



Planning & Infrastructure

**PRELIMINARY ASSESSMENT:
Wallahah 2 Coal Project
(SSD-4974)**



Director-General's
Environmental Assessment Report
Section 89E of the
Environmental Planning and Assessment Act 1979

February 2014

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EXECUTIVE SUMMARY

The Wyong Areas Coal Joint Venture (WACJV) proposes to develop the Wallarrah 2 Coal Project, a new underground coal mine, located west of Wyong on the Central Coast, approximately 100 kilometres north of Sydney. The project involves the extraction of up to 5 million tonnes of coal per annum over a 28-year project life using longwall mining methods. Only minimal processing of the coal would occur on-site before transport to the Port of Newcastle by rail for export. The project has a capital investment of approximately \$805 million, and would employ 450 people during construction and 300 during operation.

The proposed development is State Significant Development under Section 89C of the *Environmental Planning & Assessment Act 1979* (EP&A Act) as it is 'development for the purposes of coal mining', as specified in the *State Environmental Planning Policy (State and Regional Development) 2011*. The Minister for Planning and Infrastructure is the consent authority for the project. However, the Planning Assessment Commission (PAC) will determine the application under delegation. In addition to approval under NSW legislation, the project is also a controlled action requiring assessment and approval under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*. The Commonwealth will undertake a separate assessment and determination under its legislation.

The Environmental Impact Statement for the project was publicly exhibited for an extended, two-month period. The Department also accepted late submissions on the project following conclusion of the exhibition period. The Department has received 752 submissions on the project, including 18 from public authorities, 9 from special interest groups and 725 from the general public. Of the 734 public submissions, 113 supported the project, 611 objected to the project and 10 provided comments only.

WACJV provided a formal Response to Submissions (RTS) to the Department, which addresses the issues raised in all public and agency submissions. The Department forwarded the RTS to all public agencies that had previously provided submissions and invited further comments. WACJV subsequently submitted a Residual Matters Report in response to the agencies' residual concerns. This report was also distributed to the agencies, and further comments on this report were provided to the Department by some agencies.

Following this extensive consultation process, the Department has completed its preliminary assessment of the merits of the project, including consideration of all the potential environmental, social and economic impacts, and the relevant requirements of the EP&A Act. The PAC will now carry out a review of the merits of the project, paying particular attention to its potential water and biodiversity impacts. During this review the PAC will consider the findings of the Department's preliminary assessment, and hold public hearings to give the community another opportunity to comment on the proposal. Once it receives the PAC's review report, the Department will then finalise its assessment of the merits of the project and refer the project application to the PAC for determination.

The proposed development seeks to extract up to 125 million tonnes of high-grade, export quality thermal coal. The Department considers this to be a very significant coal resource, and notes that thermal coal remains a highly sought-after energy source in the Asian markets, particularly the North Asian markets of Korea, China and Japan. The Department considers that extraction of a coal resource of this size and significance would result in a range of very significant economic benefits to the Wyong LGA, the Central Coast region, the State of NSW and to Australia. The project would have direct economic benefits to the State, including \$134 million in taxes and \$207 million in mining royalties over the life of the project. The project would also generate approximately 800 jobs, which would be a significant boost to both the Wyong LGA and the Central Coast region, which have relatively high unemployment levels compared to the rest of NSW. These are significant benefits, which must be given significant weight in assessing the project's overall merits.

Based on the submissions from both the agencies and the general public, the two key areas of concern surrounding the project are:

- subsidence-related impacts from underground mining activities, particularly:
 - impacts on natural features, especially water resources and biodiversity; and
 - impacts on existing and future built features; and
- amenity and health impacts from the surface works and activities, particularly in relation to noise and air quality.

In relation to the natural environment, it is important to consider that the Yarramalong and Dooralong Valleys have been highly altered over the past century through timber clearing and subsequent agricultural uses. During this period, water has been frequently extracted from the rivers and significant streams for agricultural uses, and many of these streams are subject to erosion and scouring. In addition, the targeted coal seam is generally very deep in this area, there are few major geological structures (like faults and dykes), and the rock layers overlying the coal seam generally have very low permeability.

The Department has found that subsidence impacts on creeks and rivers are likely to be minor, and there is a very low risk to groundwater resources. The Department is satisfied that the project would have minimal impact on the region's key aquifers, in accordance with the *NSW Aquifer Interference Policy*, and would not adversely affect the region's water supply. All water taken by the project could be licenced under the appropriate water legislation and any discharges from the surface facilities could be suitably controlled. Any impacts to water resources, biodiversity and other natural features can be managed through the recommended conditions of consent. The Department has recommended performance criteria requiring that there is no connective cracking between the surface and the underground workings, and not greater than negligible environmental consequences over the great majority of the lengths of significant streams affected by subsidence. The recommended conditions also require the establishment of a comprehensive surface water and groundwater monitoring network on the site. The estimated cost of implementing recommended biodiversity offsets, including revegetation and ongoing management, is \$5.9 million over the life of the project, and the conditions also require WACJV to undertake a comprehensive Frog Research Program, which would cost \$156,000 over four years.

In terms of built features, it is important to consider that the project falls within the broader areas of North Wyong and the Central Coast, which have both been identified for significant residential and employment growth. The Department is satisfied that the great majority of impacts to built features are likely to be minor, and can be managed through the recommended conditions of consent, particularly through management plans required as part of the Extraction Plan process, including the Built Features Management Plan and Water Management Plan. Furthermore, all dwellings within the project area are within Mine Subsidence Districts and construction of new improvements is regulated by the Mine Subsidence Board (MSB). All recently-built houses have been constructed to withstand a particular level of underground mining impacts. Both new and older houses are also covered by the MSB in respect of compensation for subsidence impacts.

In relation to amenity and health impacts, it must be noted that the project's two key surface facilities are both located in areas that are earmarked for current and future industrial uses, and are therefore generally unlikely to cause any significant amenity issues for nearby residents. The main surface facility at Tooheys Road is particularly well-located between two major motorways, where background noise and air quality impacts are already high and residences are generally set back a considerable distance. The Department acknowledges the significant additional cost that this has added to the project in order to reduce surface amenity and health impacts, in that it requires construction of an inclined tunnel nearly four kilometres in length to reach the mining area. The Department is satisfied that amenity and health impacts are likely to be minor, and can be managed through the recommended conditions of consent, including appropriate noise and air quality performance criteria, provisions for independent review of any exceedances, and management plans that provide for mitigation measures where necessary.

Overall, the Department has recommended a robust set of conditions of consent based on an adaptive management approach, which accepts that knowledge and understanding of underground mining in this 'greenfields' area would substantially increase over the life of the project, and allows for appropriate alterations to mining operations to reflect this improved knowledge. The recommended conditions incorporate a range of checks and balances as the project develops and progresses, and provide various safeguards to prevent and/or minimise potential impacts. These conditions are broadly based on three key features: a strict set of performance criteria; a requirement for various management plans to monitor and minimise potential impacts; and stringent reporting and auditing requirements.

In terms of performance criteria, the Department has set a range of performance measures that WACJV must not exceed for all key types of impact by the project, including water, biodiversity, built features, heritage, noise and air quality. These criteria are largely based on similar criteria that the Department has developed and incrementally improved in development consents for other underground coal mines in NSW over the last decade, and which are now regarded as best practice.

The performance criteria have been appropriately modified to suit the specific impacts of this project, and have been developed after extensive consultation with affected agencies. Any exceedance of the performance criteria would constitute a breach of the development consent and may be subject to penalties under the EP&A Act.

In relation to management plans, WACJV would be required to prepare two sets of plans that together address each of the areas of impact identified in the performance criteria (ie water, biodiversity, built features, heritage, noise and air quality), and describe appropriate monitoring and mitigation measures to ensure that the criteria are met. Both sets of management plans must be approved by the Department in consultation with the relevant agencies. The first set of management plans relates to all potential impacts from surface activities (in particular air quality, noise and surface water flows and management) and must be prepared prior to the commencement of construction at the surface. The second set of management plans form part of the Extraction Plans, which must be approved prior to any underground longwall mining occurring. Extraction Plans must address all subsidence-related impacts on water resources, biodiversity, built features and heritage. They must also include updated subsidence predictions in specific areas of proposed mining and more detailed consideration of potential impacts in these areas.

In terms of reporting and auditing, the Department has included a range of conditions to ensure that WACJV provides regular updates on its operations and monitoring results, through management plans, incident reports and annual reviews. The Department has a Compliance Branch that carefully monitors the operation and performance of all coal mines in NSW, with a particular focus on achieving performance criteria in development consents. The recommended conditions also require WACJV to commission regular independent environmental audits of the project, which must be conducted by a team of independent experts approved by the Department. The first audit must be undertaken within 12 months of commencement of construction, and subsequent audits are then required every 3 years thereafter. To ensure transparency and accountability, the recommended conditions also require that all reports, plans, reviews and audits must be made publicly available on WACJV's website.

The Department has carefully considered all the environmental, social and economic impacts of the project in accordance with the relevant requirements of the EP&A Act. In doing this, the Department has:

- consulted extensively with Government agencies and other relevant stakeholders;
- been informed by the findings of the strategic inquiry into underground coal mining in the Wyong area in 2008, an extensive study of potential project impacts on water resources and a previous project application that was reviewed and supported by the PAC, but ultimately refused by the Minister;
- considered the issues raised in submissions; and
- assessed the extensive documentation submitted by WACJV in support of the application.

The Department considers the current application to be significantly stronger than the previous application, and believes it addresses all key concerns raised by the PAC and the Department during the previous assessment.

The Department has carefully weighed the key areas of concern, including subsidence and amenity impacts, against the significance of the resource and the socio-economic benefits. On balance, the Department has concluded that the project's benefits outweigh its potential impacts and it is therefore in the public interest. Consequently, the Department believes it should be approved subject to the recommended conditions of approval.

1. PROPOSAL

1.1 Background

In 1995, the NSW Government invited tenders for the Wyong Coal Development Areas, located on the NSW Central Coast. The Wyong Areas Coal Joint Venture (WACJV) was the successful tenderer. At that time, the majority partner in the WACJV was Coal Operations Australia Limited (COAL), with Korea Resources Corporation (Kores) representing a minority interest. BHP Billiton (BHPB) later became the majority shareholder when it acquired COAL. In 2005, BHPB sold its majority share to the minority shareholders, and Kores acquired an 82% stake in the WACJV.

1.2 Description of the Proposal

WACJV proposes to develop a new underground coal mine near Wyong, approximately 100 kilometres (km) north of Sydney on the Central Coast (see **Figures 1** and **2**). The proposal, known as the Wallarah 2 Coal Project (the project), is summarised in **Table 1**. The key surface facilities sites are depicted in **Figures 3** and **4**. The project is described in detail in the Environmental Impact Statement (EIS) for the project, which is attached as **Appendix B**.

Table 1: Major Components of the Project

Aspect	Description
Project Summary	<ul style="list-style-type: none"> • Development of a new underground coal mine using longwall mining methods; • Extraction of up to 5 million tonnes per annum (Mtpa) of thermal coal; • Development of surface infrastructure at the following three sites: <ol style="list-style-type: none"> 1. Tooheys Road Site, including rail loop and spur, raw coal and product coal stockpiles, decline tunnel, water and gas management facilities and offices; 2. Buttonderry Site, including administrative offices, training rooms and bath house, the main personnel access to the mine, new intersection with Hue Hue Road, access road and car park, upcast and downcast ventilation shafts, surface water treatment facilities; and 3. West Shaft Site, including a downcast ventilation shaft. • Transfer of all coal extracted from the mine to the Tooheys Road Site for limited processing, and railing to domestic and export markets; and • Rehabilitation of the site.
Mining and Reserves	Extraction from a total coal resource of 375 million tonnes (Mt) from the Wallarah-Great Northern Seam. Longwall panel widths would range from 125 metres (m) to 255 m, with narrower panels below the Hue Hue Mine Subsidence District (MSD) and below the 1:100 year flood zone.
Coal Processing & Reject Management	Coal would undergo minimal processing. The coal would not require washing, but would be sized and screened. A minor amount of waste rock may be produced during processing, which would be trucked offsite to a licensed emplacement facility. No fine coal tailings would be produced.
Water Demand and Supply	Underground dewatering would result in a peak water surplus of approximately 2.5 megalitres (ML) per day after 8 years of operations. The water management system would involve: <ul style="list-style-type: none"> • a 180 ML operational water dam, a 30 ML portal dam, a 20 ML stockpile dam, 20 ML treated water storage, 9 ML of brine storage, stormwater management system and potable water storage tanks at the Tooheys Road Site; and • a 10 ML entrance dam and stormwater management system at the Buttonderry Site.
Project Life	28 years, including 3 years for construction and 25 years of mining operations.
Employment	Construction workforce of 450 employees and an operational workforce of 300 employees.
Capital Investment Value	\$805 million.
Support Facilities and Utilities	Administration, store, workshop and staff facilities (bathroom, lamp room, etc); ventilation systems and service/distribution boreholes; water bores and surface water management infrastructure; power supply and communications infrastructure; bulk storage facilities; underground mine access; rail provisioning facility; internal site roads.
Hours of Operation	Operations would take place 24 hours a day, seven days a week.
Product Coal Transportation	All product coal would be transported via rail to the Port of Newcastle for export, using the project rail loop and spur. An average of approximately 4.3 trains would be loaded and dispatched per day, with a peak of 6 trains per day.
Mine Access	Access to the Tooheys Road infrastructure site would be via the Motorway Link Road. Access to the Buttonderry pit top site would be via Hue Hue Road.
Clearing, Rehabilitation and Offsets	The project would result in the loss of 89 hectares (ha) of native vegetation and indirect impacts as a result of subsidence effects. The rehabilitation and offset strategy involves rehabilitation of the Buttonderry and Tooheys Road Sites and conservation of 261 ha of land at Hue Hue Road, which includes 201 ha of native vegetation.

