSW acknowledge the stress and anxiety these impacts may cause the impacted residents. SA NSW has confirmed that provisions under the CMSC Act specifically allow multiple claims to be lodged and progressed during extended mining periods, therefore reducing these impacts.
176. The CMSC Act provides for the assessment and management of risks associated with subsidence resulting from coal mine operations and includes provisions for the compensation or repair services required to mitigate the damage caused by mine subsidence following underground coal mining. The owners of homes, buildings or other surface improvements damaged by mine subsidence can lodge claims for compensation through SA NSW.
177. SA NSW arrange for the damage to be assessed by an independent specialist assessor. If the damage is attributable to mine subsidence, a scope is prepared and the compensation determined. If property owners are not satisfied with the outcome, the CMSC Act provides a clear mechanism to request an independent review by the Secretary of the NSW Department of Customer Service.
178. Under the provisions of the CMSC Act and associated regulation, mining companies are required to pay levies into a Coal Mine Subsidence Compensation Fund which is managed and controlled by SA NSW. SA NSW has confirmed that the levy amounts are estimated and paid annually, with the value based on coal extraction rates. The Department notes that any subsidence-related compensation to home owners would be paid by SA NSW via the fund, therefore ensuring security to home owners, irrespective of the mine company financial status.

179. The Department is satisfied that this is a well-established mechanism supported by legislation which is effective in maintaining and restoring structures to a condition equal to or better than their pre-mining state at no financial cost to owners.
180. In addition to this compensation framework, SA NSW has recommended that additional safeguards be offered to homeowners whose houses experience significant damage as a result of mine subsidence movements. The recommended criteria are based on the severity of the damage and the period of time between when the damage occurs and when the house would no longer experience active subsidence movements from future mining.
181. The safeguards would allow affected homeowners to be offered property acquisition as an option for compensation, rather than repair, including requiring Tahmoor Coal to offer property acquisition when the house:
1. reaches damage category R4 or R5; and /or
 2. is in tilt of greater than 10 mm/m; and/or
 3. reaches damage category R3 or more and has/would be impacted by more than two longwalls.
182. Based on this criteria, Tahmoor Coal estimated the total number of houses where there could be a potential offer of acquisition to be around 22. This is based on an estimate of the number of houses in R4 category of 13, and the R5 category of 7, with 2 houses above LWs 105B and 106B predicted to experience damage category R3 or more and be impacted by extraction of both longwalls. No houses are predicted to experience tilts greater than 10 mm/m.
183. Similar requirements are included in the existing Tahmoor North development consent and the Department recommends that this should be extended to the Tahmoor South operations, to allow affected homeowners to be offered property acquisition as an option for compensation, rather than repair. As a reference, of the total 1,890 residential homes and commercial premises that experienced mine subsidence movements associated with Tahmoor North, only 8 properties requested they be acquired.
184. Irrespective, the Department considers that homeowners in the vicinity of the proposed Tahmoor South longwalls should be offered these additional safeguards and options, and has recommended conditions accordingly.
185. SA NSW advised the Department that the CMSC Act includes provisions for acquisition as a compensation option, noting that SA NSW is the agency responsible for regulating and administering the mine subsidence compensation system in NSW.
186. Under the provisions of the CMSC Act, SA NSW has prepared as guideline "Guidelines – Process for Claiming Mine Subsidence Compensation" which includes formal dispute resolution framework and appeal processes to the Land and Environment Court to protect the interest of claimants.

Future Urban Growth Areas

187. The Project also has implications for future development in the area. As noted above, WSC indicated a long-term target of 2,000 additional houses in Bargo by 2036, with most of the urban growth planned to occur to the east of the township and above the proposed longwalls. In

response to a request from WSC in relation to the extent to which the Project would affect local growth, MSEC conducted a simulation exercise to forecast the potential impacts of the proposed mining on the future urban growth area. It was assumed that 1,930 houses would be constructed within the SSA, with 1,509 located directly above the proposed longwall mining area. The exercise conservatively assumed that all houses would be brick veneer construction on strip footings.

188. MSEC predicted that of the 2,000 houses in the growth area, 1501 (75%) would require nil to very minor repairs (Nil-R0), 323 (16%) would require minor cosmetic repairs (R1 to R2), 131 (7%) would require substantial serviceability and structural repairs (R3 to R4) and 45 (2%) would require re-build (R5). The distribution of impacts is increased compared to the existing housing impacts because there would be a greater proportion of potential future houses that are located directly above the proposed longwall mining area. Further, MSEC predicted that the maximum tilts would be between 7 mm/m and 10 mm/m at 26 houses (i.e. 2 % of the total) and would be greater than 10 mm/m at 72 houses (i.e. 5 % of the total) at the completion of mining.
189. As the Project is located within the Bargo Mine Subsidence District, any future development in the district requires SA NSW approval. SA NSW has advised the Department that, as it is not possible to fully mitigate the predicted subsidence impacts through practical engineering design, and to prevent further impact on the community, applications to rezone and subdivide land for urban development within the proposed mining area are likely to be refused, should the Project be approved.
190. WSC has confirmed that there are currently four rezoning planning proposals within the proposed mining area which are yet to be determined, primarily due to potential future impacts due to mining, although the Department understands there are also issues associated with the provision of utility services to these areas. As discussed in Section 3.3, WSC's LSPS recognises that Bargo is constrained by the need to protect State significant mineral resources and is unsuitable for expansion and further intensification until mining activity is complete. The LSPS focuses on the Wilton Growth Area as a higher priority growth area in the next 20 to 30 years.
191. While acknowledging the potential delays to current rezoning proposals, the Department considers the Bargo area is unlikely to be a strategic urban growth area during the life of the mine. Mining associated with the Project is forecasted to cease by 2032. After this time the area could be used for further urban development.
192. Regardless, if any development within the proposed growth area is approved, constructed, and subsequently impacted by mine subsidence, impacts would be required to be managed and compensated by Tahmoor Coal in accordance with the legislative process required under the CMSC Act.

Other Built Features

193. A wide array of other built features, including road and rail; utility infrastructure and services; public amenities; agricultural land and facilities; and industrial, commercial and business establishments are located within the SSA (refer to **Figure 9**). MSEC provided predicted subsidence impacts on these features, including features located outside of the SSA which may be subjected to far-field movements or valley related movements. Predicted impacts were based on previous experience at Tahmoor North and other mines in the Southern Coalfields. A

summary of the predicted subsidence effects and impacts on all key built features is provided in **Appendix I**.

194. MSEC predicted that the structures would collectively experience the full range of subsidence movements varying from very small movements, where longwalls do not mine directly beneath them, to maximum movements (refer to **Table 11**). In general, the extent and magnitude of impact is predicted to be greatest for built features located directly above the proposed longwalls.
195. In relation to *key public infrastructure* assets in the SSA, MSEC predicted that the:
- *Main Southern Railway*, which extends north-south through the SSA (3.6 km of track located directly over the proposed longwalls) and supports passenger and freight services between Sydney and Melbourne, would experience the full range of subsidence effects. This could result in changes to track geometry (which could include vertical misalignment, horizontal misalignment, changes in track cant and track twist), changes in grades and changes in rail stress of the rail tracks. Rail expansion switches and zero toe load clips may be required to dissipate rail stress during mining. These measures have been successfully employed along the Main Southern Railway at Tahmoor North, where approximately 4.6 km of the railway has been undermined.
 - *M31 Hume Highway*, which is a major road corridor located 950 m to the south-east of LW106B, may experience far-field horizontal subsidence movements. These movements are unlikely to impact the motorway pavement but could result in minor cracking to masonry elements of the Avon Dam Road Overbridge and Wellers Bridge. Several methods may need to be employed to manage impacts of these structures, including repairing cracks or introducing articulation, such as joints, to the structures to maintain their serviceability and to improve strength and ductility.
 - *Moomba to Sydney Gas Pipeline* and the *Gorodok Ethane Pipeline*, which cross over the south-eastern ends of proposed LWs 105B and 106B, would experience the full range of subsidence effects. The pipelines have some flexibility to accommodate conventional subsidence but may be impacted by non-conventional subsidence movements along sections of the pipelines which cross streams and surface expressions of the Nepean Fault. These major high-pressure gas pipelines may need to be relieved of mining-induced stresses during mining.
196. In relation to *other public infrastructure*, MSEC predicted that Remembrance Drive, other local roads and associated road/rail culverts, bridges and viaducts which are located directly over the proposed longwalls, may experience minor cracking of the pavements, concrete structures, road cuttings and embankments. MSEC indicated that several methods may need to be employed to manage impacts of these structures, including repairing cracks or introducing articulation to the structures to maintain their serviceability and to improve strength and ductility.
197. Potable water pipelines, sewerage mains, gas pipelines, and electrical and telecommunication infrastructure are all located directly over the proposed longwalls, and would experience the full range, or close to the full range, of subsidence effects. Potential impacts associated with the majority of the utility infrastructure are predicted to be minor and relatively easy to remediate, including leaks of the water pipelines; damage to local sewerage chambers, valves and pipe fittings; changes to electrical cable catenaries and pole tilts; and micro-bending of telecommunication cable fibres.

198. *Public amenities* within the subsidence study area include two churches; several schools, pre-schools and childcare centres; shops; a community centre and a sports club; and Bargo cemetery. Most of these amenities are located within the township of Bargo, several hundred metres from the proposed LW 106B and are unlikely to be impacted by the proposed mining. However, MSEC predicted that the Bargo cemetery, which is located directly above the south-eastern end of the proposed LW 105A, may experience cracking of surrounds or displacement of some tombstones relative to graves.
199. The *Wirrimbirra Sanctuary* is a heritage-listed flora and fauna sanctuary which covers an area of 95 ha directly above proposed LWs 103A and 104A and would experience the full range of subsidence effects. Tahmoor Coal has confirmed that the sanctuary, including the visitor and education centre, native plant nursery and greenhouses, and the surrounding bushland, was significantly impacted during recent bushfires. Approval to rebuild the structures at the sanctuary is being sought through WSC and SA NSW. Potential subsidence impacts to streams, biodiversity and heritage values within the Wirrimbirra Sanctuary, are discussed in Sections 6.4, 6.6 and 6.8 of this report, respectively.
200. In relation to *agricultural facilities*, MSEC identified that there are 4,232 rural structures (sheds, garages), 299 tanks, 206 farm dams and fences located across the SSA which would experience the full range of subsidence effects, depending on their location. Predicted impacts to these structures are considered minor and relatively easy to remediate, including door swings and changes to roof and pavement drainage; alteration of water level in tanks and leaking pipe joints; slightly reduced storage levels in dams; and tilting of fence posts and changes of tension in fence wires.
201. In relation to *industrial, commercial and business establishments*, MSEC identified that there are 58 such structures within the subsidence study area including the Bargo Hotel, Post Office, petrol stations, automotive repair workshops, a grocery store, restaurants and a variety of retail businesses. Most establishments are in the township of Bargo and are unlikely to be impacted by the proposed mining due to the removal of longwalls 107B and 108B. However, MSEC noted that each business is unique in terms of the structures on the property and the activities that are conducted at each property.
202. The *Bargo Waste Management Centre* (BWMC) is a WSC operated non-putrescible waste disposal landfill facility which has been operating since 1966 (prior to declaration of the Bargo Mine Subsidence District). The BWMC includes an administration shed, landfill areas, a weighbridge, a leachate pit and surface water collection and treatment pond. The facility is located directly above proposed LWs 101B and 102B and would experience the full range of subsidence movements. Predicted impacts to the BWMC are substantial and include slope instability of the landfill, leakage from the leachate collection system and surface water treatment pond, and damage to the weighbridge.
203. WSC initially raised concerns about the potential damage to this facility, including in relation to potential discharge of leachate and pollutants into the adjacent Dog Trap Creek catchment. In response, MSEC provided additional information as part of the PAR which detailed Tahmoor Coal's previous experience in mining directly beneath similar waste facilities (including a waste management facility at Picton, Picton Recycled Water Plant and water treatment ponds and sewerage systems in Picton, Thirlmere and Tahmoor) and provided consideration of an extensive range of available mitigation and management options.

204. The Department notes that the options were developed in conjunction with geotechnical engineers Douglas Partners who were engaged to complete an assessment of the landfill site. Overall, although MSEC acknowledged that the mitigation and management measures that would be required are extensive, once implemented the likelihood of significant impacts to the BWMC were considered to be low.
205. WSC officers from the Waste Management Section subsequently expressed satisfaction with the information provided, however a more recent submission from WSC reiterated concerns and noted the potential for impacts to cause a breach of the EPL for the facility.
206. In response to concerns raised, representatives from the Department and Tahmoor Coal met with WSC officers and inspected the site. WSC confirmed that the BWMC is reaching capacity and is likely to require extensive rehabilitation and closure works within 18 to 24 months. As discussed below, Tahmoor Coal has agreed to work with WSC to ensure these works are implemented with risk controls and mitigation measures to avoid impacts due to mining and ensure no breaches of EPL conditions.

Built Feature Management and Mitigation

207. MSEC indicated that potential risks to all built features can be managed through early detection via monitoring and early response through implementation of a triggered response plan. MSEC considered that with appropriate management plans in place, built features would remain safe and serviceable (i.e. capable of being used for its intended purpose) at all times during mining.
208. There is a long history of experience in undermining built features in NSW over a period of over 150 years. Over this time, technically feasible methods to manage potential subsidence impacts on both key and other built features have been developed and there have been no major serviceability or public safety incidents related to subsidence impacts which were not able to be managed and rectified.
209. Tahmoor Coal has committed to establishing technical committees to develop risk management strategies and manage potential impacts of longwall mining on key transport and gas infrastructure, including the Main Southern Railway; bridges along the M31 Hume Motorway; Moomba to Sydney Gas Pipeline; and the Gorodok Ethane Pipeline. It is proposed that the technical committees comprise representatives from Tahmoor Coal, ARTC (for rail), TfNSW (for main roads), WSC (for local roads), APA (for gas infrastructure), as well as engineering and geotechnical specialists. The technical committees' role would be to:
- identify all potential mechanisms for impacts to the rail, roadways, gas infrastructure and associated structures;
 - identify geological structures in the surface geology that may respond in a non-conventional manner as a result of mine subsidence;
 - undertake a risk management approach, where all identified risks are assessed and risk control measures are implemented; and
 - development of management measures that include mitigation and preventive works, monitoring plans, TARPs and communication plans.
210. Tahmoor Coal noted that similar technical committees have previously been formed to manage potential mine subsidence impacts, including on the Main Southern Railway, due to extraction of LWs 25 to 32 at Tahmoor North, and committed to establishing similar committees for key

transport and gas infrastructure at Tahmoor South. Tahmoor Coal indicated that implementation of the mitigation and preventive measures recommended by the committees ensured the infrastructure remained serviceable and that there were no public safety issues associated with subsidence generated from extraction of these longwalls.

211. The Department accepts that potential impacts to key transport and gas infrastructure can be managed and that the appropriate forum to facilitate this would be via joint technical committees. The Department notes that it is common practice for mining companies to establish such committees to manage potential impacts on key infrastructure within mine subsidence areas.
212. Given the substantial impacts predicted at the BWMC, the Department considers that a similar approach should be implemented for this facility. The technical committee should comprise representatives from Tahmoor Coal, WSC, and geotechnical engineers to identify potential hazards, assess risks, consider options and select measures to control risks to ensure the facility remains safe and serviceable including the operation of leachate and surface water controls and rehabilitation capping to minimise potential for offsite impacts. The Department notes that mining would not commence in the longwalls below the BWMC until approximately 2024, so there is sufficient time to implement the required controls. WSC has accepted this approach.
213. The Department acknowledges that the extent of potential impacts to other built features is substantial, however accepts that the magnitude of predicted subsidence impacts are generally minor in nature and can be relatively easily remediated to ensure they remain in a safe and serviceable condition via a Built Features Management Plan, which would form part of the Extraction Plan process (see below).
214. The Department has proposed performance measures regarding safety, serviceability, repairability and compensation. In line with other recent underground mining development consents, the performance measures vary according to whether the built feature is an item of key infrastructure, or an item of minor infrastructure or other built feature. The Department's proposed performance measures for items of key infrastructure are that:
 - they always remain safe and serviceable; and
 - any damage that does not affect safety or serviceability must be fully repairable, and must be full repaired at the cost of Tahmoor Coal.
215. The Department's proposed performance measures for other built features, including other public infrastructure, are that:
 - they always remain safe;
 - serviceability should be maintained wherever practicable;
 - any loss of serviceability must be fully compensated; and
 - any damage must be fully repaired or replaced or else fully compensated.

Natural Features

Cliffs and Steep Slopes

216. There are numerous (24) sandstone cliff formations located within the Hawkesbury Sandstone outcrop of the SSA, primarily situated within the valleys of the Bargo River, Dog Trap Creek and the lower reaches of Hornes Creek. The cliffs are typically between 10 and 20 m high and less than 100 m long. One cliff located in the Bargo River valley is longer than 200 m and is considered

a 'cliff of special significance' (using criteria developed by the PAC in the Bulli Seam Operations determination report (2010)).

217. None of the cliffs would be directly mined beneath by the proposed longwalls. Most of the cliffs are located several hundred metres from the proposed longwalls and are predicted to experience only very low levels of vertical subsidence (<20 mm) and valley closures (<20 mm).
218. Six cliffs along Dog Trap Creek are located immediately to the east of proposed LWs 101B, 102B and 103B. These cliffs are between 10 and 15 m in height and less than 55 m in length. MSEC predicted these cliffs could experience 80-150 mm of conventional subsidence, 1.5 mm/m maximum conventional tilt and maximum predicted conventional strains of 1.5 mm/m tensile and 3.0 mm/m compressive. They may also experience non-conventional upsidence of up to 400 mm and valley closure of 425 mm.
219. Based on previous experience of mining at Tahmoor and other collieries in the Southern Coalfield, MSEC predicted that it is unlikely that cliffs beyond the extent of the longwall panels would experience large instabilities, however it is possible that isolated rockfalls could occur along less than 0.5% of the total face area of these cliffs.
220. There are also many steep slopes in the SSA, located on the sides of valleys and along the upper reaches of tributaries. Steep slopes are defined as land which has a gradient greater than 1 in 3 (33% or 18.3°). Numerous steep slopes would be directly mined beneath. MSEC predicted slopes could experience surface cracking (and associated erosion) and minor rock falls, however there is considered to be an extremely low probability of large-scale slope slippage.
221. The Department notes that there has been extensive experience of mining beneath steep slopes in the Southern Coalfield, including along the Cataract, Nepean, Bargo and Georges rivers and streams such as Myrtle Creek and Redbank Creek. Although no large-scale slope failures have been observed on these slopes, surface cracking and minor rock falls from rock outcrops have been recorded.
222. Rockfalls and cliff/slope instabilities have the potential to affect biodiversity and Aboriginal heritage sites (refer to Sections 6.6 and 6.8, respectively). They could also jeopardise public safety. MSEC has confirmed that there are no structures or roads located near any of the cliffs, and that walking tracks near the Bargo River and Hornes Creek cliffs are located outside of the 20mm subsidence zone and are unlikely to be impacted by subsidence related instabilities. There are also some built structures and public and privately-owned roads that cross valleys in the vicinity of steep slopes.
223. Tahmoor Coal has committed to continue its current strategies to manage public safety in the vicinity of cliffs in the study area, which includes consultation with landowners, visual inspections before and after mining and where the public may access the cliffs, erection of warning signs during periods of active mining. Tahmoor Coal has also committed to continue to implement its existing management strategies for steep slopes, which include:
 - identification of all structures, dams and roads that lie in close proximity to steep slopes;
 - site investigation and landslide risk assessment of structures near slopes by a qualified geotechnical engineer;
 - structural assessment of structures;
 - monitoring, including ground survey and visual inspections; and

- remediation if cracking or slippage occurs, using standard techniques including ripping, filling and seeding.
224. The Department accepts that the great majority of cliffs are unlikely to be impacted by mining induced subsidence, and that potential impacts associated with minor rock falls and surface cracking along steep slopes are likely to be minor. However, the Department considers that while the extent and probability of significant rock falls and large cliff instabilities are small, some possibility remains and attention must be paid to ensuring public safety. Consequently, the Department has recommended subsidence impact performance measures which are in-line with recent development consents in the Southern Coalfields, requiring:
- *Negligible environmental consequences* for cliffs beyond the extent of longwall panels (that is, occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 0.5% of the total face area of such cliffs within the SSA); and
 - *Negligible additional risk* to public safety.
225. The Department accepts that public safety risks have been effectively managed in the vicinity of cliffs and steep slopes at Tahmoor North, and that the existing management strategies should continue to be adopted at Tahmoor South. The Department has recommended that this be undertaken via the standard Extraction Plan process, which requires Land Management Plans to be prepared, in consultation with affected public agencies and landowners. The Land Management Plan would provide for the management of potential impacts and consequences of the proposed mining on cliffs and steep slopes, and would be the mechanism by which Tahmoor Coal demonstrates that its proposed mining layout is able to achieve the performance measures imposed in the development consent.

Subsidence Monitoring and Management

226. The Department considers that the Extraction Plan process would be vital to monitor and manage the potential subsidence effects, and the extensive range of subsidence impacts and environmental consequences of the Project. The Extraction Plan process would also allow expert stakeholders to provide ongoing advice on the Project.
227. In accordance with contemporary Extraction Plan requirements, it has been recommended that an Extraction Plan initially be required for extraction of the first series of longwalls (i.e. LWs 101A-103A) (refer to **Figure 4**). The preparation of an Extraction Plan for groups of longwall panels allows the assessment of impacts on all built and natural features to be focused at the local level, ensuring that impacts are appropriately monitored, and impact management regimes are further refined during the life of the Project in response to the results of subsidence monitoring and recorded impacts.
228. The Department's recommended Extraction Plan requirements include the imposition of performance measures and a range of monitoring and management plans for subsidence, built features, land and public safety, as well as groundwater, surface water, biodiversity and heritage (as discussed in the following sections of this report).
229. In addition, in accordance with current practice and recommendations made by the IEPMC in its *Final Report (Part 2)*, the Extraction Plans would be required to continue to include TARPs to provide a clear basis to decide whether or not the performance measures are being met and

certainty in determining the appropriate management response to exceedances and breaches. The Department agrees with the IEPMC that TARP triggers should be based on meaningful indicators, developed in consultation with relevant agencies and authorities, and has recommended conditions accordingly.

230. The Built Features Management Plans (BFMPs) would be required to be prepared for all built features predicted to be impacted by the Project, in consultation with the relevant authority or owner, MEG and SA NSW. The BFMPs would:
- contain an assessment of the pre-mining condition of the built feature;
 - recommend appropriate pre-mining mitigation measures to reduce subsidence impacts;
 - describe monitoring systems to be installed, which are capable of detecting vertical, horizontal and far-field subsidence movements;
 - set up processes for regular review and assessment of the monitoring data;
 - provide timing for the conduct of regular inspections;
 - contain procedures for the implementation of planned responses if triggered by monitoring and inspections; and
 - recommend appropriate remedial measures and include commitments to mitigate, repair, replace or compensate predicted impacts on potentially affected built features in a timely manner.
231. In addition, as discussed above, the Department has recommended that a technical committee be established to develop risk management strategies and manage potential impacts of longwall mining on the BWMC. It is noted that Tahmoor Coal has also committed to establish technical committees for key transport and gas infrastructure.

Conclusion

232. The Department considers that the SubIA (MESC, 2020b) contains an adequate prediction of subsidence effects and assessment of likely impacts and consequences anticipated to be associated with the Project.
233. The Department considers that the Project has been substantially modified to avoid subsidence-related risks and impacts when compared to the previously proposed longwall mining layouts. However, the Department acknowledges that the current Project is likely to result in subsidence impacts to a significant number of houses and other built features.
234. The Department accepts that impacts to private residences and other structures would be managed and compensated for by SA NSW under the provisions of the CMSC Act, via the Coal Mine Subsidence Compensation Fund. The Department notes that this compensation framework ensures security to homeowners, irrespective of the mine company financial status.
235. In-line with the existing Tahmoor North development consent, the Department has also recommended that additional safeguards be offered to homeowners whose houses experience significant and/or prolonged damage as a result of mine subsidence movements, including offering property acquisition as an option for compensation, rather than repair or rebuild. The Department believes these mechanisms would provide the homeowners confidence in the management and compensation process, coupled with additional options for acquisition if desired.

236. The Department has proposed performance measures addressing safety, serviceability, repairability and compensation for all other built features. The performance measures vary according to whether the built feature is an item of key infrastructure, or an item of minor infrastructure or other built feature.
237. The Department is satisfied that strict performance measures, together with an appropriate built features management plan (as a component of a robust Extraction Plan) would appropriately manage subsidence impacts on items of key infrastructure, minor infrastructure and other built features.

6.3 Groundwater

Groundwater Environment

238. Groundwater systems within the vicinity of the Project can be broadly defined as either shallow or deep aquifers. Shallow systems include soils and the underlying weathered bedrock on hill slopes, plateaus and minor alluvial deposits (primarily associated with Thirlmere Lakes). Deep systems exist within unweathered bedrock and comprise rock strata with a porous matrix (commonly sandstones) sometimes enhanced by fracturing. These two types of groundwater systems are recharged by rainfall and runoff over geological time. The process involves infiltration of rainwater, first to the surficial regolith, and then downwards percolation from these generally-perched systems to a deeper, fully saturated zone. **Figure 12** provides a cross-section of the typical hydrogeological layers in the vicinity of the Project area.
239. The Hawkesbury Sandstone is a regionally extensive rock unit which is conducive to groundwater storage and transmission. Aquifers within the Hawkesbury Sandstone are considered highly productive, containing over 980 registered groundwater bores within the Project area. The Bald Hill Claystone sits below the Hawkesbury Sandstone and generally impedes groundwater due to low permeability of its siltstones and claystones. The underlying Scarborough and Bulgo Sandstones also contain aquifers, however they are less productive due to poorer water quality and increased drilling costs for accessing deeper units.
240. For shallow alluvial systems, the potential impacts of mining include surface cracking along stream beds and rock bars causing shallow subsurface flow diversions and “baseflow” reductions. Deep groundwater systems may be impacted by strata depressurisation (or “drawdown”) associated with drainage of the fractured subsidence zone above extracted longwall panels. Drawdown of a substantial degree could affect access to water by landowners from registered groundwater bores.

Groundwater Assessments

241. The EIS included a Groundwater Assessment, prepared by HydroSimulations (HS), that included a conceptual and numerical groundwater model to predict impacts to groundwater behaviour as a result of the Project. The Groundwater Assessment (HS, 2018) was peer reviewed by Dr Prathapar Sanmugan of Prathapar & Associates, who considered it to be robust, technically appropriate and consistent with the *Australian Groundwater Modelling Guidelines* (AGMG) (Barnett et al, 2012) and the requirements of the *NSW Aquifer Interference Policy* (AIP) (2012). The Groundwater Assessment (HS, 2018) and associated peer review report are included at Appendix I of the EIS.

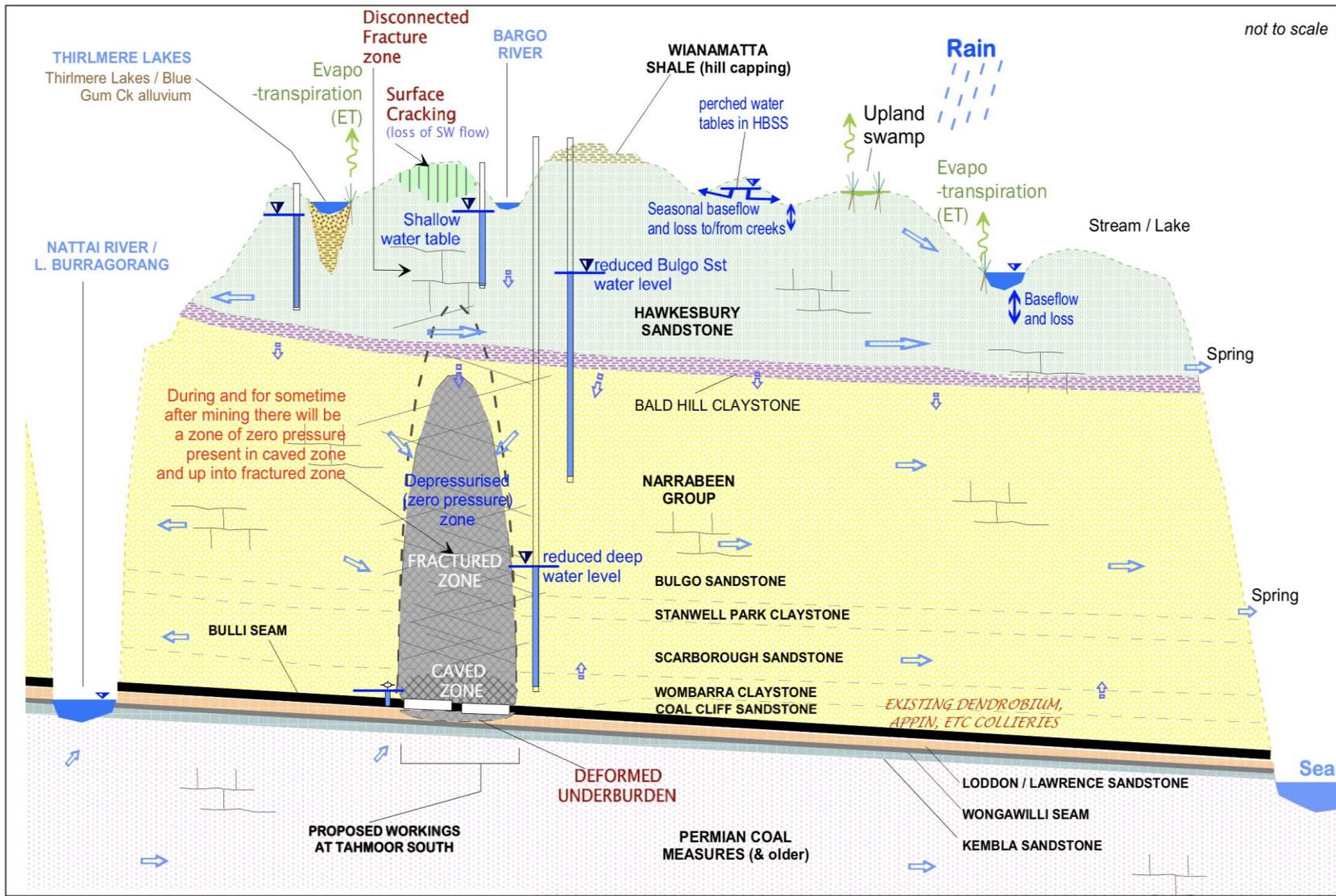


Figure 12 | Hydrogeological Conceptual Model (Post-mining)

242. The Department commissioned a separate independent peer review of the Groundwater Assessment (HS, 2018). The review was undertaken by Mr Hugh Middlemis of HydroGeologic Pty Ltd, who is considered an expert in the fields of hydrology, hydrogeology and groundwater modelling. The Department notes that Mr Middlemis was the principal author of the first Australian groundwater modelling guidelines that formed the basis for the AGMG and is the co-author of the IESC uncertainty analysis guidelines for groundwater modelling (Middlemis & Peeters, 2018). Mr Middlemis is considered by the Department to be an independent, highly qualified and experienced expert in his field and an acceptable person to undertake the peer review.
243. Both the IESC advice on the Project and the DPIE-Water/NRAR's submission on the EIS raised issues in relation to the Groundwater Assessment (HS, 2018), including incorporating shallow surface cracking, further transient watercourses representation and third party bore extraction into the model. In response to these issues, as well as the outcomes of the initial peer review by Mr Middlemis, the groundwater model was re-run and an updated Groundwater Assessment (HS, 2018) was prepared to address the issues raised and reflect the amended mine plan. The updated Groundwater Assessment (HS, 2020a) was included at Appendix C of the PAR.
244. Mr Middlemis subsequently undertook a further review of the updated Groundwater Assessment (HS, 2020a) which confirmed that, in his opinion, the updated assessment addresses the key issues raised by the IESC and DPIE-Water/NRAR. Mr Middlemis's overall conclusion stated that:
- "In my professional opinion is that the Tahmoor South Coal Project hydrogeological and groundwater modelling assessment is fit for the purpose of mine dewatering environmental impact assessment (including cumulative impacts) and informing management strategies and licensing".*
245. In its submission on the PAR, DPIE-Water/NRAR indicated that the groundwater model had been satisfactorily updated and that it now has a higher level of confidence in the provided analysis and results.
246. The Groundwater Assessment (HS, 2020a) was again revised to reflect the second amendment to the mine plan presented in the SPAR. The updated Groundwater Assessment (HS, 2020b) did not involve a re-run of the groundwater model, but presented a qualitative assessment of the revised mine plan, considering the spatial extent of the changes to longwall areas and the changed longwall scheduling and project duration.
247. The predicted groundwater effects and assessed potential groundwater impacts discussed in this section relate to those presented in the updated Groundwater Assessment (HS, 2020b) included in Appendix C of the SPAR.

Uncertainty Analysis

248. Both the IESC and DPIE-Water/NRAR recommended that the Groundwater Assessment (HS, 2018) be supported by a comprehensive uncertainty analysis in line with the IESC uncertainty analysis guidelines¹.
249. However, Mr Middlemis confirmed that the deterministic sensitivity analysis included in the updated Groundwater Assessment (HS, 2020a) provided adequate information on the effects of

¹Middlemis, H. and Peeters, L.J.M., 2018. *Uncertainty analysis—Guidance for groundwater modelling within a risk management framework*. A report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment and Energy, Commonwealth of Australia 2018.

uncertainties and that a more comprehensive analysis is not warranted at this stage. This view was based on the understanding that the groundwater model conceptualisation is mature (based on over 20 years of investigations); is consistent with data on inflows, groundwater levels and fracturing of longwalls from existing mining; and has sound multi-criteria calibration performance and sensitivity analysis.

250. Mr Middlemis indicated that the sensitivity analysis included in the Groundwater Assessment (HS, 2020a) is targeted at key uncertainties and uses conservative assumptions that would tend to over-estimate the predicted impacts to groundwater behaviour as a result of the Project. This includes increased height of fracturing (see below); treating faults as transmissive; increased Hawkesbury Sandstone conductivity; and including third party bore pumping in the analysis. Outcomes of the deterministic uncertainty analysis included in the updated Groundwater Assessment (HS, 2020a) are discussed in the following section of this report.
251. Mr Middlemis was satisfied that this sensitivity analysis “*confirms relatively low sensitivity and provides adequate information on the effects of uncertainties, suitable to support decision making*”.
252. However, the Department notes that both HS and Mr Middlemis recommended that a more rigorous sensitivity analysis on the groundwater model be undertaken as part of ongoing model development, when additional data from ongoing monitoring and investigations is available. HS and Mr Middlemis suggested that this be carried out once the OEH Thirlmere Lakes Research Program (see below) has been completed, in order to incorporate developments from that program.
253. DPIE-Water recommended that the model be rebuilt and recalibrated within two years of project determination (if approved) to incorporate the updated monitoring data, as well as make other model enhancements, including better representation of heterogeneity across the model area and refinement of the model grid (by using unstructured grid). Tahmoor Coal agreed to revise the model within this timeframe and, at the request of DPIE-Water, engaged SLR Consulting Australia Pty Ltd (SLR) to prepare a Groundwater Modelling Plan which provided a plan for the future groundwater model re-build and recalibration in line with the AGMG (refer to Appendix M of the SPAR).
254. Although DPIE-Water acknowledged the Groundwater Modelling Plan contained some useful information, it considered that the plan should be revised prior to determination to include further clarity on the modelling processes; workflow checks and feedback loops; sensitivity analysis and calibration techniques; and model review and updates throughout the project’s life. DPIE-Water also recommended that the Groundwater Modelling Plan be independently third-party reviewed.
255. Based on the advice of Mr Middlemis, the Department does not believe that the revision and review of the Groundwater Modelling Plan is a determinative issue for assessment, requiring completion prior to determination. The Department considers the Groundwater Modelling Plan should be revised and reviewed, in consultation with DPIE-Water and the satisfaction of the Secretary, prior to the commencement of construction has recommended a condition to this effect.
256. The Department accepts the recommendation from HS, Mr Middlemis and DPIE-Water that the groundwater model be reviewed and updated once additional information is available, particularly in relation to the Thirlmere Lakes Research Program. Given the research program is due to be

completed in late 2021, the Department accepts that a 2-year timeframe for completing the model review is reasonable and has recommended a condition accordingly.

Groundwater Predictions

Height of Fracturing

257. Subsidence associated with longwall mining causes fracturing and deformation of the strata overlying the longwall panels, which can result in changes in the permeability and aquifer storage properties of this overburden. The height that this cracking extends above the longwall panels is known as the “height of fracturing” (HoF). Subsidence can also result in cracking of the surface zone, which has the potential to increase permeability along stream beds and perched water tables and connect the surface water to deeper aquifers. If the HoF reaches the depth of surface cracking, “connectivity” can result which presents increased risks of vertical drainage from shallow aquifers into the deeper system and reducing water available to streams, lakes and other ecosystems.
258. The Groundwater Assessment (HS, 2020b) provided estimates of both HoF and the depth below the surface to where surface cracking extends. The calculated HoF above the proposed longwalls varies across the site from 156 to 211 m, with the fracturing extending up into the Bald Hill Claystone in the south where the cover is thinner. The estimated depth of surface cracking over the mine is less than 30 m. The vertical separation distance between the surface cracking zone and the height of connected fracturing therefore ranges from about 130 to 240 m across the proposed mining area. Based on this significant separation, HS considered it unlikely that surface to seam connectivity would occur as a result of extraction of the proposed longwall panels.
259. IESC criticised the method used by HS to estimate the HoF, and suggested that the HoF had been underestimated and that there is the potential for connectivity between the top of the HoF and the surface cracking zone. In response, HS confirmed it used the Tammetta method to calculate the HoF, which is consistent with recommendations of the IEPMC (2018), combined with investigative drilling and fracturing analysis of conditions above the Tahmoor North LW10A (SCT, 2014). This monitoring drill hole is particularly important because it showed *in situ* behaviour of groundwater levels in response to mining at Tahmoor North at a location only a few hundred meters from the proposed longwalls. The borehole was drilled to a depth of almost 245 m above extracted LW10A and showed water levels in the Hawkesbury Sandstone were essentially constant through time, suggesting no enhanced connection between the longwall/goaf and the Hawkesbury Sandstone due to mining of LW10A or adjacent panels.
260. Mr Middlemis confirmed that HS has appropriately estimated the HoF above longwalls according to the Tammetta method, which resulted in estimates consistent with the LW10A data. Mr Middlemis agreed that the estimated separation between the top of the HoF and the surface cracking greatly limits the potential for connectivity from shallow to deep horizons as a result of the proposed longwall mining.
261. The Department accepts this outcome and has recommended that a similar investigative drilling and analysis program be implemented following mining associated with the Project.

Mine Inflows

262. The groundwater model predicted average mine inflows of approximately 3.5 to 5.1 ML/day (1,600 to 1,900 ML/a), peaking at an annualised rate of 7.5-8 ML/day (or up to 2,900 ML for a

12-month period) toward the end of the operational life of the Project in the mid-late 2020s. HS indicated that these inflow rates are higher than expected, given historical inflows at Tahmoor North are 3-5 ML/day and the proposed longwall geometry is similar to that in recent Tahmoor North longwalls.

263. HS recommended progressive review and model revision should be done to confirm these estimates. The Department has recommended this be undertaken as part of the Water Management Plan process.
264. As discussed in Section 6.4 below, Tahmoor Coal proposes to continue to treat mine inflows via an upgraded Water Treatment Plant (WTP) and discharge treated water in accordance with new EPA EPL limits. The potential impacts of this discharge are discussed below.

Groundwater Drawdown

265. HS predicted that groundwater drawdown would be most prominent in the mined Bulli Seam (with a peak of 350 m drawdown) and become less pronounced in the overlying strata. Moving upwards through the sequence, Bulgo Sandstone drawdown is predicted to be approximately 300 m, lower Hawkesbury Sandstone drawdown is predicted to be approximately 30 m and upper Hawkesbury Sandstone is predicted to be approximately 10-14 m.
266. **Figure 13** shows the spatial distribution of modelled drawdown due to the Project, in both the water table (**Figure 13A**) and the lower Hawkesbury Sandstone (**Figure 13B**). The water table is the groundwater system that is connected to most environmental (surface) features and the Hawkesbury Sandstone is the source of most of the local groundwater extraction by bores. Generally, the 2 m water table drawdown contour covers the proposed longwall footprint, extending further east to near the Nepean River and halfway toward Lake Nepean. The maximum drawdown contours in the lower Hawkesbury Sandstone extend radially from the proposed longwall footprint, approaching Lake Nepean to the south, the Nepean River to the east, and to Lake Couridjah in the northwest.
267. The maximum drawdown due to cumulative mining activities of Tahmoor North and South, BSO and Dendrobium are shown in **Figure 14**. Generally, the 2 m water table drawdown extends across the footprint of all the mines, including all domains at Tahmoor.
268. Modelling predicted that in the proposed mining footprint most of the recovery of water levels would be complete about 150 years (year 2200) after the proposed cessation of operations at Tahmoor South. Within the longwall areas, recovery of water levels in the deeper Bulli Seam and Scarborough Sandstone are predicted to be incomplete, with predicted drawdowns of between 10-30 m remaining in 2500.

Groundwater Quality

269. HS predicted that mining-induced changes to the hydraulic properties and depressurisation of the strata in the Project area would result in mixing of potentially chemically different groundwater between overlying and underlying units. In particular, this has the potential to increase the salinity and specific nutrients (eg. iron, manganese and barium) of groundwater within the Hawkesbury and Bulgo Sandstones, which are the two most commonly utilised aquifers. The risk of groundwater quality reduction is predicted to decrease with distance from the longwall mine areas.

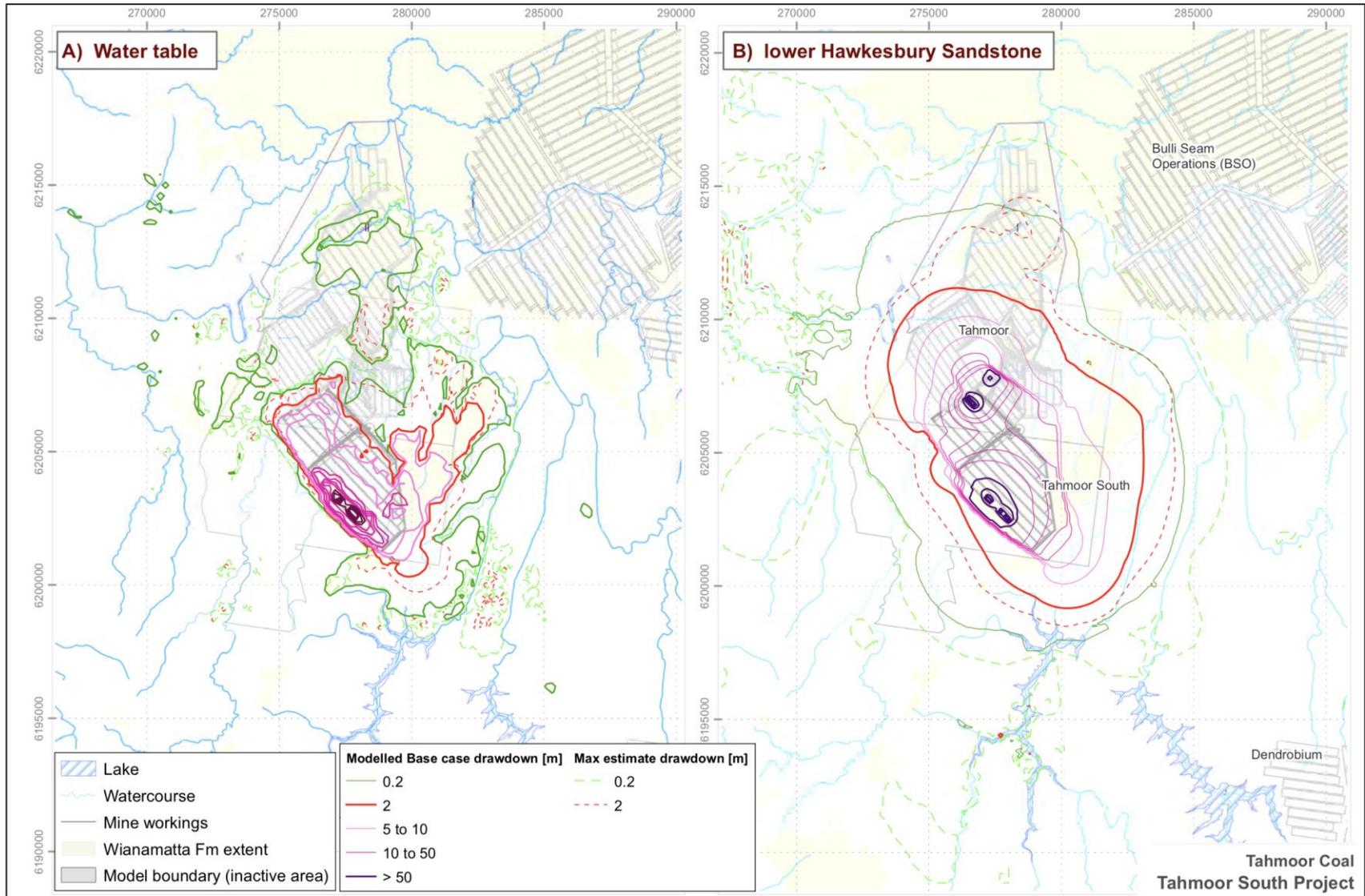


Figure 13 | Predicted maximum drawdown due to the proposed Project

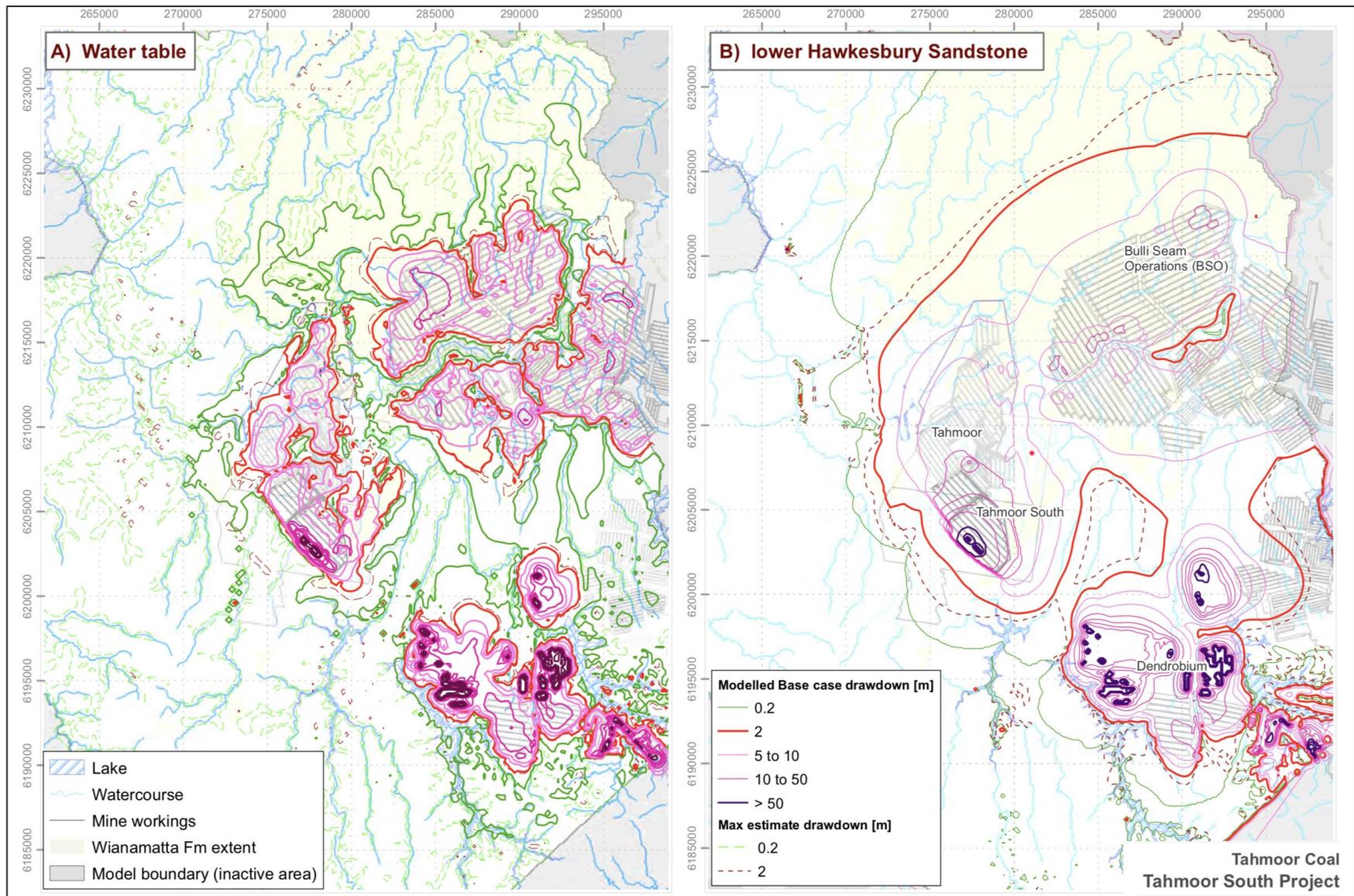


Figure 14 | Predicted maximum drawdown due to cumulative mining impacts

270. As outlined above, the Department notes that the predicted HoF where there would be enhanced vertical connectivity and depressurisation is predicted to be confined to the Bulgo Sandstone and Bald Hill Claystone at depths ranging from 160-270 m below the ground surface. That is, there is significant vertical separation between connective cracking and the surface minimising risk of surface water quality impacts as the lower groundwater aquifers repressurise following mining.
271. The Department notes that the IEPMC in its final report raised concerns about long term recovery of groundwater following mining within the special catchment areas with repressurisation of the aquifer system and potential for discharge of potentially poor quality water to surface waters. The Department notes that Illawarra escarpment mines located in the drinking water catchment are associated with access to coal seams through adit from pit top areas in the Wollongong region, and located within deeply incised geology.
272. Tahmoor Coal has advised that there are no adits associated with the Tahmoor mine that could lead to direct discharges following groundwater recovery.
273. Nonetheless, the Department has recommended a condition requiring Tahmoor Coal to prepare a Long-term Water Management Strategy for the Tahmoor complex for post mining groundwater recovery incorporating groundwater modelling, a water licensing strategy and monitoring program.

Groundwater Licensing

274. Under the *Water Management Act 2000* (WM Act), Tahmoor Coal is required to hold a water access licence (WAL) for groundwater take within the *Sydney Basin Nepean Groundwater Source* in accordance with the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011* (Groundwater WSP).
275. The Project would result in groundwater inflows from 3 management zones (MZs) within the *Sydney Basin Nepean Groundwater Source*, including approximately 2,900 ML/a in Nepean MZ2, 2 ML/a in Nepean MZ1 and 1 ML/a in Sydney Central.
276. Tahmoor Coal has confirmed that it currently holds a WAL for 1,642 ML/a which it intends to utilise for the Project. Tahmoor Coal would therefore need to secure additional WALs for the remaining 1,261 ML/a of groundwater take. HS reported that, based on the most recent Report Card for the *Sydney Basin Nepean Groundwater Source*, there was 37,303 ML/a of Unassigned Water available. NRAR is satisfied with Tahmoor Coal's ability to obtain additional water entitlements.
277. The Department is satisfied that there are sufficient share entitlements within the groundwater source to allow Tahmoor Coal to purchase the residual WALs to account for its groundwater take.
278. Following the completion of mining and cessation of pumping from underground workings induced take from overlying water would continue including base-flow reduction, until the groundwater system is repressurised. Similarly, to other mining projects, Tahmoor Coal would be required to hold entitlement to cover the post mining recovery period including surrendering entitlement in accordance with the provisions of the WM Act and the Aquifer Interference Policy.
279. The Department's recommendation for ongoing groundwater model validation and calibration, during the life of the project, along with the proposed Long-term Water Management Strategy

would continue to inform the post mining water take that would need to be accounted and surrendered post mining.

NSW Aquifer Interference Policy

280. The *NSW Aquifer Interference Policy* (AIP) provides the framework for the assessment of impacts of a proposed development on aquifers in NSW. As noted above, the Project is located in the *Sydney Basin Nepean Groundwater Source* (primarily MZ2) which is considered a 'highly productive groundwater source'. As a result, the groundwater resource is subject to the 'minimal impact' considerations stipulated by the AIP.

281. HS completed an assessment of the 'minimal impact' considerations for this water source. The Project falls within the AIP Level 2 classification of the minimal impact considerations given the modelled:

- cumulative impact on the water table at two of the lakes within Thirlmere Lakes is marginally above the 10% drawdown criterion; and
- drawdown of existing groundwater users' bores within the Permian and Triassic strata exceeds the 2 m decline criterion.

282. Consequently, the Project requires strategies to be implemented so that groundwater impacts are managed and minimised. As discussed in the following section, it is proposed that this includes 'make-good' provisions to compensate for impacts to water supply from bores.

Groundwater Impacts

Registered Bores

283. HS has identified that there are 982 registered groundwater bores within the vicinity of the Project area. Most of the bore usage in the area is from the Hawkesbury Sandstone or from surficial alluvium and basalt aquifers (89%), with about 10% from the deeper Bulgo Sandstone.

284. HS predicted that 46 registered bores would experience a drawdown in excess of the 2 m drawdown criterion of the AIP as a result of the Project. The number of bores impacted beyond 2 m rises to a possible 73 registered bores if the results of all deterministic (worst case) scenarios are taken into account.

285. Of the 46 bores predicted to be affected beyond 2 m, 22 (48%) are predicted to experience minor drawdown of 2-5 m, 8 (17%) are predicted to experience 5-10 m drawdown and 16 (35%) are predicted to experience >10 m drawdown.

286. In relation to potential cumulative impacts on bores from mining at Tahmoor and other mines in the vicinity, in particular BSO, HS predicted that the number of impacted bores would increase to 228. When considering the results of deterministic (worst case) scenarios, HS indicated this could rise to up to 264 registered bores potentially being impacted. Most of the bores predicted to cumulatively impacted are associated with operations at Tahmoor North and BSO (ie. approximately 80%).

287. The distribution of affected bores, including from the incremental drawdown from the proposed Tahmoor South and the cumulative worst-case drawdown, are presented in **Figures 15A** and **15B**, respectively.

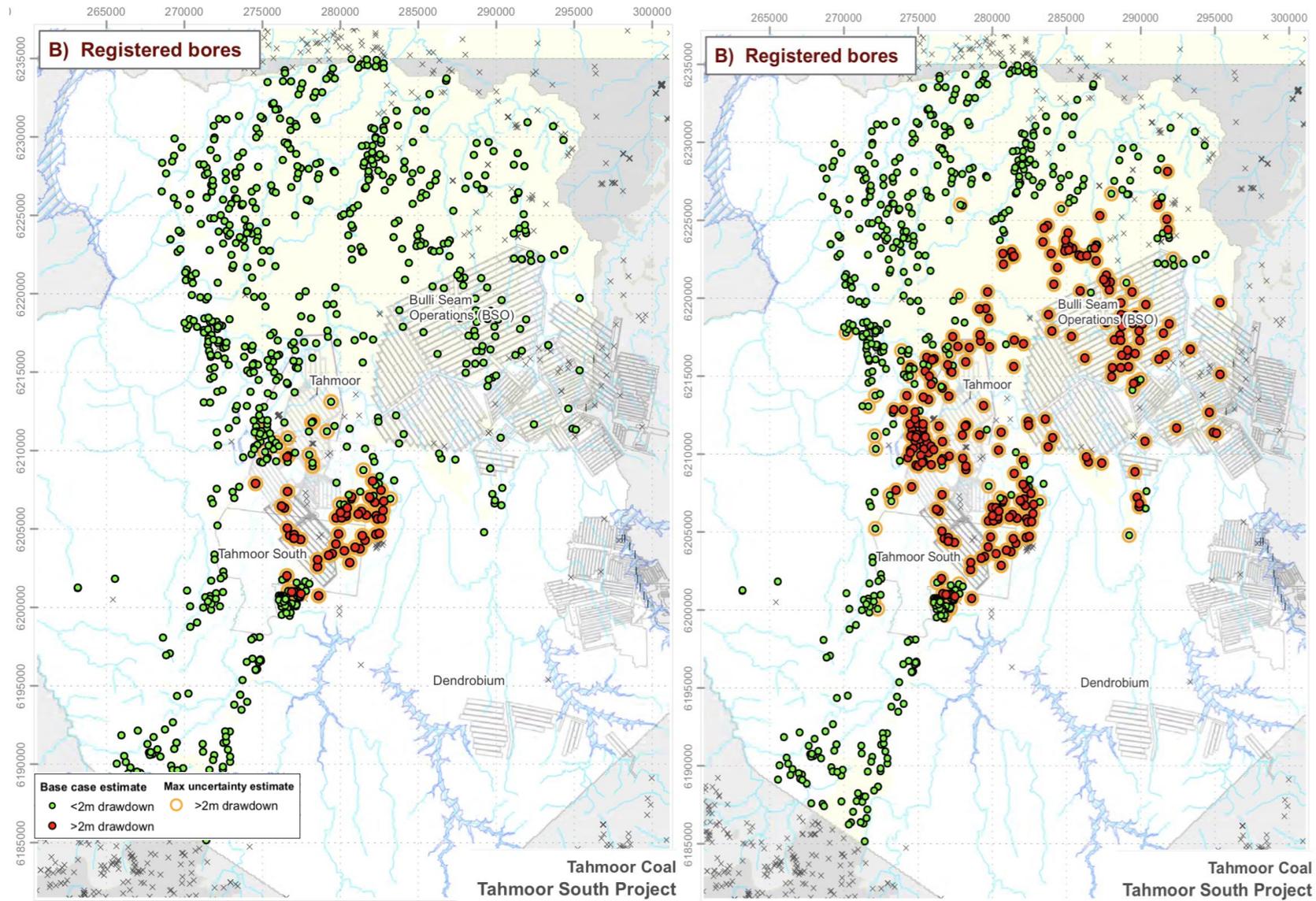


Figure 15 | Affected bores from incremental (left) and cumulative worst-case (right) drawdown

288. Tahmoor Coal has proposed to continue its current practice of implementing ‘make-good’ provisions for any groundwater users adversely impacted by the Project. ‘Make-good’ measures include lowering pumps within groundwater bores, or providing an improved pump, deepening a bore or drilling a new bore, or providing an alternative water supply.
289. For context, Tahmoor Coal noted that during over 30 years of longwall mining at Tahmoor North, the company has enacted ‘make good’ provisions for only 2 private bores, despite the fact that the revised groundwater model predicted that historical operation of Tahmoor North would have affected 72 bores. Tahmoor Coal also reported that mining operations at BSO to the north-east of the Project has resulted in claims for ‘make-good’ provisions being enacted for only 10 bores.
290. HS suggests that this supports the view that the model and assessment methods are highly conservative. HS further notes that many users might be affected beyond 2 m drawdown but not notice the effect compared to available drawdown. HS notes that because most bores in the area are relatively deep (i.e. >50 m) and have large available drawdowns, a 2 m or even up to 10 m drawdown would largely go unnoticed by most bore users.
291. Based on this analysis, HS used a risk classification system to summarise the risk of a water supply bore requiring ‘make good’ due to the Project. As detailed in **Table 14**, the risk classification system was based on the proximity of bores to the proposed longwalls; the magnitude of predicted groundwater drawdown and subsidence; and operational history and record of ‘make good’ at Tahmoor North.
292. Using this system HS predicted that 10 bores have a ‘high’ risk of requiring ‘make good’ provision, 7 bore have a ‘moderate’ risk, 3 have a ‘moderate to low’ risk, 26 have a ‘low’ risk and 8 have ‘negligible’ risk (primarily associated with removing LWs 107B and 108B from the mine plan). The location of the bores predicted to be impacted is shown on **Figure 16**.
293. Of the bores predicted to have high and moderate risks of impact, 10 are registered for domestic use, 3 for irrigation and 1 for livestock use. One bore is confirmed as not being used and the use of the remaining 2 bores is unknown.

Table 14 | Risk of registered bores likely to require ‘make-good’ provisions

Risk Rating	Number of Bores	Criteria	Justification
High	10	Above longwall pillars	Groundwater drawdown plus the likelihood of subsidence (strata deformation) likely to affect bore integrity. Historical effects on a bore above a pillar at Tahmoor North have required ‘make good’.
Moderate	7	Model predicts a maximum drawdown >10m and within 1km of a panel	A drawdown of greater than 10m is approximately 10-30% of available drawdown, but potentially more. Historical effects on a bore 250m from panels at Tahmoor North have required ‘make-good’.
Moderate-low	3	Model predicts a maximum drawdown >10m and beyond 1km of a panel	Drawdown due to mining of this magnitude at this distance is only predicted in deeper bores, and so would be a fraction of the expected available drawdown.

Risk Rating	Number of Bores	Criteria	Justification
Low	26	Model predicts a maximum drawdown between 2-10m	Drawdown of this magnitude is a fraction of available drawdown expected in this environment and is approaching seasonal variation.
Negligible	8*	Model predicts a maximum drawdown of <2m	Below AIP 'minimal harm' threshold.

* now considered negligible impact due to the removal of LW107B and LW108B from the mine plan.