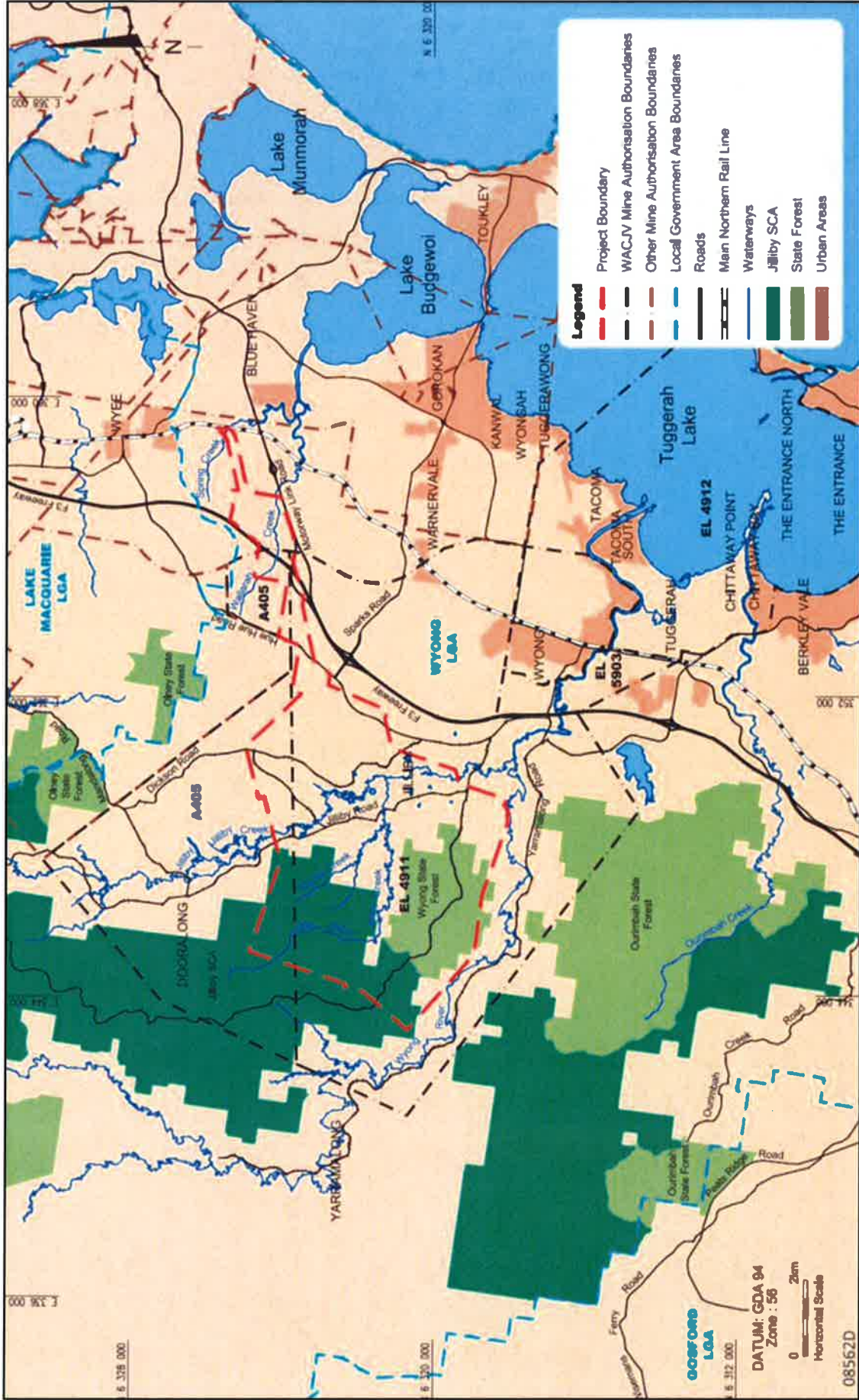


Figure 1: Regional Location of the Project

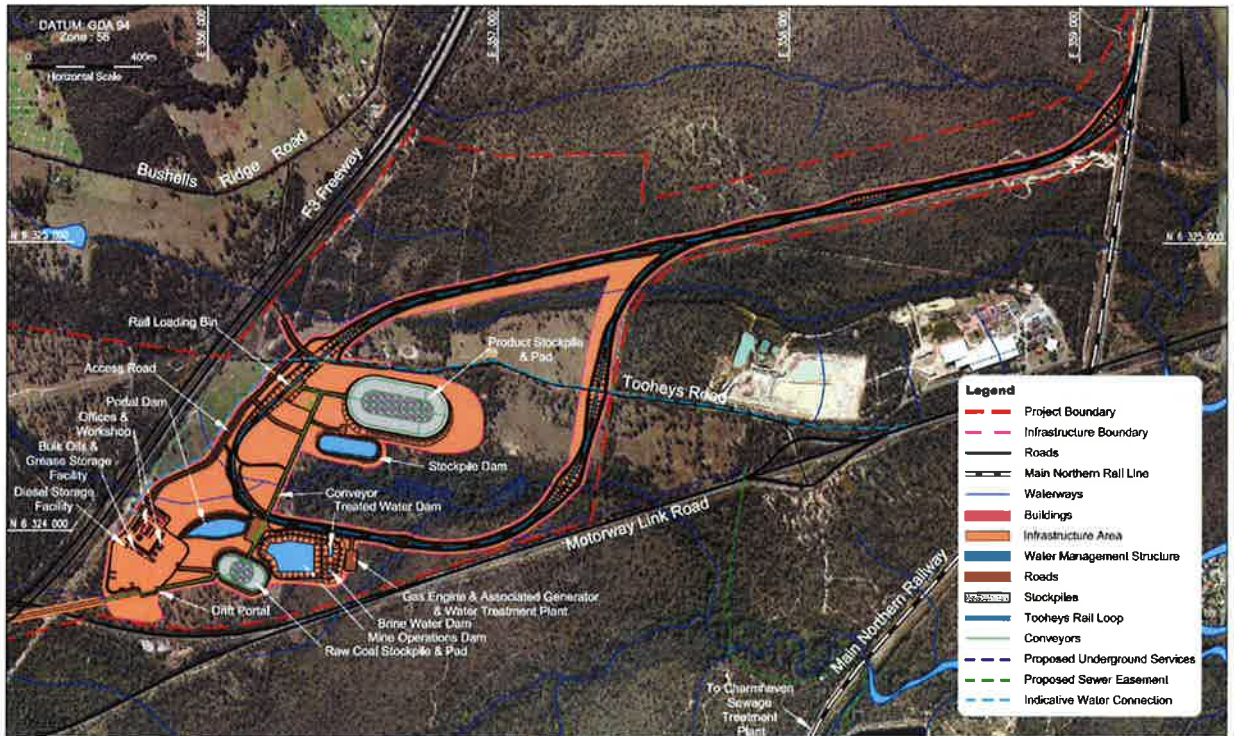


Figure 3: Proposed Coal Processing Site at Tooheys Road

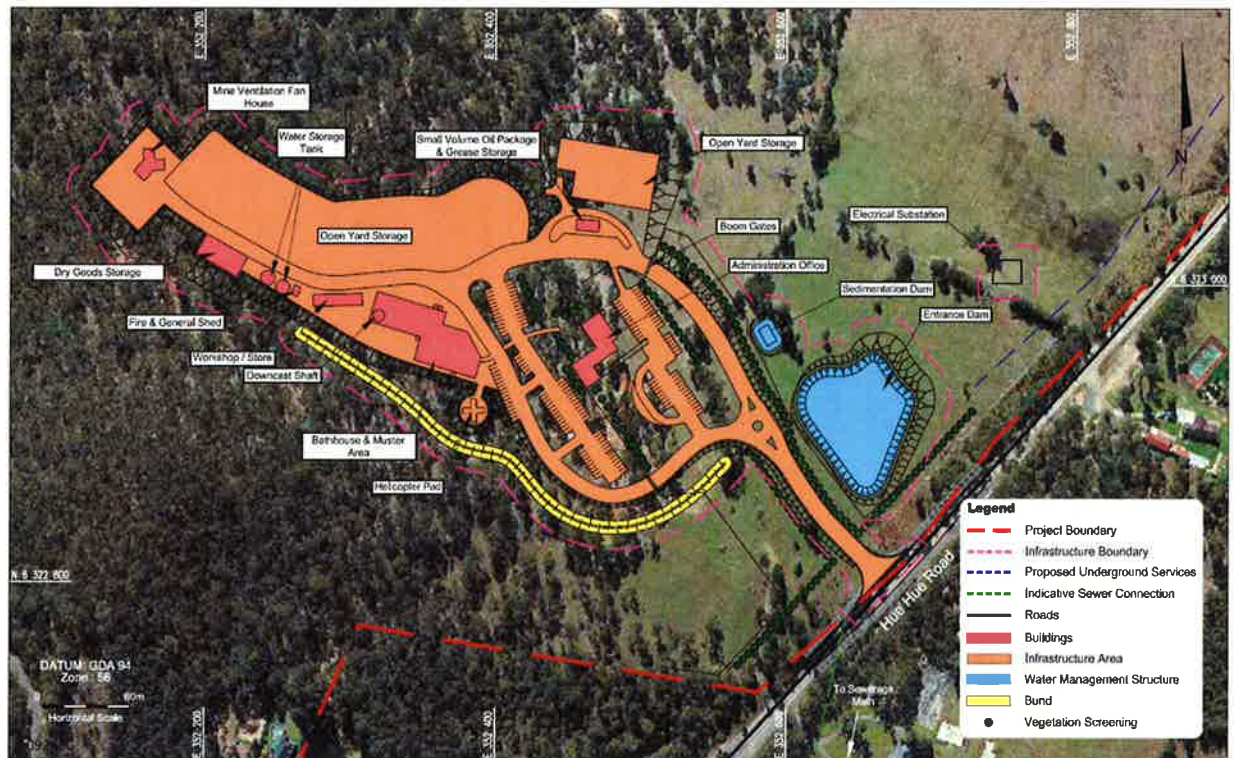


Figure 4: Proposed Administrative Facilities and Drift Site at Buttonderry

1.3 Mine Layout

The underground workings can conceptually be divided into three domains, with a total of 35 longwalls: the Northern Domain (19 longwalls), the Southern Domain (10 longwalls) and the Southwestern Domain (6 longwalls).

The proposed project life is 28 years, which includes approximately 3 years of construction and 25 years of longwall mining. However, the Department notes that the development application area and EIS includes a long-term conceptual mine plan that outlines a 38 year project life with 46 longwalls (ie an additional 11 years of mining and 11 longwalls). The proposed additional mining would occur in the far western extent of the project area (see cross-hatched longwalls in Figure 5). These additional 11

longwalls do not form part of the current development application and WACJV would be required to submit a separate development application (or modification application) in the future for approval of these longwalls.

This assessment report focuses almost exclusively on the current application for 35 longwalls. However, the Department notes that the EIS for the current project includes consideration of the impacts associated with these additional 11 longwalls. As a result, many of the submissions raised issues that were not strictly relevant to the current development application. Consequently, the Department has also briefly considered the potential impacts of these additional longwalls, albeit largely where it is relevant to distinguish the current project (involving 35 longwalls) from any future development applications (involving the additional 11 longwalls).

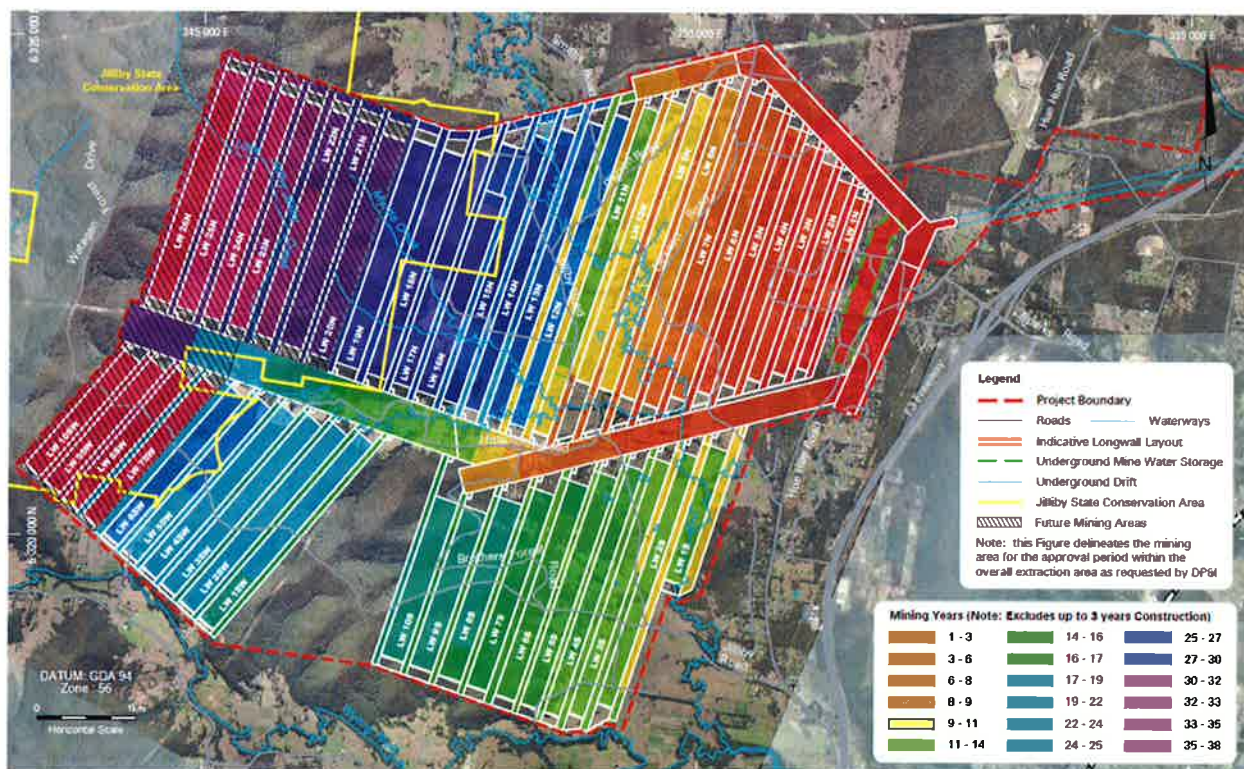


Figure 5: Conceptual Mine Layout

1.4 Justification for the Proposal

Coal Resource Recovery

Exploration, mine planning and environmental studies have identified significant thermal coal resources in the vicinity of the project, with a potentially viable coal resource of 375 Mt. This application seeks to extract up to 125 Mt of coal at a rate of 5 Mtpa.

NSW has a large and mature coal industry based around substantial coal resources. Over the past decade, NSW coal production has grown steadily due to growing demand from export markets in Asia. In particular, thermal coal remains a highly sought-after energy source in Japan, China, Korea and India. This project would facilitate the recovery of a valuable, export quality thermal coal resource.

Mine Design Trade-offs

WACJV has designed the project to significantly reduce its potential environmental and amenity impacts, by:

- constructing a 3.5 km underground drift from the proposed mine workings to the Tooheys Road Site, which in turn is located to reduce amenity impacts (noise and air quality) and avoid coal handling near important environmental features (particularly water resources);
- removing a large area of available coal resources (up to 15 Mt) from the south of the project area in order to avoid the Wyong River, a large section of the Central Coast's drinking water catchment area and a key water pipeline linked to the Mardi Dam;
- proposing to mine only between 3 and 4.5 m of the available coal seam thickness of up to 6.8m in order to reduce subsidence impacts; and

- narrowing the width of proposed longwalls in the Dooralong and Yarramalong Valleys to minimise subsidence impacts on residences and other built structures.

Economic Benefits

Coal is NSW's biggest mineral commodity in terms of value, with the industry generating around 80% of the State's mining income. Coal is the State's single largest export in revenue terms - around 25% of the State's export revenue. NSW is the third-most important mineral-producing State in Australia after Western Australia and Queensland, and generates approximately 12% of the gross value of Australian mineral production.

The production of coal from this project is predicted to generate a total of approximately 800 jobs, including 300 direct jobs and 500 flow-on jobs. This would be of particular significance in the Central Coast region, where the Wyong LGA has fared poorly in relation to recent State averages for key socio-economic indicators. For example, in September 2012, the unemployment rate in the Wyong LGA was 8.1%, which is nearly 60% higher than the NSW rate of 5.1%.

Cost-Benefit Analysis

WACJV has included a cost-benefit analysis in the EIS which calculates the net community benefit (NCB) of the project to be \$531 million including \$207 million in mining royalties, \$134 million in taxes and \$186 million in social and economic values of employment. As discussed in detail in section 5.8, the Department considers that there is likely to be only a minor reduction in the predicted NCB due to externalities and the true economic values of employment.

2. STRATEGIC CONTEXT

2.1 Land Use and Population

The Department has carefully taken both broad and local strategic considerations into account in assessing this Project. The project area and its surrounds comprise a variety of land uses, ranging from light industrial and commercial uses, small-scale cattle grazing properties and hobby farms, rural-residential developments and small townships. Over the last 20 years, the character of the area has largely changed from agricultural to rural-residential, as larger holdings have been sub-divided and converted to hobby farms, rural weekend retreats, and small-scale farms.

The expected growth in population and the limited available employment opportunities on the Central Coast, and in Wyong Shire in particular, is also an important consideration in balancing the economic benefits of the project against potential environmental costs. The project falls within the areas covered by the *Central Coast Regional Strategy (CCRS)* and the *North Wyong Structure Plan (NWSP)*. Currently, over 300,000 people live on the Central Coast and the region continues to grow at one of the fastest rates in NSW, with the population expected to grow by around 100,000 over the period to 2031. The CCRS predicts that the majority of this population growth will occur in Wyong Shire and the NWSP identifies the need for up to 17,800 new homes and 17,000 new jobs in this area.

At a broad strategic level, the State-wide *Strategic Regional Land Use Policy (SRLUP)* is also an important consideration in assessing this project. The SRLUP sets out a range of new policy initiatives aimed at balancing growth in the mining industry with the need to protect important agricultural land and water resources. In particular, the policy package includes establishment of the *Aquifer Interference Policy (AIP)*, which includes strict requirements for assessing the potential impacts of mining projects on water resources, and clear criteria for judging the acceptability of these impacts. The provisions of the SRLUP that relate to Biophysical Strategic Agricultural Land (BSAL) are not relevant to this project, as the project area is not mapped as BSAL.

2.2 Natural Environment

Large sections of the natural environment in the project area and its surrounds are in a heavily-altered state. The general character of the area has been changed dramatically following European settlement, with large areas of land cleared for agricultural activities. In particular, floodplain areas within the Dooralong and Yarramalong Valleys have been highly altered with little remnant vegetation existing. In addition, the soil landscapes in this area are naturally prone to stream bank erosion and suffer from seasonal water-logging and flooding. The streams are dominated by meander cut-offs, terraces, oxbows and back swamps. Many of the watercourses have already been subject to significant degradation by erosion of streambeds and banks, siltation and weed invasion.

Approximately a third of the underground mining resources are located within the Wyong State Forest and Jilliby State Conservation Area (SCA), which feature heavily timbered hills and a number of watercourses, including Little Jilliby Creek. However, only 7 of the proposed 35 longwalls are located within the boundaries of the Jilliby SCA. The majority of the sensitive features in the Jilliby SCA are located outside of the project's proposed mining area.

In terms of geology, the project is located within the southern part of the Newcastle Coalfield, which is relatively free of major geological structures, and is bounded by major dykes. Economic coal resources are contained within the upper part of the Newcastle Coal Measures at considerable depths of up to 690 m below the surface. The strata overlying the Coal Measures generally comprise a series of sandstones with minor siltstones and occasional shales. Broadly speaking, these strata have low permeability and do not contain any significant aquifers.

This combination of deep coal seams, a lack of major geological features and generally low permeability in the overlying rock strata has significant advantages in reducing the potential for impacts on surface water resources.

2.3 Built Environment

The key built features within the project area include:

- the F3 Freeway;
- the Main Northern Railway;
- two 330 kV transmission lines, and 29 associated towers;
- 245 residences overlying the underground workings;
- the Jilliby Public School; and
- a large number of rural buildings, farm dams and swimming pools.

The mine layout has been designed to avoid subsidence impacts on the freeway, railway and school. WACJV has had ongoing consultations with TransGrid about the transmission lines and towers, and has agreed to bear the costs of any mitigation or management measures to reduce potential subsidence impacts.

All of the 245 residences are located within either the Hue Hue MSD or the Wyong MSD, which were proclaimed many years ago - in 1986 and 1997, respectively. The MSDs are managed by the Mine Subsidence Board (MSB) under the *Mine Subsidence Compensation Act 1961* (MSC Act). The MSB is responsible for reducing the risk of mine subsidence damage to properties within MSDs by assessing the buildings and other improvements proposed to be erected in MSDs and applying particular building standards to them. All houses and other improvements built since the MSDs were proclaimed should therefore have been constructed to the building specifications set by the MSB to limit potential subsidence impacts on the structure.

The MSB is also responsible for repair or compensation wherever houses and other improvements are damaged by mine subsidence. All landowners should be aware of the potential for underground mining, as MSDs are identified in Section 149 Certificates attached to contracts of sale whenever a residence or land is purchased.