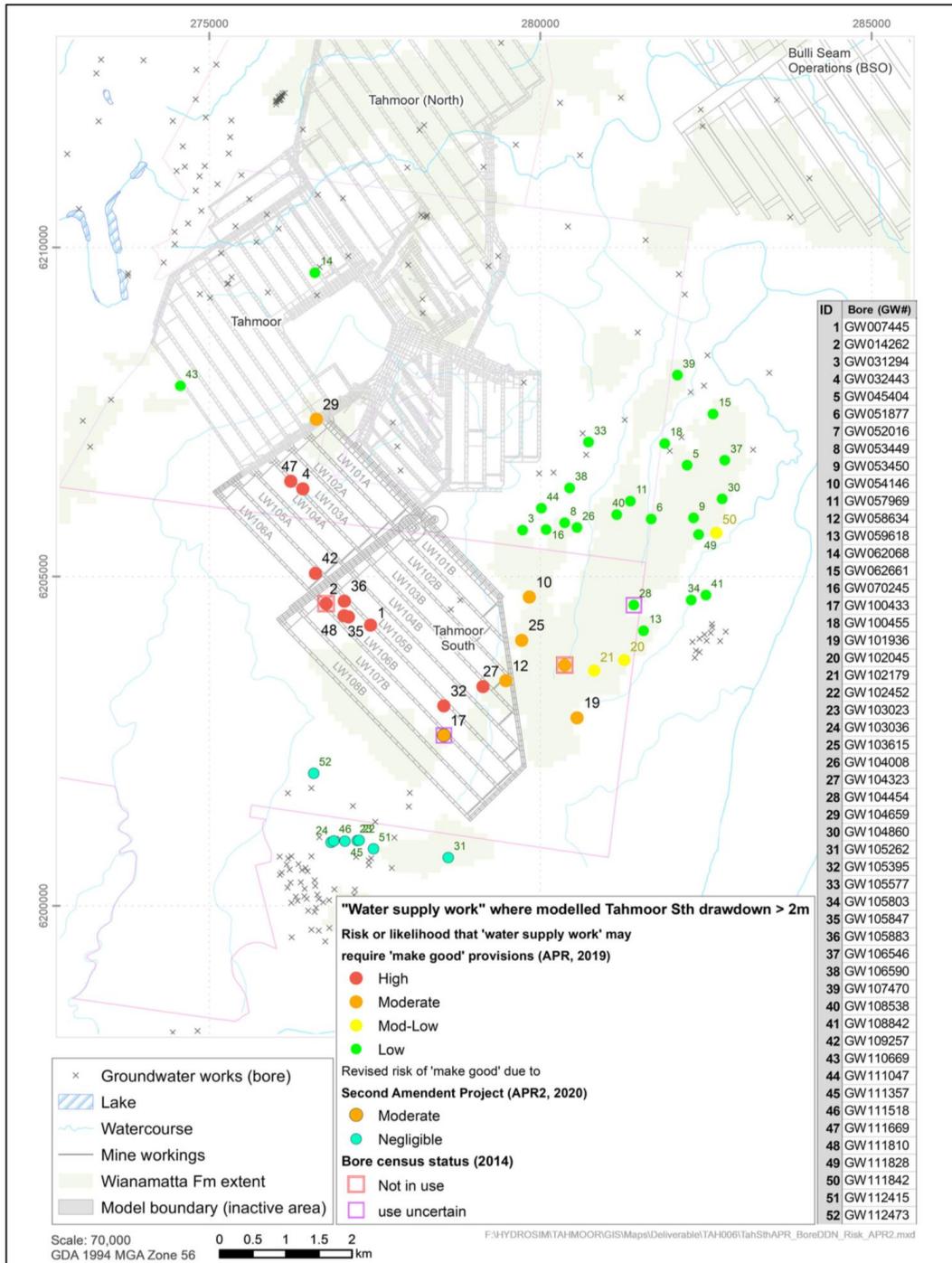


Figure 16 | Bores where 'make-good' provisions may be required

294. At the request of the Department, HS used this risk classification system to reassess potential cumulative impacts to bores, specifically associated with the proposed Tahmoor South operations and BSO to the north-east of the mine (refer to **Appendix G**). This indicated that 11 bores could potentially require 'make good' provisions as a result of cumulative impacts, including 6 which were already predicted to be impacted beyond the 2 m drawdown threshold by the Project alone and 5 which are predicted to exceed the threshold due to the additional predicted BSO drawdown contribution (see **Figure 17**).
295. The majority of the cumulatively impacted bores (10) were classified as being at 'low' risk, with one bore classified as being at a 'low to moderate' risk due to greater predicted drawdown (ie. almost 17m).
296. Tahmoor Coal has confirmed that the BSO mining domain closest to Tahmoor Mine and most relevant to potential cumulative bore impacts is Appin Area 8. Appin Area 8 longwalls are proposed to be extracted in 2028-2039. The north eastern panels closest to the BSO mining (Tahmoor South LWs 101B and 102B) are proposed to be extracted several years prior during 2025. It is therefore likely that any impacts to bores located between the two mining operations would be attributed to operations at Tahmoor South in the first instance.
297. DPIE-Water raised the issue of apportionment of responsibility for cumulatively impacted bores, stating that those impacted should not need to engage in multiple processes with various companies to gain compensation for impact. DPIE Water indicated that the responsibility of the impact should be placed with the latest applicant. As BSO is already an approved operation, the onus would be on Tahmoor Coal to provide make good to these landowners.
298. The Department realises that the risk of bores requiring 'make good' provisions due to cumulative impacts is low at all but one bore. However, the Department agrees with DPIE-Water that owners of impacted bores should not have to deal with multiple processes to gain compensation. Consequently, in line with DPIE-Water's proposed approach, the Department has recommended a condition requiring Tahmoor Coal to conduct a bore census (see below) on all 46 bores predicted to exceed the 2 m threshold due to the Project alone, and also the additional 5 bores where the 2 m threshold is predicted to be exceeded due to incremental impacts with BSO. As the latest applicant, Tahmoor Coal would be responsible for enacting make good provisions on these bores if there was more than a 2 m reduction in water supply level¹.
299. Overall, the Department accepts that due to conservative assumptions within the groundwater model and the availability of the existing drawdown (aquifer depth and yield), it is unlikely that the number of bores modelled to be impacted beyond the 2 m drawdown would result in 'make-good' provisions. However, both DPIE-Water and the Department acknowledge that there is likely to be adverse impacts, including reduced water supply and quality, to some privately-owned licensed bores in the vicinity of the Project.

¹ Including bores GW19590, GW031294, GW059106, GW062661, GW100455, GW104466, GW105787, GW106546, GW108155, GW111047 and GW111842

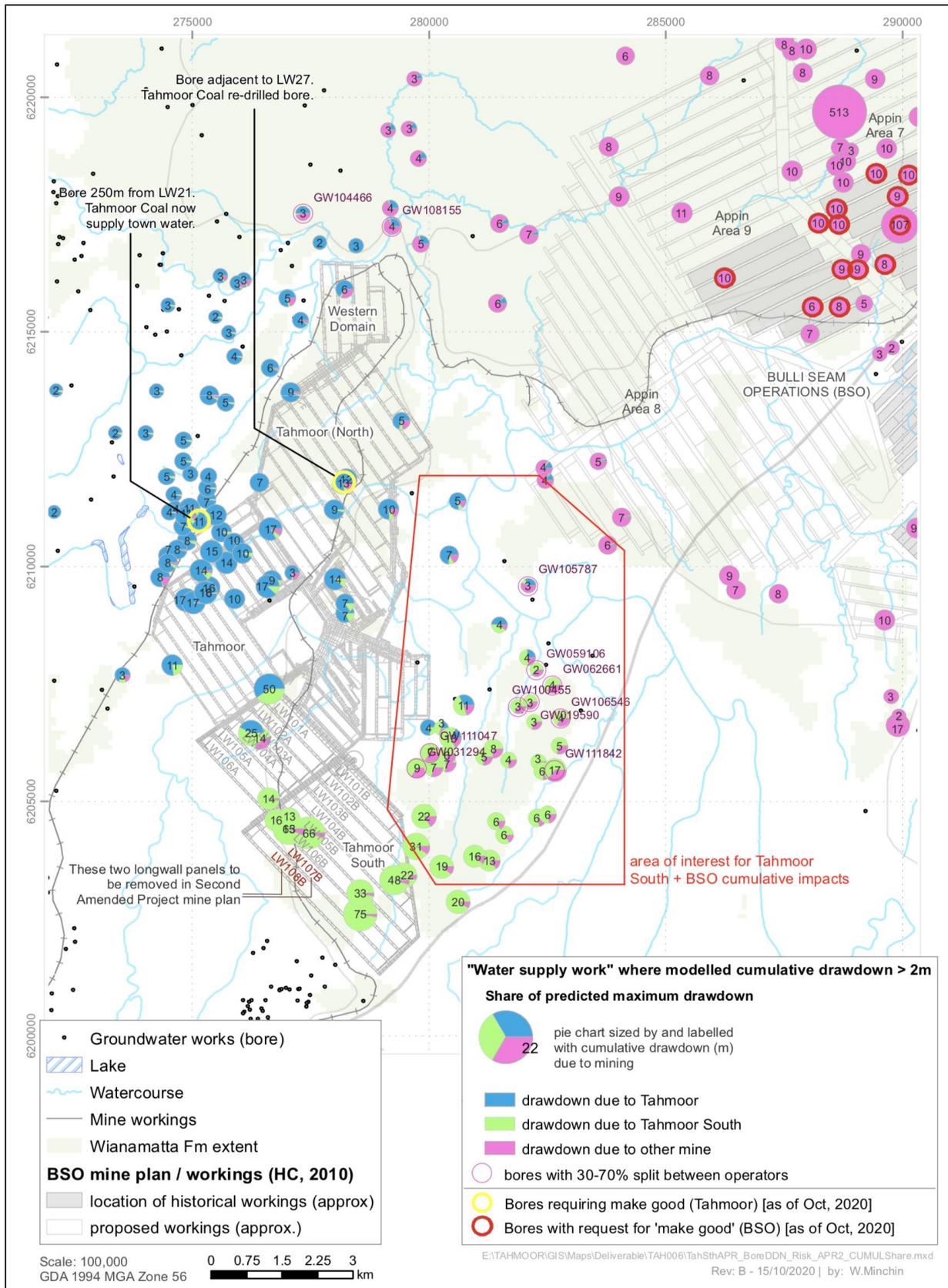


Figure 17 | Share of cumulative bore drawdown

300. Water supply compensation requirements are applicable under the following regimes:

- the CMSC Act 2017 for supply reductions and/or quality from direct damage to bore structures as a result of subsidence within a Subsidence District; or
- the AIP due to water supply reductions from drawdown in excess of the 2 m drawdown criterion.

However, the Department notes that there is no specific guidance on how an impact can or should be compensated in the legislation or the AIP.

301. Consequently, at the request of the Department, Tahmoor Coal provided a proposed strategy to 'make good' on the predicted incremental and cumulative impacts to registered bores surrounding the Project (refer to **Appendix G**). Tahmoor Coal confirmed that the 'make good' process would be staged in accordance with the proposed mining schedule and the result of the predictive groundwater modelling. In summary, the Make Good Strategy proposed would involve Tahmoor Coal:

- making contact with landowners whose registered bores are predicted to be impacted at least 2 years prior to the modelled impact;
- undertaking an individual site survey prior to any mining induced impact to verify baseline bore details (location, depth, condition or bore and pump, standing water levels and usage) and disseminating information to landowners;
- maintaining contact with landowners and, if requested, investigating any reductions in water quality or supply during or following mining;
- if mining induced bore water quality and/or supply impacts are identified, negotiating applicable options to 'make good' water supply based on individual bore details and characteristics, including:
 - bore maintenance;
 - payment of additional costs for increased pumping;
 - deepening the bore;
 - replacing the bore;
 - provision of an alternative water supply (via town water supply or on-site storage); and/or
 - implementing an agreed 'make good' option within an agreed timeframe.

302. This process would be managed by SA NSW through the CMSC Act 2017 claims process for any impacts to water supply bores as a result of subsidence related damage to a bore. To ensure water supply reductions from drawdown in excess of the 2 m AIP drawdown criterion are appropriately identified, managed and compensated, the Department has recommended conditions requiring:

- a bore census detailing baseline data regarding groundwater levels, yield and quality and bore condition be completed, including for bores potentially impacted by cumulative drawdowns beyond the 2 m threshold, to the satisfaction of the Planning Secretary, prior to the commencement of second workings;
- notify owners of licensed privately-owned groundwater bores that are predicted to have a drawdown of greater than 2 m as a result of the Project; and
- a compensatory or alternative water supply (equivalent volume and quality) be provided to any landowner whose rightful water supply is adversely impacted as a result of the Project, in consultation with DPIE-Water and to the satisfaction of the Planning Secretary.

303. A formal dispute resolution process is provided in the CMSC Act for disputes between landowners and Tahmoor Coal for bores damaged by subsidence. Similarly, the Department has recommended a condition that if Tahmoor Coal and the landowner cannot agree on the 'make-good' measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Planning Secretary for resolution.
304. Overall, the Department accepts that the number of bores predicted to be impacted by the Project and potentially requiring 'make-good' provisions (10 'high' risk bores) is manageable and has recommended conditions that would ensure any impacts are appropriately compensated via a well understood, feasible and equitable process. The Department's recommended condition also requires that the burden of proof rests with Tahmoor Coal to demonstrate that any loss of water (other than negligible) is not due to the development.

Groundwater Dependant Ecosystems - Thirlmere Lakes

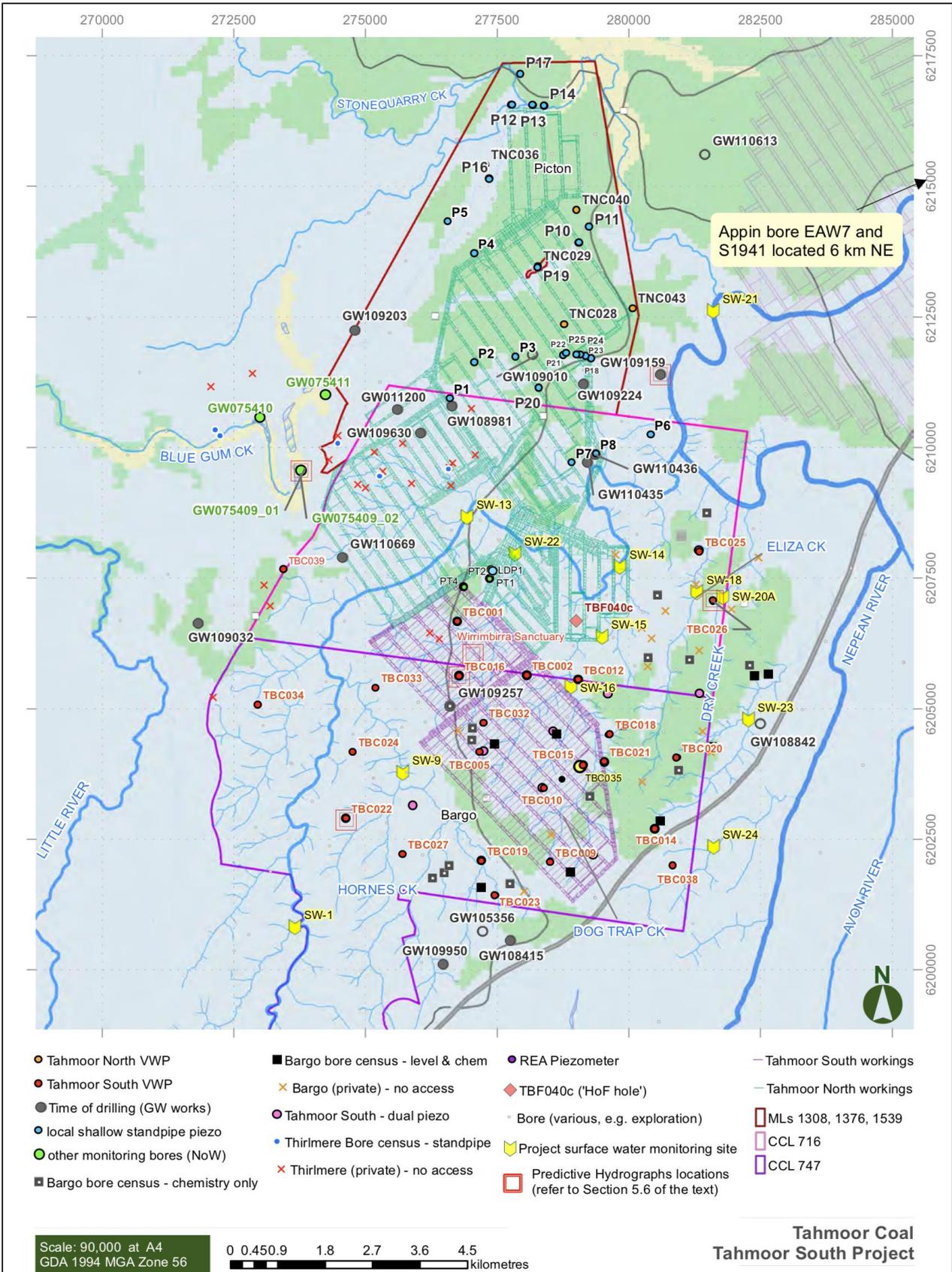
305. Thirlmere Lakes are the only High Priority GDE listed in the Groundwater WSP in the vicinity of the Project. Thirlmere Lakes are a series of five shallow freshwater bodies located along a horseshoe bend in Blue Gum Creek, within the Thirlmere Lakes National Park, which is part of the Greater Blue Mountains World Heritage Area. Thirlmere Lakes are made up of Lake Gandangarra, Lake Werri Berri, Lake Couridjah, Lake Baraba and Lake Nerrigorang.
306. As shown in **Figure 4**, the easternmost lake (Couridjah) is located approximately 3.5 km to the north west of the nearest proposed longwall. The Tahmoor North longwalls (mined in the late 1990s to early 2000s) are located between the proposed longwalls and the lakes, with the nearest historical longwall being about 650-750 m from the lakes.
307. As discussed in Section 3.5, the Thirlmere Lakes Inquiry was undertaken in 2011 in response to community concerns about lowering water levels in the lakes. The Inquiry and subsequent reviews found that, while there is evidence to suggest that mining may have contributed to changes in groundwater tables and hydraulic gradients in the Hawkesbury Sandstone, it is not possible to say whether that is temporary or long-lasting. Further, it was found that with the information available it is not possible to differentiate groundwater changes due to mining from those due to private bores, natural climate change (droughts), and anthropogenic climate change (primarily increased temperature).
308. The NSW Government has subsequently established several monitoring and research programs to expand the scientific data and knowledge into the causes of changes in water levels in Thirlmere Lakes. The most recent of these is the BCS led (formerly OEH) Thirlmere Lakes Research Program, which was commissioned in 2017 to investigate the sensitivity of these wetland systems to external influences, including mining. This program is due to be completed in late 2021.
309. Data to date indicates that in all but one of the lakes (Lake Nerrigorang) the lake levels are consistently above the alluvial groundwater levels, indicating losing lake conditions. The lake levels near Lake Nerrigorang however, are lower and more variable, indicating variable gaining to losing conditions. Preliminary data therefore suggests that there is limited dependence on groundwater for the water levels and associated ecosystems of the Thirlmere Lakes.
310. The Groundwater Assessment predicted that Thirlmere Lakes would experience groundwater drawdown within the alluvium of ≤ 0.02 m due to the Project, which was modelled to represent

0 to 1% of alluvial water level fluctuations. Cumulative drawdown is predicted to be between 0.07 m up to 0.48 m in parts of the Thirlmere Lakes alluvium. These predicted cumulative drawdowns are 3% to 12% of the shallow water table fluctuations. HS notes that these cumulative effects are primarily associated with the existing Tahmoor North operation.

311. The water balance model (see Section 6.4 below) predicted an average 2.6 ML/year (2.2%) increase in groundwater recharge ('leakage') and an average 0.8 ML/year (2.1%) decrease in discharge to Blue Gum Creek (from Lake Nerrigorang) as a result of the Project. This level of change is very small compared to natural variability in downstream catchment conditions, and in the context of the potential impacts on inflow to downstream Lake Burrigorang (Warragamba Dam), HEC indicated it would be unmeasurable or imperceptible.
312. The IESC advice on the EIS questioned the conclusion that Thirlmere Lakes would not be significantly impacted by associated with the Project. Of greatest concern to the IESC was the potential risks from regional groundwater drawdown that could occur along geological structures beyond the subsidence zone.
313. As noted above, in response to IESC's concerns, the revised Groundwater Assessment incorporated conservative assumptions in the sensitivity analysis which included treating faults as transmissive. In addition, the revised assessment modelled a hypothetical situation where the mapped length of the T2 fault (see **Figure 8**) was connected between the mine workings and the Thirlmere Lakes alluvium, as well as applying increased hydraulic conductivity parameters to this fault. HS confirmed that the model results were not sensitive to this scenario.
314. Mr Middlemis was satisfied that the sensitivity analysis confirms relatively low sensitivity to fault/lake connectivity and increased fault transmissivity. Further investigations into different model scenarios investigating hypothetical mine/fault/lake connectivity is not considered justified given that there are no mapped faults that connect the lakes to the proposed mine workings, and that most faults in the area are characterised as not transmissive (except for major faults which would have already been identified).
315. However, Mr Middlemis identified minor flaws in the modelling in relation to Thirlmere Lakes, particularly that the model only represents losing condition of the lakes and does not assess the variably losing/gaining conditions in Lake Nerrigorang. Despite this flaw, Mr Middlemis considers that *"the rates and volumes of exchange fluxes between the lakes and groundwater are relatively small, such that they would not be expected to greatly affect the impact assessment in terms of drawdowns and dewatering rates"* (pg. 6).
316. Overall, in relation to Thirlmere Lakes Mr Middlemis concluded that *"given that the Tahmoor North longwalls closest to the Thirlmere Lakes were mined (under approval) more than 15 years ago, and that the nearest Tahmoor South proposed longwalls are more than 3.5 km from the nearest lake, there appears to be a relatively low risk groundwater impact context to the proposed Tahmoor South project"* (pg. 18).
317. The Department accepts this conclusion and, as mentioned above, has recommended that a more rigorous uncertainty analysis on the potential impacts of mining the proposed longwalls on the water levels in Thirlmere lakes be undertaken, when additional data from ongoing monitoring and investigations is available. The Department has recommended that relevant findings of the Thirlmere Lakes Research Program be represented within the groundwater conceptual and numerical model reviews required as part of the Groundwater Management Plan (see below).

Groundwater Management and Monitoring

318. Tahmoor Coal has committed to utilising the existing groundwater monitoring network, and undertaking additional monitoring, to inform and facilitate operational groundwater monitoring associated with the Project. The locations of the existing groundwater monitoring sites are shown in **Figure 18**. Many of the monitoring sites have been installed since 2012 or earlier. The existing network is extensive and includes:
- 19 bores within the Tahmoor North and Western mining domains, including the installation of vibrating wire piezometers (VWPs), shallow bores within the Hawkesbury Sandstone;
 - 39 bores about the proposed Tahmoor South mining domain, including monitoring bores with dual and multi piezometer installations, shallow bores along Redbank and Myrtle Creek and bore census survey across of standing water levels (conducted in November 2019);
 - 4 DPIE Water monitoring bores at Thirlmere Lakes that monitor the shallow Hawkesbury Sandstone and/or alluvium (installed mid 2011);
 - a deep horizon water sampling bore (TBC035) for EC, oxygen, deuterium and tritium isotope sampling; and
 - 7 bores monitoring groundwater at the REA.
319. In response to recommendations made by HS, the IESC and DPIE-Water, Tahmoor Coal has committed to reviewing and augmenting the existing groundwater monitoring network to include:
- a condition assessment of existing groundwater bores and monitoring equipment, including the re-installation of at least one bore in the footprint of Tahmoor North;
 - monitoring in longwall centrelines of pre- and post-mining conditions at Tahmoor South, including packer testing and installing VWPs to assist in defining a profile of fracturing and depressurisation above longwalls;
 - shallow groundwater monitoring within Hawkesbury Sandstone (in association with surface water monitoring around Dog Trap Creek, Hornes Creek, Eliza Creek, Bargo River);
 - additional groundwater monitoring sites at or near the Thirlmere Lakes;
 - additional bore census monitoring from registered bores not previously surveyed; and
 - improved volumetric take (total mine inflow) metering and monitoring.
320. The Department considers that the existing and proposed updated groundwater monitoring programs are adequate to monitor and assess any impacts to groundwater resources associated with the Project, including make-good measures for any bores identified to be affected by the mine. The Department also considers that the programs are adequate to provide robust information for conceptualisation and model calibration/verification.
321. The Department has recommended a condition requiring a comprehensive Groundwater Management Plan (GMP) be prepared for the Project by suitably qualified and experienced persons, in consultation with WaterNSW and DPIE-Water. The GMP would be required to include detailed information on baseline data; the groundwater monitoring program; and a TARP, with management responses including investigation, mitigation and make-good measures; and a program to periodically validate the groundwater model for the Project.



Conclusion

322. The Department accepts the conclusions Mr Middlemiss that the revised Groundwater Assessment provided in the PAR was “fit for purpose”, based on “conservative assumptions” and included “sound calibration performance to multiple criteria”. However, the Department agrees that further uncertainty analysis should be undertaken in the future, when additional data from ongoing monitoring and investigations is available, including the findings of the Thirlmere Lakes Research Program.
323. The Department considers that there are sufficient entitlement shares within the Groundwater WSP to allow Tahmoor Coal to purchase WALs to account for its maximum groundwater take.
324. The Department accepts that Tahmoor Coal has extensive experience managing subsidence and groundwater impacts from over 30 years of longwall mining in the area, including make-good measures for bores identified to be affected by mining. The Department accepts that the number of bores predicted to be impacted by the Project and potentially requiring ‘make-good’ provisions (10 ‘high’ risk bores) is manageable.
325. The Department considers that Project would result in relatively low risks of groundwater impact to Thirlmere Lakes. However, the Department considers it important that potential impacts are monitored, reported and validated via a comprehensive GMP, and has recommended conditions accordingly.

6.4 Surface Water

Surface Water Environment

326. The existing Tahmoor Mine and proposed Project are located within the Bargo River catchment which covers an area of around 130 km². The Bargo River flows in a north-eastern direction to the west of the Project (690 m from nearest proposed longwall), through incised valleys and gorges to its confluence with the Nepean River, near the Pheasants Nest Weir. The Bargo River has intermittent flow in its upstream reaches, with perennial flow downstream of the Tahmoor North due to licensed discharges from the mine.
327. The headwaters of the Nepean River lie in the coastal ranges to the east of the Project. Flows in the upper reaches of the Nepean River are highly regulated by the Upper Nepean Water Supply Scheme, which incorporates four major water supply reservoirs on the Cataract, Cordeaux, Avon and Nepean Rivers.
328. These water storage reservoirs are within the declared MSA, which is managed by WaterNSW, and supply water to the Macarthur and Illawarra regions and the townships of Bargo, Picton, Thirlmere, Tahmoor, The Oaks, Buxton and Oakdale, and also provide approximately 20% of the supply to the Sydney Metropolitan Area. The proposed longwalls are located to the north of and outside the boundary of the MSA (i.e. 255 m from the south-east end of the proposed LW106B).
329. As shown in **Figure 19**, tributaries of the Bargo and Nepean Rivers traverse the Project area, in particular Tea Tree Hollow and Dog Trap Creek which are 3rd order streams (with associated 1st and 2nd order tributaries) located directly above proposed longwalls. Several headwater tributaries of Hornes Creek, which flow into Bargo River at Picton Weir, are located along the south-western boundary of the Project area. Eliza Creek, Carters Creek and Cow Creek, which

flow to the north-east to the Nepean River, are located immediately outside the Project area on the eastern boundary.

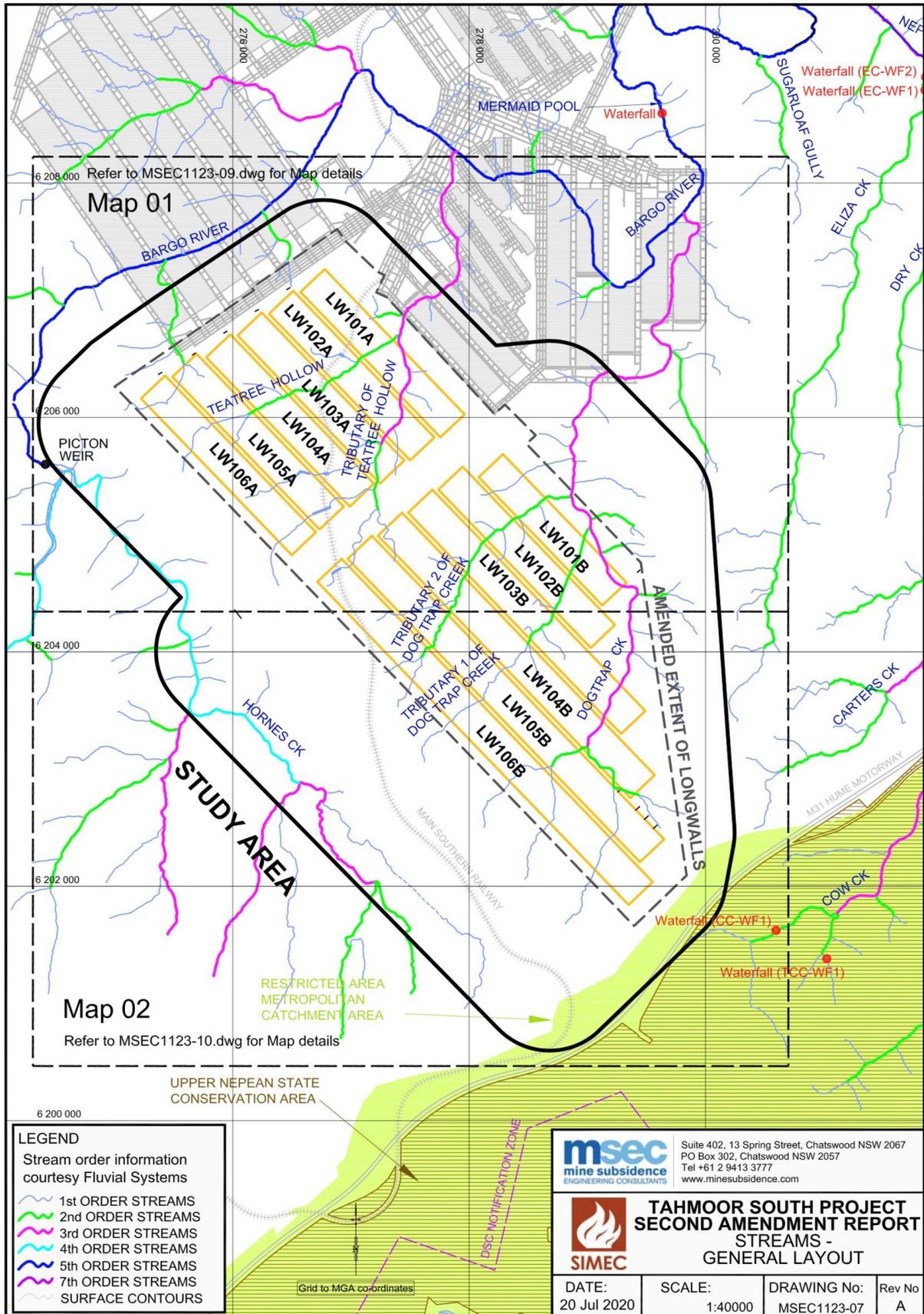


Figure 19 | Watercourses in the study area

330. Analysis of water quality data from watercourses in the vicinity of the Project indicates that elevated concentrations of some metals and salinity, and slightly low (acidic) pH values, are typical to the surface water systems within the region. This is likely caused by a combination of mining activities, increased urbanisation and runoff from agricultural activities across the Bargo River catchment.

Surface Water Assessments

331. The EIS included an assessment of surface water impacts for the Project, prepared by Hydro Engineering Consulting Pty Ltd (HEC), which comprised four components:

- Surface Water Baseline Study;
- Water Management System and Site Water Balance Report;
- Flood Study; and
- Surface Water Impact Assessment (SWIA).

The surface water impact assessments were included at Appendix J of the EIS.

332. The surface water impact assessment reports were subsequently updated and revised to reflect the amended mine plan (Appendix D to the PAR) and address issues raised by the IESC and BCS, specifically in relation to monitoring data and model calibration. A letter report detailing the limited changes to predicted surface water predictions and impacts associated with the second amended mine plan was included in Appendix D of the SPAR.
333. In particular, the Surface Water Baseline Study in the PAR was updated to incorporate additional streamflow and surface water quality monitoring data collected between 2015 and 2019. The additional streamflow monitoring data was then adopted in a re-calibration of the catchment-scale water balance model used for the project, known as the Australian Water Balance Model (AWBM). The AWBM was used to simulate surface runoff and baseflow processes for Dog Trap Creek Downstream, Eliza Creek and Bargo River Upstream in the vicinity of the project.
334. In accordance with advice from the IESC, the updated AWBM was also used to make comparisons of modelled versus observed flow behaviour at Redbank and Myrtle Creeks, which are upper headwater creeks of the Nepean River and have been undermined by LWs 22 to 31 at Tahmoor North.
335. HEC indicated that monitoring of flows and water quality in these tributaries prior to and during mining at Tahmoor North also provided a useful data set which was used to calibrate the AWBM model for watercourses within the project area, including Tea Tree Hollow and Dog Trap Creek which have a similar scale and form as Redbank and Myrtle Creeks.
336. In response to concerns raised by BCS on model calibration, HEC confirmed that the ratio of modelled to recorded streamflow volumes matched to within recommended percentage variations (ie. within 5%) for Dog Trap Creek, Eliza Creek and Bargo River Upstream². The goodness-of-fit metrics for these streams were also assessed as varying between very good,

² Based on Vaze, J., Jordan., Beecham, R., Frost, A. and Summerell, G. (2001), *Guidelines for Rainfall Runoff Modelling: Towards Best Practice Model Application*, eWater Cooperative Research Centre (CRC).

satisfactory and acceptable³. HEC indicates that these calibration outcomes illustrate the robustness of the AWBM and provide confidence in the simulated streamflow for each catchment.

337. Department accepts that incorporating additional streamflow and water quality data into the surface water modelling and assessments has led to improved predictions. However, the Department and BCS believe the model should be further validated as additional streamflow monitoring data becomes available, particularly following mining in the Tahmoor North western domain and from the BCS Thirlmere Lakes Research Program. The Department has recommended this be undertaken as part of the development of the Surface Water Management Plan.

Subsidence Predictions for Watercourses

338. As discussed in Section 6.2, non-conventional ground movements, such as valley closure and upsidence, typically affect watercourses. Watercourses potentially impacted by the Project and associated maximum predicted values of total subsidence, upsidence and closure for the watercourses are summarized in **Table 15**. These predictions were made by MSEC using both the IPM and ACARP models.
339. The Bargo River would not be directly undermined by the Project longwalls, however a 165 m long length of the Bargo River that is immediately upstream from the Picton Weir is located inside the SSA. The Bargo River is located 690 m north-west of the nearest proposed longwall (LW102A). MSEC predicted that at this distance from the amended longwall panels and with the low predicted ground movements (<20mm), the river is not expected to experience any noticeable subsidence or upsidence movements.
340. MSEC confirmed that there has been a long history of mining beneath and near the Bargo River at Tahmoor North, and that no impacts have been observed when mining has been undertaken more than 500 m away from the river. This is also considered the case for Hornes Creek, which is located over 1,180 m south-west of the nearest proposed longwall (LW106B).
341. Watercourses that lie directly over the proposed longwalls (Dog Trap Creek, Tea Tree Hollow and associated tributaries) are predicted to experience a greater range of subsidence. As indicated in **Table 15**, Dog Trap Creek and Tributary 2 to Dog Trap Creek, which would be undermined over 1.8 km and 2.1 km, respectively, and are predicted to experience the greatest subsidence effects.
342. As discussed below, based on the previous experience at Tahmoor North, it is likely that this level of subsidence would result in fracturing and surface flow diversions occurring in the sandstone bedrock along the streams, particularly those that lie directly over the proposed longwalls.

³ Based on the Nash Sutcliff coefficient of efficiency (NSE) presented in Moriasi, D.N., Arnold, J.G., Van Liew, M.W., Bingner, R.L., Harmel, R.D. and Veith, T.L. (2007). *Model Evaluation Guidelines for Systematic Quantification of Accuracy in Watershed Simulations*, *American Society of Agricultural and Biological Engineers*, 50(3): 885-900.

Table 15 | Maximum Predicted Total Subsidence, Upsidence and Closure for Streams

Watercourse	Location Description	Maximum Predicted Subsidence (mm)	Maximum Predicted Upsidence (mm)	Maximum Predicted Closure (mm)
Bargo River 4 th order	Nearest point located 690 m north-west of LW102A (not directly mined beneath)	<20	<20	<20
Teatree Hollow 2 nd order	Located directly above LW101A to LW106A (2.1 km directly mined beneath)	1,350	375	275
Tributary to Teatree Hollow 3 rd order	Located directly above LW101A to LW103A, and LW104A to LW106A (1.7 km directly mined beneath)	1,250	400	350
Dog Trap Creek 3 rd order	Located directly above LW101B, and LW103B to LW104B (1.8 km* directly mined beneath)	1,550	575	425
Tributary 1 to Dog Trap Creek 2 nd order	Located directly above LW101B LW106B (2.1 km directly mined beneath)	1,500	750	750
Tributary 2 to Dog Trap Creek 2 nd order	Located directly above LW101B to LW106B (2.1 km directly mined beneath)	1,550	525	450
Hornes Creek 4 th order	Nearest point located 1180 m south-west of LW106B (not directly mined beneath)	<20	20	<20

* includes 400m reduced length (refer to Section 2.2)

343. Changes to stream bed grade are likely to occur as a result of tilt and curvature (refer to **Table 11**). The natural grade along the stream reaches overlying the proposed longwalls varies between 5 mm/m (0.5%) and 50 mm/m (5%). MSEC predicted the maximum change in stream bed grade (increase and/or decrease) to be 1% along Dog Trap Creek and its associated tributaries and 0.8% along Teatree Hollow. As discussed below, these changes in stream gradients can potentially result in increased levels of ponding and scouring.

Subsidence-Induced Surface Water Impacts

344. Potential impacts to surface waters predicted to occur as a result of mining induced subsidence include:

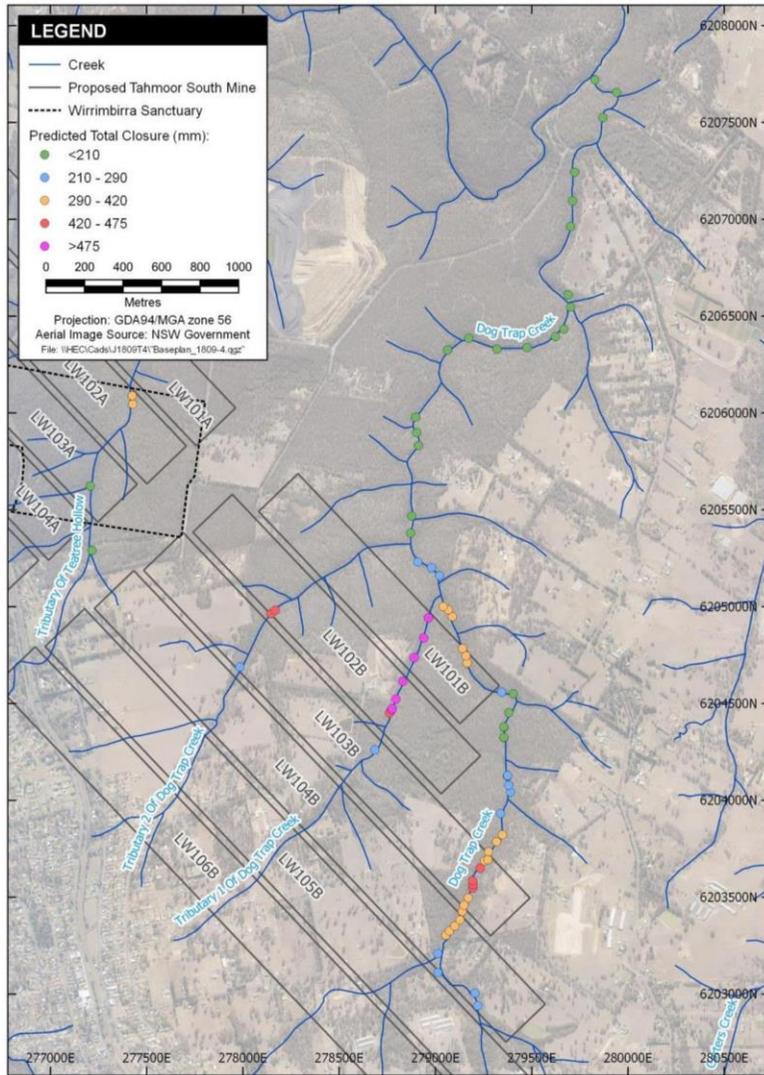
- impacts to flow rate and quantity of flow due to subsidence induced shallow fracturing and baseflow reductions;
- changes to hydraulic characteristics and the physical stability of the watercourses due to subsidence induced tilts and curvature;
- impacts to the water quality of watercourses as a result of increases in subsidence induced scour and liberation or contaminants (iron and gas releases); and

- changes to localised flooding and flood regimes due to the effects of subsidence on the geometry of watercourses.

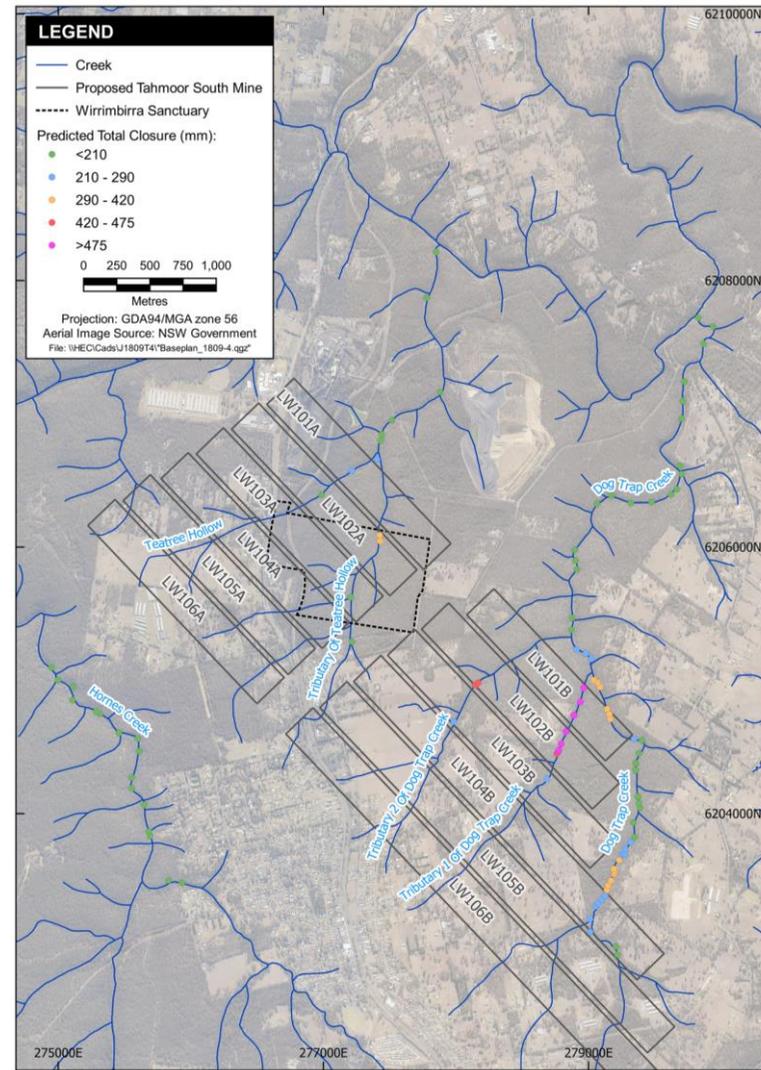
The nature and extent of these predicted impacts are discussed below.

Subsidence-induced Fracturing

345. HEC considered that where the longwalls mine directly beneath the streams, fracturing may result in surface water flow diversion. Diversion of surface flows occurs predominantly via pools where the fractures intersect the bed of pools, creating a head and supply of water to 'feed' the fracture system. Past experience from the Southern Coalfield, including preliminary monitoring results from Redbank Creek in Tahmoor North, indicates that diversion of surface water and loss of water from pools is unlikely to result in net loss of flow from catchments as redirected flow generally reappears in the surface water system further downstream, rather than being diverted into deeper strata or the mine voids. This would be the case for Tahmoor South as there is no predicted surface to seam fracturing predicted to occur as outlined in Section 6.2.
346. Based on previous experience, HEC predicted the impacts of localised diversion of surface flow in the shallow, subsurface fracture network include loss of water holding capacity of pools, reduced frequency of pools overflowing and periodic loss of interconnection between pools during dry weather within the affected reach. HEC confirmed that such impacts would most likely occur along Tea Tree Hollow, Dog Trap Creek and associated tributaries, where 62 pools have been mapped (**Figure 20**).
347. HEC used a rock bar model developed by Barbato et al (2014) to predict the extent of impacts to pools from subsidence induced fracturing associated with the Project. The model was based on past experience of mining in the Southern Coalfields, relating the likelihood of Type 3 impact on rock bars with predicted total valley closure along the length of streams. Type 3 impact is defined as *fracturing in a rock bar or upstream pool resulting in reduction in standing water level based on current rainfall and surface water flow*.
348. As discussed in Section 2.2 and shown in **Figure 20**, a large number of pools (17) were located directly above or adjacent to the original extended southern end of LW103B. HEC predicted that many of these pools had a high likelihood (40% or greater) of impact. In response to concerns raised by BCS that there was insufficient avoidance of potential impacts to 3rd order streams, the Department has recommended that the mine plan be further amended to avoid mining directly below these pools, resulting in significantly reduced potential for impact to pools along Dog Trap Creek (refer to **Figure 20A and B**).



A) Original proposed length of LW103B



B) Amended (shortened by 400m) length of LW103B

Figure 20 | Quantitative Risk of Impact to Pools

349. The modelled likelihood of impacts to mapped pools along potentially impacted watercourses is provided in **Table 16**. The location of the pools along the watercourses in relation to the proposed mine plan is provided in **Figure 20B**. Most pools predicted to be impacted by subsidence induced fracturing are located along Dog Trap Creek (41), however the majority of these pools have a relatively low (<20%) likelihood of experiencing adverse impacts. Seven (7) pools located in the second order Tributary 1 of Dog Trap Creek over LWs 101B and 102B have a higher (>40%) likelihood of impact.

Table 16 | Likelihood of Subsidence induced Fracturing to Pools

Watercourse	Number of pools above or near longwalls	Likelihood of “Type 3” Impact				
		<10% (<210mm*)	<20% (210-290mm*)	<30% (290-420mm*)	<40% (420-475mm*)	>40% (>475mm*)
Tea Tree Hollow	4	3	1	0	0	0
Teatree Hollow Tributary 1	5	2	1	2	0	0
Dog Trap Creek	41	14	14	13	0	0
Dog Trap Creek Tributary 1	9	0	1	0	1	7
Dog Trap Creek Tributary 2	3	0	1	0	2	0

* millimetres of predicted valley closure

350. Numerous public and special interest group submissions raised concerns about potential impacts to watercourses as a result of the Project, citing adverse impacts evident along Redbank and Myrtle Creeks from mining at Tahmoor North.

351. As noted above, monitoring along Redbank and Myrtle Creeks prior to and during mining at Tahmoor North has allowed the effect of subsidence from longwall mining on these creeks to be assessed. Observations of subsidence impacts to Myrtle Creek and Redbank Creek associated with LW22 to LW30 have been reported in Tahmoor North End of Panel reports and summarized in the SWIA.

352. During mining, cracking was observed in rock bars and in soils along the banks of both streams, and pools were observed to drain at times of low flow. Analysis of flow data from sites along Redbank Creek has indicated that there had also been a change in the flow behaviour at sites with time. During mining a clear change was evident at a downstream monitoring location (R11), with greater prevalence of baseflow and flow being more persistent. HEC indicated that this is considered likely associated with subsidence-induced fracturing causing underflow and delayed drainage of flow reporting to the downstream site.

353. Towards the end of mining, flow at this downstream site returned to more of an ephemeral nature with the prevalence of baseflow diminishing. HEC indicated that the most likely causes of this change include natural ‘healing’ of subsidence induced fracturing reducing the prevalence of

underflow and delayed drainage and/or closure of subsidence cracking within the previously mined area due to the mining of additional longwalls.

354. The Department agrees with BCS that it is likely that subsidence induced mining would result in impacts to some pools located within watercourses above the proposed longwalls. However, the Department notes that past experience has provided evidence that not all pools would be impacted. HEC's analysis predicts that of the 62 pools located above the proposed longwalls, around 15 pools (24%) could be impacted.
355. The Department acknowledges that Tahmoor Coal has designed a mine layout that avoids mining directly beneath significant streams in the region, including the Bargo and Nepean Rivers. The longwall mine design presented in the EIS also avoided mining under significant surface water features and Aboriginal heritage sites along Dog Trap Creek located to the south east of LW101B-102B.
356. Additional amendments to the mine plan have resulted in further avoidance and setbacks from streams, including avoiding a 3rd order length of Dog Trap Creek over previously proposed LW109B; avoiding several 1st order sections of Tea Tree Hollow, Dog Trap Creek and associated tributaries over previously proposed LW107B; setting back from Hornes Creek by removing LWs 107B and 108B from the mine plan. The reductions in the width and height of the proposed longwalls would also result in overall slightly reduced impacts to streams.
357. The Department's recommendation to reduce the length of LW103B at the southern end would further avoid directly undermining 9 pools and reducing the likelihood of impact to an additional 8 pools.
358. The Department is aware that these concessions have resulted in an overall decrease in coal volume of 15 Mt ROM coal (48 Mt ROM in EIS, to 43 Mt ROM in PAR to 33 Mt ROM in SPAR), representing a significant reduction (31%) in resource recovery.
359. In its submission on the SPAR, BCS indicated that impacts to pools and flow along 3rd order sections of some watercourses would be almost inevitable, and that insufficient justification had been provided to demonstrate that impacts would be repairable. This issue was also raised by Dr Ian Wright, who was engaged by WSC to undertake a peer review of parts of the SWIA. Dr Wright requested information and data to support the 'expected recovery' of subsidence related damage to Redbank and Myrtle Creeks.
360. In its response, Tahmoor Coal described the recent remedial works the company has completed in Pool 23 of Myrtle Creek and is continuing to implement in Pool 26 of Redbank Creek, to remediate impacts from operations at Tahmoor North. These works have been undertaken in accordance with the *Myrtle Creek & Redbank Creek Corrective Management Action Plans* (dated May 2018 and June 2019, respectively), prepared by Tahmoor Coal in consultation with the RR. Progress and monitoring results have been documented in subsequent *Quarterly Progress Reports*.
361. Remediation of the controlling rock bar at Pool 23 along Myrtle Creek was completed in early February 2020. The works consisted of drilling boreholes to 17 m below the creek bed and filling/injecting fractures using an approved polyurethane material to create a 'grout curtain wall'. As illustrated in **Figure 21**, water level monitoring over the 7 months since completion of the remediation works, shows that water levels in the pool returned following rainfall and continue to

be sustained. Before and after photographs for Pool 23 of Myrtle Creek are provided in **Photograph 1**.

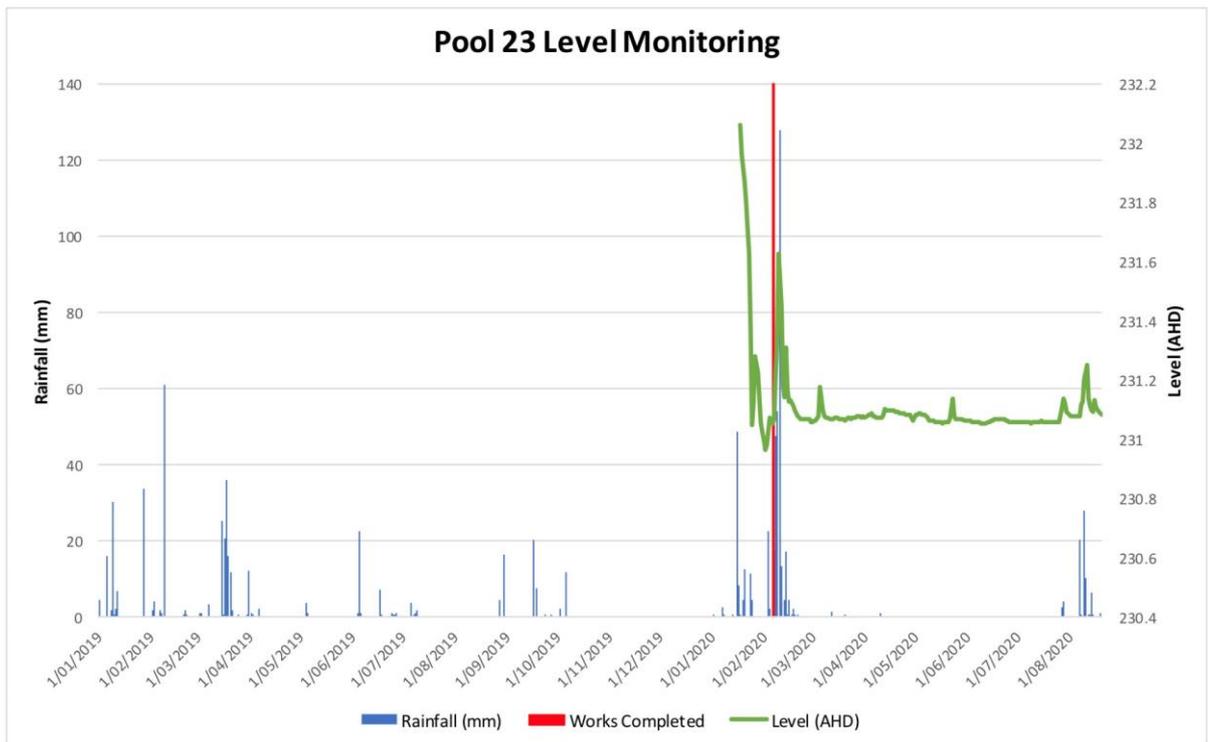


Figure 21 | Pool 23 Water Level Monitoring Results



Photograph 1 | Pool 23 post-mining and post-remediation comparison

362. The *Myrtle Creek Aquatic Monitoring Report* completed by Niche Environment & Heritage Pty Ltd (Niche) in July 2020 reported that an improvement in stream health, due to both the overall wetter conditions in February 2020 and the presence of stored water in the pool following remediation. This resulted in a rapid response from aquatic macroinvertebrates that colonised the habitat. The report notes that while it is difficult to determine what recovery of Pool 23 should look like with no pre-mining macroinvertebrate surveys, the AUSRIVAS and benthic quantitative

data suggests that Pool 23 is close to reference condition and has ecology reflective of good stream health.

363. Tahmoor Coal has confirmed that a similar remediation program to that used at Pool 23 of Myrtle Creek is currently being implemented at Pool 26 of Redbank Creek, and that a series of other impacted sites are currently undergoing shallow pattern grouting of seal surface fractures.
364. The Department supports the extensive pool remedial works being implemented by Tahmoor Coal and accepts that preliminary water level and aquatic health monitoring results suggest that the works in Pool 23 have been effective.
365. The Department also notes that there are examples in the Southern Coalfield where there has been some level of creek remediation that occurs naturally over time following mining¹. Gippel (2013) reported this occurs from fine sediments (sand, gravel and mud) commonly found in the creek beds filling fractures during flow events, thereby reducing the rate of flow through the fractures. At other mines within the Southern Coalfield, there have been reports of pools naturally recovering over time due to the sealing of fractures by deposited fine sediment (Tahmoor Colliery, 2004; Centennial Tahmoor, 2005; Centennial Coal, 2006; Centennial Coal, 2007; Xstrata Coal, 2008).
366. Tahmoor Coal committed to remediate pools along watercourses physically impacted by subsidence induced fracturing in a similar manner to the remediation programs implemented at Redbank and Myrtle Creeks. To ensure this occurs, the Department has recommended a rehabilitation objective requiring watercourses damaged by subsidence impacts to be restored to pre-mining surface flow and pool holding capacity as soon as reasonably practicable.
367. The Department also recommended a condition requiring Watercourse Corrective Action Management Plan(s) be prepared for any watercourses damaged by subsidence impacts associated with the Project. The plans must be prepared in consultation with the RR, DPIE Water, BCS and WSC, and be submitted to the Planning Secretary for approval prior to undertaking any watercourse remediation works. The plans are required to investigate remediation options; propose remediation strategies, objectives and completion criteria; and outline remediation methods, site access, materials, equipment and environmental controls necessary to ensure effective remediation outcomes.

Baseflow Reductions

368. **Table 17** provides a summary of HS's predicted maximum baseflow reductions accumulated along key watercourses. For context, the maximum baseflow reductions are compared to the existing baseflows and the mean daily flow rates at each watercourse, as estimated by HEC.
369. The maximum predicted reduction in baseflow at each watercourse is very small when compared to existing mean daily flows (0.05 - 1.3%), but represents a significant percentage of the average estimated baseflow at Dog Trap Creek (51.9%)² and a small to moderate percentage at Bargo River (1.08%), Carters Creek (1.94%) and Cow Creek (3.45%).

¹ Tahmoor Colliery (2004), Centennial Tahmoor (2005), Centennial Coal (2006), Centennial Coal (2007) and Xstrata Coal (2008).

² This predicted baseflow reduction is considered an overestimate as it does not allow for the reduced baseflows that would occur due to the shortening of the length of LW103B.

Table 17 | Predicted Baseflow Reductions at Key Watercourses

Watercourse (monitoring site)	Mean Daily		Maximum Baseflow Reduction Due to the Project		
	Flow (ML/day)	Baseflow (ML/day)	Maximum Reduction (ML/day)	% Mean Daily Flow	% Mean Daily Baseflow
Bargo River (SW-13)	30.1	4.73	0.051	0.17%	1.08%
Tea Tree Hollow (SW-22)	6.7	3.90	0.027	0.40%	0.70%
Dog Trap Creek (SW-15)	7.8	0.19	0.101	1.30%	51.9%
Eliza Creek (SW-18)	1.5	0.29	0.001	0.06%	0.28%
Carters Creek (SW-23)	3.3	0.08	0.002	0.05%	1.94%
Cow Creek (catchment extent)	2.6	0.52	0.018	0.69%	3.45%

* As modelled by HydroEngineering & Consulting (2020)

370. HEC indicated that the level of change in most watercourses would be imperceptible and very small compared to natural variability in catchment conditions and are therefore considered to be negligible. However, HEC indicates that the moderate level of change in Cows Creek may be detectable, while the predicted significant level of change to baseflows at Dog Trap Creek would be detectable, particularly during normal periods of low flow.
371. The baseflow reduction predictions for local and regional streams as a result of cumulative impacts remain very small when compared to existing mean daily flows (0.07 - 1.71%) and a small to moderate when compared to existing baseflows (1.75% - 3.69%), but are again a significant proportion of mean baseflows along Dog Trap Creek (68.53%).
372. In regard to Special Areas, HS predicted a peak decline in baseflow of approximately 0.1 ML/day (36 ML/year) in the MSA (to the east) and approximately 0.01 ML/day (<30 ML/year) in the Warragamba Special Area (to the west). For context, environment releases from Avon and Nepean Dams totalled 8,463 ML for the 12 months to November 2019. Baseflow impacts in the Special Areas are therefore considered negligible.
373. Overall, predicted maximum baseflow reductions from all watercourses (key and other) are estimated to be 0.299 ML/d (109 ML/a) for the proposed Tahmoor South, 0.780 ML/d (285 ML/a) for Tahmoor Mine (North and South combined) and 1.283 ML/d (468 ML/a) cumulatively (Tahmoor and other mining operations combined).

Surface Water Licensing

374. Under the *Water Management Act 2000* (WM Act), Tahmoor Coal is required to hold a surface water access licence (WAL) for predicted baseflow reductions within the *Nepean River Water Source* in accordance with the *Water Sharing Plan for the Greater Metropolitan Region Unregulated Rivers Water Source 2011* (Surface Water WSP).
375. The Project would result in a reduction in baseflow in 6 management zones (MZs) within the *Nepean River Water Source*, including 69.4 ML/a in Maldon Weir MZ, 17.9 ML/a in Upper Nepean Tributaries Headwaters MZ, 10.2 ML/a in Maguires Crossing MZ, 5.1 ML/a in Peasants Nets Weir to Nepean Dam MZ, 3.7 ML/a in Little River MA and 2.9 ML/a in Stonequarry Creek MZ. HEC reported that the total issue component of WALs from this water source was 15,854 ML in 2018. The total predicted surface water “take” equates to 0.69% of the total issued entitlement within the *Nepean River Water Source*.
376. The Department is satisfied that the predicted baseflow reductions are relatively minor and that there are sufficient entitlement shares within the water source to allow Tahmoor Coal to purchase WALs to account for its surface water take.

Watercourse Hydraulics and Stability

377. Subsidence can result in changes to the vertical and horizontal alignment of overlying watercourses, which in turn can result in changes to the hydraulic characteristics of the watercourses and has the potential to change erosion and sediment deposition patterns.
378. HEC used a two-dimensional hydraulic model (TURFLOW) to assess the potential effect of predicted subsidence movements on the hydraulic characteristics of overlying watercourses. The hydraulic effects due to subsidence were assessed via pre and post-mining comparisons of predicted flow velocity (ie. energy of stream flow) and bed shear stress (ie. erosional forces acting on stream bed and banks).
379. Simulated peak flow velocity along Dog Trap Creek, Tea Tree Hollow and associated tributaries is predicted to decrease in some areas and to increase in other areas. Significant increases in flow velocity (ie. between 0.7 and 1.0 m/s) were predicted in isolated sections of Dog Trap Creek overlying LWs 104B and 106B and Tea Tree Hollow over LWs 103A and 105A.
380. Simulated bed shear stresses are predicted to be relatively lower in the upper sections of the watercourses and higher further downstream. Small increases in bed shear stress (30-50 Pa) were predicted in isolated sections of Dog Trap Creek overlying the south-western (upstream) side of LW 101B, 102B and 104B. More notable changes were predicted on the south-western sides of Tea Tree Hollow above LW 102A (30-140 Pa) and 103A (30-70 Pa). MEC indicated that these have the potential to cause localised increased erosion, depending on the specific nature of the bed materials.
381. Tahmoor Coal has committed to remediate geomorphic impacts to watercourses as a result of the Project. To ensure this occurs, the Department has recommended a rehabilitation objective requiring watercourses damaged by subsidence impacts to be hydraulically and geomorphologically stable, with riparian vegetation that is the same or better than prior to mining.

Subsidence Induced Water Quality Impacts

382. Based on past experience in the Southern Coalfield, including at Tahmoor North, HEC identified potential subsidence induced impacts on water quality of the overlying watercourses, including:
- release of iron and other constituents (aluminium, manganese and zinc) from subsidence induced fracturing in watercourses due to flushing of freshly exposed fractures in the sandstone rocks; and
 - emergence of ferruginous springs, caused by enhanced groundwater inflows and oxidation of iron commonly present in shallow groundwater in the area, and resulting in iron flocs, staining of the bed and increased turbidity; and
 - drainage of strata gas and expression to the surface through the surface water potentially causing vegetation die back.
383. HEC predicts that these sorts of water quality impacts have the potential to affect Tea Tree Hollow, Dog Trap Creek and downstream watercourses. However, analysis of water quality monitoring data from Myrtle and Redbank Creeks, indicates that release of increased concentrations of iron and other constituents from fractured creek beds and emergence of ferruginous springs are likely to occur as transient spikes and be relatively localised. HEC has confirmed that no gas emissions have been identified along watercourses above the Tahmoor North longwalls. Based on past experience in other mines in the Southern Coalfield, HEC indicated that if such impacts were to occur in watercourses overlying the proposed longwalls, they are likely to be temporary and reduce over time.
384. The Department accepts that subsidence induced fracturing of creek beds may result in localised and transient increases in iron concentrations and other constituents and localised ferruginous springs.
385. The Department has recommended subsidence performance measures requiring negligible gas releases and iron staining and negligible increase in water cloudiness in watercourses as a result of the Project.

Surface Water Impacts from Operation of Surface Facilities

Mine Water Discharges

386. Potential impacts to surface waters predicted to occur as a result of the operation of the surface facilities include impacts from controlled mine discharges from licenced discharge points (LDPs), licenced overflow points (LOPs) and overflows from sediment dams.
387. HEC prepared a Water Management System & Site Water Balance report for the Project (refer to Appendix D of the PAR and Appendix D of the SPAR) which described the changes to site water management required to support the Project and provided a site water balance of the proposed water management system.
388. The current water management system at Tahmoor has one LDP (LDP 1) and three LOPs (LOP3, LOP 4 and LOP5) which are authorised under EPL 1389 to discharge treated surplus mine water and water from sedimentation basins at the pit top and REA sites to Tea Tree Hollow.
389. The existing EPL includes a requirement to enhance treatment of water prior to release via Pollution Reduction Program (PRP) 22, which involved the development and commissioning of

a water treatment plant (WTP) to reduce concentrations of arsenic, nickel and zinc in mine water released from LDP 1. The WTP was constructed in 2015, however the plant had continued performance issues and has now been deemed incapable of treating the mine water to the required quality. As a result, Tahmoor Coal has confirmed that has been investigating options to construct a new reverse osmosis (RO) based treatment plant, with a specification for the design and construction of the new plant issued in January 2020.

390. The EPA has recently varied EPL 1389 to require the installation of the new WTP and specify concentration limits for treated water (Condition E1.1). The Department notes that the construction and operation of the WTP is a direction for pollution control works under the *Protection of the Environment Operations Act 1997* (POEO Act), and therefore does not form part of the proposed Tahmoor South development application. The EPL requires the WTP to be operational prior to the commencement of secondary coal extraction in the Tahmoor South area, which is currently scheduled for September 2022.
391. The EPL requires the development of the WTP to progress through a two-stage process, firstly involving developing, commissioning and testing a pilot plant, followed by the development and commissioning of a permanent plant. The EPL also requires the Applicant to undertake an assessment of reasonable and feasible options for disposal of brine produced from RO treatment by 31 October 2021. Tahmoor Coal has confirmed that it is currently assessing the different options for the disposal of brine produced by the WTP, including disposal to a newly built facility at Port Kembla or disposal to historical Tahmoor North underground workings.
392. HEC confirmed that the proposed volumetric treatment capacity of the WTP (ie. 6ML/day) is adequate to treat the predicted mine water volume of 2,030 ML/yr. It is noted that this is marginally higher than previous discharge volumes (which ranged from 1,424 ML/yr to 1,716 ML/yr) but well within the existing EPL volumetric discharge limit from LDP 1 of 15.5 ML/day (ie. 5,657 ML/yr).
393. Numerous public and special interest group submission raised concerns about downstream water quality impacts as a result of discharges from the existing Tahmoor North operations. HEC reported that, although water quality limits at LDP 1 have historically not exceeded the previous water quality limits specified in EPL 1389, concentrations of sodium, barium and alkalinity have exceeded the ANZECC default guideline trigger values for recreational use and median concentrations of aluminium and copper have exceeded guideline trigger for the protection of aquatic ecosystems.
394. However, the Department is aware that in September 2020, Tahmoor Coal was issued a penalty notice from the EPA for the discharge of a fine-grained clay from its CHPP that was not treated. Turbidity and TSS limits in the EPL were exceeded and could be detected several kilometres downstream. Tahmoor Coal's Annual Reviews have also reported minor exceedances of total suspended particulates and/or electrical conductivity (EC) on two occasions (April 2016 and July 2014).
395. The varied EPL has set updated concentration limits for pH, EC, bicarbonate alkalinity, dissolved aluminium, arsenic, barium, copper, nickel, zinc and total nitrogen to which the new WTP must be designed to meet.
396. The Department considers that the operation of a new RO based WTP would ensure the quality of the water discharged via LDP1 into Tea Tree Hollow from the Project would improve

significantly in accordance with EPA requirements. The recently varied EPL also requires a Toxicity Monitoring Program (Condition E2.1), Aquatic Health Monitoring Program (Condition E3.1) and a Tea Tree Hollow Sediment Investigation (Condition E4.1) to investigate and address previous adverse impacts to the downstream aquatic environment as a result of historic discharges.