2.4 Strategic Review of Coal Mining in Wyong Shire

In February 2007, the NSW Government appointed an independent expert panel to conduct a strategic review into the potential impacts of coal mining in the Wyong local government area (LGA). The Panel was chaired by Kerry Chikarovski, and included three experienced experts in their fields: Emeritus Professor Jim Galvin (subsidence), Dr Noel Merrick (groundwater) and Brian Elton (social and community impacts). The panel made a public call for submissions, held public hearings in August 2007 and undertook field inspections. The expert panel's report, *Strategic Review of Impacts of Potential Underground Coal Mining in the Wyong LGA*, was published in July 2008.

The report carefully assessed the full range of issues associated with underground coal mining that are relevant to the current proposal, including subsidence-related impacts on water resources, amenity and health impacts due to noise and health, and socio-economic impacts. The panel also specifically considered the previous application for the Wallarrah 2 Coal Project, then at an early stage.

The report included 13 recommendations that it considered should apply to any future coal mining within the Wyong LGA. The Department is satisfied that the panel's key recommendations relevant to the current project have been adhered to by the WACJV, including:

- collating the existing groundwater data and establishing water sharing plans;
- demonstrating a strong commitment to community consultation;
- implementing best practice to reduce noise and dust impacts; and
- undertaking a cost-benefit analysis of the proposal.

2.5 Previous Project Application and PAC Review

In late 2006, the Department received a project application for the Wallarah 2 Coal Project under the now repealed Part 3A of the *Environmental Planning & Assessment Act 1979* (EP&A Act). In July 2010, the then-Minister directed the Planning Assessment Commission (PAC) to review the project, including conducting a public hearing (which occurred in October 2010). The PAC ultimately supported approval of the project, but expressed its disappointment at the level of information provided in the Environmental Assessment (EA).

The PAC raised concerns about uncertainties in the EA around subsidence predictions, particularly in the western part of the project site, the site water balance, limited assessment of impacts associated with discharge of treated mine water and sewage effluent, and a lack of ecological and heritage survey effort in the western part of the project site. In order to overcome these uncertainties, the PAC made 40 recommendations, which mainly proposed imposing numerous conditions on the project. These conditions relied heavily on an adaptive management approach to potential project impacts, and development and implementation of a significant list of environmental management plans.

Notwithstanding the PAC's support for a conditional approval, in March 2011 the then-Minister refused the application on the basis of the information gaps and uncertainties raised by the PAC.

A large proportion of the PAC's previous recommendations are now standard in all development consents for underground mining projects, for example, conditions relating to Extraction Plans, independent audits, ongoing reporting requirements, and the establishment of community consultative committees (CCCs). The adaptive management approach recommended by the PAC is also a common feature for coal mining approvals in NSW, particularly underground coal mines. In addition, the WACJV has also acted on many of the PAC's recommendations, including conducting substantially more work on assessing significant surface features in the western part of the project area (particularly within the Jilliby SCA) and preparing a suitable offset strategy. The Department has considered all of the PAC's recommendations in assessing the project and drafting the recommended conditions of consent.

3. STATUTORY CONTEXT

3.1 State Significant Development

The proposed development is declared to be State Significant Development under Section 89C of the *Environmental Planning & Assessment Act 1979* (EP&A Act) as it is 'development for the purposes of coal mining', which is specified in clause 5 of schedule 1 to *State Environmental Planning Policy (State and Regional Development) 2011*.

Consequently, the Minister for Planning and Infrastructure is the consent authority for the development. However, the development application falls within the Minister's delegation to the Planning Assessment Commission (PAC) dated 14 September 2011, because there were more than 25 public submissions in the nature of objections and Wyong Shire Council has objected to the proposal. Consequently, the PAC must determine the application.

3.2 Permissibility

The project site is located in the Wyong LGA. Under the *Wyong Local Environmental Plan 2013* (Wyong LEP), some of the project area is zoned to permit mining with development consent. However, there are several areas which are zoned E1 National Parks and Nature Reserves, E2 Environmental Conservation, E3 Environmental Management, SP2 Infrastructure, and RE 1 Public Recreation, where mining is prohibited.

However, particular provisions of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (the Mining SEPP), ensure that the project is fully permissible with consent. Under these provisions, development for the purposes of underground mining is permissible anywhere in the State.

3.3 Integrated and Other Approvals

Under section 89J of the EP&A Act, a number of other approvals have been integrated into the Part 4 approval process and are not required to be separately obtained for the project. These include:

- heritage-related approvals under the *Heritage Act 1977* and *National Parks and Wildlife Act 1974*; and
- particular water-related approvals under the *Water Management Act 2000*.

Under Section 89K of the EP&A Act, a number of further approvals are required to be obtained, but must be approved in a manner that is consistent with any development consent for the project. These include:

- a mining lease under the *Mining Act 1992*;
- an environment protection licence under the *Protection of Environment Operations Act 1997*; and
- a consent under the *Roads Act 1993*.

The Department has consulted with the relevant public authorities responsible for these other approvals (see Section 4) and has considered the issues relating to these approvals in its assessment of the project (see Section 5). None of the relevant authorities object to the project on grounds related to these other approvals.

The project has been declared to be a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as it may impact on nationally-listed threatened species. The Commonwealth Department of the Environment (**DOE**) will assess the project separately under this legislation.

3.4 PAC Review

On 16 January 2014, the Minister requested that the PAC carry out a review of the Wallarrah 2 Coal Project, including:

- considering this report, the EIS for the project, the issues raised in submissions, WACJV's formal response to submissions (RTS), and any other relevant information provided on the project during the course of the review;
- assessing the merits of the project as a whole, paying particular attention to potential water and biodiversity impacts of the project;
- recommending any further measures required to avoid, minimise, and/or manage the potential impacts of the project;
- conducting public hearings during the review as soon as practicable after this report is provided to the PAC; and
- submitting its final report on the review to the Department within six weeks of the public hearings, unless the Director-General of the Department agrees otherwise.

Once it receives the PAC's review report, the Department will finalise its assessment of the merits of the project and refer the project application to the PAC for determination.

3.5 Environmental Planning Instruments

Under section 79C of the EP&A Act, the consent authority is required to consider the provisions of relevant environmental planning instruments (EPIs), including any exhibited draft EPIs and development control plans (see **Appendix H**).

The Department has considered the project against the relevant provisions of relevant EPIs, and also considered WACJV's consideration of these instruments in its EIS. The key instruments include:

- *Wyong LEP 2013*;
- *SEPP No. 33 – Hazardous and Offensive Development*;
- *SEPP No. 44 – Koala Habitat Protection*;
- *SEPP No. 55 – Remediation of Land*;
- *SEPP (State and Regional Development) 2011*;
- *SEPP (Infrastructure) 2007*; and
- *Mining SEPP*.

On 4 November 2013, the Government amended the Mining SEPP to clarify the decision-making process for proposals for the mining of mineral resources, including coal. The amendment introduced a clear statutory requirement that the consent authority must consider the significance of the resource, both to the State and the region where it is located, as part of its decision-making process. While the amendment made clear that the significance of the resource is an important factor in the decision-making process, it is not the only factor, and environmental, social and economic impacts continue to be significant considerations. The Department has included careful consideration of the significance of the project's coal resource in its assessment (see Section 5.8).

Based on its assessment of these instruments and its broader environmental assessment (see Section 5), the Department is satisfied that the project can be undertaken in a manner that is consistent with the aims, objectives and provisions of these instruments, subject to a range of mitigation, monitoring and management measures, as proposed in the recommended conditions of consent.

3.6 Objectives of the EP&A Act

The Minister is required to consider the objects of the EP&A Act when making decisions under the Act. The objects of most relevance to the Minister's decision on whether or not to approve the project are found in section 5(a)(i),(ii),(vi)&(vii) of the Act. They are:

- (a) *to encourage:*
- (i) *the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,*
 - (ii) *the promotion and co-ordination of the orderly and economic use and development of land...*
 - (vi) *the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and*
 - (vii) *ecologically sustainable development"*

The Department is satisfied that the project encourages the proper use of resources (Object 5(a)(i)) and the promotion of orderly and economic use of land (Object 5(a)(ii)).

The encouragement of environmental protection (Object 5(a)(vi)) is considered in Section 5 of this report. Following this consideration, the Department is satisfied that the potential impacts of the project can be suitably mitigated, managed and/or offset to ensure an acceptable level of environmental performance.

The Department has considered the encouragement of ecologically sustainable development (ESD) (Object 5(a)(vii)) in its assessment of the development application. This assessment has sought to integrate all significant economic and environmental considerations, and to avoid any serious or irreversible damage to the environment, based on an assessment of risk-weighted consequences.

4. CONSULTATION

4.1 Description of Consultation Process

Under Section 89F of the EP&A Act, the Director-General is required to publicly exhibit the EIS for the project for at least 30 days.

After accepting the project EIS, the Department:

- publicly exhibited the EIS for an extended period of nearly 2 months from 26 April 2013 until 21 June 2013 at the:
 - Department's Information Centre in Sydney;
 - Wyong Shire Council's Offices in Wyong, the Lake Haven Library and Tuggerah Library;
 - Nature Conservation Council's office; and on the
 - Department's website;
- notified relevant State government authorities and the Wyong, Lake Macquarie and Gosford Councils by letter;

- notified relevant electricity supply and transmission authorities, in accordance with the Infrastructure SEPP;
- notified relevant road authorities, in accordance with the Mining SEPP; and
- advertised the exhibition in the *Sydney Morning Herald*, *Newcastle Herald* and the *Central Coast Express Advocate* on 25 April 2014.

In undertaking these processes, the Department has satisfied the notification requirements of Section 89F of the EP&A Act, the Mining SEPP, the Infrastructure SEPP and the Wyong LEP.

During the assessment process the Department also made other documents publicly available on its website, including:

- the development application;
- Director-General's environmental assessment requirements;
- WACJV's EIS;
- community and agency submissions received during the exhibition of the EIS;
- WACJV's Response to Submissions (RTS); and
- WACJV's Residual Matters Report.

4.2 Submissions

As at 31 January 2014, the Department had received a total of 752 submissions on the project, including:

- 18 from public authorities;
- 9 from special interest groups; and
- 725 from the general public, including over 450 form letters.

Of the 734 submissions from special interest groups and the general public, 611 objected to the proposal (over 400 of these objections were form letters), 113 supported the project (including one submission that attached a petition with 450 signatures) and 10 provided comments only. A full copy of these submissions is attached in **Appendix C**.

4.3 Key Areas of Concern

The majority of objections raised concerns about potential subsidence impacts on natural features (including water resources and heritage) and built features (including residences and other structures). These concerns are addressed in Section 5.1 to 5.5 of this report, with a particular focus on groundwater, key watercourses including Wyong River, Jilliby Jilliby Creek and Little Jilliby Jilliby Creek, and threatened biodiversity species.

The other key group of concerns related to noise impacts and air quality impacts (including both health and greenhouse gas issues) from the proposed surface operations at the Tooheys Road and Buttonderry Sites. These concerns are addressed in Sections 5.6 to 5.7 of this report, with a particular focus on appropriate management and mitigation measures.

Other concerns raised in submissions included potential impacts on traffic, transport and agriculture. These issues are discussed in **Table 10**.

The number of times that each issue was raised is shown in **Figure 6**.

4.4 Special Interest Group Objections

The Department received six submissions from special interest groups objecting to the project, including the Australian Coal Alliance (**ACA**), the Nature Conservation Council (**NCC**), the Wallarah North Precinct (**WNP**), the Bateau Bay-Shelly Beach Progress Association (**BBSBPA**), Our Land, Our Water, Our Future (**OLOWOF**) and Economists at Large (**EaL**).

The extensive **ACA** submission addressed the full range of potential issues associated with the project. As noted above, the key issues can largely be divided into two groups - comprising potential impacts resulting from subsidence and potential impacts resulting from the proposed surface facilities. In terms of subsidence, ACA raised concerns about potential impacts on surface water and groundwater resources (particularly in relation to the Central Coast's drinking water supply catchment), and potential impacts on biodiversity. In terms of the surface facilities sites, ACA raised concerns about potential health and amenity impacts associated with air quality (generally dust) and noise.

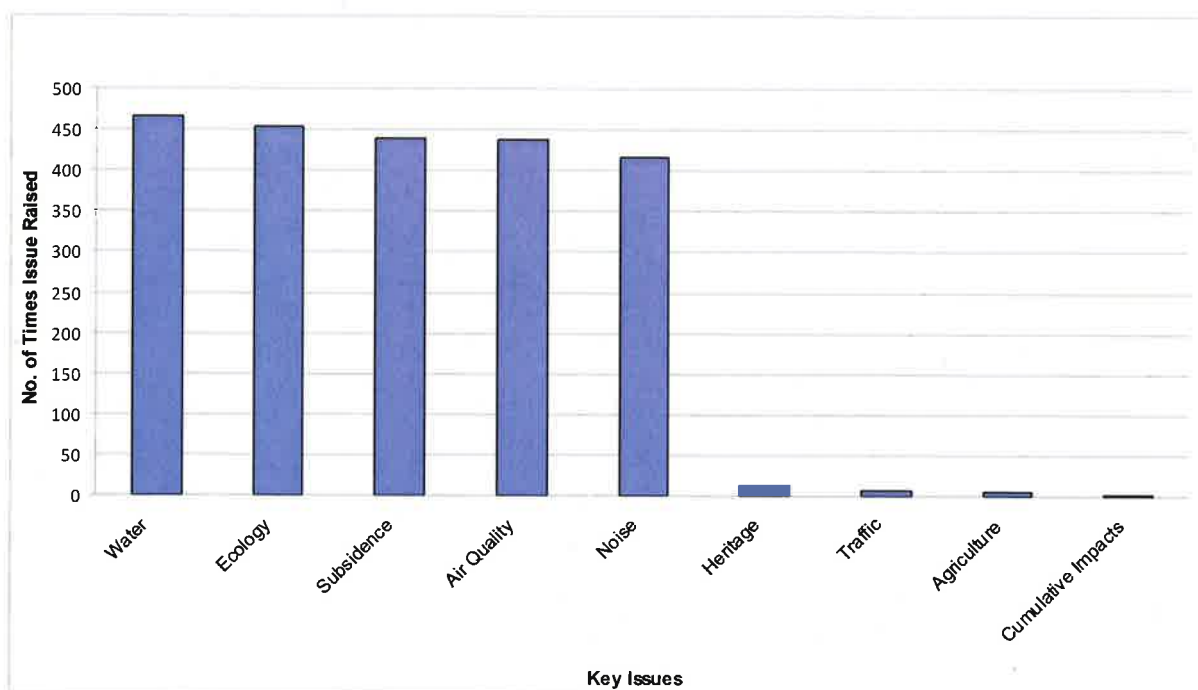


Figure 6: Key Issues Raised by Special Interest Groups and the General Public

The **NCC** also raised concerns about potential impacts on the local population's health due to coal dust particulate exposure, potential impacts on threatened flora and fauna species, and climate change impacts. The **WNP**, the **BBSBPA** and **OLWOF** raised similar concerns to the **ACA** and **NCC**.

EaL questioned the findings of the economic impact assessment in the EIS, which is discussed in detail in Section 5.8 of this report.

4.5 Submissions in Support

The Department also received a large number of submissions in support of the project. These submissions emphasised the socio-economic advantages of the proposal, including economic benefits and additional employment and training opportunities in the region. Many of these submissions also stated that the environmental impacts were not sufficient to warrant refusal of the project.

4.6 Special Interest Group Submissions in Support

The Department received two special interest group submissions supporting the project. These came from the Construction, Forestry, Mining and Energy Union (**CFMEU**) and the Central Coast Poultry Club (**CCPC**). The **CFMEU** submission provided an assessment of subsidence which concluded that the overall impacts would be low. Both the **CFMEU** and **CCPC** emphasised the economic benefits and employment opportunities associated with the project.

4.7 Response to Submissions

The Applicant subsequently provided a formal Response to Submissions on 17 September 2013 (see **Appendix D**). The RTS addresses the issues raised in all community and agency submissions. The Department forwarded the RTS to all public agencies that had previously provided submissions and invited further comments. Agency comments on the RTS are set out in **Appendix E**.

Seven agencies provided further comments indicating residual concerns, including the **Office of Environment and Heritage (OEH)**, the NSW Office of Water (**NOW**), the Hunter-Central Rivers Catchment Management Authority (**HCRCA**), Wyong Shire Council (**WSC**), Central Coast Water Supply (**CCWS**), Lake Macquarie Shire Council (**LMSC**) and **NSW Health**. All of these agencies have since provided input on the recommended conditions of consent, which have largely addressed their residual concerns.

A number of agencies provided brief comments accepting WACJV's responses to their initial submissions in the RTS and providing recommended conditions of consent, including the Environment Protection Authority (**EPA**), Roads and Maritime Services (**RMS**), Transport for NSW (**TNSW**), the NSW Heritage Council, the Office of Agricultural Sustainability and Food Security (**OEASFS**), Fisheries NSW, and Crown Lands.

The MSB, the Division of Resources and Energy (**DRE**) within Department of Trade and Investment, Regional Infrastructure and Services, **TransGrid**, **Forestry NSW**, **DOE** and the Australian Rail Track Corporation (**ARTC**) chose not to make any further comments.

4.8 Residual Matters Report

On 30 October 2013, WACJV submitted a Residual Matters Report in response to the residual concerns raised in agency comments on the RTS (see **Appendix F**). This report was distributed to those agencies that had provided comments on the RTS. Agency comments on the Residual Matters Report are set out in **Appendix G**.

4.9 Additional Meetings

The Department has also held further meetings with agencies in order to resolve certain residual issues including:

- with OEH on 11 September 2013;
- with NOW and WACJV on 11 October 2013; and
- with OEH and WACJV on 24 October 2013.