Discharges from sediment dams

397. Tahmoor Coal proposes to continue to use existing sedimentation dams. The only key change proposed to the water management system is the construction of two additional sedimentation dams (S11 and S12) to collect runoff from the REA expansion area. Wet weather overflows from dam S12 are predicted to average around 12 ML/year during the last few years of the mine life and would be discharged to Tea Tree Hollow. Overflows from S11 are predicted to average around 10 ML/year for the life of the mine and would be released to the Bargo River.
398. The IESC raised concerns about the potential impacts to the surface water receiving environment from overflow discharges from sedimentation basins into Tea Tree Hollow and the Bargo River.
399. In response, HEC confirmed that predicted wet weather discharge volumes from all sediment dams to Tea Tree Hollow would average 115 ML/yr, which is within the range of previous overflow volumes for the existing mine. The water quality in Tea Tree Hollow is heavily influenced by existing licensed discharge from LDP1, which in future would be controlled by treated discharge from the upgraded WTP. To further control discharge quality from the sediment dams, Tahmoor Coal has committed to design the sediment dams in accordance with Landcom (2004) and DECC (2008) guidelines.
400. Further, HEC noted that the average predicted wet weather discharge rate of 10 ML/year from proposed dam S11 is very low when compared to the mean daily flow rate in Bargo River of 10,990 ML/year (30.1 ML/day). This discharge would likely be indistinguishable from natural variability in catchment conditions. The assessment indicated that the proposed release may result in a very slight increase in the concentration of sodium and total dissolved solids at Bargo River downstream, however these concentrations would remain below the ANZECC guideline default trigger values for aquatic ecosystems (ANZG, 2018) and recreational use (ANZECC, 2000).

NorBE Predictions

401. The Sydney Drinking Water Catchment SEPP requires that a consent authority must not grant consent to a proposed development in a drinking water catchment unless it is satisfied that the proposed development would have a neutral or beneficial effect (NorBE) on water quality. As noted above, the Project has been specifically designed to avoid mining or associated activities on land within the Sydney drinking water catchment. The Department acknowledges that, as the Project is not located on land within the catchment and that any subsidence impacts that could directly affect surface water quality would be in catchments that do not flow into the MSA, the NorBE requirements do not strictly apply. Irrespective, consideration of the NorBE test is provided below.
402. The main channel of Cow Creek, which is within the MSA, is located approximately 1 km to the east of the nearest proposed longwall (LW106B) (see yellow shaded area on **Figure 19**). MSEC reports that, at this distance, the maximum predicted subsidence, upsidence and valley closure

are less than 20 mm. Accordingly, the potential for localised impacts on Cow Creek such as fracturing, and surface water flow diversion are considered extremely low.

403. As indicated above, HS predicted a peak decline in baseflow of approximately 0.1 ML/day (36 ML/ year) in the MSA (to the east) and approximately 0.01 ML/day (<30 ML/year) in the Warragamba Special Area (to the west). This predicted flow depletion is expected to be around 0.1% and <0.001% of mean daily flow from the MSA and Warragamba catchments respectively, which are considered to be very minor.
404. HS indicated that there are five WaterNSW water storage reservoirs partly or wholly within the groundwater model domain. Capture of leakage/baseflow into Lake Nepean, which is closest to the Project, is predicted to be up to 0.006 ML/d, which is considered very small. For context, environmental releases from Avon and Nepean Dams totalled 8,463 ML for the 12 months to November 2019. Baseflow impacts in the Special Areas are therefore considered negligible.
405. It is therefore predicted that the Project would have a neutral impact on water quality within the catchment and that the Project would not contravene the aims of the SEPP Sydney Drinking Water Catchment.
406. WaterNSW has confirmed that it considers that groundwater drawdown and baseflow reduction from the Project would pose a low risk to water in the Sydney drinking water catchment.

Surface Water Monitoring and Management

407. Tahmoor Coal has committed to utilising the existing surface monitoring network, and undertaking additional monitoring, to inform operational surface water monitoring associated with the Project. The locations of the existing water monitoring sites are shown in **Figure 22**. Many of the monitoring sites have been installed since 2012/13.
408. The existing network includes:
 - two years of baseline water quality, streamflow and water level monitoring at 12 watercourse locations; and
 - additional recent streamflow monitoring on Hornes Creek, Dog Trap Creek, Tea Tree Hollow and Eliza Creek.
409. In response to recommendations made by HEC and DPIE Water, Tahmoor Coal has committed to expanding the existing surface water monitoring network to include:
 - gauging stations on Dog Trap Creek and Tea Tree Hollow with enhanced low flow control weirs in order to reliably record low flows;
 - a water quality monitoring site on the Bargo River downstream of the confluence with Tea Tree Hollow and upstream of SW14;
 - conducting a geomorphology survey (baseline, during and post mining) of waterways overlying and within the 20 mm line of subsidence for each longwall;
 - monthly collection and analysis of water quality samples (increased to weekly exceedance site specific trigger values are detected);
 - a TARP for water quality exceedances, streamflow loss and loss of pool water holding capacity; and
 - continued surface water management system performance monitoring including climatic, main water transfers, off-site discharges and stored water volume monitoring.

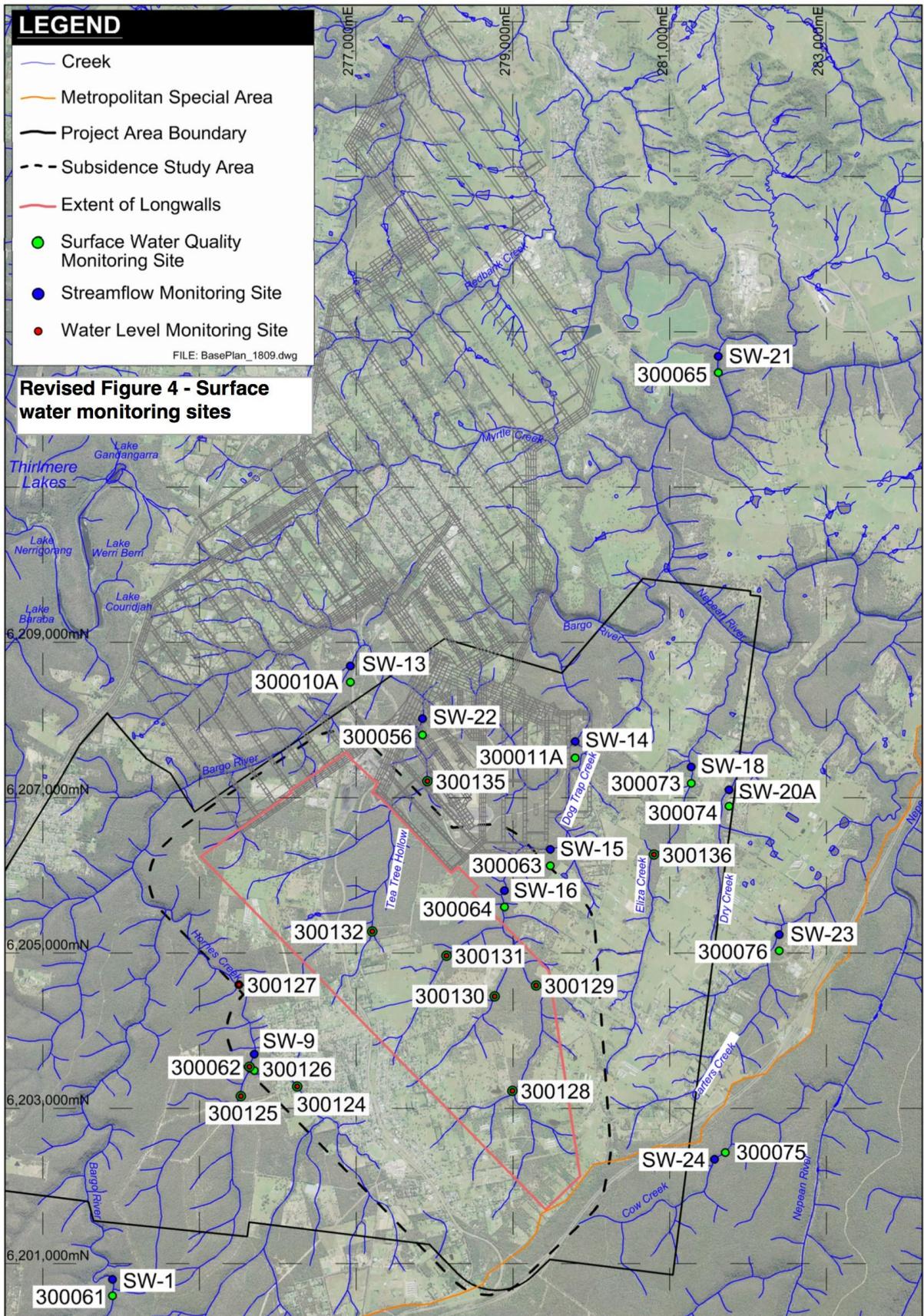


Figure 22 | Surface water monitoring sites

410. Tahmoor Coal has committed to continue monitoring of streamflow, pool water levels and water quality for a period of two years following cessation of longwall subsidence related movement in a watercourse or following completion of any stream/pool remediation.
411. The Department considers that the existing and proposed updated surface monitoring programs are adequate to monitor and assess any impacts to watercourses associated with the Project.
412. The Department has recommended conditions requiring a comprehensive:
- Surface Water Management Plan (SWMP) to manage surface water impacts and water discharges associated with surface operations sites, in consultation with the EPA; and
 - Water Management Plan (WMP) be prepared as part of the Extraction Plan process to manage subsidence induced surface water impacts, in consultation with DPIE-Water and WaterNSW.
413. Both the WMP and the SWMP would be required to include detailed information on baseline data; surface water monitoring programs; and TARPs, with management responses including investigation, mitigation and remedial measures.

Conclusion

414. The Department accepts that the surface water impact assessment has been based on up-to-date streamflow and water quality data and calibrated to an acceptable level of accuracy using actual data from Tahmoor North operations. However, the Department considers the surface water modelling should be validated in the future, when additional data from ongoing monitoring and investigations is available, and has recommended a condition requiring this be done as part of the SWMP.
415. The Department considers that there are sufficient entitlement shares within the Surface Water WSP to allow Tahmoor Coal to purchase WALs to account for its surface water (baseflow) take.
416. The Department accepts that the Project may result in subsidence induced impacts to some pools, including flow diversions and reduced pool holding capacity. Surface water along watercourses may also be locally impacted by iron and other constituents from fractured creek beds, ferruginous springs and strata gas emissions. However, the Department is confident that watercourses can be remediated and has recommended remediation activities along watercourses be implemented if impacts occur.
417. The Department accepts that controlled water discharge volumes associated with the proposed surface operations would be similar to existing volumes and that future mine water would be treated to a high standard via a new WTP.
418. The Department considers it important that potential surface water impacts are monitored, reported and validated via comprehensive surface water management plans, and has recommended conditions accordingly.

6.5 Noise

419. The EIS included a Noise Impact Assessment (NIA) prepared by EMM Consulting Pty Ltd. In response to comments made by EPA and to reflect the amended mine plans, revised reports were provided in the PAR (Appendix I) and SPAR (Appendix G).
420. The NIA was prepared in accordance with the *NSW Noise Policy for Industry 2017* (NPfI), *NSW Road Noise Policy* (RNP), the *Rail Infrastructure Noise Guideline* (RING) and in consideration of the *Voluntary Land Acquisition and Mitigation Policy* (VLAMP).

Existing Noise Setting

421. Sensitive receivers in the vicinity of the Project area are shown in **Figure 23**. A higher density of residential receivers are located to south and north of the site, reflecting the townships of Bargo and Tahmoor, respectively.
422. Other land uses surrounding the Project area include a mix of small-scale agricultural activities and a mix of rural and environmental land uses. Since the mine was first approved, residential communities surrounding the mine have grown and the mine now operates in a complex rural-suburban noise environment.
423. Noise at the site is currently regulated in accordance with noise limits set out in the Tahmoor DA 1994 consent (refer to Table 1). These limits include:
- a L_{10} level of 45 dB(A) for noise emanating from Tahmoor mine and associated facilities including the washery, stockpile area and rail loading facilities; and
 - a L_{10} level of 37 dB(A) or background + 5 dB(A), whichever is greater, for noise emanating from operations at the REA.
424. At the time the development consent was granted, the L_{10} noise index was commonly used to establish noise criteria rather than the L_{Aeq} , which has been used since the release of the *Industrial Noise Policy 2000* and subsequent NPfI. An indicative comparison between these indices can be obtained by adding 3 dB to the L_{10} .
425. The site's EPL does not contain any noise limits for existing operations. However, in response to elevated noise levels and complaints over the years, the EPA has imposed a number of Pollution Reduction Programs (PRPs) to reduce noise emissions from the site. These PRPs involved a number of mitigation and monitoring measures, including:
- a real-time noise monitoring network;
 - acoustic treatments to vent shafts, drift conveyor, transfer chutes and the reject bin;
 - GPS monitoring of REA haul trucks; and
 - replacement of mobile plant reversing alarms.
426. The site has been subject to noise complaints throughout its years of operation, the highest recorded in 2010 with over 90 complaints. The frequency of complaints has generally declined since 2010 coinciding with the implementation of PRPs. Complaints have predominantly related to vent shaft operations and pit top activities, night-time operations and peak noise level events.

Noise Assessment and Mitigation

427. The NIA categorised receiver locations surrounding the Project area into 11 Noise Catchment Areas (NCAs, see **Figure 23**) based on similar ambient acoustic environments. Project Noise Trigger Levels (PNTLs) were established for each NCA based on the intrusiveness criteria prescribed under the NPfl (ie background + 5 dB(A)). In accordance with the NPfl, background noise levels include noise generated by the existing mine, being a development that has formed part of the acoustic environment for over 10 years.

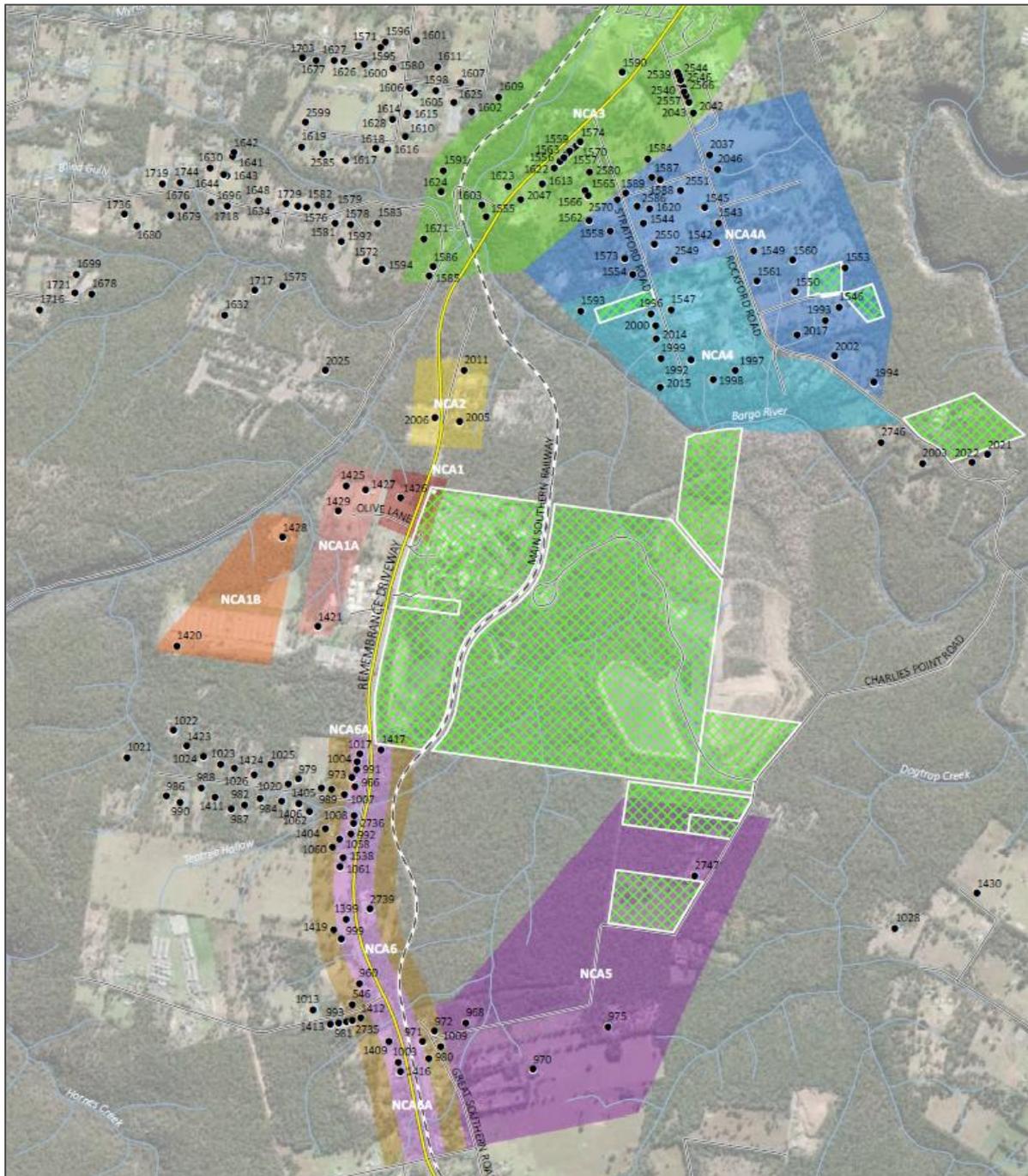


Figure 23 - NCAs and receiver locations in the vicinity of the Project

428. It is important to note that existing mine noise exceeds PNTLs at 209 receiver locations (see **Table 19** below). These exceedances reflect a legacy mining operation in a changing noise environment over time, as well as the application of contemporary noise policy.
429. Tahmoor Coal identified that noise emissions predicted to be generated from the Project would also result in the exceedance of PNTLs at a high number of receiver locations, and as such, identified a range of reasonable and feasible mitigation measures to be implemented for Project. These mitigation measures include:
- acoustic treatment of the CHPP – including reduced openings, improved cladding and engineering design solutions to reduce plant noise;
 - equipment improvements – including noise suppression for dozers, improved enclosures on compressors, laminated transfer chutes and lagging of the reject stone bin;
 - noise barriers – including a new barrier along the western side of the stockpile area and increasing the height of the existing barrier along the northern side of the rail loop;
 - restriction of operations at night– including the use of only one dozer, restricted location of dozer operations and restricting activity in the REA to the day and evening period only; and
 - restriction of construction activity at outside of standard construction hours – only drilling at ventilation shaft sites to occur during the evening and night period.
430. Modelling in the NIA indicates that the mitigation measures would result in a significant reduction of noise emissions at receiver locations (ie between 2 and 18 dB(A)).
431. With the exception of restricting construction activity at night, Tahmoor Coal contend that it would require 3 years to implement all mitigation measures. This is discussed further below.

Modelling

432. During the first two years of the Project, there would be an overlap of activities occurring under Tahmoor North mining consents (ie the continued use of the CHPP, coal stockpiling areas, train load-out facility, rail loop, site access road, ancillary workshops, and administrative buildings) and activities associated with the Project (ie site establishment, construction activities and the commencement of first and second workings). **Table 18** provides an indicative timeframe of these activities.

Table 18 | Timeframe Site Activities

Activity	Project timeframe (months)									
	0	6	12	18	24	30	36	42	48	
Tahmoor North Extraction and Processing	█									
Commencement of the Project										
Construction	█									
Site Establishment and First Workings	█									
Second Workings							█			

433. The NIA included noise modelling of various construction and operational scenarios for the Project in comparison to PNTLs and existing noise generated by the mine. However, due to the

overlapping nature of existing operations and time proposed to implement noise mitigation measures, there is complexity in determining the relevant noise criteria for the different stages of the Project.

434. During the first two years, the Project would not materially change the nature of noise generation for surrounding receivers, with the exception of noise from the construction of the ventilation shaft sites.
435. Subsequently, mining operations at Tahmoor North would be completed and operations under the Project would become the source of all noise emissions from the site. On this basis, the Department requested updated noise modelling scenarios from Tahmoor Coal (see **Appendix G**), to reflect the following scenarios:
 - Existing + Construction noise (ie noise from all activities on site until mitigation is implemented); and
 - Operational noise with mitigation (ie worst case noise emissions following the implementation of mitigation measures).

Predictions

Construction Noise

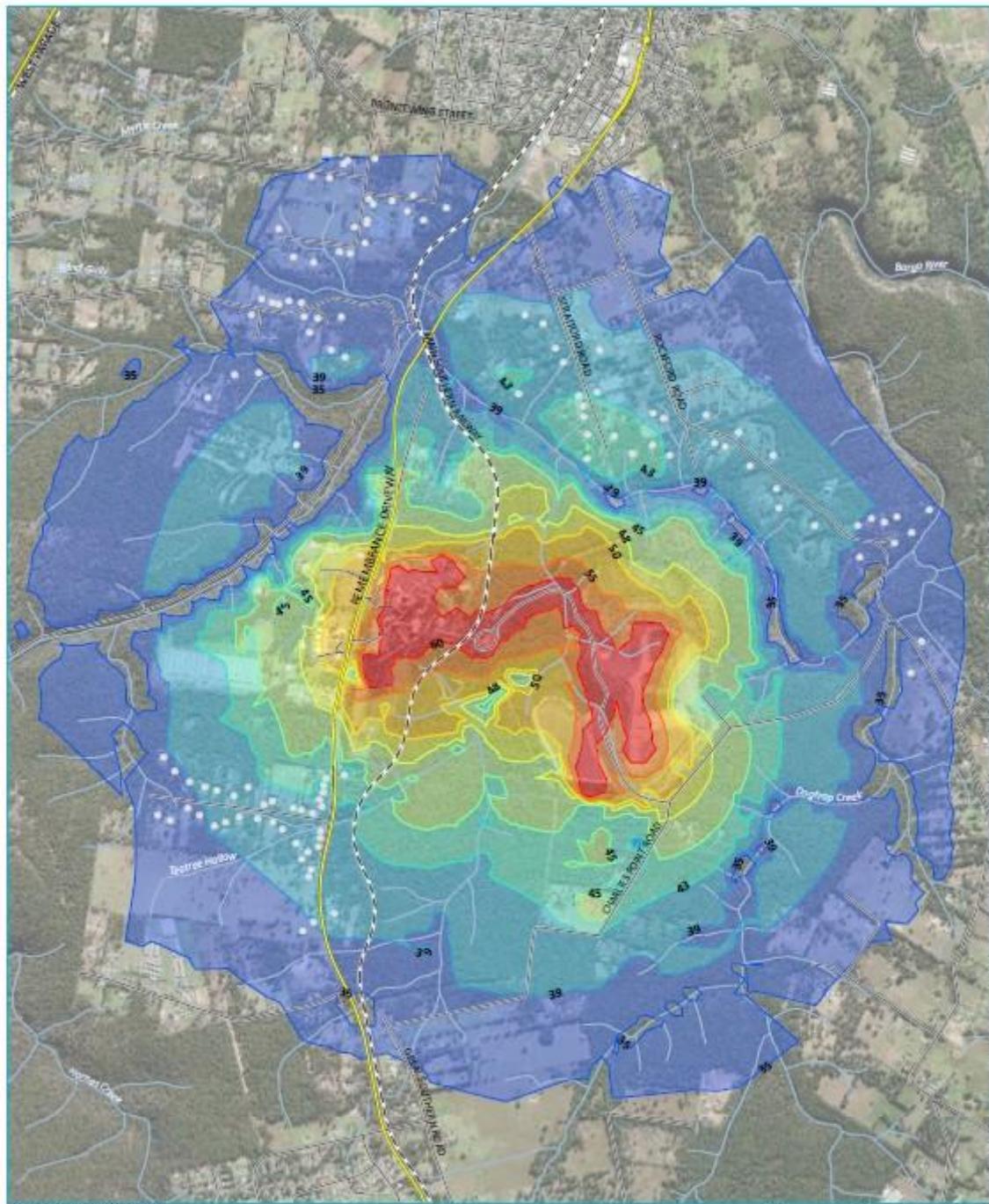
436. Tahmoor Coal has advised that construction of the two ventilation shaft sites would occur consecutively over a period of up to four years. Due to the extended duration of construction noise and the type of noise to be generated by these activities, the Department has assessed construction noise in accordance with the NPfl and VLAMP. EPA supported this approach.
437. The NIA predicted noise levels associated with construction of the ventilation shaft sites in comparison to existing mine noise from Tahmoor North (unmitigated) and PNTLs (see **Table 19** below).
438. In comparison to existing mine noise, no privately-owned receivers are predicted to experience noise level increases outside of standard construction hours (ie evening and night periods³). Tahmoor Coal advise that this is due to the level of existing mine noise and the proposed mitigation strategy to only undertake drilling during these hours and no other construction activities.
439. During the day, construction activities would increase noise emissions at 61 receiver locations, including:
 - 36 receiver locations with noise level increases between 1-2 dB;
 - 20 receiver locations with noise level increases between 3-5 dB; and
 - five receiver locations with noise level increases greater than 5 dB.
440. The Department notes that a noise level increase of up to 2 dB reflects a negligible impact that is barely perceptible to the human ear. Construction noise associated with the Project would therefore not materially change the nature of noise that has been experienced over the last four decades at the 36 identified receiver locations, and other receivers surrounding the site.

³The AQIA identified that noise levels would increase in the evening and night periods for Receiver 2747, however, this property was purchased by SIMEC.

441. Twenty receiver locations would experience relatively noticeable noise level increases (ie between 3-5 dB (A)). These receivers are primarily located along Remembrance Driveway and Charlies Point Road, proximal to the ventilation shaft sites. Noise levels at these receivers are predicted to range between 40 and 43 dB(A) $L_{Aeq\ 15min}$ but would remain at or below the relevant PNTLs.
442. Five receivers would experience significant noise level increases (ie greater than 5 dB). Noise levels at these receivers are predicted to range between 42 and 49 dB(A) $L_{Aeq\ 15\ min}$ and would exceed the relevant PNTLs by between 2 and 9 dB(A).
443. One of these receivers (Receiver 2747) was recently purchased by SIMEC and is therefore not considered any further in this assessment. Noise levels at three of the remaining four receivers (Receivers 970, 975, 1028 and 1430) are predicted to exceed the PNTL by 3 dB or greater, and as such, the Department considers that these receivers are eligible for mitigation rights in accordance with the VLAMP.
444. The Department has recommended that construction noise limits are set for those receivers predicted to experience noticeable noise level increases, with mitigation rights to be afforded to the three receivers identified above, in accordance with the VLAMP. These limits would apply only when construction activities are occurring.
445. For all remaining receivers and for all receivers during times when construction activities are not occurring, the Department considers that Tahmoor Coal should continue to operate under existing noise limits specified in Tahmoor DA 1994, until the proposed noise mitigation measures are implemented and revised project noise limits are established for all receivers. This approach is discussed further below.

Operational Noise

446. The NIA modelled worst-case noise impacts of the Project following the implementation of the proposed noise mitigation measures (see **Figure 24**).
447. **Table 19** identifies the number of receivers predicted to exceed the PNTL and categorises the significance of exceedances in accordance with the NPfl.
448. In comparison to existing noise levels, the mitigated scenario would provide a significant reduction in the number of receiver locations that would experience an exceedance of the relevant PNTL. Notwithstanding, there would still be 119 receivers that would experience an exceedance of the relevant PNTL, including:
- 62 receiver locations with negligible exceedances;
 - 47 receiver locations with marginal / moderate exceedances; and
 - 1 receiver location with significant exceedances (reduced from 6 for existing operations).
449. The Department has recommended that noise limits are set at the predicted noise levels, with mitigation and acquisition rights to be afforded to those that meet the marginal, moderate and significant thresholds, in accordance with the VLAMP. Under the VLAMP, Tahmoor Coal can also seek negotiated agreements with landowners such that noise limits would not apply subject to the terms of any agreement.



Source: EMM (2020); DWSI (2017)

KEY

- Assessment location
- Rail line
- Main road
- Local road
- Watercourse/drainage line

Evening worst case scenario noise contour range (indicative only)

- 60 < dB (A)
- 55 - 60 dB (A)
- 50 - 55 dB (A)
- 46 - 50 dB (A)
- 45 - 48 dB (A)
- 43 - 45 dB (A)
- 39 - 43 dB (A)
- 35 - 39 dB (A)

All stages - evening noise contours – indicative only, noise-enhancing weather

Tahmoor South Project
Noise impact assessment
Figure 2

Figure 24 – Worst-case noise contours – Project with Mitigation (Evening Period)

Table 19 | Number of receiver locations and associated PNTL exceedances

NCA	PNTL			No. of Receivers Exceeding PNTL Existing			No. of Receivers Exceeding PNTL Project with mitigation		
	Day	Eve	Night	Negligible	Marg/Mod	Significant	Neg	Marg/Mod	Significant
1	51	48	43	0	0	1	0	0	1
1a	47	47	43	0	0	4	2	2	0
1b	43	43	39	0	1	1	0	1	0
2	51	48	43	2	1	0	0	0	0
3	44	42	35	15	17	0	0	0	0
4	41	41	41	10	0	-	3	7	0
4a	40	40	35	6	23	0	8	0	0
5	40	39	35	4	0	0	0	1	0
6	49	42	35	4	16	0	6	8	0
6a	45	39	35	6	5	0	3	2	0
7	40	35	35	56	37	0	40	26	0
				103	100	6	62	47	1

450. Tahmoor Coal has proposed to implement the identified mitigation measures within three years of the commencement of the Project. However, the Department considers that the mitigation measures should be implemented within two years of the commencement of the Project, as:

- mitigation measures would provide a significant reduction in noise emissions from the site and should be implemented as soon as practicable;
- Tahmoor North mining operations would be concluded and all noise sources from the site would be associated with the Project, with a two year timeframe aligning closer to the commencement of longwall mining at Tahmoor South and increased production rate; and
- there is no clear justification provided by Tahmoor Coal for the proposed three year schedule, noting that if it was a greenfield site it would be expected that all reasonable and feasible measures to reduce noise would be implemented prior to activities commencing.

Reject Emplacement Activities

451. Prior to the implementation of noise mitigation measures, Tahmoor Coal proposes to continue reject emplacement activities during all periods. However, reject emplacement would only occur at heights above the existing approved limit (ie RL 300 m) in specific areas of the REA.

452. Additional modelling provided by Tahmoor Coal demonstrates that reject emplacement up to a height of RL 310 m in areas titled Stage 1 and Stage 5 of the REA (see **Figure 6**) could be undertaken within existing noise limits for the site (ie 37 dB(A) L_{A10}). However, operations at heights about RL 300 m could not occur concurrently with ventilation shaft construction activities.

453. The Department has recommended a condition to this effect, noting that following the implementation of all mitigation measures, all emplacement activities would be limited to the day

and evening period only and revised contemporary noise limits would be established for all receivers.

Sleep disturbance

454. The NIA identifies that existing maximum noise levels from Tahmoor Mine at the nearest receivers are in the order of 53 dB L_{Amax} . These noise events are predominantly generated by dozer activity or loading coal into rail wagons.
455. During the early years of the project, the source of maximum noise level events has the potential to change due to:
- activities associated with construction of the ventilation shaft sites; and
 - dozer activity on the REA, if operating above existing height limitations.
456. The NIA identifies that noise at the ventilation shafts sites during the night period would be continuous in nature (ie drilling only) and is not predicted to exceed relevant sleep disturbance criteria at all assessment locations.
457. The Department has recommended that emplacement in the REA is retained at the existing height prior to the implementation of the proposed mitigation measures, with the exception of two areas in the REA where it has been demonstrated that existing noise limits can be achieved. On this basis, there would be no change to existing maximum noise levels prior to the implementation of mitigation measures.
458. Following the implementation of the proposed mitigation measures, the frequency and level of maximum noise level events are expected to reduce and activities in the REA would be restricted to the day and evening periods only. The NIA predicts that maximum noise level events at all private receivers would remain at or below 52dB (A) L_{Amax} . On this basis, a detailed sleep disturbance assessment was not undertaken.

Low Frequency Noise

459. Low frequency noise has been a historic issue for the Tahmoor Mine and the EPA recommended that priority should be placed on mitigating low-frequency noise emissions from the CHPP.
460. The NIA identified that low frequency noise above the octave thresholds identified in NPfI exist for six receivers located in NCAs 1 and 1A (ie in the vicinity of Olive Lane). As such, modifying factors were applied to noise predictions at these receiver locations in accordance with Fact Sheet C of the NPfI.
461. Following the implementation of the proposed mitigation measures, the applicable modifying factors at these receivers would reduce from:
- 5dB(A) to 2 dB(A) during the evening and night period at receivers 1425, 1426, 1427, 1428 and 1429; and
 - 2 dB(A) to 0 during the day period at receiver 1420.
462. Nonetheless, four of these receivers are still predicted to experience marginal to significant exceedances of the relevant PNTLs. These exceedances were accounted for in operational noise predictions and relevant acquisition and/or mitigation rights have been recommended accordingly.
463. The Department notes that the proposed mitigation measures, particularly cladding of the CHPP, would contribute to the reduction of tonality or low frequency noise characteristics at nearby

receivers. The Department has recommended that these measures are implemented within two years of the commencement of the Project.

464. The Department has also recommended that the Applicant undertake regular monitoring of low frequency noise as part of its noise monitoring program and continue to investigate ways to reduce noise from the development.

Rail Noise

465. Tahmoor Coal advised that the Project would continue to utilise its existing train path allocation of four paths per day for the duration of the Project life. This path connects the mine to Port Kembla via the Moss Vale to Unanderra Railway Line.
466. The Department notes that rail line capacity and associated rail noise impacts are managed by the Australian Rail Track Corporation (ARTC), which include noise limits under an EPL.
467. The Department recognises that rail noise associated with the Project would not increase but would be extended for the duration of the Project life.
468. In order to minimise rail noise impacts as much as possible, the Department has recommended a condition requiring Tahmoor Coal to use locomotives and rolling stock that are approved to operate on the NSW rail network in accordance with the noise limits in ARTC's EPL and use reasonable endeavours to ensure that rolling stock is selected to minimise noise.

Road Noise

469. The NIA included an assessment of road traffic noise at the nearest residential properties on the three key roads affected by the Project. These roads include Remembrance Driveway, Rockford Road and Charlies Point Road (see **Figure 24**).
470. The NIA concludes that traffic noise would increase by less than 1 dB(A) at the closest receivers on Remembrance Driveway and Rockford Road, which would comply with the applicable RNP criteria (ie 2 dB(A) relative increase).
471. However, the closest receiver on Charlies Point Road is predicted to experience a noise level increase of up to 7 dB (A) L_{Aeq} (15 hour) during the day and 8 dB(A) L_{Aeq} (9 hour) during the night (see **Table 20** below).

Table 20 | Predicted noise levels - Charles Point Road

Period	Existing Noise Level (dB(A))	Proposed Vehicle Movements	Predicted Noise Level (dB(A))	Increase (dB(A))
Day 7am to 10 pm L_{Aeq} (15 hour)	46	45	53	7
Night 10pm to 7am L_{Aeq} (9 hour)	41	9	49	8

472. Tahmoor Coal advises that higher noise level increases on Charlies Point Road reflect the existing low volume of traffic on this road, and contend that total traffic noise levels would still comply with the sub-arterial noise assessment criteria of the RNP (ie 60 dB(A) L_{Aeq} (15 hour) during the day and 55 dB(A) L_{Aeq} (9 hour) during the night).

473. However, based on the low volume of traffic on this road and its location in relation to other key arterial and sub-arterial roads in the area (ie Hume Highway, Remembrance Driveway, Rockford Road and Arina Road), the Department questions whether this road is more suitably defined as a 'Local Road' under the RNP, in which case, alternative road noise criteria would apply (ie 55 dB (A) L_{Aeq} 1 hour (day) and 50 dB (A) L_{Aeq} 1hour (night)).
474. The Department notes that the highest level of traffic noise would occur from the passing of heavy vehicles. Tahmoor Coal has advised that no more than 4 heavy vehicle movements would occur in any one hour, and based on this staging, the Department considers it likely that daytime local road noise objectives would be achieved.
475. However, traffic noise predictions during the night period assume up to 5 heavy vehicle movements in/out of the ventilation shaft sites. During the night period, background traffic noise is lower, and the Department considers that incremental noise increases during this time would be more likely to affect local amenity.
476. Additionally, these movements and any associated truck activity have not been factored into the night construction noise modelling scenario, which assumes only drilling activities would occur.
477. On this basis, the Department has recommended that no heavy vehicles be permitted to enter/exit the ventilation shaft sites during the night period.
478. The Department notes that noise predictions on this road are based on peak traffic generation during the construction of the ventilation shaft sites, and upon completion, the number of vehicles travelling to these sites would significantly reduce.

Vibration

479. The NIA considered the potential vibration impacts associated with construction and operational activities of the Project.
480. Operator attended vibration monitoring was undertaken in June 2019 approximately 30 m south of the existing ventilation fan site. Peak vibration levels during the survey did not exceed 0.035 mm/s which is considered to be significantly below levels of human perception.
481. It was concluded that there is sufficient separation distance between surface facilities and ventilation shaft sites and receivers that would avoid noticeable vibration impacts.

Conclusion

482. The Department has carefully assessed the operational, construction, road and rail noise impacts of the Project, having regard to existing legacy noise issues and overlapping operations associated with completion of mining at Tahmoor North.
483. With the exception of specific noise limits associated with construction activities, the Department considers that Tahmoor Coal should continue to operate under existing noise limits specified in the Tahmoor 1994 consent, for a period of up to two years.
484. Subsequently, the Department considers it reasonable to require the implementation of all the proposed mitigation measures and the application of contemporary project noise limits in accordance with the NPfI.
485. While the Project is predicted to result in exceedances of PNTLs at 119 receiver locations, there would be a significant reduction in the number and severity of PNTL exceedances in comparison

to existing operations (209 exceedances). Additionally, the majority of exceedances would be very minor and imperceptible.

486. Marginal / moderate and significant exceedances are predicted to occur at 47 receivers, which could be managed through proactive and reactive noise management on site, in combination with at-receiver mitigation treatments, upon request.
487. Lastly, the one significantly impacted receiver would be eligible for acquisition upon request, noting that under the existing operations, 6 receivers are predicted to be significantly impacted.
488. Overall, the Department considers that noise associated with the Project could be managed through stringent conditions of consent, including a pro-active and re-active noise management system, regular noise monitoring, and continued investigation into methods to reduce noise generated by the development.
489. The EPA supported the Department's proposed conditions.

6.6 Biodiversity

490. The EIS included a Biodiversity Assessment Report (BAR), prepared by Niche Environment and Heritage Pty Ltd, to assess the terrestrial ecology, aquatic ecology and stygofauna impacts of the Project. In accordance with the SEARs and transition provisions under the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*, the BAR was prepared in accordance with the *Framework for Biodiversity Assessment (FBA)* and the *NSW Biodiversity Offsets Policy for Major Projects*.
491. The BAR was updated and revised on two occasions to reflect the amended mine plans (Appendix E and F of the PAR and Appendices E and F of the SPAR).

Direct Terrestrial Ecology Impacts

492. The Project would directly impact terrestrial ecology through the clearing of 24.32 ha vegetation (see **Figure 25**), including:
 - 10.1 ha of native vegetation associated with the construction of the two ventilation shafts (8.84 ha) and powerline easement (1.26 ha); and
 - 14.22 ha of mine rehabilitated native vegetation within the current REA footprint (which would enable the REA to increase in height, without increasing its footprint).
493. It should be noted that additional remnant native vegetation to be cleared occurs within the REA footprint, however, these areas are approved for disturbance under the existing development consent, and are not considered further as part of this assessment.

Impacts on Endangered Ecological Communities

494. The Project involves the clearance of up to 10.1 ha of '*Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest*' (PCT 1395), which aligns with the *Shale Sandstone Transition Forest in the Sydney Basin Bioregion*' (SSTF), and is listed as a Critically Endangered Ecological Community (CEEC) under both the BC Act and the EPBC Act.

495. Of the vegetation proposed for clearance, 4.12 ha is in good condition and the remaining 5.98 ha is derived native grassland. The clearing of this CEEC is associated with the ventilation shaft and transmission line infrastructure only.
496. This clearing represents around 1% of the total mapped occurrence of SSTF within the locality (ie 10 km of the Project area).

Impacts on Threatened Flora

497. The Project's direct impacts to threatened flora from vegetation clearing are shown in **Figure 25** and summarised in **Table 21**.

Table 21 | Disturbance of threatened flora

Species	No. of individuals	Listing status
Small-flower grevillea (<i>Grevillea parviflora</i> subsp. <i>parviflora</i>)	55 individuals	V* – BC Act V – EPBC Act
Bargo geebung (<i>Persoonia Bargoensis</i>)	1 individual	E* – BC Act V – EPBC Act

*V – vulnerable; E – endangered

498. The removal of these individuals would reflect a very minor reduction in relation to the species within the immediate locality (ie 0.55% and 0.14% respectively). Tahmoor Coal proposes to offset the impacts on these species in accordance with the FBA.

Impacts on Threatened Fauna

499. The BAR advised that 34 threatened and migratory fauna have a moderate or higher likelihood of occurring within the Project Area.
500. Five species-credit-species were recorded or identified with known or potential foraging habitat in the proposed disturbance area (see **Figure 25**), including the Koala, Large-eared Pied Bat, Large-footed myotis, Eastern Cave Bat and Eastern pygmy-possum. Additionally, ecosystem credits would be generated for species assumed to be present in the Plant Community Types (PCTs) proposed for clearing.
501. The BAR concludes that the Project would be unlikely to lead to a long-term decrease in the population of threatened species as there is extensive potential foraging habitat within the surrounding landscape and majority of these species are highly mobile (ie birds and microbats). The Department and BCS accept this conclusion.
502. Whilst Koalas were not detected during field surveys, areas proposed for surface disturbance form part of a primary Koala corridor. Vegetation clearing would result in minor fragmentation of potential koala habitat. However, the BAR concludes that the proposed vegetation clearing would be unlikely to impede Koala movement as no potential barriers would be erected and extensive habitat exists in surrounding areas.
503. However, due to the importance of this habitat in relation to broader regional Koala linkages, the Department has recommended that rehabilitation of disturbed areas include the re-establishment of habitat for the Koala, as well as other threatened fauna.

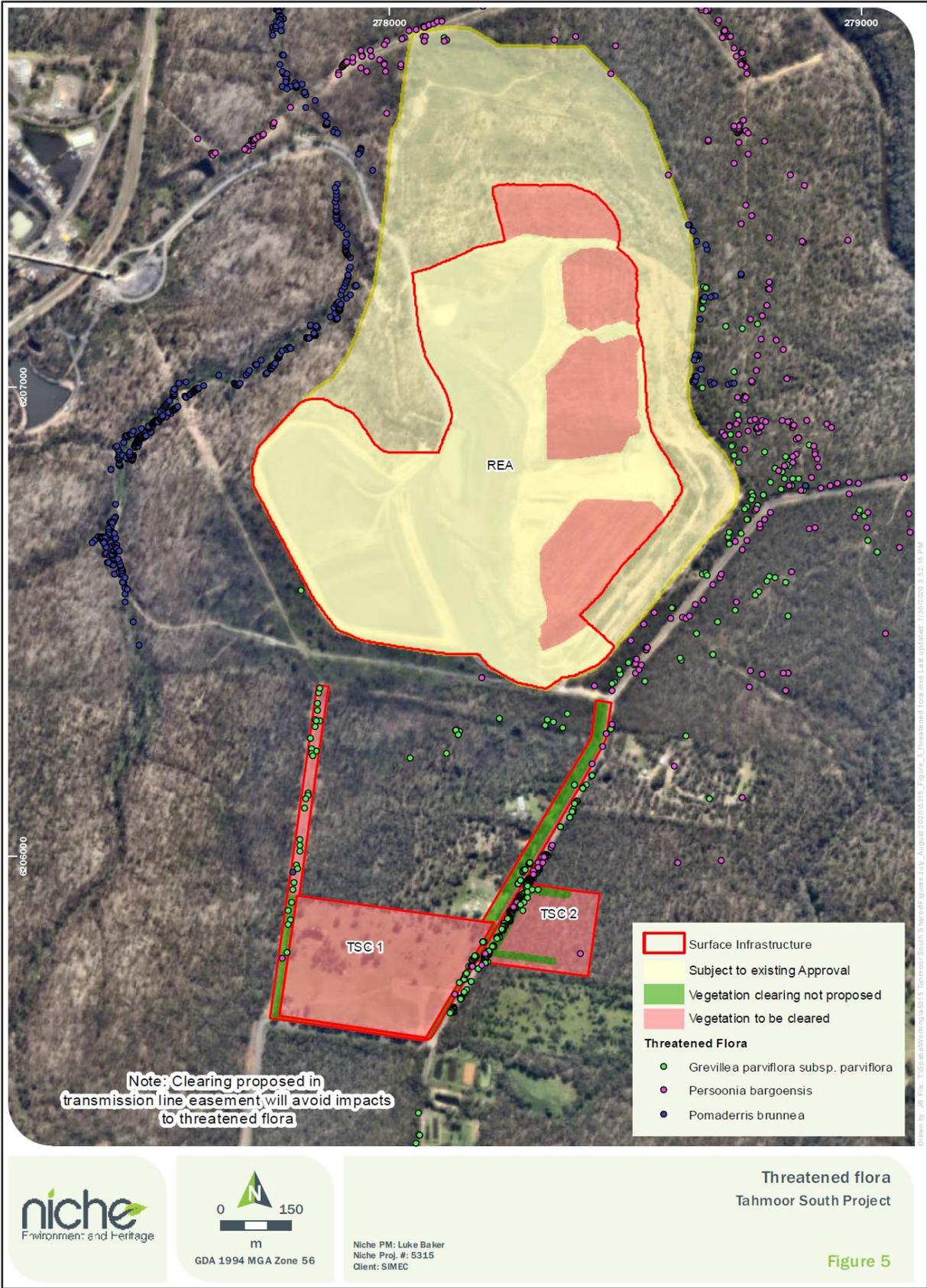


Figure 25 | Areas of direct vegetation clearing and threatened flora in the vicinity

Indirect Terrestrial Ecology Impacts

504. The Project also has the potential to indirectly affect vegetation through subsidence impacts, such as:
- surface cracking, water ponding and erosion;
 - fracturing of river and creek beds causing changes to surface water flows, and/or water quality; and
 - cliff instability, rock falls, and slippages on steep slopes.
505. The BAR identified a Subsidence Study Area of approximately 2,142 ha based on the predicted 20 mm subsidence impacts. This area contains a range of vegetation and flora species, including:
- various dry sclerophyll forest woodland / forest vegetation communities;
 - riparian vegetation along watercourses;
 - threatened flora species along creek lines, including *Pomaderris brunnea* on the banks of Tea Tree Hollow; and
 - over 250 ha of the SSTF CEEC and 9.05 ha of 'Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain' (PCT 849) that aligns to the Cumberland Plain Woodland CEEC under both the BC Act and the EPBC Act.
506. The Wirrimbirra Sanctuary also forms part of the Subsidence Study Area, which is a heritage-listed sanctuary that is home to a diverse range of flora and fauna species. Vegetation within the sanctuary was subject to significant impacts from the December 2019 bushfires.
507. Observations of past subsidence in the Southern Coalfield indicate that, apart from swamp communities, adverse impacts on vegetation are unlikely, but when they do occur, are localised and minor. The Department considers that this would also be the case for the Project, particularly as key creek lines are ephemeral in nature and woodland / forest vegetation communities are not solely reliant on groundwater for survival.
508. However, the Department considers that indirect impacts on vegetation should be carefully monitored, remediated, or offset if unexpected impacts occur that cannot be remediated. The Department has recommended a condition to this effect, including specific subsidence performance measures for watercourses, threatened species, EECs and all land affected by subsidence.

Aquatic Ecology

509. The BAR included an Aquatic Ecology Impact Assessment (AEIA), prepared by Niche Consulting Pty Ltd. This document was revised to reflect the amended mine plans (Appendix F of the PAR and Appendix F of the SPAR).

Existing Setting

510. Watercourses within the SSA provide habitat for a range of aquatic species.
511. As discussed in Section 6.4, elevated concentrations of some metals and salinity, and slightly low pH values, are typical of the surface water systems within the region, and likely due to a

combination of mining, increased urbanisation and runoff from agricultural activities across the catchment.

512. Existing mine water discharges are known to effect aquatic ecology in Tea Tree Hollow and Bargo River and there has been an increase over time in pollution tolerant invertebrates downstream of the LDP. A barium precipitate has also been observed in Tea Tree Hollow, which is a known impact of mine water discharge.
513. Four threatened aquatic species potentially occur within 10 km of the Project area, including the Macquarie Perch, Giant Dragonfly, Sydney Hawk Dragonfly and Adam's Emerald Dragonfly. However, only the Sydney Hawk Dragonfly, has potential habitat in the Project area.
514. All creeks within the Project Area have been mapped as Key Fish Habitat (KFH) based on DPI key fish habitat mapping for Wollondilly LGA (DPI 2013c) or are classified as KFH based on stream order (ie third order and above).
515. No upland swamps or High Priority GDEs were recorded within the SSA.

Predicted Impacts

516. The Project has the potential to affect aquatic ecology via hydrogeological and water quality impacts within the SSA. These impacts are discussed in detail in Section 6.3 and 6.4.

Hydrogeological Impacts

517. The AEIA identified that impacts to aquatic habitat have the potential to occur in watercourses directly undermined by the Project, particularly in Dog Trap Creek, Tea Tree Hollow and associated tributaries where there is a higher likelihood of water loss to pools.
518. No threatened aquatic ecology species listed under either the *Fisheries Management Act 1994* or the EPBC Act were recorded during the surveys and the AHIA concluded that there would be no significant impact on these species.
519. However, fracturing and the partial or total loss of water in pools could result in the localised loss of aquatic habitat (including Type 1 and 3 KFH) and impacts to aquatic flora and fauna, including native fish and macroinvertebrates. The AHIA identifies that the Project would be unlikely to change the overall ecology of affected waterways which are already subject to highly variable flows, however there is likely to be some reduction in the abundance of fauna habitat in pools as a result of baseflow reductions particularly during dry periods.
520. In accordance with the FM Act, impacts on KFH would require rehabilitation or offset to ensure that there is no net loss. The Department has recommended a range of conditions regarding monitoring, management and remediation of watercourses which are discussed in detail in Section 6.4.

Water Quality

521. The Project has the potential to impact aquatic ecology through changes to water quality in the receiving environment. In particular, the Project would continue licensed discharge of mine water into Tea Tree Hollow. The AEIA identifies that the existing presence of barium in mine water discharges has resulted in impacts on benthic macroinvertebrates by smothering the substrate and limiting habitat and the availability of food resources.

522. Tahmoor Coal has committed to:

- determining potential remediation methods to remove the impacts of the barium precipitate on aquatic habitat; and
- establishing an aquatic ecology monitoring program aimed at assessing the aquatic health impacts from the LDP discharge and that focusses on barium precipitate at Tea Tree Hollow.

523. The EPA has included these requirements under its recent variation to EPL 1389 which includes special conditions to commission a new WTP based on reverse osmosis technology. These conditions impose strict water quality discharge parameters for LDP1 (see Section 6.4), including a barium concentration limit. The Department notes that the commissioning of the new WTP and the imposition of these discharge parameters will significantly improve the quality of mine water discharges.

524. As discussed in Section 6.4, water quality issues associated with subsidence impacts would be localised and temporary in nature. However, the AEIA identified that some natural recovery of pool capacity, water quality and aquatic habitat is expected from natural infilling of cracks based on the type of substrate located upstream (ie sand, mud and cobbles).

525. DPI Fisheries requested that a water quality monitoring program is developed, including baseflow monitoring in the creeks and monitoring of iron floc entering the Bargo River. The Department has recommended conditions accordingly.

Impacts to groundwater stygofauna and hyporheic fauna

526. The Project Area includes subterranean ecosystems in both aquifers and river systems, however, community diversity across the sampled bores and hyporheic zones was considered to be low in comparison to other regions. Additionally, no subterranean ecosystems identified in sampling are listed as endangered under the TSC Act, FM Act or the EPBC Act.

527. The Stygofauna Assessment (Niche, 2014) determined the ecological value of the hyporheic sites across sampled across the Project Area to be low, with only the Cow Creek site (which is outside of the Project's 20 mm subsidence contour) identified as having a moderate ecological value.

528. The Project is predicted to have a moderate risk of impact to subterranean aquatic ecosystems, as there are possible linkages between the perched, shallow aquifers and hyporheic zones in some areas of the SSA, which could potentially be impacted by reductions in baseflow.

529. However, it was also identified that many of the sampled hyporheic sites are located on the periphery of the SSA and would therefore be at lesser risk of subsidence impacts. It should also be noted that the Stygofauna Assessment was not updated to reflect the amended mine plans, and as such, the periphery of subsidence impacts would be less than predicted.

Avoidance, minimisation and mitigation

530. As an underground mining project, which utilises mostly existing mining infrastructure, the Project has a considerably smaller surface disturbance footprint than a comparable open cut or greenfield mining project.

531. In each amended development application, Tahmoor Coal has reduced the extent of the Project's potential biodiversity impacts (see **Table 21**). In comparison to the original Project, proposed vegetation clearance has been reduced by 51 percent (ie from 49.2 ha to 24.3 ha), including a 77 percent reduction in the clearing of SSTF CEEC.
532. Additionally, the proposed mine plan has been amended to remove a number of longwall panels, which has reduced the proposed extent of indirect subsidence-related biodiversity impacts. The mine plan has also been designed to avoid mining beneath a number of watercourses including the Bargo River, Hornes Creek, Carters Creek, Cow Creek, Dry Creek, Eliza Creek and Sugar Leaf Gully. Further, the Department has required that LW103B be shortened to avoid directly undermining Dog Trap Creek and a significant number of pools.
533. As outlined in Section 2.2, the Department considers that further opportunities to avoid biodiversity impacts along creek lines are limited due to the location of existing surface facilities site and the coal resource, and the cost of further sterilisation of the coal resource against the incremental benefits of further reductions in longwall panel length.
534. To further reduce the Project's biodiversity impacts, Tahmoor Coal has committed to implement:
- a vegetation clearance protocol to avoid inadvertent impacts on fauna and habitat adjacent to approved disturbance areas;
 - a program to monitor and manage the Project's impacts on biodiversity, including threatened species and aquatic ecology;
 - appropriate weed and pest management;
 - erosion and sediment control practices; and
 - a bushfire management procedure.
535. The Department has also recommended a range of conditions to ensure that biodiversity impacts are minimised and appropriately mitigated, including:
- the development of a Biodiversity Management Plan;
 - specific subsidence performance measures for natural features, including threatened species or populations, EECs, watercourses and aquatic ecology;
 - a biodiversity component of each Extraction Plan to carefully manage and monitor the impact of second workings; and
 - rehabilitation requirements to re-establish native woodland ecosystems and habitat, feed and foraging resources for threatened fauna.

Biodiversity offset strategy

536. To offset the residual biodiversity impacts of the Project, Tahmoor Coal propose to implement a Biodiversity Offset Strategy, including the retirement of ecosystem credits and species credits, in accordance with the requirements of the BC Act.
537. **Tables 22** identifies these credit liabilities and Tahmoor Coal's proposed staged approach for their retirement.

538. Tahmoor Coal advised that it would retire credits using one or a combination of mechanisms available under the Biodiversity Offsets Scheme. The BAR identified that five landholdings owned by Tahmoor Coal could potentially be established as biodiversity stewardship sites to generate the majority of credits required. Alternative methods of retirement include purchasing credits available on the public register, or payment into the NSW Biodiversity Conservation Fund (BCF).

Table 22 | Credit Liabilities

Vegetation type / species	Offset liability (FBA credits)				
	Area (ha)	Stage 1 (Year 1)	Stage 2 (Year 2)	Stage 3 (Year 4 +)	Whole Project
Ecological communities					
PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (SSTF)	10.1	267	188	0	455
PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin	14.2	0	315	84	399
Total	24.3	267	503	84	854
Flora					
Small-flower grevillea (<i>Grevillea parviflora</i> subsp. <i>parviflora</i>)	-	0	770	0	770
Bargo geebung (<i>Persoonia Bargoensis</i>)	-	0	77	0	77
Total	-	0	847	0	847
Fauna					
Koala		17	90	0	107
Large-eared pied bat		8	46	0	54
Large-footed myotis	4.12*	15	76	0	91
Eastern cave bat		8	46	0	54
Eastern pygmy-possum		13	69	0	82
Total	4.12	61	327	0	388

*Note – species credits generated for proposed clearing of good quality foraging habitat in PCT 1395.

539. Tahmoor Coal has proposed to retire credits in three stages that align with distinct areas of vegetation clearing, including:

- Stage 1 (Year 1) - Ventilation Shaft TSC 1;
- Stage 2 (Year 2) - Ventilation Shaft TSC 2, powerline easement and majority of the REA; and
- Stage 3 (Year 4+) - remaining areas of the REA.

540. The Department notes that there is a very short timeframe between these credit retirement stages and that the credit requirements of each stage are relatively low (ie 96% of credits would be retired in the first two years). On this basis, the Department questions the need for a staged approach to offsetting, particularly considering the administrative processes associated with credit retirement.
541. The Department has therefore recommended that all credits are retired within two years of the commencement of the Project.
542. With the commencement of the BC Act on 25 August 2017, the NSW Government released a new Biodiversity Assessment Method which replaces the FBA used for this Project. As a result, the credit requirements identified above may require conversion to reasonably equivalent biodiversity credits under the BC Act to facilitate retirement under the new legislation. The Department has included a note in the conditions to reflect the policy arrangement.
543. BCS advised that it was satisfied with calculated offset liability.

Conclusion

544. The Department considers that the Project has been designed to avoid, mitigate and manage biodiversity impacts where practicable. However, the Project would result in a range of residual impacts on biodiversity through the disturbance of 24.3 ha of native vegetation, including CEECs, and threatened flora and fauna species listed under the BC Act and EPBC Act.
545. The Department has carefully considered these impacts on biodiversity values, and considers that they would be suitably managed, mitigated and/or offset under the recommended conditions of consent. Additionally, the retirement of ecosystem and species credits would sufficiently compensate for residual biodiversity impacts, in accordance with the BC Act.
546. Overall, the Department considers the impacts of the Project on biodiversity, including aquatic ecology, are acceptable.

6.7 Traffic

Existing Road Network

547. The main vehicle access to the existing Tahmoor Mine is via a T-junction intersection on Remembrance Driveway onto the Tahmoor Mine Access Road. This intersection is in close proximity to the Wollondilly Anglican School Access Road and Olive Grove Lane. A secondary access exists on the eastern side of the mine which is accessed via Rockford Road and Charlies Point Road.
548. Regionally, the existing mine is primarily serviced via a principal road network consisting of the Tahmoor Mine Access Road, Remembrance Driveway, Avon Dam Road and the Hume Highway. The principal haulage route contains two key intersections on Remembrance between the mine and the Hume Highway, at Avon Dam Road and the Mine Access Road (see **Figure 26**).
549. Existing mining operations generate approximately 766 vehicle movements per weekday. These movements include employee vehicles and heavy vehicle movements associated with various

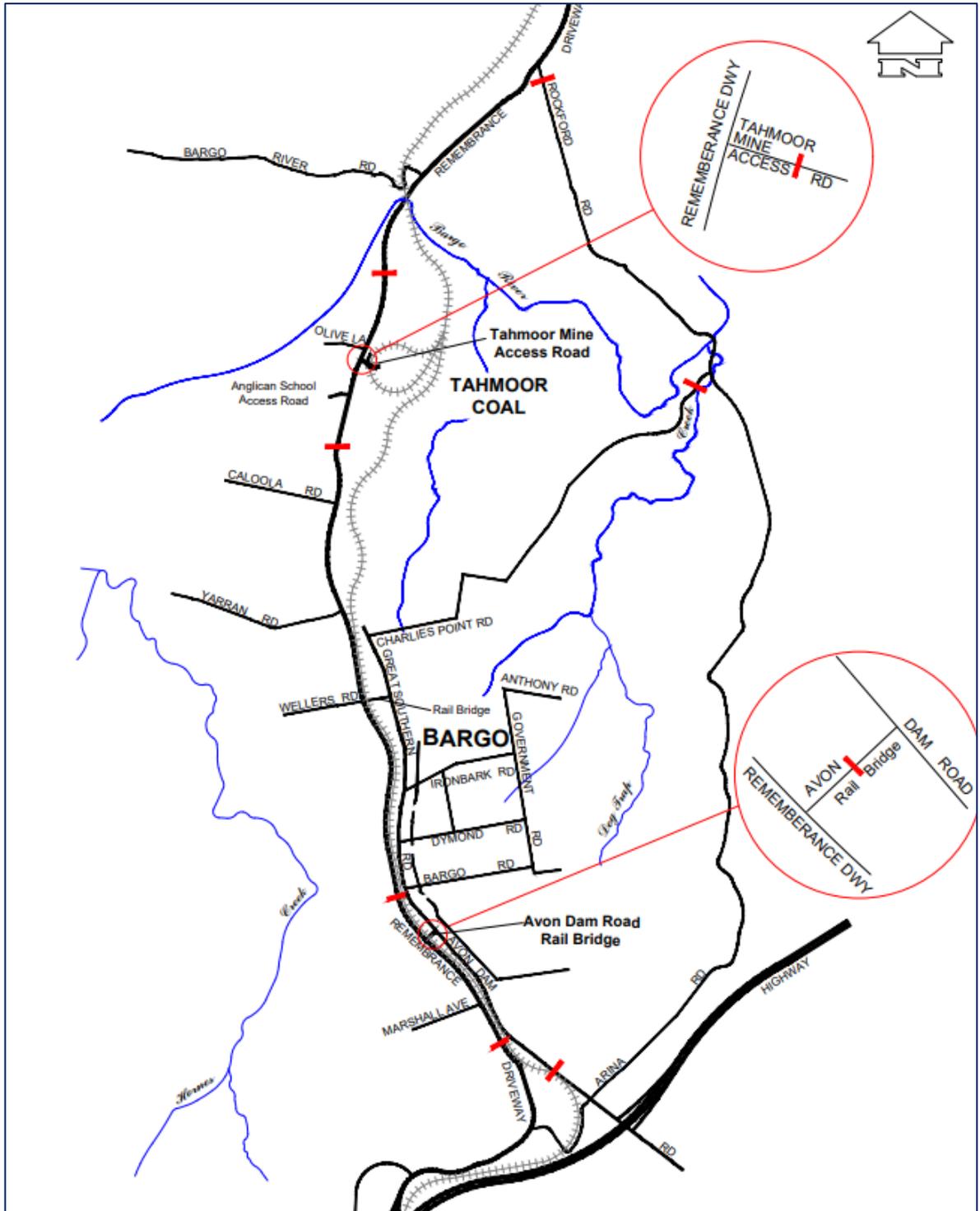


Figure 26 | Existing road network

Predicted Project Traffic

550. The EIS included a Traffic Impact Assessment prepared by Transport & Urban Planning Pty Ltd (TUP) (Appendix P of the EIS).
551. Under the Project, TUP predicted that traffic generation would increase to approximately 956 vehicle movements per weekday. Additional traffic would be generated from:
- increased employees and contractors on the site – particularly during the early years of the project (ie from 390 to 510 employees and contractors);
 - increased haulage of materials to and from the site (ie from 50,000 tonnes to 200,000 tonnes per annum), including:
 - dispatch of reject material to the Sydney Brickworks facility as an alternative method of reject disposal;
 - receipt of ROM coal from other mines to be processed/blended on site; and
 - dispatch of product coal to end users without rail access.
 - construction-related traffic – including arrival and departure of construction workers as well as delivery of materials and equipment.
552. TUP modelled the predicted performance of two key intersections on the principal road network during the AM and PM peak periods. This model was based on an ‘operational scenario’ including:
- employment related traffic of up to 119 light vehicle (LV) movements per hour; and
 - heavy vehicle (HV) haulage of coal materials of up to 16 HV truck movements per hour.
553. Intersection modelling predicted the average delay and associated Level of Service (LoS) ranking for each intersection. LoS rankings range from A to F, with A indicating minimal delay and LOS F the worst performing intersection performance with unsatisfactory delays. **Table 23** provides a summary of the predicted performance at these intersections during these peak periods.