4.10 Residual Concerns and Recommendations in Agency Submissions¹

Environmental issues

OEH retains some minor concerns about the potential impacts on groundwater dependent ecosystems (GDEs), particularly within the Jilliby SCA. The Department has consulted extensively with OEH and WACJV on this issue and is satisfied that the recommended conditions of consent, which have taken OEH's comments into account, would sufficiently protect GDEs across the project area. The Department notes that a large proportion of the GDEs in the project area occur in its western extent, which would generally not be subject to mining as part of this project. The Department considers the risks to GDEs to be low, due to their low reliance on the water table in the elevated areas and the low permeability of the alluvium and high rainfall in the valley areas. The Department also notes that OEH's initial concerns about the potential subsidence impacts on frog species have been thoroughly addressed through a recommended condition of consent for a comprehensive frog research program.

HCRMA retains some minor concerns about subsidence-related impacts on Jilliby Creek, including the potential for increased erosion and ponding. The Department accepts that this is an important issue and has addressed it through appropriate performance criteria in the recommended conditions of consent. HCRMA also has some minor concerns about the proposed offsets; however the Department notes that both OEH and DOE are satisfied with the proposed offset package.

CCWS retains some concerns about potential loss of water resources from the local catchment, however it has recommended conditions of consent to address these concerns, including appropriate monitoring, mitigation and compensatory procedures in the event that water loss is greater than expected. The Department has carefully considered the potential impacts of the project on the local catchment and town water supply in Section 5.2.7, and is satisfied that they are unlikely to be significant. Nevertheless, the Department has taken CCWS's recommendations into account by requiring consideration of any potential impacts on town water extraction availability under various climatic scenarios within the Water Management Plan component of each successive Extraction Plan, which requires approval prior to longwall mining. The Department notes that WACJV need a licence to take any groundwater or surface water in accordance with the requirements of the *Water Act 1912* and the *Water Management Act 2000*, respectively. WACJV would not need to take any water directly from the town water supply and it is not necessary for WACJV to pay compensation to CCWS.

WSC acknowledged that the RTS and Residual Matters Report resolved a large number of the issues that it had initially raised; however it retains some concerns, particularly in relation to groundwater, surface water and air quality impacts. WSC states that certain management plans addressing these issues should be provided prior to determination. The Department agrees with WSC that management plans and further studies are required for numerous aspects of the project, including water and air quality, and has recommended conditions of consent requiring these to be developed prior to commencement of construction. However, the Department does not consider that these need to be included in the EIS or considered prior to determination. WSC also sought that conditions of consent

¹ This section is generally limited to residual concerns held by agencies, and their recommendations, after consideration of the RTS and Residual Matters Report, rather than the history of each agency's concerns.

contain requirements for preparation of a Disaster Risk Management Plan and dilapidation reports for potentially affected WSC infrastructure, particularly the Buttonderry Waste Management Facility.

The Department first notes that the Buttonderry facility is located over 1 km from the nearest proposed longwall and that it is very unlikely to be impacted. Nonetheless, it acknowledges WSC's concerns about its infrastructure and is satisfied that the recommended conditions of consent would provide adequate measures to deal with any such impacts. Under the conditions, WACJV must consult with all owners of affected built features (including WSC) during the preparation of the Built Features Management Plan component of each successive Extraction Plan. The proposed performance measures require mitigation, repair or replacement and/or compensation for any mining impacts on WSC's built features. The Built Features Management Plan would contain detailed assessment of expected and potential impacts and set out WACJV's commitments in regard to mitigation, repair or replacement and/or compensation.

NOW has accepted the additional information that WACJV provided in the Residual Matters Report, in relation to a 'minimal impacts' assessment under the *Aquifer Interference Policy*. It is satisfied that there is a low risk of vertical hydraulic connectivity and there is likely to be only minimal impacts to aquifers. Nonetheless, NOW has recommended conditions of consent requiring the development of a monitoring, response and mitigation strategy in the event that vertical leakage is greater than predicted. The Department has incorporated these recommendations into its recommended conditions of consent.

EPA is satisfied with the additional information that the RTS provided in relation to discharge limits into Wyong River and has no residual concerns about the proposal. It has recommended a number of conditions of consent relating to discharge limits, noise criteria, air quality and brine disposal. These have been incorporated into the recommended conditions of consent.

LMCC retains some minor concerns about greenhouse gas emissions and subsidence-related water impacts. The Department has recommended conditions of consent requiring both a Greenhouse Gas Management Plan and a Water Management Plan to be provided as part of the Extraction Plan process, which would address LMCC's concerns.

Social, health and amenity issues

LMCC also retains some minor concerns about the social impacts of the project. The Department has carefully considered these impacts in section 5.8, and is satisfied that the project would have a significantly positive net community benefit.

NSW Health initially raised concerns about the calculation and assessment of health risks. However, these concerns have now been resolved by additional information provided in the RTS and the Residual Matters Report. NSW Health also provided recommended conditions of consent.

Built features

The **MSB** did not raise any concerns about the project, however made a number of recommendations that have been reflected in the Department's recommended conditions of consent. The MSB initially recommended conditions of consent to ensure that WACJV (as against the MSB) would be responsible for any subsidence-related damage resulting from tilts greater than 7 millimetres/metre (mm/m), as repairing residences affected by such tilts can be difficult and expensive. However, there are only a small number of residences that are predicted to experience such tilts (see Section 5.4.4), and the MSB has since acknowledged that any such damage would be dealt with by the MSB, in consultation with WACJV, under the relevant provisions of the MSC Act. This process is also specifically referred to in the recommended conditions of consent relating to the rehabilitation of built features damaged by mining operations.

No residual concerns

DRE raised no concerns about the proposal, however recommended a number of conditions of consent relating to rehabilitation and mine closure. DRE's subsidence expert has reviewed the subsidence impact assessment presented in the EIS and is satisfied that it is appropriate.

TNSW (including **RailCorp**) is satisfied that its initial minor concerns about road safety, intersection performance and rail network impacts have been addressed by the RTS. It has suggested that further mitigation measures may be required in relation to the 200 m radius curve for the rail loop, which has been taken into account in drafting recommended conditions of consent.

RMS had some minor concerns that have been resolved through the RTS, and made recommendations for a Traffic Management Plan, which have been taken into account in drafting recommended conditions of consent.

The **NSW Heritage Council** raised no concerns about the proposal. However, it made some recommendations about the requirement for a Heritage Management Plan, which have been taken into account in drafting recommended conditions of consent.

OASFS is satisfied that its initial minor concerns about potential damage to farm infrastructure and property values can be adequately addressed through appropriate conditions of consent.

Fisheries NSW raised no concerns about the proposal. However, it made some recommendations about the requirement for Water and Biodiversity Management Plans, which have been taken into account in drafting recommended conditions of consent.

DOE raised no concerns about the proposal and is satisfied with the biodiversity offsets that WACJV has proposed.

ARTC and **TransGrid** are both satisfied with the level of consultation that has occurred in relation to their infrastructure and have raised no concerns about the proposal.

Crown Lands raised no concerns about the proposal, however noted that certain Crown land may be affected and may require acquisition. **Forestry NSW** raised no concerns about the proposal.

Gosford City Council was sent a copy of the EIS, however chose not make a submission.

5. ASSESSMENT

In its assessment of the merits of the project the Department has considered the:

- EIS, submissions, RTS, Residual Matters Report and additional information provided by WACJV and public authorities;
- the *Wyong Water Study*, the *Strategic Review of Impacts of Potential Underground Coal Mining in Wyong* and the *2010 PAC review* report from the previous Wallerah 2 Coal Project application;
- relevant environmental planning instruments, policies and guidelines; and
- relevant provisions of the EP&A Act, including the requirements of section 79C and the objects of the Act.

The Department considers the key issues relating to this project to be:

- predicted ponding and surface flow impacts in creeks;
- potential impacts on streams in the upland areas;
- subsidence induced impacts on built features, including flooding; and
- noise and air quality impacts, particularly in relation to the Tooheys Road Site.

The following is a summary of the findings of this assessment.

5.1 SUBSIDENCE

5.1.1 Introduction

This assessment report adopts the approach taken in all other recent Departmental assessment reports for underground coal mines in considering subsidence effects separately to their impacts and consequences. The term 'subsidence effect' describes subsidence itself. The term 'subsidence impact' refers to any physical change to the fabric or structure of the land or its surface. The term 'environmental consequence' or 'consequence' is used to describe any change in the amenity or function of a feature (whether natural or built) that arises from a subsidence impact.

This section of this report firstly provides a broad overview of the geology of the area, the modelling approach utilised by WACJV and its appropriateness in assessing subsidence and its impacts and consequences. It then provides an overall summary of the predicted subsidence effects, impacts and environmental consequences. Later sections of the report (sections 5.2 to 5.5) discuss specific effects, impacts and consequences with respect to the key surface features.

5.1.2 Geology

The project is located within the southern part of the Newcastle Coalfield. Economic coal resources are contained in the upper part of the Newcastle Coal Measures at very substantial depths (between 350 and 690 m). The strata overlying the coal measures are largely a series of sandstones with minor siltstones and occasional shales. An indicative stratigraphic column is shown in **Figure 7**. NOW has confirmed that it is satisfied that, below the uppermost alluvium, all of these strata have very low permeability and do not contain any significant aquifers.

The uppermost Terrigal Formation outcrops in the elevated south-western half of the project area, while the underlying Patonga Claystone outcrops in the lower, more undulating areas in the valleys. In small parts in the northeast of the project area, there are outcrops of the Tuggerah Formation.

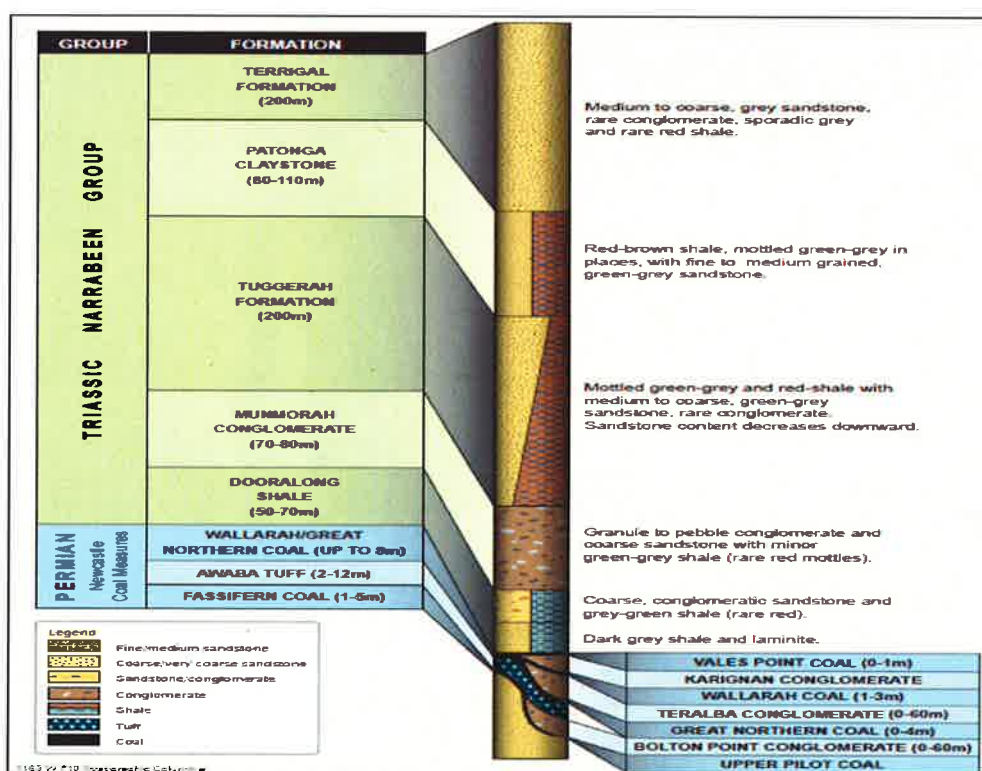


Figure 7: Indicative Stratigraphical Column

The southern part of the Newcastle Coalfield is typified by dominant NW-SE structural trends, with dyke orientations reflecting these pre-existing joint and fault directions. There were initially some concerns raised in agency submissions about the presence of faults, lineaments and other geological structures. However, WACJV has undertaken a large amount of drilling (see **Figure 8**), which reveals that the project area itself is relatively free of major geological structures, but is bounded by major dykes and seam splitting.

5.1.3 Modelling

A Subsidence Impact Assessment (SIA) was undertaken jointly by SCT Operations (SCT) and Mine Subsidence Engineering Consultants (MSEC). Professor Bruce Hebblewhite then undertook an independent peer review of the SIA. The EIS also includes a Geology Report prepared by WACJV that provides a summary and analysis of subsurface geology, based on the extensive drilling program that WACJV has undertaken.

Subsidence predictions were prepared by SCT using numerical modelling techniques. The results of these predictions were then used by MSEC to calibrate its Incremental Profile Method (IPM) subsidence prediction model for use in the project area. Subsidence profiles were then produced by MSEC using a two-dimensional, explicit-finite-difference program developed specifically for solving mining and geotechnical engineering problems (the modified Fast Lagrangian Analysis of Continua (FLAC) model). The FLAC model was validated through back analysis of a number of historical subsidence data sets from coal mines in the Southern, Western and Newcastle Coalfields.

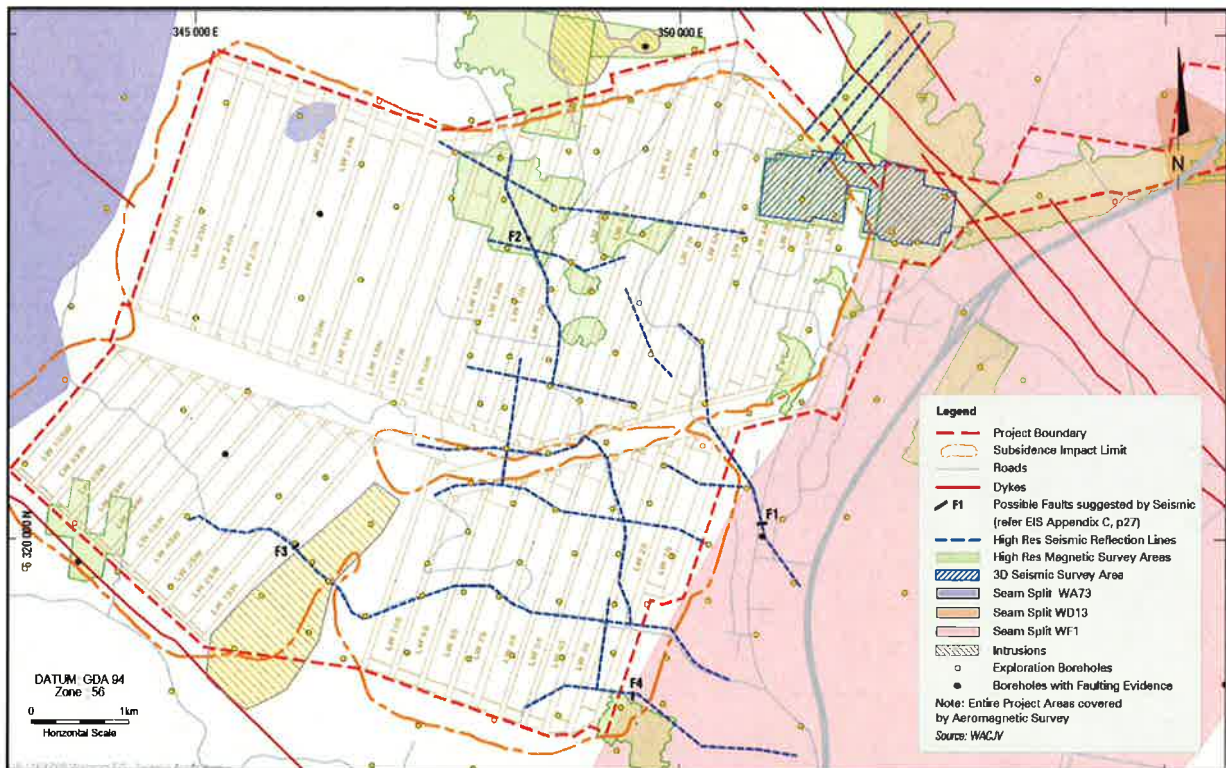


Figure 8: Geological Structures at Seam Level and Exploration Borehole Network

The Department notes that, in WSC's initial submission, its expert consultant Professor Philip Pells stated that using one model to calibrate another is 'unwise' and 'not widely regarded as best practice'. However, this view is in great contrast to both Professor Hebblewhite's peer review and the Department's 2008 *Strategic Review of Impacts of Potential Underground Coal Mining in the Wyong LGA*, which both consider the innovative 'hybrid approach' of the SIA to be leading practice for mine subsidence. The Department also notes that WSC did not raise any concerns about subsidence in its final submission, after consideration of the RTS and Residual Matters Report.

Established subsidence prediction models such as IPM, which are primarily suitable for application in the Southern Coalfield and the northern part of the Newcastle Coalfield, have been developed and refined over many decades of longwall extraction in these areas. However, these models cannot be directly applied to the unique geological environment of the project area. For example, while the higher finer-grained sandstones and shales in the project area are generally similar to those in the Southern Coalfield, the near-seam strata are comparatively weaker. In addition, the maximum depth of cover is substantially greater than mines in the northern Newcastle Coalfield, and also greater than for most mines in the Southern Coalfield. It is for that reason that WACJV has used a combination of MSEC's IPM Method and SCT's numerical model to better predict potential subsidence effects, impacts and environmental consequences.

The Department acknowledges that no single subsidence modelling approach is flawless. However it is satisfied that the SIA's hybrid approach has a high degree of conservatism built in and is entirely appropriate for the purposes of assessing this project. The Department understands that subsidence modelling (as with any modelling) fundamentally requires continual additions of new data as longwalls are extracted and consequent adjustments and updating. The Department also notes that all recent development consents for underground mining involve application of such an adaptive management approach. Recent consents require preparation of detailed Extraction Plans, with further specific subsidence predictions in particular areas of proposed mining, prior to longwall mining occurring. The Department is satisfied that further subsidence modelling and more detailed consideration of potential impacts can be appropriately managed through the Extraction Plan process.

5.1.4 Subsidence Predictions

The depth of cover to the coal seam ranges from 345 m (in the Dooralong Valley) up to 690 m (in the elevated western areas). The panel width and targeted seam thickness also vary, depending on the topography and surface features (see **Table 2**). Because subsidence behaviour would vary across the proposed extraction area, the SIA divided it into three mining domains, being the:

- Hue Hue MSD Area, which is the shallower, more-urbanised area (ie rural residential lots) where longwall panels and targeted seam thickness are both reduced;
- Valley Area, which is the deeper, relatively flat rural areas in the base of the valleys; and
- Forest Area, which is the hilly, forested terrain comprising most of the western half of the proposed extraction area.

Table 2: Proposed Longwall Widths and Thicknesses

Domain	Panel Width (m)	Target Seam Extraction Thickness (m)
Hue Hue MSD Area	125-175	3.5
Valley Area	175-205	4.0
Forest Area	205-255	4.5

Conventional Subsidence Effects

'Conventional subsidence effects' includes vertical displacement, tilt, and tensile and compressive strain. There are two types of strain in rocks associated with subsidence, tensile and compressive, and they result in two corresponding types of curvature of the ground. Curvature in an outwards direction results in the ground swelling or 'hogging', which occurs when the ground is subjected to tensile strain. Curvature in an inwards direction results in the ground 'sagging', which occurs when the ground is subjected to compressive strain. As strain is affected by many localised factors, some surface features are likely to experience locally-concentrated strains, whilst predicted strains may not eventuate at other places.

Overall, tilt and vertical subsidence are not expected to have great impacts in the project area due to the relatively high depth of cover. Subsidence effects would also develop incrementally, and not plateau above an individual longwall panel until at least a further two panels have been extracted. Movement at any point on the surface would not stabilise until a number of adjacent longwall panels have been extracted.

When two adjacent points undergo a different amount of vertical displacement, the slope of the ground surface between them changes, which then induces tilt in features located on the surface. The project's mine layout has been designed with narrow chain pillars that should yield (or compress and then collapse) when isolated between two adjacent subsided longwall panels. This is likely to result in significantly reduced variations in vertical subsidence across most of the mining domain, which should in turn significantly reduce tilts in those areas as well.

The localised, peak maximum vertical subsidence predictions are shown in **Table 3**. However, more typical predicted vertical subsidence figures are:

- Hue Hue MSD Area: 600-1,000 mm;
- Valley Area: 1,200-1,400 mm; and
- Forest Area: 1,500-2,000 mm.

The most relevant impact that may result from conventional subsidence in the project area is fracturing of the surface zone. In the Southern Coalfield, fracturing of the stiff, and sometimes thinly-layered, surface rocks present there (ie massive and sometimes cross-bedded sandstones) has significant potential to fracture streambeds and other surface rock exposures, which may in turn displace near-surface water to deeper aquifers.

Table 3: Maximum Conventional Subsidence Effects

Domain	Vertical Subsidence (mm)	Tilt (mm/m)	Hogging Curvature (/km)	Sagging Curvature (/km)	Tensile Strain (mm/m)	Compressive Strain (mm/m)
Hue Hue MSD Area	1,000	4	0.12	0.15	3	3
Valley Area	2,000	10	0.28	0.3	3	3
Forest Area	2,600	15	0.28	0.37	3.6	4.6

However, as discussed in more detail in section 5.2.5, potential fracturing of streambeds (particularly in the Valley Area) is not seen as a significant concern in the project area, due to the:

- ability of the deep alluvium (and/or outcrops of claystone) beneath the streams to absorb and/or infill any potential surface cracking in the bedrock below;
- generally low permeability of the strata below the alluvium; and
- significant depth of the targeted coal seams.

Non-conventional Subsidence Effects

'Non-conventional subsidence' components can arise in steep or incised topography, especially in the presence of high horizontal stresses, such as occur in the Southern Coalfield. Non-conventional subsidence includes valley closure, upsidence and far-field horizontal movements. 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 floor. Upsidence and closure can generate fracturing of bedrock beneath streams, dilating the immediate strata down to a depth of several metres, and potentially resulting in subterranean flows which can reduce the normal environmental flow of the stream.

Non-conventional compressive strains due to mining may occur which could exceed the maximum predicted conventional strains provided in **Table 3**. However, these types of strains generally only occur in the base of narrow valleys, which are not present in the project area. In any case, given the deep alluvium and lack of stiff rock sheets at the surface, minor non-conventional strains are unlikely to cause significant impacts on streams.

It is likely that there would be measurable upsidence and valley closure movements within the project area. Strains, upsidence and valley closure are all of greatest concern for natural features associated with surface or near surface water, and these potential impacts are discussed in greater detail below.

5.2 WATER RESOURCES

5.2.1 Introduction

The project has the potential to affect surface water and groundwater resources in three key ways:

- potential impacts on groundwater flows in subsurface aquifers, water availability to local groundwater users, and baseflow to local creeks and GDEs. The key concern is whether there is likely to be any connective cracking between surface water sources and groundwater aquifers;
- potential impacts on surface water flows in local and regional catchments, and consequent water availability to downstream water users. The key issue is the nature and extent of any surface cracking, particularly within streambeds; and
- potential impacts on water quality in downstream surface water and groundwater resources, particularly in relation to mine discharges and the proposed underground disposal of brine.

5.2.2 Catchment Context

The project is located within the Tuggerah Lakes Basin, which has a total catchment area of approximately 700 km². The total area of land potentially affected by project-related subsidence is 37 km², which represents approximately 5% of the total catchment.

Water is extracted from all rivers and significant streams in the area for agricultural purposes and from the Wyong River and Ourimbah Creek for the Central Coast's regional drinking water supply. Water supply on the Central Coast is managed co-operatively between Gosford and Wyong Shire Councils, via the CCWS. There are three operational dams (Mangrove Creek Dam, Mardi Dam and Mooney Dam) and three operational weirs in the CCWS's joint water supply system.

There are two major streams located within the project area - the Wyong River (6th order) and Jilliby Jilliby Creek (4th and 5th order). The confluence of Jilliby Jilliby Creek and the Wyong River is located a short distance southwest of the extraction area. Jilliby Jilliby Creek also has a number of smaller tributaries joining it along its alignment, including Little Jilliby Jilliby Creek (3rd and 4th order) and Armstrong and Myrtle Creeks (both 2nd order in upper reaches and 3rd order in lower reaches).

Jilliby Jilliby Creek and its tributaries generally have sandy channels, with an alluvium depth of between 3 and 30 m. The creeks are largely well vegetated, with tree roots providing a high degree of lateral stability. However, erosion is evident in many sections of the creeks that lack good vegetation coverage.

As shown in **Figure 9**, all of the 3rd and higher order streams are underlain by either alluvium or the Patonga Claystone. The significance of this in terms of subsidence impacts is discussed in detail below in section 5.2.5.

The panel's July 2008 report concluded that mining-induced subsidence in the area is '*unlikely to compromise in any significant way the water supply of the Central Coast*' due to the depth of the coal seams and the geomorphologic context. It also found that mining under Jilliby Jilliby Creek and near Wyong River would be unlikely to cause any hydraulic connectivity between the surface water and the groundwater. In relation to the Jilliby SCA, it found that surface tensile cracks may result from mining-related subsidence; however these impacts would be on a '*much smaller scale*' than those associated with mining in the Southern Coalfield, due to the absence of deeply incised valleys.

Wyong Water Study

In May 2010, the Department engaged an independent consultancy (SKM) with expertise in water resources to conduct a review of the adequacy of the surface and groundwater data in the previous project application for the Wallarah 2 Coal Project. The study was completed in August 2010.

It concluded that the baseline information available at the time was sufficient for the purposes of undertaking a proper assessment of the proposal, however also recommended an adaptive management regime that would require further monitoring if consent was granted. In particular, the study recommended that a total of 2 years of baseline data should be collected (including previous monitoring) and that ongoing sampling should continue for the life of the project.

An international expert (Aqualine) undertook a review of the study and agreed with the vast majority of SKM's conclusions and recommendations. Aqualine agreed that the existing baseline data was adequate to assess the previous Wallarah 2 Coal Project proposal, however made some additional recommendations in relation to ongoing monitoring. The Department accepts that these recommendations have been met by WACJV in preparing the current EIS.

PAC Review

The 2010 PAC review of the previous project application for the Wallarah 2 Coal Project raised concerns about subsidence-related impacts on the site water balance and a lack of assessment of impacts associated with the discharge of process waters from the surface facilities. The Department notes that both of these issues have been comprehensively addressed in the current application and are discussed in section 5.2.7. It is also important to note that the PAC had no concerns about connective cracking between surface water and groundwater sources.

Independent Expert Scientific Committee Advice

The Independent Expert Scientific Committee (IESC) on Coal Seam Gas and Large Coal Mining Development was established by the Commonwealth Government in 2012 as a statutory committee under the EPBC Act. It provides scientific advice to decision makers on the impacts that coal seam gas and large coal mining developments may have on Australia's water resources.

In April 2013, DOE requested that the IESC provide advice on a draft EIS for the project (dated February 2013), which was substantially revised prior to exhibition. On 24 May 2013, the IESC provided its advice on the February draft EIS, which raised a number of concerns about the level of information relating to surface water and groundwater modelling, monitoring and mitigation.

On 25 July 2013, DOE met with WACJV to discuss the IESC's concerns and the additional information provided in the exhibited EIS. On 31 July 2013, WACJV provided a detailed response to the IESC's concerns, which had been largely addressed in the exhibited EIS. In its submission to the Department dated 22 August 2013, DOE indicated that WACJV had adequately addressed all concerns previously raised by the IESC.

EIS Assessments

The EIS includes a Groundwater Impact Assessment (GIA) undertaken by Mackie Environmental Research (MER), and a peer review of the GIA undertaken by Kalf and Associates. The groundwater model in the GIA is an updated version of the model prepared for the previous project application, and is largely informed by extensive core inspections and borehole testing (170 packer tests at 31 exploration boreholes) undertaken to determine permeabilities in the various underground strata. A number of other groundwater studies have also previously been undertaken in the area by Coffey Partners International, ERM, Hydroilex Pty Ltd, L. Cook and Associates, and EcoEngineers, which were all taken into account in the GIA. MER has also provided additional information about vertical hydraulic conductivity in an 'Issues Paper' attached to the RTS and further information in the Residual Matters Report.

A Surface Water Impact Assessment (SWIA) was undertaken by WRM Water & Environment (WRM), which uses a hydraulic model to assess the impacts of potential subsidence on erosion potential along significant watercourses in the project area. This computer-based simulated water balance model (GoldSim) was designed to reflect changes in the water management system over the life of the project, with predicted groundwater inflows sourced from the GWIA and estimated surface water runoff volumes based on NOW-operated stream gauging stations. The SWIA includes a risk assessment for all key natural features located within the subsidence-affected portion of the Jilliby SCA. The SWIA found that water quality and environmental quality are much lower in the lower reaches of the affected streams, which have been affected by previous disturbance and agricultural land uses.

The EIS also includes a Flood Impact Assessment (FIA) undertaken by G Herman and Associates, which utilised two-dimensional flood modelling software, as recommended by the *Strategic Review of Impacts of Potential Underground Coal Mining in the Wyong LGA*.

5.2.4 Groundwater Impacts

The only significant groundwater aquifers in the project area are within the alluvium of the Yarralong and Dooralong Valleys and in the shallow weathered zone of the uppermost strata. The alluvial groundwater systems of the Yarralong and Dooralong Valleys are characterised by low hydraulic conductivities and increasing salinity with depth.

Strata within the deeper Narrabeen Group are generally considered to be aquitards. However, the *NSW Aquifer Interference Policy (AIP)* requires that all saturated rocks are classified as either 'highly productive' or 'less productive' aquifers. NOW has advised that both the alluvial and hard rock groundwater systems are classified as 'less productive' aquifers for the purposes of assessment against the AIP.

For deep groundwater systems, the potential environmental impacts of underground mining are related to 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 that have registered bores and/or result in stream baseflow reductions.

For shallow groundwater systems, there are two key potential impacts of underground mining. Firstly, connectivity between surface cracking and the fractured zones above the extracted longwall panels, which can lead to loss of surface flow directly into the mine workings. Secondly, added infiltration of surface water from cracking of stream beds and rock-bars as a result of tensile fractures and/or bedding shear associated with conventional subsidence or valley closure movements.

Connective Cracking

The GIA and SIA both conclude that, due to the high depth of the proposed underground mining and the low permeability of the rock strata beneath the alluvium, there would be virtually no connectivity between the mine workings and the surface. Extensive core inspections and borehole testing, undertaken as part of the SIA, indicate that groundwater movement through the deeper rock strata in the Narrabeen Group strata is negligible. The SIA predicts that there would be at least a 100 m thick 'constrained zone' above the goaf and fractured zone that would be free of connective cracking.

The Department notes that WSC's expert consultant, Professor Philip Pells, has raised concern about potential permeability through micro-fractures and further possibility of 'tortuous' path connectivity between surface water and the mine workings. While the Department accepts that this is a legitimate issue, it does not consider that the consequences of this potential 'tortuous' connection are significant in terms of overall drawdown, groundwater inflow and (most importantly) surface water resources.

The Department is satisfied that the groundwater in the alluvium would only be minimally impacted due to the high storage capacity of the alluvium and the high rate of rainfall recharge. NOW has also carefully assessed the impacts of the project on groundwater, and considers that the potential impacts on water table, water pressure and water quality are Level 1 under the AIP (ie acceptable).

Surface Cracking

Notwithstanding the expected lack of connective cracking, the GIA predicts that some groundwater in the alluvium of the Yarralong and Dooralong Valleys will be displaced into subsidence-induced shallow fractures in the underlying bedrock, which would temporarily decrease groundwater stored in the alluvium. The GIA estimates that leakage from the alluvial aquifer would be very low at 0.02 ML/day, while rainfall is predicted to average 130 millilitres/day. This relatively high rainfall, together

with associated runoff from the surrounding hill slopes, would restore these minor losses of alluvial groundwater relatively quickly. Further, it is expected that fine sediment from the alluvium would substantially infill these cracks in the bedrock.

Drawdown

The generally low permeabilities of the strata in the constrained zone limit the potential for water movement and depressurisation. The groundwater model predicts that total leakage from the shallow hardrock aquifer would be around 0.04 ML/day.

The GIA predicts total groundwater inflow to the mined void to be 26,500 ML over the 28-year life of the project. The daily inflow is predicted to increase from 0 ML/day in Year 1 of mining to a maximum rate of 2.5 ML/day in Year 19 of mining. The GIA predicts the regional rate of recovery to be slow due to the increase in storage caused by the creation of underground workings and goaf, as well as the low permeability of the hard rock strata. As there is no groundwater Water Sharing Plan under the *Water Management Act 2000* (WM Act) in place in this area, WACJV will be required to acquire appropriate licences for the extraction of groundwater under Part 5 of the *Water Act 1912*. NOW has acknowledged this in its submissions, and the Department has included reference to this requirement in the recommended conditions of consent.

However, there is not expected to be any significant impacts on registered groundwater users in the area, since the great majority of this water is sourced from the coal seam itself, or from the overlying rock strata forming the goaf and fractured zone. There are 12 registered bores and wells located within the proposed mining area and an additional 49 bores located within 5 km of this area. These include pumping bores and monitoring bores which are largely used for domestic, stock, farm, irrigation, waste disposal and poultry purposes. The GIA predicts the yields of these existing bores and wells would not be significantly affected due to the lack of connective cracking. Nevertheless, WACJV has committed to ongoing consultation with registered groundwater users, and repair or replacement of water supply if necessary.

Ongoing Groundwater Monitoring and Management

WACJV has obtained access to five bores on a private property within the Dooralong Valley, at which monitoring has already commenced. WACJV is also in the process of installing piezometers and a deep monitoring bore. These bores would provide at least two years of monitoring data prior to the commencement of any longwall coal extraction. Across the project area, WACJV has committed to implementing a comprehensive groundwater monitoring program, including construction of at least 20 piezometers and 8 pore pressure transducers. This network of monitoring boreholes would be focussed on the initial proposed longwalls in the eastern area.

If it is determined from these initial bores that adverse impacts may occur in either the alluvial lands or the elevated western areas, WACJV proposes to adjust the mine plan to reduce subsidence effects to an acceptable level. This may include changing the height of seam extraction or reducing panel widths. Depending on the scale of any changes to the mine layout, it is possible that a future modification to any consent may be required before longwall extraction could continue.

The Department has recommended conditions of consent requiring a Water Management Plan (WMP), which must be prepared in consultation with NOW and EPA, as part of the Extraction Plan process. The WMP must be prepared and approved prior to any longwall extraction of coal and include details about the proposed monitoring program and management measures.

5.2.5 Surface Water Impacts

There are three key potential subsidence-related impacts on streams within the project area:

- increased levels of ponding and scouring;
- changes to stream alignment; and
- fracturing of the bedrock and surface water flow diversions.