Table 23 | Predicted performance at key intersections on the principal road network

Intersection	Existing ^c		With Project (Year 2) ^{a,b}		With Project (Year 8) ^b	
	Los	Avg Del	Los	Avg Del	Los	Avg Del
Mine Access Road	A / A	0.9 / 1	A / B	1.3 / 1.5	B / B	1.1 / 1.3
Remembrance Driveway						
Avon Dam Road / Remembrance Driveway	A / B	4.5 / 6.6	B / B	5.1 / 9.1	B / E	6.4 / 24.4

a Model assumes intersection upgraded with channelised right turn and auxiliary left-hand turn lane treatment.
b Growth factor of 3.3% per annum applied
c Existing traffic volumes based on surveys conducted in 2017.

554. Over the past five years, there have been 17 accidents in the vicinity of the Remembrance Driveway and Mine Access Road intersection. This includes two accidents involving vehicles waiting to turn right into the mine. To avoid the risk of this situation over the life of the project, Tahmoor Coal has committed to upgrading this intersection during the first two years of the Project, including:
- a channelised right turn (CHR) bay in the southern approach on Remembrance Driveway with a northbound through lane and a left turn lane into Olive Grove Lane;

- an auxiliary left-hand turn (AUL) lane in the northern approach on Remembrance Driveway; and
 - widening of the Mine Access Road to provide two approach lanes at the intersection.
555. TUP's predicted intersection performance in Years 2 and 8 was based on this upgraded intersection configuration, and following its completion, the intersection was predicted to operate at an acceptable performance standard for the life of the Project.
556. The Avon Dam Road / Remembrance Driveway intersection consists of a T-junction intersection and railway crossing with basic left and right-hand turn configuration. TUP predicted that this intersection would continue to operate at a satisfactory level during the AM period, however, poor performance (ie LoS E) is predicted in the PM peak in Year 8.
557. The Department notes that background traffic this intersection was assumed to increase relatively substantially (ie by 3.3 % per annum, resulting in a 33% increase by year 8 of the Project). However, mine-related traffic is expected to decrease after year 2 due to reduced employee numbers. It is therefore reasonable to conclude that deterioration at this intersection is directly related to the assumed background traffic growth.
558. WSC advised that the railway overbridge at the Avon Road /Remembrance Driveway intersection is managed by ARTC and John Holland Rail and that any upgrade work would be difficult due to site access and cost.
559. TUP advised that traffic from the project would represent approximately 2.1 % of the intersection's total traffic volume. The Department considers that the Project's contribution of traffic to this intersection does not warrant an upgrade by Tahmoor Coal.
560. Nonetheless, the Department notes that poor intersection performance is only predicted to occur during the PM peak period, and there is opportunity for the company to minimise project-related traffic during this period, including scheduling heavy vehicle movements outside of peak periods. To facilitate this, the Department has recommended that the operating capacity of the intersection is periodically reviewed, and that Tahmoor Coal provide detail in a Traffic Management Plan detailing options to reduce the Project's impacts on the intersection can be minimised in the future.

Construction Traffic

561. The Project would also generate construction-related traffic associated with arrival and departure of construction workers, as well as delivery of materials and equipment.
562. TUP predicted that construction traffic would include additional movements at the Mine Access Road and Remembrance Driveway intersection, including:
- up to 30 inbound LV movements between 6-7am;
 - up to and 30 outbound LV movements between 5-6pm; and
 - up to 6 HV movements per week.
563. Tahmoor Coal advised that these movements would occur outside of peak hour, and the TIA concluded that performance at the key intersections would be no worse than predicted in the operational scenario.

564. The construction of the ventilation shaft sites would also generate additional traffic on Rockford Road and Charlies Point Road, including up to:
- 26 LV trips per day (ie 13 in / 13 out); and
 - 16 heavy vehicle movements per day (ie 8 in / 8 out).
565. These vehicle movements would represent approximately 2.6% of total traffic on Rockford Road and up to 31% of total traffic on Charlies Point Road. Tahmoor Coal has advised that LV trips would occur during the early morning (5:30am to 6:30 am) and evening (5:30 – 6.30pm) periods and that a maximum of 4 HV would access the sites in any hour.
566. On this basis, the Department considers that these additional vehicle movements would be unlikely to adversely affect local traffic or and carrying capacity of these roads. Consideration of potential road noise impacts associated with these vehicle movements is provided in Section 6.5.

Mitigation and Management

567. Tahmoor Coal has committed to managing the Project’s traffic impacts through a Traffic Management Plan, that includes measures to minimise impacts on the local road network and a Driver’s Code of Conduct. The Department has recommended a condition to this effect.
568. Additionally, the Department has recommended a range of transport conditions to ensure the appropriate management of traffic and road safety over the life of the project, including:
- the completion of upgrade works to the Mine Access Road and Remembrance Driveway intersection prior to the commencement of second workings;
 - pre and post dilapidation surveys of the affected road network;
 - daily, hourly and tonnage restrictions on heavy vehicle haulage of coal and reject material;
 - periodic assessment of the performance of the Avon Dam Road and Remembrance Driveway intersection; and
 - detail of measures to minimise traffic disruption during school drop off / pick-up and peak traffic periods.
569. Subject to the recommended conditions, the Department considers the Project’s potential traffic impacts would be acceptable.

6.8 Other Issues

570. The Department has summarised its assessment of a range of other matters in **Table 24**.

Table 24 | Other Issues

Issue	Findings and Recommendation
Air Quality	<ul style="list-style-type: none"> • The EIS included an Air Quality Impact Assessment (AQIA) which was updated to reflect the amended mine plans. • The AQIA included dispersion modelling of the worst-case operating scenario, including maximum daily ROM throughput and emissions from vent shafts and flares. • EPA raised no concerns with the air quality impacts associated with the Project. <p><i>Particulates</i></p> <ul style="list-style-type: none"> • The AQIA predicts the Project would comply with applicable project specific particulate air quality assessment criteria at all sensitive receivers.

Issue**Findings and Recommendation**

- However, as background particulate matter occasionally exceeds the 24-hour PM₁₀ and PM_{2.5} criteria, further assessment was undertaken to predict whether the Project would result in additional days of exceedance at the closest receivers.
- This assessment combines the highest predicted 24-hour PM₁₀ particulate matter concentrations with the highest observed background concentrations using historical meteorological data.
- Six privately owned receivers were predicted to experience additional days of exceedances ranging from 2-5 days per year. One receiver (R10) has since been acquired by Tahmoor Coal due to predicted noise impacts associated with ventilation shaft construction. Receptor R1 (located in Olive Lane directly across from the surface infrastructure area) is predicted to have a peak project alone PM₁₀ 24 hr concentration of 46 ug/m³, just under the criterion of 50 ug/m³, with background concentrations included the criterion is predicted to be exceeded up to 5 times per year over the project life.
- The Department also notes that acquisition rights have been afforded to Receptor R1 (Receiver 1426 in the noise assessment) as a result of predicted noise impacts.
- To manage the potential dust impacts at these receivers, the EPA recommended additional real-time PM₁₀ monitors be installed close to the nearest impacted receivers (in the Olive Road area) and managed under a TARP to ensure operations are appropriately managed to minimise cumulative impact exceedances.

NOX/ volatiles

- The AQIA predicted that concentrations of nitrogen (NO and NO₂), carbon monoxide (CO) and volatile organic compounds (VOCs) associated with flaring of coal seam methane would be well below the relevant EPA criteria at all private receivers.

Odour

- The Project has the potential to generate odour emissions from mine ventilation shafts. The Department notes that there is a history of odour complaints between 2012 and 2015 from residents in the vicinity of the existing T2 upcast ventilation shaft (see **Figure 2**). At this time, Tahmoor Coal undertook additional investigation and modelling to better understand the conditions causing odour level spikes. Odour complaints subsequently reduced.
- The Department notes that this ventilation shaft is used for existing operations and that Tahmoor Coal would reduce the use of the T2 ventilation shaft from two fans to one, once the new ventilation shafts (TSC1 and TSC2) are operational. However, odour dispersion modelling assumed that two fans would continue to operate at T2 over the life of the Project in order to provide a conservative representation of potential impacts.
- The odour modelling predicted that the Project would comply with applicable odour criteria for all receivers. However, given a higher population density around the T2 ventilation shaft site odour levels are predicted to be around the odour criteria at Receiver R8. The Department notes that this would be alleviated once the T2 shaft is reduced to one fan.

Recommendations

- The Department has recommended a condition to address EPA's concerns about mitigating cumulative particulate emissions at receptors located in the Olive Road area.
- The Department has recommended that Tahmoor Coal take all reasonable steps to minimise odour emissions from the ventilation shafts and that these steps are documented and managed under the recommended Air Quality and Greenhouse Gas Management Plan. The recommended conditions also require that no offensive odour is emitted from the site.
- The Department has also recommended other robust and contemporary air quality management conditions, including requirements to:
 - minimise particulate matter, odour and fume emissions, including during adverse weather conditions; and
 - undertake continuous air quality monitoring (including the establishment of at least two new PM₁₀ monitors near sensitive receivers proximal to the surface facilities site) to ensure compliance with the air quality criteria.
- Subject to the recommended conditions, the Department considers that the air quality impacts of the Project are acceptable.

Greenhouse Gas

- The EIS included a Greenhouse Gas Assessment (GGA) updated to reflect the project amendments. The GGA estimated the Scope 1, 2 and 3 greenhouse gas emissions (GHGEs) over the life of the Project under two scenarios, including an:

Issue**Findings and Recommendation**

- 'abated' scenario – which assumed both methane flaring and power generation would be undertaken on site at the Waste Coal Mine Gas (WCMG) Power Plant; and
- 'unabated' scenario – which conservatively assumed there would be no methane flaring or power generation and that– all methane would be vented into the atmosphere.
- The Project's main sources of Scope 1 emissions include fugitive methane emissions from mine ventilation, pre and post-drainage, and flaring. Other GHGEs include consumption of diesel and petrol (Scope 1) and electricity use (Scope 2). Scope 3 GHGEs predominantly relate to the combustion of product coal by end users.
- Over the life of the Project, the maximum estimated total GHGE (unabated scenario) would total 93.8 Mt CO₂-e, including approximately:
 - 26.7 Mt CO₂ of Scope 1 (with an annual average of 2.22 Mt CO₂);
 - 1.24 Mt CO₂ of Scope 2 (with an annual average of 0.1 Mt CO₂); and
 - 65.8 Mt CO₂ of Scope 3 (with an annual average of 7.81 Mt CO₂).
- Under the 'abated' scenario, around 35% of the methane gas would be captured and either flared or used for power generation. This would reduce Scope 1 and 2 emissions by around 26.5%. However, Tahmoor Coal has advised that the concentration of methane within captured gas is not always suitable for beneficial re-use and therefore flaring and power generation is subject to variability. Additionally, gas management infrastructure on the site is operated by a third party and is therefore subject to commercial contractual considerations.
- The Department has considered the findings of the GGA (including Scope 3 emissions), having regard to both national and State-level commitments made under the *2016 Paris Agreement* and *NSW Climate Change Policy Framework (CCPF)*. Further discussion of these policies is provided in **Appendix H**.
- The total Scope 1 and 2 emissions from the Project represent approximately 0.65% of total NSW emissions and 0.2% of total Australian emissions.
- Scope 3 emissions account for approximately 70 % of the Project's total GHGEs, with the majority of these emissions arising from the consumption of coal for steel making and power generation by end consumers.
- It should be noted that GHGEs associated with burning coal to produce coke and burning coke to produce steel are accounted for at other domestic or international steelworks where that combustion takes place. In other words, one entity's Scope 3 emissions are another entity's Scope 1 emissions.
- Tahmoor Coal has advised that its coal products are and would continue to be sold to countries that are signatories to the Paris Agreement, or with equivalent domestic policies for reducing emissions.
- The Department considers that the key areas for active management of GHGEs within the development assessment and approval process for new projects in NSW are reductions in direct emissions and improved energy efficiency (ie Scope 1 and 2 emissions).
- Tahmoor Coal has committed to implementing a range of measures to minimise these emissions, with a key focus on flaring and beneficial re-use for power generation. Other proposed mitigation measures include:
 - use of ventilation control devices (to minimise fugitive emissions);
 - sealing panels to reduce methane emissions from the goaf;
 - real-time measurement of methane at the ventilation shaft, to inform reuse options; and
 - developing an Energy Savings Action Plan to minimise energy use and greenhouse gas emissions from the operation of the Project.
- The Department recognises there are no current alternatives to the use of coking coal to produce large scale raw steel materials. Whilst there is potential for the development of coal-free steel making technologies over the medium to long term, these alternatives are unlikely to be available on a commercial scale during the life of the Project.
- This view is supported by the *NSW Government's Strategic Statement on Coal Exploration and Mining in NSW (2020)*, which identified that in the medium term there would still be a strong global demand for both thermal and metallurgical coal for power generation and steel making.
- In terms of Scope 1 and Scope 2 emissions, the Department considers that the Project's direct GHGEs and bought-in electricity use would make a very small

Issue	Findings and Recommendation
Site Water Balance	<p>contribution towards anthropogenic climate change at the State, national or global scale.</p> <p><i>Recommendations</i></p> <ul style="list-style-type: none"> The Department has recommended conditions requiring the Applicant to implement all reasonable and feasible measures to maximise the beneficial re-use of methane on site and that all mitigation measures are detailed in an Air Quality and Greenhouse Gas Management Plan. <hr/> <ul style="list-style-type: none"> The average annual water supply is estimated to be around 2,900 ML largely from groundwater inflows to the mine workings. Average annual site operational water demands are estimated at around 500 ML. The site would therefore have a large water surplus averaging around 2,400 ML/yr. This compares to around an average of 1,700 ML/yr from existing operations. Most of the excess water would be treated via the proposed new WTP and discharged from the existing LDP 1 in accordance with Tahmoor Coal's EPL (1389) and also as discharges from sediment dams. Tahmoor Coal also proposes that excess water be stored in underground goaf areas of the Tahmoor North longwalls once mining in this area is completed, commencing in around 2025. The Department notes that these are average annual estimates and that excess water volumes would increase during higher rainfall years and/or greater than predicted groundwater inflows into underground workings. Modelling completed for the PAR of the 95%ile conditions indicated a risk towards the end of the original Project life that the capacity of the proposed WTP (nominal design capacity of 6 ML/day) and underground storage capacity (around 4,750 ML) may be exceeded. However, now that the Project life has been shortened by around 3 years, there would be sufficient storage capacity in the underground goaf area. The EPA and IESC questioned the quality of the water proposed to be stored underground and the risk of impacts to the underground receiving environment. Additional information documented in the RTS/ PAR confirmed that, based on the groundwater quality data, groundwater inflow quality into the Tahmoor South workings is expected to be similar to that of the groundwater inflow to Tahmoor North. As such, impacts to groundwater quality due to underground storage are considered unlikely. The EPA did not raise any further concerns on this matter in its response to the RTS/PAR. The Department notes that as the proposed storage area is not within the project application area, in order for Tahmoor Coal to lawfully store any excess water from the Tahmoor South development in the underground goaf areas of the Tahmoor North Mine, the Applicant would be required to modify the existing development consent for the Tahmoor North Mine (67/98) to allow this activity. The water balance modelling also included scenarios incorporating additional WTP capacity of 1.5 and 3 ML/day which significantly reduced reliance on underground storage. Subject to closely monitoring groundwater inflow and climatic conditions experienced at the mine excess water would be appropriately managed through a combination of goaf water storage and discharge from the upgraded WTP. The Department notes that RO plants are modular in nature with additional capacity able to be readily installed. The Department also notes that the current LDP 1 volumetric discharge limit is 15.5 ML/day which is well in excess of the predicted discharge volumes. <p><i>Recommendations</i></p> <ul style="list-style-type: none"> The Department has recommended that the Applicant be required to prepare a Site Water Balance as part of the Water Management Plan and ensure that any discharges from the site are undertaken in accordance with the requirements of the POEO Act, including the discharge limits (quality and quantity) set in the EPL.
Sewage Treatment Plant	<ul style="list-style-type: none"> Several public representations on the Project raised issues associated with the existing Sewage Treatment Plant (STP) at the surface facilities, including concerns about the existing effluent discharge arrangement via LDP1. Tahmoor Coal has committed to upgrade the existing STP as part of the Project. The upgraded STP is proposed to have a peak capacity of 61 kL/day and would be designed and constructed to produce effluent of a suitable quality to enable discharge via LDP 1 or to be used in future for irrigation of the REA. The Department considers this would further improve the quality of water discharged via LDP 1 and ensure protection of the downstream aquatic environment.

Issue	Findings and Recommendation
	<ul style="list-style-type: none"> Tahmoor Coal has committed to commissioning the STP prior to the commencement of secondary extraction associated with the Project. <p><i>Recommendations:</i></p> <ul style="list-style-type: none"> The Department has recommended a condition accordingly. In addition, the Department has recommended a condition requiring on-site sewage treatment and disposal be managed in accordance with the requirements of EPA and WSC.
Flooding	<ul style="list-style-type: none"> Subsidence has the potential to affect flood prone areas as a result of changes in slope and cross section geometry of watercourses and their floodplains. Results of flood modelling indicated that predicted subsidence would result in some localised minor changes to flooding in overlying watercourses for events up to the 1% Annual Exceedance Probability (AEP) level. The largest increases in flood inundation were predicted to occur in mostly undeveloped, open areas in the upper reaches of Dog Trap Creek, and are therefore not predicted to result in any significant flooding impacts on built features. The Department notes the IESC advice indicating that it has “<i>confidence in assessment of the relative impacts on the flood risks estimated by the modelling and agrees that the likely impacts on flooding risk due to mining activities is low</i>”.
Aboriginal Heritage	<ul style="list-style-type: none"> The EIS included an Aboriginal Cultural Heritage Assessment (ACHA) with updated assessments completed for the PAR and SPAR. The ACHA identifies that the Project area was a significant cultural precinct for Aboriginal people in the past, particularly due to the density and diversity of sites within Dog Trap Creek. There is one Open Camp Site of low archaeological significance located within the footprint of the TCS2 ventilation shaft site with 2 artefacts found adjacent to an access road. At the request of BCS further test excavation was undertaken and no additional artefacts were found. The broader SSA contains an additional 29 Aboriginal sites of low (23), moderate (2) and high (4) archaeological significance. These sites include rock shelters, art sites, axe grinding grooves and a scared tree. The majority of these sites are located directly above or in close proximity to Longwalls 101B to 103B, including a cluster of rock shelter sites along Dog Trap Creek. Sites of high archaeological significance include four rock shelter sites with artwork located along Dog Trap Creek to the south east of Longwall 102B. Predicted levels of vertical subsidence for Aboriginal sites ranges between 50 mm and 1550 mm, with tilt between 0.5 and 10 mm/m. Tahmoor Coal advises that these subsidence predictions have the potential to impact Aboriginal sites through fracturing of bedrock, shear movements along bedding planes, minor deformation of cliff faces and rock instability. However, the AHIA categorises the likelihood of significant harm to these sites as low. The AHIA also identifies that earthworks associated with subsidence remediation of watercourses may also have the potential to harm Aboriginal sites. Tahmoor Coal has proposed to implement mitigation and management measures, including: <ul style="list-style-type: none"> during detailed design of the TSC2 ventilation shaft site seek to avoid disturbance of the identified site. In the event that direct disturbance cannot be avoided, salvage measures would be implemented in consultation with Registered Aboriginal Parties and a qualified archaeologist; pre and post-mining subsidence monitoring of Aboriginal sites within the SSA; developing a specific heritage management plans in consultation with Registered Aboriginal Parties and BCS; and implementing trigger action response plans to identify and respond to adverse subsidence impacts. <p><i>Recommendations:</i></p> <ul style="list-style-type: none"> In response to concerns raised by BCS that there was insufficient avoidance of potential impacts to 3rd order streams, the Department has recommended that Longwall 103B be further amended to avoid mining directly below Dog Trap Creek, with the commencing position to be reviewed by the Planning Secretary, subject to further stream/riparian features assessment. As discussed in Section 2.2, this recommendation would result in significant environmental benefits while maintaining the economic viability of the Project. It would reduce the likelihood of impacts to 17 pools, avoid directly undermining a

Issue	Findings and Recommendation
	<p>further 2 Aboriginal heritage sites and reduce the risk of impact to an additional 3 Aboriginal sites.</p> <ul style="list-style-type: none"> • The Department has also recommended conditions to ensure the Project's impact on Aboriginal cultural heritage is appropriately managed, including: <ul style="list-style-type: none"> - specific subsidence performance measures for all identified heritage items; - the preparation of a Heritage Management Plan under each Extraction Plan; and - operating conditions regarding protection of Aboriginal heritage including requirements for unexpected finds. • Overall, the Department recognises that the Project has the potential to impact a number of Aboriginal heritage sites within the SSA. However, it is considered that these impacts can be appropriately managed and mitigated subject to the recommended conditions.
Historic Heritage	<ul style="list-style-type: none"> • The EIS included a Historic Heritage Assessment (HHA) with updated reports prepared for the PAR and SPAR. • 24 heritage sites were identified within the SSA with six sites directly located over the proposed longwall panels, including the Bargo Cemetery, Kaylinya Gardens, Old Coomeroo Homestead, Wellers Road Overbridge, Great Southern Road and the Wirrimbirra Sanctuary. • These sites are classified as having local heritage significance, with the exception of the Wirrimbirra Sanctuary, which is an item on the State Heritage Register. • Predicted levels of vertical subsidence for these sites ranges between < 20 mm and 1300 mm, and tilt between 0.5 and 4 mm/m. • MSEC predicted that these levels of subsidence have the potential to result in minor impacts on these sites, including: <ul style="list-style-type: none"> - cracking of brick and concrete surrounds, and internal linings; - dislodgement of internal weather boards; and - impacts on awnings and column support. • The remaining 18 sites lie within the broader SSA, with the majority located to the west of LW106B within the township of Bargo and include historic built features such as houses, homesteads, cottages, a post office, a public school and railway infrastructure. Additionally, the Tahmoor Colliery itself is a locally listed item under the Wollondilly LEP. • Predicted levels of vertical subsidence for all of the sites was less than <20 mm, with the exception of one weatherboard cottage and one brick homestead which had predicted levels 40 mm and 50 mm, respectively. • Due to the low levels of predicted subsidence, the SubIA identifies that these sites would experience negligible or minor impacts, in which restoration works could be undertaken to maintain heritage values. • As discussed in Section 6.2, Wirrimbirra Sanctuary is a historical conservation area that contains a range of heritage items including a number of built features (visitors centre, cottages, ancillary structures etc), animal pens, structured paths, water bodies and relics. • Nine structures within the Sanctuary were destroyed in the December 2019 bushfires, including five cabins, the education and laboratory buildings, amenities block and a shed. Approval to rebuild the structures at the sanctuary is being sought through WSC and SA NSW. • Subsidence impacts within the Sanctuary are predicted to be variable, however, the HHA concludes that most features would experience negligible subsidence impacts or environmental consequences. The exception to this is for the visitors centre, two cottages, two ancillary structures and a well, which are predicted to have minor impacts including non-structural cracking of walls, concrete floors or ceilings. • A Statement of Heritage Impact (SoHI) prepared for the Sanctuary (Appendix O of the SPAR) concluded that impact on heritage items could be managed without loss of value. • Tahmoor Coal has proposed to implement mitigation and management measures, including: <ul style="list-style-type: none"> - undertaking pre-mining conditional and structural assessments of locally significant heritage items within the SSA; - developing specific heritage management plans in consultation with property owners for all locally significant items; - undertaking mitigation strengthening measures as required, prior to mining;

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	<ul style="list-style-type: none">- ongoing monitoring of ground and building movements as well as regular visual inspections of surface features; and- implementing TARPs to identify and respond to adverse subsidence impacts. <ul style="list-style-type: none">• Due to potential long-term impacts on the Wurrumbirra Sanctuary, Heritage NSW recommended that the proposed longwalls be relocated outside the State Heritage Register curtilage and an adequate buffer zone be identified around the curtilage. However, the Department does not consider this warranted, given subsidence impacts on heritage items and structures within the Sanctuary are predicted to be minor or negligible, and able to be monitored and, if necessary, repaired. <p><i>Recommendations:</i></p> <ul style="list-style-type: none">• The Department has recommended a number of conditions to ensure the Project's impact on heritage features are appropriately managed, including:<ul style="list-style-type: none">• specific performance measures for all identified heritage items, including the Wurrumbirra Sanctuary;• the preparation of a Heritage Management Plan under each Extraction Plan, including pre and post mining condition assessments of heritage items within the SSA; and• TARPs for all natural, heritage and built features subject to specific performance measures.• Overall, the Department recognises that the Project has the potential to impact a number of heritage items within the SSA. However, it is considered that these impacts can be appropriately managed and mitigated subject to the recommended conditions.
Economics	<ul style="list-style-type: none">• The SPAR included an updated Economic Impact Assessment (EIA) incorporating a Cost Benefit Analysis (CBA) and a Local Effects Analysis (LEA) to estimate the net benefits of the project to the State and the local benefits to the Wollondilly region.• The EIA was prepared in accordance with the <i>Guidelines for the economic assessment of mining and coal seam gas proposals</i> (NSW Government, 2015) (Economic Guideline) and the associated Technical Notes.• The EIA does not account for the Department's recommended amendments to shorten Longwall 103B. However, it is considered this reduction (ie approximately 0.35 Mt of the 33 Mt) would not significantly affect the Project's net benefit in net present value (NPV) terms.• For NSW, the EIA estimated that the Project would result in:<ul style="list-style-type: none">- direct benefits of \$215 million NPV, including royalties of \$131.5 million NPV;- indirect benefits of \$450 million in NPV terms, comprised of \$217 million of worker benefits and \$233 million of supplier benefits;- indirect costs of \$0.11 NPV for greenhouse gas emissions; and- an overall economic benefit of \$664.9 million NPV.• Tahmoor Coal advised that allowance has been made in the Project's estimated capital expenditure for environmental costs including, subsidence compensation, rehabilitation, surface water remediation works, compensatory water supply measures, biodiversity offsets and noise mitigation works. It should also be noted that the installation of the upgraded WTP was not factored into the EIA as this is an existing obligation under the site's EPL.• The LEA focused on the net economic impacts of the Project on the Wollondilly region of NSW. The Project would directly provide ongoing employment for 245 workers and purchase goods and services from suppliers located in the region. The LEA indicated a total estimated net benefit of \$137.5 million in NPV terms to local suppliers and employees in the Wollondilly local area. This benefit assumes:<ul style="list-style-type: none">- \$100.3 million in benefits to local workers, assuming that 45% of the mine's direct employees are located in the local area; and- \$32.5 million in benefits to local suppliers, assuming that 12.9% of the inputs to production are supplied from the region.• The EIA included a sensitivity analysis of the LEA which indicated a lower bound net benefits of \$129.8 million in NPV terms and an upper bound estimate is \$146.2 million in NPV terms.• The Department commissioned the Oxford Economics (Oxford) to provide an expert review of the EIA. Overall, Oxford considered that the CBA was broadly consistent with the Economic Guidelines, but identified several areas requiring further consideration. Key issues identified included the:

Issue	Findings and Recommendation
	<ul style="list-style-type: none"> - calculation of benefits to workers should be excluded from the CBA as it is unlikely that the entire Project's workforce would be drawn from the non-mining sector or that workers would be employed in occupations other than mining if the mine did not exist; and - allocation of Scope 1 and 2 greenhouse gas emission costs to NSW (only) when the global cost of such externalities is calculated as \$102.3 million NPV. <ul style="list-style-type: none"> • The Department also commissioned Minecraft Consulting Pty Ltd to conduct a review of the proposed mine plan and analyse the economic opportunities and limitations of alternative mine plan options. This review advised that bord and pillar or partial extraction would not be economically viable and that further restrictions on longwall mining (ie reduced panel width or resource extraction) would significantly reduce the Project's overall benefit. The review concluded that the proposed mine plan should enable the mine to continue operating and provide benefits to the State of NSW for the life of the project. • Of the public and special interest group submissions received in support of the Project, 76% (53 submissions) cited local employment opportunities as a positive outcome of the Project. The Project is expected to require an operational workforce of 510 employees and contractors during the early stages of operation, as well as an additional short-term construction workforce. • The Department accepts that the Project would generate a significant number of direct and indirect jobs, and that a significant percentage of the workers would reside in the local and regional area. Further, the Department expects that a large proportion of workers' salaries would be reinvested and circulated within the region. • However, the Department also agrees with findings from Oxford that the calculation of worker benefits should be excluded from the CBA as it is highly likely that the Project's workforce would comprise workers from the mining sector, including those employees currently working at the mine. • The Department recognises that there is inherent uncertainty in estimating costs and benefits over the life of a mine. However, when considering conservative assumptions, including a zero worker benefits and the global proportion of greenhouse gas emission costs⁴, the Department considers that the project would still result in significant economic benefits to local and regional areas, and to the State of NSW. As such, the Department considers the project justified from an economic efficiency perspective.
Social	<ul style="list-style-type: none"> • The EIS included a Social Impact Assessment (SIA) prepared by AECOM and updated assessments provided in the PAR and SPAR. • The SIA was undertaken generally in accordance with the Department's <i>Social Impact Assessment Guideline for State significant Mining, Petroleum and Extractive Industry Development (2017)</i> (SIA Guideline). • Key stakeholders were consulted during the preparation of the SIA including residents of Bargo and nearby receivers, local community groups, Registered Aboriginal Parties and WSC. • Key issues raised in consultation included adverse impacts on natural features and heritage values in the surrounding landscape and impacts on amenity, infrastructure and health associated with subsidence, noise, dust and other key operating features of the Project. • Stakeholders also identified positive social outcomes of the project related to local employment and increased opportunities for community investment. • The Department has carefully considered the environmental impacts of the Project as outlined in this assessment report. Generally, these impacts are within the relevant criteria, or else mitigation and management strategies are proposed to reduce the impact to acceptable levels set under NSW Government policy. • The Department acknowledges that people may experience these impacts differently and that there would likely be some residual amenity impacts to the community. However, the Department considers that the specialist assessments and additional

⁴ The apportionment of greenhouse gas emission costs to NSW only is consistent with the Technical Notes supporting the Department Economic Guideline.

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information provided by Tahmoor Coal satisfactorily address the environmental social impacts of the Project.

- The SIA identified that there was a high likelihood of stress and anxiety impacts associated with subsidence impacts on private properties and bores. In particular, psychological stress may result from actual or anticipated property damage or water supply loss, as well as hardship and disturbance associated with the timing, duration and process of reparation and compensation claims.
- As discussed in Section 6.2, to mitigate these impacts, Tahmoor Coal propose to:
 - distribute information packages to affected residents following the approval of each Extraction Plan, including information on potential subsidence impacts and the subsidence claims process;
 - consult affected groundwater users in determining suitable 'make-good' provisions;
 - employ dedicated personnel to engage and support property owners prior to, during and after the active subsidence period.
- To further mitigate the social impacts of the project, Tahmoor Coal has proposed to:
 - continue engagement with the community through a Community Consultative Committee, regular community information days and opinion surveys;
 - continue contributions to the local community through the Tahmoor Corporate Social Involvement Plan, including contributions to community partnerships and initiatives; and
 - establish a Voluntary Planning Agreement with WSC, that would contribute 1% of the project's capital investment value (approximately \$3.4 million) towards upgrades at the Bargo Sportsground. Council advised that this agreement is supported in principle, with final terms to be agreed and established in an executed agreement following further consultation.
- The Department notes that the Tahmoor Colliery has been operating in the community for over four decades and that the project presents an extension to existing operations, as opposed to a new development.