Substantial fracturing of bedrock within streams and surface flow diversions have occurred in the Southern Coalfield, including in the Upper Georges River and Waratah Rivulet. However, it is important to differentiate between the geomorphological and environmental features of the Southern Coalfield and the project area. In its review of the previous Wallarrah 2 Coal Project application, the PAC listed a few of these differences:

- the ridges in the forested areas of the project area are jointed and stress relieved;

- the upland streams in the project area are contained within V-shaped gullies separated by unconfined ridges, in contrast to the Southern Coalfield streams which are contained in more U-shaped gorges cut into a plateau;
- the valleys in the project area are not only much broader than the gorges of the Southern Coalfield but are filled with some 20-30 m of alluvium;
- rock-bars and associated pools typical of the Southern Coalfield do not exist, or are uncommon, in the upland streams in the project area; and
- streams in the alluvium-filled valley floors above the proposed longwalls have water levels that are generally above the surrounding groundwater levels and the water levels in these streams are not controlled by a series of exposed rock-bars.

Ponding and Scouring

Increased ponding and scouring can occur where mining-induced tilts substantially decrease or increase the natural gradient of the stream. However the consequences of this can be greatly reduced when a stream has a natural ability to re-equilibrate its gradient, which means that ponding is only temporary. In general, the key streams in the project area, which meander through floodplains, are dynamic and experience natural processes of erosion and scouring during storm and flood events, which would indicate an ability to adapt to changed gradients and natural ponding.

Changes to Stream Alignment

Changes in stream alignment can occur as a result of mining-induced tilts across stream beds; however it is important to consider the natural state of streams in assessing the potential consequences of such impacts. Broadly speaking, the key streams within the project area naturally experience extensive changes in surface water flow depths and widths as a result of flooding events, which are likely to have greater consequences than any mining-induced tilts. Further, the meandering nature of the streams within their floodplains indicates that the stream beds are themselves dynamic.

Fracturing of the Bedrock and Surface Water Flow Diversions

Surface cracking can cause noticeable impacts in rock-bar controlled streams, including loss of surface flow. However, unlike in the Southern Coalfield, the water levels in the streams in the project area are not controlled by a series of exposed rock-bars within a hard sandstone surface layer. In contrast, the stream beds are directly underlain by deep alluvium (in the valleys) or the Patonga Claystone (in the forested hills, see **Figure 9**), which is too weak to form rock-bars.

There may be mining-induced fracturing of the bedrock beneath the alluvium, however these cracks would be quickly infilled with sediment and displaced groundwater. As discussed above, surface cracks are not expected to result in any loss of water to deeper aquifers due to the low permeability of the rock strata and the lack of connective cracking.

Predicted Impacts on Streams

The EIS identified five key watercourses that are predicted to be affected by subsidence, including the Wyong River, Jilliby Jilliby Creek, Little Jilliby Jilliby Creek, Myrtle Creek and Armstrong Creek. The SIA predicted the maximum subsidence effects for each of these streams and the other remaining streams, as summarised in **Table 4** below. A more detailed analysis of subsidence effects/impacts on each of these watercourses is provided below.

Table 4: Maximum Predicted Subsidence Effects for Streams

Location	Maximum Vertical Subsidence (mm)	Average Natural Gradient (mm/m)	Maximum Tilt (mm/m)	Hogging Curvature (/km)	Sagging Curvature (/km)	Maximum Upsidence (mm)	Maximum Closure (mm)
Wyong River	150	0.7	1	0.01	0.01	150	100
Jilliby Jilliby Creek	1,500	1.3	10	0.15	0.2	150	75
Little Jilliby Jilliby Creek	2,000	5.2	12	0.2	0.25	650	775
Armstrong Creek	2,600	16	13	0.25	0.3	650	775
Myrtle Creek	2,500	12	15	0.28	0.37	800	1000
Remaining streams	2,600	15	15	0.28	0.37	800	1000

Wyong River

Wyong River is a 6th order stream which lies outside of and parallel to the southern boundary of the project area. As there is no mining proposed beneath the Wyong River, only small levels of subsidence have been predicted along the river's alignment. The SIA predicts that subsidence of this small scale would not have a measurable impact, as active scouring erosion and sediment deposition already occurs during natural flow events.

In addition, the SIA has predicted small levels of upsidence of up to 150 mm, which if it occurred, would result in a net subsidence along the Wyong River of just 25 mm. Consequently, the change in stream gradient along the river is predicted to be negligible and the SIA predicts no significant changes in the levels of ponding or scouring.

The Department accepts that the predicted subsidence levels are very small and that impacts to the river are not likely to occur. However, given the significance of the stream in terms of its catchment value, the Department has recommended performance criteria in the consent conditions requiring not greater than negligible environmental consequences on the river, and no connective cracking at all.

When assessing the relevant Extraction Plan and revised subsidence predictions, the Department would have the option of requiring the finishing line of the proposed longwalls to be further set back from the Wyong River in order to meet the negligible environmental consequence performance criteria, if considered necessary.

Jilliby Jilliby Creek

Jilliby Jilliby Creek is a 5th order stream that runs approximately north-south across the project area through the Dooralong Valley. The creek contains a number of abandoned channels and ox-bow channels, which indicates that natural erosion and stream meandering processes have been occurring in the creek over time. The EIS also notes that in locations where the streambeds comprise sediments, rainfall events can result in natural changes in the stream alignment. The entire length of the creek contains a saturated alluvium with depths of up to 30 m. The EIS predicts that any fractures that may develop in the bedrock beneath this alluvium would become charged with groundwater as they form, resulting in an imperceptible diversion of surface water flow.

The SIA and SWIA predict that subsidence effects along Jilliby Jilliby Creek would be relatively uniform due to the yielding pillars that are built into the mine plan, which would limit the impacts on flow velocities. The EIS concludes that, due to the existing dynamic nature of the creek, it is most likely that subsidence impacts on the creek channel would be difficult to separate from the existing natural variability in vegetation and bed and bank condition. In fact, the EIS states that increased flow velocities from natural storm events are likely to be an order of magnitude greater than those resulting from mining-induced changes to bed gradients.

Nevertheless, there are some locations along the creek within the project area that are expected to experience increased ponding and minor impacts on local stream flow velocities. The potential for increased ponding is expected to occur in sections of Jilliby Jilliby Creek that overlie LW1S and LW6N (see **Figures 10** and **11**). LW6N is expected to commence in Year 6 of mining, and it is at the commencing end of this panel that the most significant ponding is currently predicted. It is at this point that the greatest differentiation in subsidence would occur with the maximum predicted tilt of 10 mm/m. This tilt is significantly greater than the existing gradient of the creek channel (1.3 mm/m).

After this commencing end of LW6N, the yielding chain pillars are predicted to result in fairly uniform subsidence levels from LW6N to LW11N (along the channel of Jilliby Jilliby Creek), which should prevent any further ponding in the Northern Domain. However, when mining commences in the Southern Domain in Year 11 of mining, there is also likely to be some ponding in line with the commencing end of LW1S and the finishing end of LW2S (see **Figures 10** and **11**).

The Department acknowledges that Jilliby Jilliby Creek has an important role in providing water for surrounding agricultural uses and also forms part of the broader catchment for the water supply for the Central Coast. However, the Department notes that over a third of the project's proposed 35 longwalls are located beneath the Jilliby Jilliby Creek. This is a very significant coal resource that should not be unnecessarily sterilised. Consequently, the Department has sought to ensure that an appropriate balance is struck between maximising the extraction of the coal resource and minimising any environmental impacts on the creek.

In particular, the Department has considered the potential ponding or scouring that may occur in limited sections of the creek at the edge of the various longwall domains (ie adjacent to LW6N, LW1S and LW2S). However, it is satisfied that, due to the dynamic nature of the creek and its natural propensity to rework its sediments, it is likely that the creek would be able to quickly re-equilibrate under natural geomorphic processes. Any impacts to Jilliby Jilliby Creek are likely to be only temporary, until sediments are reworked and local gradients have adjusted to their most stable levels.

The Department has also carefully considered the potential impacts of the project on the local catchment and town water supply in Section 5.2.7, and is satisfied that there are unlikely to be any significant impacts in that regard. Furthermore, the project area is covered by two surface Water Sharing Plans, and WACJV would be required to acquire the appropriate water access licences under the WM Act for any surface water take. In other words, it would be required to operate, along with other surface water users in the area, in accordance with the sustainable water limits of the various Water Sharing Plans.

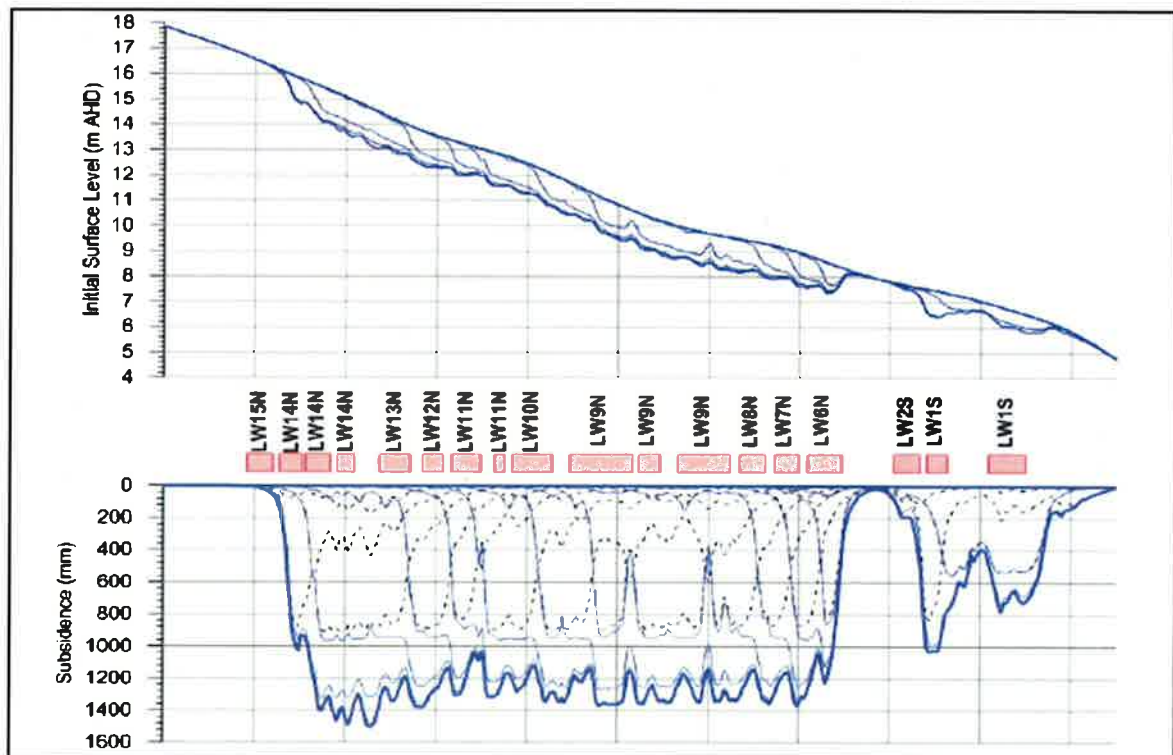


Figure 10: Predicted Subsidence Profile of Jilliby Jilliby Creek

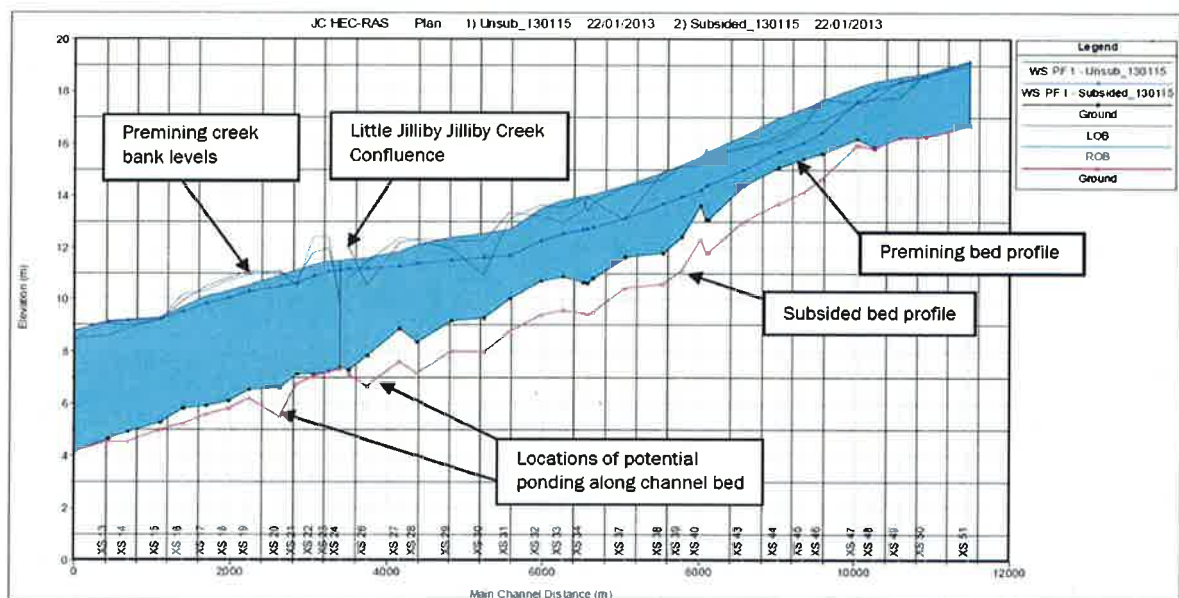


Figure 11: Longitudinal Section of Predicted Flow Conditions in Jilliby Jilliby Creek

Consequently, the Department has recommended performance criteria requiring not greater than negligible environmental consequences over 80% of the creek affected by subsidence, and not greater than minor environmental consequences over the remaining 20% of the creek. These criteria recognise that there may be minor environmental consequences on the creek, which are likely to only be temporary in nature and not inconsistent with the natural state of the stream.

The Department retains some minor concerns about the predicted ponding over LW6N and LW1S in Jilliby Jilliby Creek and cannot be confident at this stage that it would not have more than minor environmental consequences in its current layout. However, the Department notes that WACJV would be required to seek Extraction Plan approval prior to any mining and WACJV has already acknowledged in the EIS that narrowing of the proposed longwalls may be necessary to reduce ponding impacts. In addition, the proposed longwalls would not be extracted in the vicinity of the Jilliby Jilliby Creek until Year 6 of mining, by which time there would be a much better understanding of subsidence, and an opportunity to modify the longwall layout through the Extraction Plan process.

Little Jilliby Jilliby Creek

The hydrologic value of Little Jilliby Jilliby Creek is high due to its relatively high runoff yield, contribution to town water supplies and habitat value for native species. Little Jilliby Jilliby Creek can be divided into three sections for the purposes of this assessment.

The first and lowermost section is a 1.3 km section, classified as a 4th order stream, which joins Jilliby Jilliby Creek in the eastern part of its lower reaches. This section is entirely underlain by deep alluvium. The second and middle section is classified as 3rd order, runs east-west along the lower part of the Jilliby Jilliby Valley and is mostly underlain by alluvium (albeit shallower). No longwalls underlie the first section, and only three longwalls (LW11N, LW12N and LW13N) underlie the second section.

The third and uppermost section runs generally north-south is also classified as 3rd order and features outcrops of the Patonga Claystone. Many submissions raised concerns about this section of the creek. Although WACJV has proposed longwalls in this area in its long-term conceptual mine layout, no mining would occur under this section of the creek within the life of the current project. Consequently, there are no subsidence-induced impacts to be assessed in this section.

There are no substantive pools associated with intact rock-bars across the entire alignment of Little Jilliby Jilliby Creek, even in the third section. There is not expected to be any ponding in the first and second sections. There is the potential for superficial cracking of the bedrock (ie the Patonga Claystone) however this is unlikely to have any significant impacts due to the absence of rock-bars, the presence of alluvium and the predicted lack of connective cracking. Consequently, the Department has recommended performance criteria requiring not greater than negligible environmental consequences over 80% of the creek affected by subsidence, and not greater than minor environmental consequences over the remaining 20% of the creek.

Armstrong Creek, Myrtle Creek and other Watercourses

Armstrong Creek is classified as a 3rd order stream for approximately 1.3 km of its lower reaches near its confluence with Jilliby Jilliby Creek, above the Southern Domain. Myrtle Creek is classified as 3rd order stream for approximately 1.2 km of its lower reaches near its confluence with the 4th order section of Little Jilliby Jilliby Creek. The upper reaches of both Armstrong and Myrtle Creeks are 2nd order in the forested hills, and there are a number of other 2nd order watercourses including Hughes Gully, Splash Gully, Calmans Gully and Youngs Gully.

The 3rd order sections of Armstrong and Myrtle Creeks are almost entirely underlain by alluvium, as they are located on the valley floor. Notwithstanding the fact that these sections would be undermined by proposed longwalls, the Department is satisfied that any impacts are likely to be minor due to the presence of the deep alluvium and the predicted lack of connective cracking. This is reflected in the Department's recommended performance criteria requiring not greater than negligible environmental consequences over 80% of the creek affected by subsidence, and not greater than minor environmental consequences over the remaining 20% of the creek.

The upper reaches of Armstrong and Myrtle Creeks (2nd order) have a greater occurrence of sandstone (Tuggerah Formation) outcrops in their channels. However, the SWIA found that these outcrops are generally well jointed and consequently less vulnerable to damage from subsidence impacts than the more massive sandstones present in the Southern Coalfield. Consequently, the Department is satisfied that the impacts on the upper reaches of Myrtle and Armstrong Creeks, and

other 2nd order creeks, are also likely to be minor, as described in the EIS. For that reason, the Department has recommended performance criteria requiring that the environmental consequences are not greater than predicted in the EIS.

Ongoing Surface Water Monitoring and Management

WACJV has accepted that additional flow monitoring would potentially provide additional information to confirm the predicted impacts of the project. However, due to natural climatic variability, it is very difficult to detect small mining-induced impacts on surface flows. Nevertheless, WACJV has committed to developing a comprehensive surface water monitoring program, which would include expanded monitoring of surface water quality and stream stability. Monitoring would be undertaken at the 14 locations in the existing monitoring network.

The Department has recommended condition of consents that require WACJV to prepare a Water Management Plan as part of the Extraction Plan process, in consultation with NOW and OEH, which must be approved by the Director-General prior to any longwall mining. This Plan would deal with the potential impacts and consequences of specific longwalls, as well as the need for additional monitoring locations and measures to ensure achievement of the performance criteria.

5.2.6 Flooding

Subsidence has the potential to alter local aspects of topography within a floodplain by creating small ridges and swales, which in turn can alter local flood flow directions and speeds. However, more generally (ie across the whole floodplain), subsidence results in lower actual flood levels, as the same amount of water is carried across a lowered landscape. Even so, flood depths would increase within subsided areas, insofar as it now represents a 'pond' within the overall landscape.

The FIA predicts that flood behaviour in the Yarramalong Valley (which crosses the Southwestern Domain), would not change significantly as a result of subsidence. Only one residence would experience an increase in flood depth, which would be minor (0.17 m) and below the existing floor level of the dwelling. There would also not be any significant access interruptions due to flooding impacts in the Yarramalong Valley.

In the Dooralong Valley (across both the Southern and Northern Domains), the FIA predicts a number of changes to flood behaviours during a 100 year ARI event. Actual flood levels are predicted to decrease by up to 1.3 m, however there are many areas in the valley where the flood levels would remain unchanged. Flood depths would increase by up to 1.3 m; however such increases would generally be less than 0.5 m. Overall, an additional 33.2 ha of land is expected to be flooded in an event of this size, however 4.9 ha of land would no longer be inundated, resulting in a net increase in inundation of approximately 28.3 ha.

According to the FIA's flood modelling, of the 88 structures located on the floodplains of the Yarramalong and Dooralong Valleys, 36 dwellings are expected to be beneficially affected and 33 are expected to be adversely affected. Four of the 33 are not currently subject to flooding. An additional 15 roads and bridges are predicted to be affected by flood impacts, which would in turn have adverse impacts on access to residences in terms of increasing the period of inundation. For example, it is predicted that one section of road (low point D50 on Jilliby Road) may lead to a longer inundation period per flood incident for up to 172 residences (see **Figure 12**).

WACJV has committed to mitigation and management measures to prevent or reduce impacts to properties that are adversely affected by mining-induced flood impacts. These measures can include house raising, house relocation, flood proofing, compensation or acquisition. The FIA has identified that house raising and relocation are suitable measures for D0060 (proposed to be raised 0.6 m), D0061 (to be raised 0.9 m) and D0237 (to be raised 2 m), while flood levees are suitable for five other dwellings (D0017, D0058, D0737, D0063 and D0430). There are some high hazard areas where property modification options are likely to be impractical or ineffective. In these situations, WACJV has committed to purchasing the properties or providing compensation. The FIA has also identified measures to ensure that roads are altered to prevent adverse flood impacts.

The Department has recommended conditions of consent requiring that the Water Management Plan which must be prepared as part of any Extraction Plan, must include a program to monitor flooding (including updated flood modelling); minimise, manage and mitigate flood impacts on residences, private properties, roads and other infrastructure; and identify private properties where mitigation measures are not reasonable or feasible and compensation would instead be offered. This plan must

be developed in consultation with NOW and OEH and must be approved by the Director-General prior to any longwall mining.

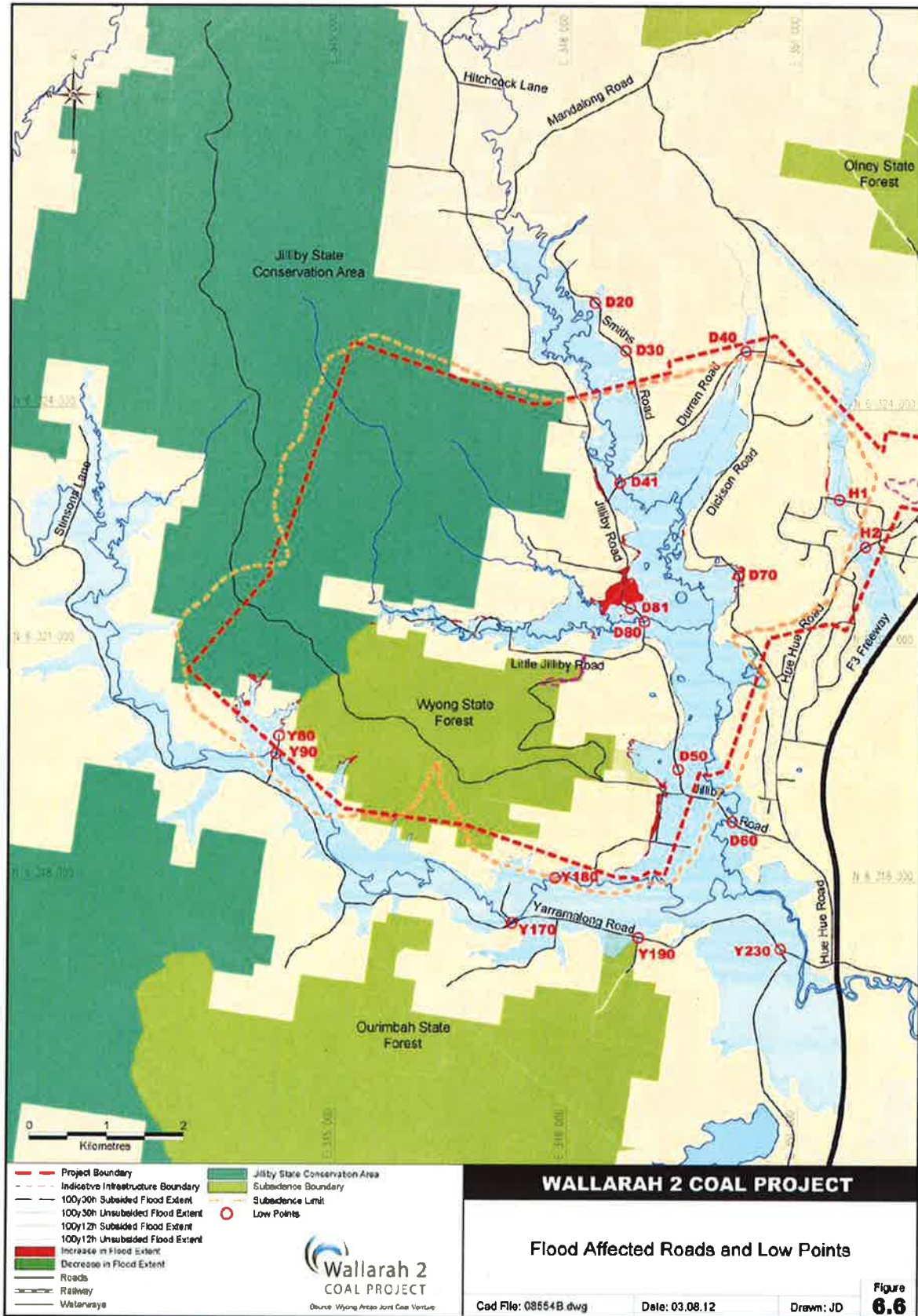


Figure 12: Predicted Increase in Flooding Extent

5.2.7 Water Use

Surface Water Management

The EIS proposes that a water treatment plant, including a combined reverse osmosis and brine treatment plant, would be used to treat sufficient mine water to meet the project's operational needs. The reverse osmosis process would generate both treated water and brine, with the brine accounting for approximately 10% of the total inflows to the plant. The brine would then be treated in a brine treatment plant to produce a partly-dried salt product for at least the first 14 years of underground mining. The proposed water management system at the Tooheys Road Site would also discharge excess treated water into a tributary of Wallarah Creek.

The water treatment plant would have the capacity to treat a maximum of 3 ML/day, which is greater than the maximum predicted groundwater inflow of 2.5 ML/day. Across the surface facilities sites, there is capacity to store up to 270 ML of water of varying qualities (see **Table 5** below).

Table 5: Water Storage Capacities

Storage	Capacity (ML)
<i>Tooheys Road Site</i>	
Mine Operations Dam	180
Portal Dam	30
Stockpile Dam	20
Treated Water Storage	20
Brine Storage	9
<i>Buttonderry Site</i>	
Entrance Dam	10
Sediment Dam	1
<i>Underground</i>	
Underground Sump	120

Water Balance

The EIS includes a simulated water balance which shows that the project's maximum demand from external water supplies is 52 ML in Year 1 of mining. The external water demand then decreases to approximately 20 ML/year over the first four years, and peaks again at 49 ML/year in Year 14 of mining, before decreasing to approximately 20 ML/year for the remainder of the project life (see **Figure 13** below).

The Water Sharing Plans (WSPs) that cover the area of the project are the Jilliby Jilliby Creek Water Source WSP and Central Coast Unregulated Water Sources WSP. The project would not directly extract water from any defined point in the Gosford-Wyong Water Supply Scheme (GWSS) catchment but rather intercept some volume of surface water through additional groundwater storage in the alluvium.

The EIS conservatively estimates that a maximum annual volume of 270 ML/year could potentially be taken from the Jilliby Jilliby Creek Water Source and 30 ML from the Central Coast Unregulated Water Source, as a result of subsidence-induced increases in alluvial storage. The relative cost of this surface water would be very low in comparison to the value of the coal resource that is proposed for extraction. At a broader catchment level, the maximum annual water take from the project represents less than 0.7% of the current system yield of 45,600 ML/year. Consequently, the Department is satisfied that it is unlikely to have significant impacts on the GWSS catchment.

Furthermore, water access licences under the *Water Management Act 2000* would be required to be purchased by WACJV to account for this water take. NOW has informed the Department that there are sufficient licences available for WACJV to purchase, including 88 transferable licences with 4,107 shares of unregulated river category licences in the Wyong Water Source and 26 transferable licences with 1,029 shares of unregulated river category licences in the Jilliby Jilliby Water Source.

It is for this reason that the Department cannot recommend that any loss of available offtake for water supply purposes must be compensated for by WACJV. Whatever surface water is taken from the water source as a result of subsidence is already subject to a licensed allocation (probably for irrigation or some other farming purpose). If WACJV buys that allocation on the open market, it then has the right to take that water. It should not have to pay twice by compensating CCWS for any water

no longer available in the Wyong River or other stream. Nonetheless, the Department has recommended conditions which, as a component of each Extraction Plan, require WACJV to monitor stream flows, including potential impacts on town water extraction availability.

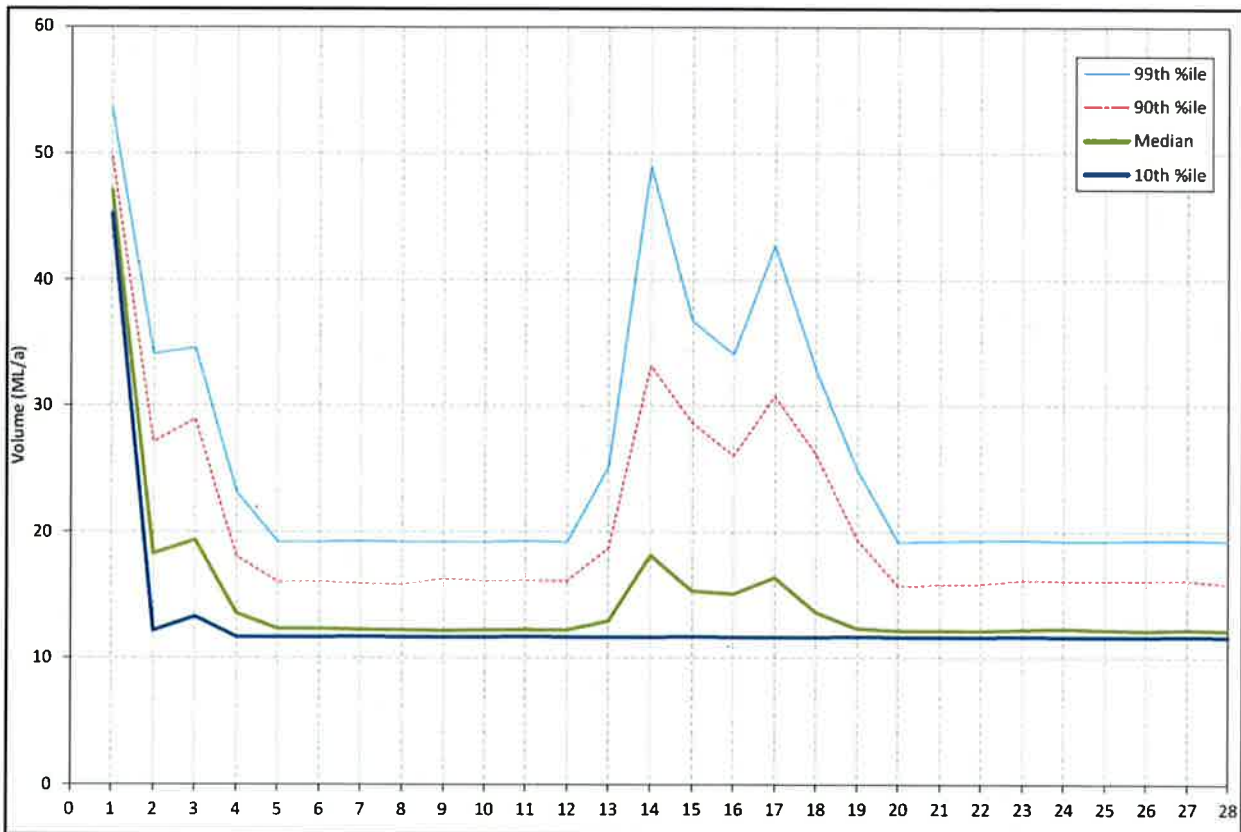


Figure 13: Predicted Maximum External Water Requirements

Site Discharges

The SWIA predicts that maximum annual discharges will occur in Year 7 of mining and range from 50 ML/year in a median rainfall year to more than 500 ML/year under very wet conditions. Under wet conditions, the flow volumes in Wallarah Creek are predicted to increase by approximately 2%, while under average to dry conditions, flow volumes are expected to increase by approximately 3%. These different percentage increases reflect the varying flows in the creek under wet and average to dry conditions.

The SWIA states that the quality of treated mine water would be comparable to the background water quality of the receiving waters within Wallarah Creek. It is important to note that the project would not discharge groundwater or mine water into the Central Coast's water supply catchment, as the surface facilities are located outside of the drinking water catchment. The EPA has recommended discharge quality and quantity limits, which WACJV has accepted, which would be implemented through an Environment Protection Licence (EPL) to be issued by the EPA under the *Protection of the Environment Operations Act 1997*. On this basis, the Department is satisfied that there is a very low likelihood of negative environmental or health risks from the proposed water discharges.

The Department has recommended a condition of consent that would require WACJV to prepare and implement a Surface Facilities Water Management Plan (SFWMP) in consultation with NOW and EPA. This Plan must include details about the proposed monitoring and management measures and must be prepared prior to the commencement of surface facilities construction.

Underground Brine Disposal

After Year 14 of mining, WACJV proposes to store waste brine within the goaves of completed longwalls. The brine would be pumped into underground workings at the start lines of panels to the west and southwest of the sealed storages (see **Figure 14** below). The brine volumes requiring storage underground are predicted to range from approximately 18 ML/year to 25 ML/year. Storage capacity has been estimated to be at least 120 ML (see Table 5).

The EIS and RTS include calculations of groundwater flow paths to understand the potential migration of this brine over the long term. The predicted pathways follow an easterly flow direction before eventually rising to the surface in low lying coastal areas approximately 2 to 3 km to the east of the project boundary. The velocity of migration is predicted to be extremely slow, resulting in a travel time of more than 8,000 years before any increase in salinity might be observed near the surface.

The post-mining recovery of water levels and pore pressures is also predicted to be extremely slow. As a result, the underground mine is predicted to behave as a groundwater sink for at least 500 years after mining, which would inhibit the highly saline brine from migrating outwards from the mine workings. Due to the high density of the salt mixture and the very slow rate of groundwater recovery, the storage of brine and salt is not predicted to have any measurable impacts on water quality.