Recommendations:

- The Department has recommended Tahmoor Coal prepare a Social Impact Management Plan (SIMP) in consultation with WSC, local affected communities and key stakeholders. The SIMP would detail:
 - measures to avoid, minimise and mitigate negative social impacts associated with the project, including specific measures to minimise stress-related impacts and impacts resulting from mine closure;
 - measures to enhance the project's positive impacts, by detailing opportunities to support community services and facilities; and
 - a stakeholder engagement strategy to evaluate and implement social management and mitigation measures over the life of the project.
- Additionally, the Department has recommended the establishment of a Community Consultative Committee in accordance with the Department's *Community Consultative Committee Guidelines: State Significant Projects* (2019), a requirement to frequently publish relevant documentation on the company's website, and a community hotline and complaints register.
- The Department considers that with the implementation of the mitigation measures proposed for the various environmental impacts, the extent of actual and perceived social impacts could be appropriately managed.
- Overall, the Department considers that with these measures in place the Project would not significantly impact the local community.

Human Health

- In its submission on the EIS, NSW Health recommended that a Health Impact Assessment (HIA) be prepared for the Project to assess potential impacts to human health in relation to air quality, noise, water and social wellbeing. A HIA was subsequently prepared by Environmental Risks Sciences Pty Ltd (ERS) as documented in the PAR.
- The HIA concluded that:

Issue	Findings and Recommendation
	<ul style="list-style-type: none"> - emissions of dust and emissions from the operation of the flare (nitrogen dioxide, carbon monoxide and VOCs as hydrocarbons) would pose no health risk issues of concern; - the potential for adverse health impacts within the off-site community associated with noise generated by the Project is considered to be low; - the potential for adverse health impacts within the off-site community associated with impacts to surface water and groundwater as a result of the Project is considered to be negligible; and - employment opportunities associated with the Project have the potential for a range of health benefits. <ul style="list-style-type: none"> • Based on the HIA, NSW Health accepted the potential for adverse health impacts within the off-site community as a result of the Project are low to negligible. NSW Health emphasised the importance of ongoing community consultation with the local community. <p><i>Recommendations:</i></p> <ul style="list-style-type: none"> • The Department has recommended conditions requiring compliance with strict noise and air criteria, as well as the preparation and implementation of monitoring and management plans for air, noise, surface water and groundwater. • In addition, the Department has recommended conditions requiring Tahmoor Coal to keep the local community informed about the progress and specific aspects of the Project; record handle and respond to all complaints; and establish and operate a Community Consultative Committee.
Rehabilitation and Mine Closure	<ul style="list-style-type: none"> • The EIS included a <i>Conceptual Mine Closure Plan</i> (CMCP) prepared by SLR. The CMCP was subsequently revised to reflect the project amendments, primarily in relation to the retention of the existing REA footprint and the increase in the height of the REA. • Tahmoor Coal developed rehabilitation and mine closure objectives for the site, including commitments to: <ul style="list-style-type: none"> - undertaking progressive rehabilitation as soon as practicable; - minimising the potential for water and wind induced erosion; - creating a stable and self-sustaining landform by re-establishing native vegetation; - revegetating areas to match surrounding vegetation communities, where appropriate; - minimising the risk of environmental harm from seepage; and - providing for public safety following mine closure. • Tahmoor Coal proposed that all existing mine-related infrastructure would be removed from the surface facilities and ventilation shaft sites, and that the affected land would be returned to as close to a pre-mining land use as possible (predominantly native bushland). The proposed final landform is shown in Figure 7. • As discussed in Section 6.6, to avoid expanding the REA into the SSTF CEEC, Tahmoor Coal proposed to increase the existing approved height of the REA by 20 m. This would result in the clearing of existing rehabilitated vegetation and potentially increased erosion risks associated with steeper grades. To prevent erosion and assist with groundcover establishment, Tahmoor Coal Proposed that most of the REA would be reshaped to 10 degrees (18%) or less. • RR sought further information on several aspects of the REA design, including target vegetation communities; opportunity to emplace reject material on the northern part of the REA to improve rehabilitation outcomes in that area; design of the surface water drainage network to manage erosion and downstream sedimentation; make-up of the reject material; and quantity and source of capping material. • In its response, Tahmoor Coal committed to incorporating this information in a Rehabilitation Strategy which it proposed would be prepared post-determination. <p><i>Recommendations:</i></p> <ul style="list-style-type: none"> • The Department accepts that detailed information on rehabilitation strategies can be prepared post-determination. The Department has recommended that Tahmoor Coal prepare a comprehensive Rehabilitation Strategy in consultation with the RR, DPIE Water, BCS and WSC within 6 months of the commencement of the Project. The Rehabilitation Strategy must build upon rehabilitation objectives listed above and in the project approval, and include details of: <ul style="list-style-type: none"> - target vegetation communities and species to be established within the proposed revegetation areas;

Issue	Findings and Recommendation
	<ul style="list-style-type: none"> - the design of the surface water drainage network on the final landform; - the capping design of the REA as well as the quantity and source of capping material; - investigations into opportunities to refine and improve the final landform over time, including the configuration of the REA; and - a post-mining land use strategy. • The Department has recommended targeted and comprehensive rehabilitation objectives, including requirements to: <ul style="list-style-type: none"> - incorporate relief patterns and drainage structures that mimic natural topography and mitigate erosion risks; - establish habitat, feed and foraging resources for threatened fauna species, local vegetation connectivity and wildlife corridors; - maintain hydraulically and geomorphologically stable watercourses, with aquatic ecology and riparian vegetation that is the same or better than prior to mining; and - restore pre-mining surface flow and pool holding capacity. • In addition, the Department has recommended that a Rehabilitation Management Plan be prepared for the Project, in accordance with the conditions imposed on the mining lease(s) associated with the development under the <i>Mining Act 1992</i>. RR supports the recommended conditions.

7 Evaluation

571. The Department has carried out a detailed assessment of the merits of the Project, having regard to all Tahmoor Coal's project documentation (EIS, PAR, SPAR and associated responses and additional information) and submissions from the NSW government agencies, and members of the public and special interest groups. The Department has also considered advice on the Project from the IESC and independent experts.
572. The Department has also considered the objectives of the EP&A Act, including ESD principles, and relevant considerations under section 4.15 of the EP&A Act.
573. The Department considers that substantial amendments have been made to the original mine plan to significantly reduce subsidence impacts to built and natural features, as well as biodiversity and noise impacts, while maintaining the economic viability of the Project.
574. The Department has recommended a comprehensive and precautionary suite of conditions to ensure that the Project complies with contemporary criteria and standards, and that residual impacts are effectively minimised, managed, offset and/or compensated for. In particular, the Department has recommended conditions requiring:
- additional safeguards be offered to homeowners whose houses experience significant and/or prolonged damage as a result of mine subsidence movements, including offering property acquisition as an option for compensation, rather than repair or rebuild;
 - a comprehensive bore census and provision of 'make good' on the predicted incremental and cumulative impacts to water supply bores;
 - rehabilitation objectives requiring watercourses damaged by mine subsidence to be restored to pre-mining surface flow and pool holding capacity and remain hydraulically and geomorphologically stable;

- compliance with strict noise criteria and application of mitigation measures and acquisition rights for residences adversely impacted by noise generated during both construction and operational phases of the Project;
- improved groundwater and surface water monitoring; and
- regular review of the groundwater model for the Project.

575. The recommended conditions were provided to key NSW Government agencies and their comments were taken into account in finalising them. Tahmoor Coal has reviewed and accepted the recommended conditions. The Department considers that the conditions reflect current best practice for the regulation of underground coal mining projects. A copy of the recommended consent is provided at **Appendix J**.

576. The Department recognises the relationship of the coal resource to the existing approved operations, and the synergies this presents for utilising existing infrastructure and reducing the capital costs.

577. The Department also considers that the Project would result in significant economic benefits to the local and regional areas and to the State of NSW and is therefore justified from an economic efficiency perspective.

578. The Department has carefully weighed the environmental impacts of the Project against the significance of the Project's identified coal resource and the wider socio-economic benefits associated with extending the operation of the Tahmoor Mine for a further 10 years. On balance, the Department considers that the benefits of the Project outweigh its residual costs, that the Project is in the public interest and is approvable, subject to the strict conditions of consent.

579. This Assessment Report is hereby presented to the Commission for determination, noting that the Minister for Planning and Public Spaces has requested that the Commission conduct a hearing into the carrying out of the Project prior to determination.



17/12/2020

Steve O'Donoghue
Director
Resource Assessments



17/12/2020

Mike Young
Executive Director
Energy, Industry and Compliance

Appendices

Appendix A – Environmental Impact Statement

See Departments website at:

<https://www.planningportal.nsw.gov.au/major-projects/project/10966>

Appendix B – Project Amendment Report & Response to Submissions

See Departments website at:

<https://www.planningportal.nsw.gov.au/major-projects/project/10966> *Review of Tahmoor South*

Appendix C – Second Project Amendment Report & Response to Advice

See Departments website at:

<https://www.planningportal.nsw.gov.au/major-projects/project/10966>

Appendix D – Submissions

See Departments website at:

<https://www.planningportal.nsw.gov.au/major-projects/project/10966>

Appendix E – Agency Advice

See the Department’s website at:

<https://www.planningportal.nsw.gov.au/major-projects/project/10966>

Table E – Agency and local government advice

E1 – Agency advice		
	EIS advice	E1_A-1
Biodiversity and Conservation Division	PAR advice	E1_A-2
	SPAR advice	E1_A-3
	EIS advice	E1_B-1
Environment Protection Authority	PAR advice	E1_B-2
	SPAR advice	E1_B-3
	EIS advice	E1_C-1
Heritage NSW	PAR advice	E1_C-2
	SPAR advice	E1_C-3
	EIS advice	E1_D-1
DPI Agriculture	EIS advice	E1_D-1
DPI Fisheries	EIS advice	E1_E-1
	SPAR advice	E1_E-3

E1 – Agency advice

	EIS advice	E1_F-1
DPIE Crown Lands	PAR advice	E1_F-2
	SPAR advice	E1_F-3
DPIE Water and Natural Resources Access Regulator	EIS advice	E1_G-1
	PAR advice	E1_G-2
	SPAR advice	E1_G-3
NSW Health	EIS advice	E1_H-1
	PAR advice	E1_H-2
Resources Regulator	EIS advice	E1_I-1
	PAR advice	E1_I-2
	SPAR advice	E1_I-3
Rural Fire Service	EIS advice	E1_J-1
Regional NSW – Mining, Exploration and Geoscience	EIS advice	E1_K-1
	PAR advice	E1_K-2
	SPAR advice	E1_K-3
Subsidence Advisory NSW	EIS advice	E1_L-1
	PAR advice	E1_L-2
	SPAR advice	E1_L-3
Transport for NSW (including Roads and Maritime Services)	EIS advice	E1_M-1
	PAR advice	E1_M-2
	SPAR advice	E1_M-3
WaterNSW	EIS advice	E1_N-1
	PAR advice	E1_N-2
	SPAR advice	E1_N-3

E2 – Local Government Advice

	EIS advice	E2_A-1
Wollondilly Shire Council	PAR advice	E2_A-2
	SPAR advice	E2_A-3
	VPA advice	E2_A-4
Wingecarribee Shire Council	EIS advice	E2_B-1

Appendix F – IESC Advice

See Departments website at:

<https://www.planningportal.nsw.gov.au/major-projects/project/10966>

Appendix G – Additional Information

See Departments website at:

<https://www.planningportal.nsw.gov.au/major-projects/project/10966>

Table G – Additional Information

G1 – Independent Expert Advice	
G1-1	Oxford Economics – Peer Review of Economic Impact Assessment (April 2020)
G1-2	MineCraft Final Report – Review of Proposed Mine Plan (Oct 2020)
G1-3	Groundwater Assessment Independent Review (April 2020)
G2 – Tahmoor Coal Supplementary Advice	
G2-1	Response to Request for Information No. 1 – 14 Sep 2020
G2-2	Response to Request for Information No. 2 – 23 Oct 2020
G2-3	Response to Request for Information No. 3 – 4 Nov 2020
G3 - Other	
G3-1	EPL 1389 - Notice of Variation (December 2020)
G3-2	SA NSW Claims Guideline

Appendix H – Consideration of EPIs

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

Non-discretionary development standards for mining (Clause 12B)

The Department has considered the cumulative noise, cumulative air quality, air blast overpressure, ground vibration and aquifer interference associated with the Project. The Department is satisfied that:

- a range of additional noise and air quality mitigation measures would be implemented and that the Project would comply with the relevant noise and air quality standards, with the application of mitigation and acquisition measures under the VLAMP;
- no blasting is proposed therefore no air blast overpressure or ground vibration is predicted; and
- groundwater impacts associated with the Project have been assessed against the *Aquifer Interference Policy* and the Project is predicted to comply with the Level 2 minimal impact considerations for water table decline and depressurisation in a 'highly productive groundwater source', with the implementation of specific compensatory measures for impacts to water supply from bores.

Compatibility of proposed mine, petroleum production or extractive industry with other land uses (Clause 12)

The Department is aware that mining at the Tahmoor Coal Mine has been undertaken for over 40 years and that since this time urban development has developed in the vicinity of the surface facilities site. Rural residential properties now surround the site, with higher density housing on the outskirts of Tahmoor and Bargo to the north and south, respectively.

The Project represents a continuation of historic and existing land use. The Project proposes significant mitigation and improvements to the surface facilities site and operational measures to minimise impacts to the surrounding community. This includes range of additional noise and air quality mitigation measures and compensatory measures for impacts to water supply bores. With these measures in place, combined with comprehensive monitoring programs, the Department considers that the Project can operate within acceptable environmental standards and be compatible with existing land use.

Consideration of voluntary land acquisition and mitigation policy (Clause 12A)

The noise and air quality impact assessments for the Project have considered the applicable provisions of the *Voluntary Land Acquisition and Mitigation Policy*. The Project would not trigger the voluntary mitigation or acquisition rights established under the policy for residual impacts to air quality. However, based on predicted noise impacts, voluntary noise mitigation rights have been afforded to 47 privately-owned receivers and voluntary acquisition rights have been afforded to 1 receiver.

Under the Paris Agreement, each country must identify its own post-2020 climate actions to achieve a balance between anthropogenic emissions and removal by GHG sinks in the latter half of this century. These actions are referred to as Nationally Determined Contributions (NDCs).

Australia's NDC includes a commitment to reduce national GHG emissions by between 26 and 28% by 2030 (from 2005 levels). Australia has committed to achieve this target through initiatives to expand renewable energy sources, support low emissions technologies, improve energy efficiencies and provide corporate incentives to reduce emissions. The CCPF outlines the state's long-term aspirational objectives of achieving net-zero emissions by 2050 and making NSW more resilient to climate change.

It is important to note that the established national and state policy frameworks do not seek to restrict private development in order to meet Australia's commitments under the Paris Agreement. Nor do these frameworks impose any prescriptive emissions criteria which can be applied in development assessments.

Further, it is important to note that there is no current practical alternative to the use of coking coal for the large scale, economic production of virgin iron and steel. While progress is being made in regard to the development of 'green steel' technology based on using hydrogen as a fuel, the Department is not aware of any steelmaking in Australia or overseas able to produce steel in commercial quantities without relying on coking coal. It is likely to be many years before this technology is adopted at a scale that would significantly reduce global demand for coking coal.

This view is supported by the *NSW Government's Strategic Statement on Coal Exploration and Mining in NSW* (2020), which identified that in the medium term there will still be a strong global demand for coking coal for steel making.

In terms of Scope 1 and Scope 2 emissions, the Department considers that the Project's direct GHGEs and bought-in electricity use would make a very small contribution towards anthropogenic climate change at either the State, national or global scales. The Project contains proposals by which its direct GHGEs from drained mine gas may be substantially mitigated through flaring, which through combustion turns methane into CO₂, with its substantially reduced greenhouse intensity.

The Department has recommended conditions requiring Tahmoor Coal to take all reasonable and feasible steps to implement greenhouse gas abatement measures (including beneficial reuse and/or flaring) and to reduce fugitive greenhouse gas emissions of the development.

Compatibility of proposed development with mining, petroleum production or extractive industry (Clause 13)

The Department considers that the Project represents a logical use of existing mine infrastructure, including the continued use of the surface facilities site and REA.

The Department considers that the Project has been designed to be long term stable and that it is compatible with, and would not adversely affect, adjacent or future mining-related activities.

Natural resource management and environmental management (clause 14)

The Department has recommended a robust suite of conditions to ensure that the Project is undertaken in an environmentally sensitive manner. These include conditions to avoid, minimise, compensate, offset and/or remediate, to the greatest extent practicable:

- impacts on water resources and water supply (see Section 6.2 and 6.3);
- impacts on biodiversity, including threatened species;
- greenhouse gas emissions.

The Department has considered the assessment of greenhouse gas emissions provided in the EIS (including downstream emissions, having regard to applicable State and national policies, programs and guidelines (see Section 6.8).

Resource Recovery (Clause 15)

The Department has considered the efficiency of the Project with respect to resource recovery, in consultation with MEG and the RR. The Department considers the Project to be an efficient development and utilisation of coal resources which will foster significant social and economic benefits, based on:

- its high-quality hard coking coal used for the production of steel and other metallurgical purposes;

- its strategic location in the Southern Coalfields and its close proximity to key regional infrastructure, in particular PKCT;
- the relationship of the resource to the existing Tahmoor North, and the synergies this presents for utilising existing infrastructure and reducing the capital costs;
- the socio-economic benefits of the development including:
 - ongoing employment of 390 people with an additional 50 to 175 staff prior to completion of Tahmoor North and start of secondary extraction at Tahmoor South;
 - \$342 million in capital investment;
 - a net economic benefit of \$664.9 million NPV; and
 - significant royalty revenue to the State.

Transport (clause 16)

Coal from the surface facilities would continue to be transported by rail to the PKCT. Road transportation of ROM coal, product coal and coal reject material is proposed to increase as part of the Project (from around 100,000 tpa to around 200,000 tpa). The Department has recommended road transport associated with the Project is managed through a Traffic Management Plan, that includes measures to minimise impacts on the local road network and a Driver's Code of Conduct.

Rehabilitation (Clause 17)

The Department has recommended strict conditions to ensure the Project sites are rehabilitated in a timely and integrated manner and that the final landforms are made safe, stable and non-polluting. The proposed rehabilitation strategy involves a landform which is re-establishing with native vegetation. Detailed rehabilitation outcomes are discussed in Section 6.8 of this report.

State Environmental Planning Policy (Infrastructure) 2007

The Infrastructure SEPP requires the consent authority to notify relevant public authorities about development that may affect public infrastructure or land. The Project would involve undermining a wide range of public infrastructure including transport, gas, water, electrical, sewerage and telecommunications assets. The Project also requires the construction of new 66 kV electrical power line to vent shaft sites.

The Department notified all relevant public authorities of the Project and has carefully considered the advice from these authorities in its assessment of this application. In particular, the Department has considered advice from both the East Australian Pipeline Limited and Gorodok Pty Ltd (APA) in relation to the Moomba to Sydney Ethane Pipeline and Moomba to Wilton Natural Gas Pipeline and WSC in relation to the Bargo Waste Management Facility. As discussed in Section 6.2, Tahmoor Coal would be required to establish a technical committees to develop risk management strategies and manage potential impacts of longwall mining on the Bargo Waste Management Facility and consult directly with asset owners of other key infrastructure through the preparation of Extraction Plans as longwall mining develops.

The Department is aware that similar technical committees have previously been formed to manage potential mine subsidence impacts for similar or the same infrastructure at Tahmoor North, and that implementation of the mitigation and preventive measures recommended by the committees ensured the infrastructure remained serviceable and that there were no public safety issues associated with subsidence generated from extraction of longwalls.

The Department notes that there is a long history of experience in undermining built features in NSW over a period of over 150 years and that technically feasible methods to manage potential subsidence impacts on infrastructure have been developed. There have been no major serviceability or public safety incidents related to subsidence impacts which were not able to be managed and rectified.

State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011

This SEPP applies to land within Sydney's drinking water catchment and aims to provide healthy water catchments whilst permitting development compatible with this goal. The SEPP also limits a consent authority from granting consent to proposed development under Part 4 unless it would have a neutral or beneficial effect on water quality.

The Project has been specifically designed to avoid mining on land within the Sydney drinking water catchment. The main channel of Cow Creek, which is within the Metropolitan Special Area, is located approximately 1 km to the east of the nearest proposed longwall (LW106B). At this distance, the predicted subsidence induced impacts to water resources are considered extremely low.

WaterNSW has confirmed that it considers that groundwater drawdown and baseflow reduction from the Project would pose a low risk to water quantity in the Sydney drinking water catchment.

Department is therefore satisfied that the development would have a neutral impact on water quality within the catchment and that the development would not contravene the aims of this SEPP.

State Environmental Planning Policy No 33 – Hazardous and Offensive Development (SEPP 33)

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 associated with the Project exceed the screening thresholds for potentially hazardous developments. It was confirmed that the proposed development would not exceed the screening thresholds.

The Department therefore accepts that the Project operations are not potentially hazardous and a hazard analysis is not required. Hazardous materials would continue to be managed in accordance with the mine's existing management practices and updated where new procedures do not exist for a work activity.

State Environmental Planning Policy No 44 (Koala Habitat Protection) (SEPP 44)

State Environmental Planning Policy (Koala Habitat Protection) 2019 (Koala SEPP 2019) commenced on 1 March 2020. However, clause 15 of the Koala SEPP 2019 provides that any development made, but not yet determined, prior to the commencement of the Policy must be assessed in accordance with SEPP 44.

Some vegetated areas within the Wollondilly LGA (within which the proposed development would be confined) may constitute potential or core koala habitat under SEPP 44. The Terrestrial Ecology Assessment undertaken as part of this EIS identified that Potential Core Koala Habitat is present within the footprint of the proposed Project. Despite the presence of Koala feed tree species within the proposed development area, the Terrestrial Ecology Assessment considered it unlikely that Koalas would occur regularly within the area, given the absence of Koala sightings or evidence of the presence of Koalas (such as scats, or scratches on trees) during field surveys, despite targeted searches. This would typically preclude the need to offset the species as a species-credit-species. Nevertheless, Tahmoor Coal has committed to offsetting potential koala impacts as a precaution. This commitment is reflected in the Department's recommended conditions.

With this offsetting in place, the Department accepts that the Project is consistent with the aims, objectives and requirements of SEPP 44.

State Environmental Planning Policy No 55 – Remediation of Land (SEPP 55)

The Department accepts that there are currently no recorded contamination sites within the Revised UEP application area and that there is limited risk of any significant material contamination of the land. Any minor areas of the surface facilities site which may require the management for the presence of contaminants such as hydrocarbons from fuel storage could be easily managed and/or remediated under conditions of consent and/or an EPL for the site. The development is therefore considered generally consistent with the aims, objectives, and provisions of SEPP 55.

A Phase II Environmental Site Assessment (ESA) was undertaken as part of the EIS. The ESA identified hydrocarbon contamination within the existing surface facilities site. The ESA indicated that the contamination is likely to be diesel from a historical underground storage tank. The extent of migration was considered to be minor given that there was limited hydraulic conductivity and the source of the contamination (diesel) is no longer stored in this area.

Offsite migration of diesel or other Total Petroleum Hydrocarbons (TPH) was considered to be unlikely given the slow recharge of groundwater wells and low hydraulic connectivity. Existing soil and groundwater contamination was 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 recommended under the provisions of SEPP 55.

Based on the information available at the time of this assessment, the Department is of the view that the Project is generally consistent with the aims, objectives and provisions of SEPP 55.

Wollondilly Local Environmental Plan 2011

The majority of the Project area is contained within the boundaries of the Wollondilly LGA. The Wollondilly LEP 2011 presents local environmental planning provisions for land within the Wollondilly LGA, and outlines permissibility of various land uses within individual land use zones.

The Project area covers a number of land use zones under the Wollondilly LEP 2011. The surface facilities site and REA are on land zoned RU2 Rural Landscape, while the longwall mine plan extends beneath land zoned primarily E2 Environmental Conservation, E4 Environmental Living, RU1 Primary Production, RU2 Rural Landscape and RU4 Rural Small Holdings. The footprint of the mine plan also includes areas of Low and Medium Density and Large Lot Residential (R2, R3 and R5, respectively), and SP2 Infrastructure (Road and Railway).

The proposed development would constitute activities that are ordinarily permitted with consent in some of these land use zones (RU4), and prohibited in others (RU1 and RU2, for example) under the Wollondilly LEP 2011. However, as discussed in Section 4.2, the Project in its entirety is permissible pursuant to the provisions of the Mining SEPP.

The Department notes that WSC did not raise any concerns in relation to inconsistencies with the Project and land use objectives.

The Project would not result in direct clearing or impacts to land zoned E2 Environmental Conservation, which is located above the proposed extraction area. As discussed in Section 6 of this report, the subsidence impacts to biodiversity and cultural values of the land as a result of the Project are predicted to be minimal. In accordance with the objectives of this land use zoning, the Department has recommended conditions to protect, manage and (if necessary) restore and/or offset ecological, scientific, cultural or aesthetic values of this land as a result of any subsidence-related impacts.

The Department considers that the Project has been designed to avoid and minimise adverse impacts on land use to the greatest extent practicable.

Appendix I – Predicted Subsidence Effects and Impacts on Built Features

Built Feature	Location Description	MSEC Predicted Subsidence Effects	MSEC Predicted Potential Subsidence Impacts
<i>Road and Rail</i>			
Main Southern Railway	7.9 km of track runs from N to S across SSA (3.6 km of track directly mined beneath)	Full range, or close to the full range, of subsidence effects	Some changes to track geometry (including vertical misalignment, horizontal misalignment, changes in track cant and track twist), changes in grades and changes in stress of the rail tracks
M31 Hume Motorway	Nearest point located 950m to the SE of the LW106B (not directly mined beneath)	Far-field horizontal movements	Motorway pavement unlikely to be impacted. Avon Dam Road Bridge and Lupton Road Bridge less ductile and may experience cracking to masonry elements to the structures
Remembrance Drive	Follows similar alignment to Main Southern Railway	Full range of subsidence effects	Minor cracking of the pavement, road cuttings and embankments
Local Roads	Network located across the SSA, concentrated in Bargo township	Full range of subsidence effects	Minor cracking of the pavements, road cuttings and embankments
Culverts, bridges and viaducts	Numerous structures located across the SSA and beyond	Full range of subsidence effects, including far-field horizontal movements	Compression heaving of pavements on approach to the bridges, minor cracking of concrete structures and damage to associated cuttings and embankments
<i>Utility Infrastructure and Services</i>			
Potable water pipelines	53km of water pipelines within SSA (9 km of waterpipes directly mined beneath)	Full range, or close to the full range, of subsidence effects	Minor water leaks along the older pipelines
Picton Weir	Nearest point 885m from nearest longwall	Far-field horizontal movements	Unlikely to be adversely impacted
Sewerage pipelines	Main pressurised line runs N to S across study area. Local reticulation system	Full range of subsidence effects	Main pressurised system in Bargo designed to accommodate mine subsidence movements and is unlikely to be impacted.

Built Feature	Location Description	MSEC Predicted Subsidence Effects	MSEC Predicted Potential Subsidence Impacts
	concentrated in Bargo township. 47 km of sewerage pipework within SSA (4.4km of pipework directly mined beneath)		Local sewerage reticulation system into houses may experience minor damages to local chambers, valves and pipe fittings
Gas pipelines	Momba to Sydney Gas Pipeline and Gorodok Ethane Pipeline (high pressure) cross E ends of LW105B-106B. Steel main runs N to S across SSA. Local pipeline concentrated in Bargo township	Full range of subsidence effects	Momba to Sydney Gas Pipeline and the Gorodok Ethane Pipeline have some flexibility but may experience stresses. Local gas reticulation system has been designed in accordance with SA NSW requirements and is not expected to be impacted
Electrical infrastructure	154 km of powerlines within SSA including 66kV, 11kV and low voltage lines (30 km directly undermined)	Full range of subsidence effects	Majority would experience no impact. Potential minor changes to some cable catenaries and pole tilts
Telecommunication infrastructure	222km of optical fibre and copper cables located across the SSA (59km directly undermined)	Full range of subsidence effects	Minor “micro-bending” of fibres, leading to reduction in the capabilities of the cables and some transmission loss
Survey control marks	Located across the study area and beyond	Full range of subsidence effects, including far-field horizontal movements	May be altered and require re-establishing after mining
<i>Public Amenities</i>			
Churches	Bargo District Baptist Church located 1400m from LW106B and St Pauls Anglican Church 580m from LW106B (neither would be directly mined beneath)	Very low level of subsidence (<20mm)	Extremely unlikely to be impacted
Schools	Wollondilly Anglican Collage located to the W of finishing end of LW101A. The Auditorium partly located above LW101A. Bargo Public School located 650 m from LW106B (not directly mined beneath)	Wollondilly Anglican Collage and the Auditorium - up to 300mm of subsidence. Bargo Public School - very low level of subsidence (<20mm)	Wollondilly Anglican Collage and the Auditorium may experience non-structural cracking of walls, floors or ceilings. Bargo Public School unlikely to be affected

Built Feature	Location Description	MSEC Predicted Subsidence Effects	MSEC Predicted Potential Subsidence Impacts
Pre-schools and childcare centres	Wollondilly Mobile Preschool, Community Kids Bargo Early Education Centre and Little Elves Child Centre located 650 m, 840 m, and 700 m from LW106B (not directly mined beneath)	Very low level of subsidence (<20mm)	Unlikely to be impacted
Shops	Majority located in Bargo township approximately 650 m from LW106B (not directly mined beneath)	Very low level of subsidence (<20mm)	Unlikely to be impacted
Community Centres	Bargo Community Centre and Bargo Sports Club located 990m and 940m from LW106B, respectively (not directly mined beneath)	Very low level of subsidence (<20mm)	Unlikely to be impacted
Tennis Courts	Bargo Sportsground courts located 1140m from LW106B and Wollondilly Anglican College courts located 150m from LW102A (not directly mined beneath)	Bargo Sportsground courts - very low level of subsidence (<20mm). Wollondilly Anglican College courts - low level subsidence (<50mm)	Unlikely to be impacted
Avon Caravan Park	680m from 106B (not directly mined beneath)	Very low level of subsidence (<20mm)	Extremely unlikely to be impacted
Wirrimbirra Sanctuary	Covers area of 95ha above LWs 103A and 104A	Full range of subsidence effects	Non-structural cracking of walls, concrete floors or ceilings of buildings
Bargo Cemetery	Located above LW105A	Less than maximum predicted movements	May experience cracking of surrounds or displacement of some tombstones relative to graves
<i>Agricultural Lands and Facilities</i>			
Rural structures (sheds, garages, etc)	4,232 structures within study area	Full range of subsidence effects (depending on location)	Minor serviceability impacts including door swings and issues with roof and pavement drainage

Built Feature	Location Description	MSEC Predicted Subsidence Effects	MSEC Predicted Potential Subsidence Impacts
Tanks	299 tanks within study area	Full range of subsidence effects (depending on location)	May impact serviceability by alteration of water level in tanks and leaking pipe joints
Farm Dams	206 farm dams within study area	Full range of subsidence effects (depending on location)	Majority of dams unlikely to be impacted, but some may experience minor reduced storage levels
Fences	Located across study area	Full range of subsidence effects	Minor tilting of fence posts, changes of tension in fence wires
<i>Industrial, Commercial and Business establishments</i>			
Fuel storages	Shell petrol station located above LW102A, BP petrol station located 880m from LW108B	Shell petrol station - full range of subsidence effects. BP petrol station – very low level subsidence (<50mm)	Shell petrol station may experience impacts to petrol tanks and fuel lines, the hardstand areas or building and awning structures. BP petrol station unlikely to be impacted
Bargo Waste Management Centre	Located directly above LW102B	Full range of subsidence effects	Slope instability of the landfill, impacts to leachate collection system and surface water treatment pond, damage to weighbridge

Appendix J – Recommended Instrument of Consent

See Departments website at:

<https://www.planningportal.nsw.gov.au/major-projects/project/10966>