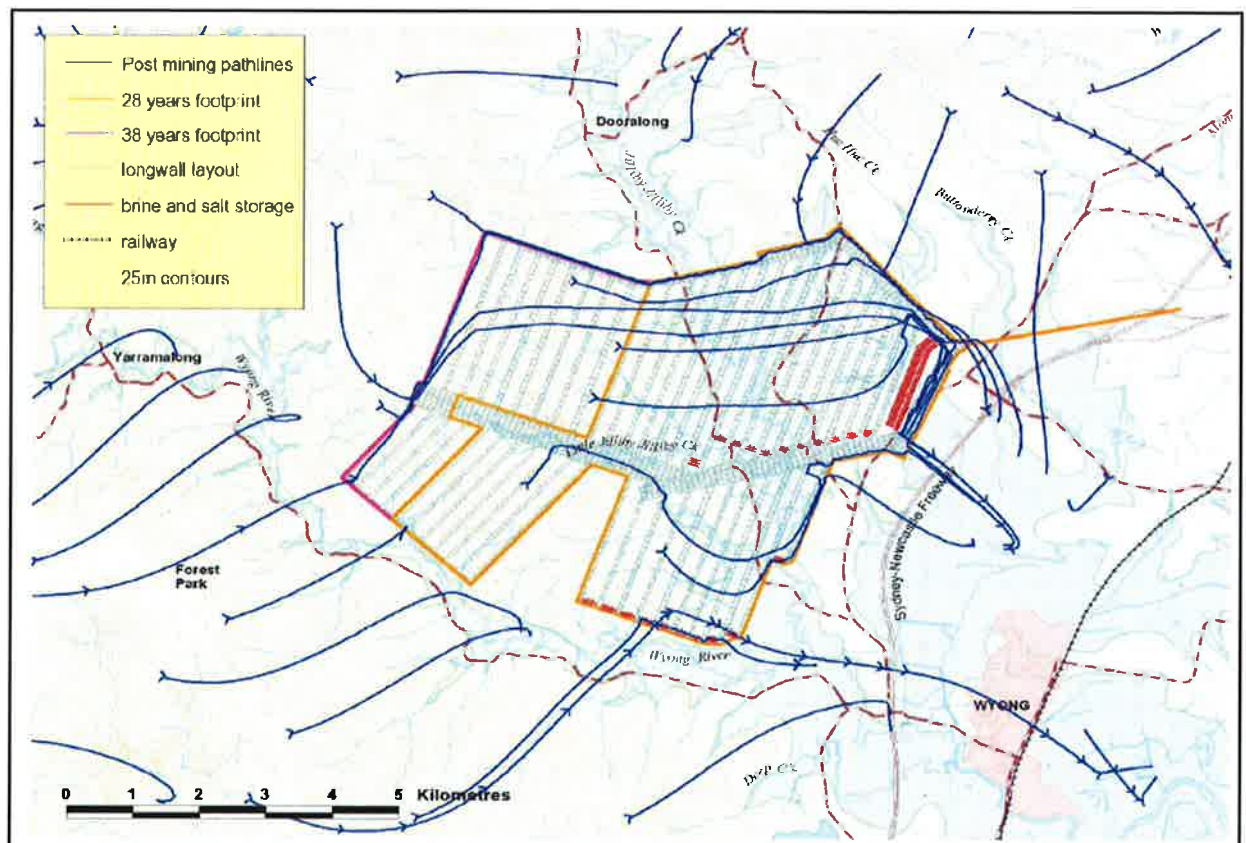


Figure 14: Predicted Post-mining Groundwater Flow Paths

The Department is satisfied in principle with WACJV's proposal for treatment and disposal of brine. Fundamentally, the project seeks to return a significant proportion of the salt initially present in groundwater within the coal seam back to that same seam, following extraction of the coal. Given the alternatives of landfill disposal of salt at the surface, discharge of saline mine water to the freshwater Wallarah Creek, or piping of saline mine water to Tuggerah Lake, it seems the most environmentally responsible option. It must also be remembered that the coal seams are generally characterised by multiple small fractures (called cleats) and highly saline groundwater, which together mean that most coal seams are effectively saline aquifers. The predicted return to the surface simply reflects the Coal Measures outcropping east of the mining domain. That is, these coal seams are already a source of upwelling saline groundwater in these coastal areas.

Nonetheless, in the absence of previous experience with this technique, the Department has recommended a cautious approach to this process. It has recommended conditions of consent requiring WACJV to prepare a Brine Treatment Management Plan, in consultation with EPA and NOW, as part of its Water Management Plan prior to construction of the surface facilities sites, which must provide further detailed description of the volumes of salt and brine, and the proposed mitigation and management measures.

5.3 ECOLOGY

5.3.1 Introduction

The EIS includes an Ecological Impact Assessment (EIA) undertaken by Cumberland Ecology, which included a desktop review of previous studies and detailed flora and fauna surveys within the project area and surrounds. OEH initially raised some minor concerns about the level of survey work undertaken. WACJV has since undertaken further field survey work (in July and August 2013) that OEH is largely satisfied with, except for frog survey work (discussed in detail below).

The vegetation within the project area generally consists of a mixture of mature and regenerating forest and woodland communities, and cleared floodplain lands comprising grassland with some areas of wetland and riparian vegetation. The cleared floodplain lands have been substantially altered by clearing for agricultural uses, and are dominated by exotic agricultural species.

5.3.2 Listed Species

The EIA identified over 450 flora species within the project area, with six of these being listed as threatened species under the *Threatened Species Conservation Act 1995* (TSC Act) and/or the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). These comprise the Bynoe's Wattle, the Charmhaven Apple, the Leafless Tongue Orchid, the Small-flower Grevillea, the Biconvex Paperbark and Black-eyed Susan. The EIA identified 29 threatened fauna species, 4 of which are listed under the EPBC Act, including the Green and Golden Bell Frog, Giant Barred Frog, Spotted-tailed Quoll and Grey-headed Flying Fox. The EIA also identified 8 internationally-protected migratory fauna species within the project area, including the Black-tailed Godwit, White Egret, Cattle Egret, Latham's Snipe, White-bellied Sea-Eagle, White-throated Needletail, Black-faced Monarch, Glossy Ibis and Rufous Fantail. The locations of threatened flora and fauna species identified in the assessment are shown in **Figures 15** and **16**.

The project has been deemed a Controlled Action under the EPBC Act for the Charmhaven Apple and Black-eyed Susan (listed as vulnerable), and Spotted-tailed Quoll and Giant Barred Frog (listed as endangered).

The EIA addresses potential impacts to Matters of National Environmental Significance, as listed under the EPBC Act, including Assessments of Significance, in accordance with the EPBC Act's Significant Impact Criteria. These tests were undertaken as a risk assessment tool to determine which listed threatened flora and fauna species may be most at risk from the project.

The EIS also includes an Aquatic Ecology Impact Assessment (AEIA) undertaken by Marine Pollution Research. The AEIA identified 17 aquatic macrophytes, 77 aquatic macroinvertebrates and 3 fish species, including two native species (Firetail Gudgeon and Flathead Gudgeon), and one introduced pest species (Plague Minnow). No water dependent mammals were recorded.

5.3.3 Clearing and Habitat Removal

The EIA calculated that approximately 89 ha of vegetation would be directly impacted over the life of the project. The affected vegetation consists of remnant and regenerating woodland communities and large areas of open grassland. This cleared area also includes potential habitat for up to 34 threatened fauna species. A summary of the areas of vegetation that would be directly impacted and the proposed offset areas is provided in **Table 6**.

The areas of vegetation and threatened species habitat within the offset areas are significantly greater than the areas to be disturbed. The offset areas would be conserved in perpetuity. The BOS would include conservation and ongoing management of existing vegetation, as well as revegetation and rehabilitation of degraded areas. The estimated cost of revegetation and ongoing management of offsets is \$5.9 million over the 28 years of the project.

The Department has recommended a condition of consent requiring that the offsets are permanently protected by an appropriate mechanism, such as a Biobanking Agreement, incorporation into a nearby State Conservation Area, or a Voluntary Conservation Agreement under the *National Parks and Wildlife Act 1974*. In addition, the Department has recommended a condition requiring the implementation of a Biodiversity Management Plan (BMP), to be approved prior to construction, which would detail the management procedures to be implemented within the offset areas.

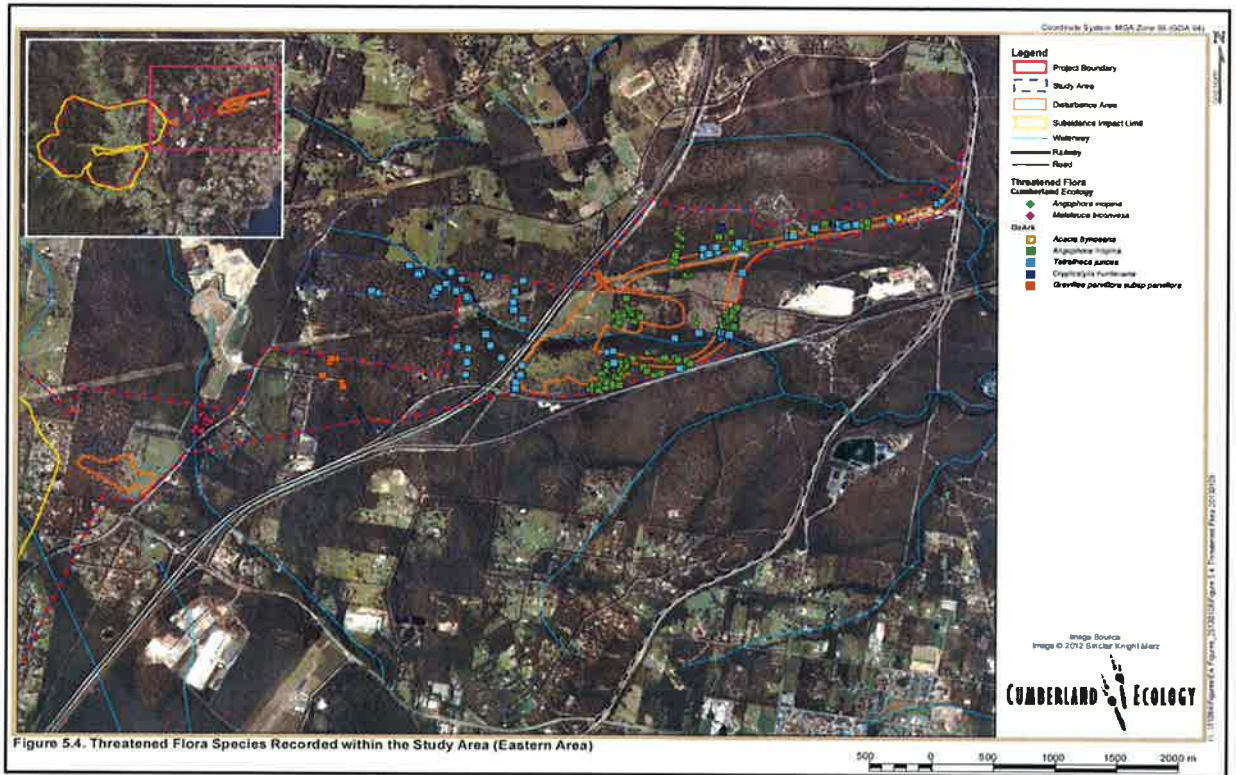


Figure 15: Threatened Flora Species

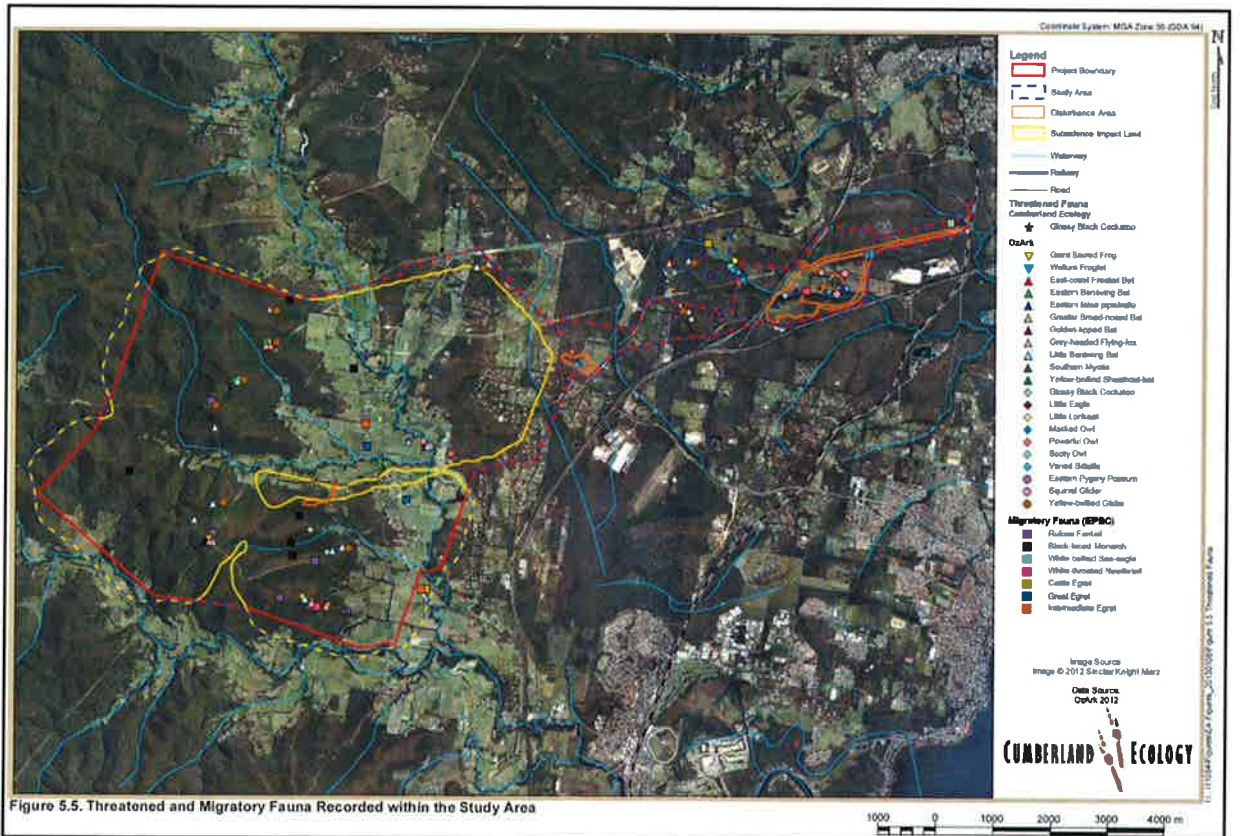


Figure 16: Threatened Fauna Species

Table 6: Vegetation Impacts, Biodiversity Offset Areas and Offset Ratios

Vegetation Community	Vegetation Condition	Areas of Vegetation to be Removed (ha)				Offsets		
		Tooheys Road Site	Buttonderry Site	Western Shaft Site	Total	Condition of Offset Areas	Area in Biodiversity Offset Areas (ha)	Ratio
Blackbutt – Turpentine open forest of the foothills of the North Coast*	Moderate to Good	5.9	0	0	5.9	Moderate to Good	16.9	2.9:1
Swamp Mahogany swamp forest on coastal lowlands of the North Coast and northern Sydney Basin*	Moderate to Good	1.8	0	0	1.8	Moderate to Good	6.5	3.7:1
Paperbark swamp forest of the coastal lowlands of the North Coast and Sydney Basin*	Moderate to Good	1.1	0	0	1.1	Moderate to Good	3.9	3.6:1
Spotted Gum – Broad-leaved ironbark grassy open forest of dry hills of the lower Hunter Valley, Sydney Basin*	Moderate to Good	0	4.5	0	4.5	Moderate to Good	55.4	12.4:1
Mountain Blue Gum – Turpentine moist shrubby open forest of the coastal ranges of the Central Coast, Sydney Basin	Moderate to Good	0	0	1.7	1.7	Moderate to Good	0	N/A
Scribbly Gum – Red Bloodwood healthy woodland on the coastal plains of the Central Coast, Sydney Basin	Moderate to Good	33.8	0	0	33.8	Moderate to Good	40	1.2:1
Smooth-barked Apple – Red Gum grassy woodland of the Macdonald River Valley on the Central Coast, Sydney Basin	Moderate to Good	1.8	2	0	3.8	Moderate to Good	74	19.6:1
Spotted Gum – Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin	Moderate to Good	0	0	0.8	0.8	Moderate to Good	0	N/A
Rough-barked Apple – Red Gum grassy woodland of the Macdonald River Valley on the Central Coast, Sydney Basin	N/A	N/A	N/A	N/A	N/A	Moderate to Good	0.4	N/A
Derived Native Grassland	Moderate to Good	7.3	0	0	7.3	Moderate to Good	11	1.5:1
Exotic/Agricultural/Low Diversity Grassland	Low	24.2	3.6	0.2	28	Low	31.4	N/A
Total		75.9	10.1	2.7	88.7		208	N/A
Total EEC Vegetation					13.3		83	6.3:1
Total Non-EEC Vegetation					75.4		125	2.6:1

*Vegetation community listed as EEC under the TSC Act.

5.3.4 Aquatic Ecology Impacts

There is potential for subsidence-related ponding as longwalls progress beneath the floodplains of the major watercourses; however the AEIA found that this would likely have little additional impact on aquatic species due to the existing variability in stream geomorphology and flows. The floodplains already include a number of areas of natural ponding. Nonetheless, WACJV has committed to ongoing monitoring to identify mining-related ponding events and the implementation of appropriate adaptive management measures, such as drainage or re-levelling.

The Department is satisfied that subsidence impacts on aquatic ecology are likely to be minimal. OEH also has no residual concerns about aquatic ecological impacts. The Department has recommended a condition of consent requiring a Biodiversity Management Plan, to be prepared in consultation with OEH, which would ensure that adequate aquatic ecology monitoring would be undertaken and that appropriate Trigger Action Response Plans (TARPs) are developed.

Subsidence Impacts on GDEs and Threatened Frog Species

The EIA identified four potential Groundwater Dependent Ecosystems (GDEs) above the longwalls within the 25 year mining area, including 239.2 ha of Coachwood-Crabapple rainforest, 28 ha of Woollybutt-Paperbark sedge forest, 1.2 ha of *Phragmites australis* and *Typha orientalis* wetland and 0.7 ha of Swamp Mahogany forest (see **Figure 17**). These are all listed as Endangered Ecological Communities (EECs). There are six threatened frog species that have the potential to occur within the project area, comprising the Stuttering Frog, Giant Barred Frog, Giant Burrowing Frog, Green-thighed Frog, Littlejohn's Tree Frog, Green and Golden Bell Frog.

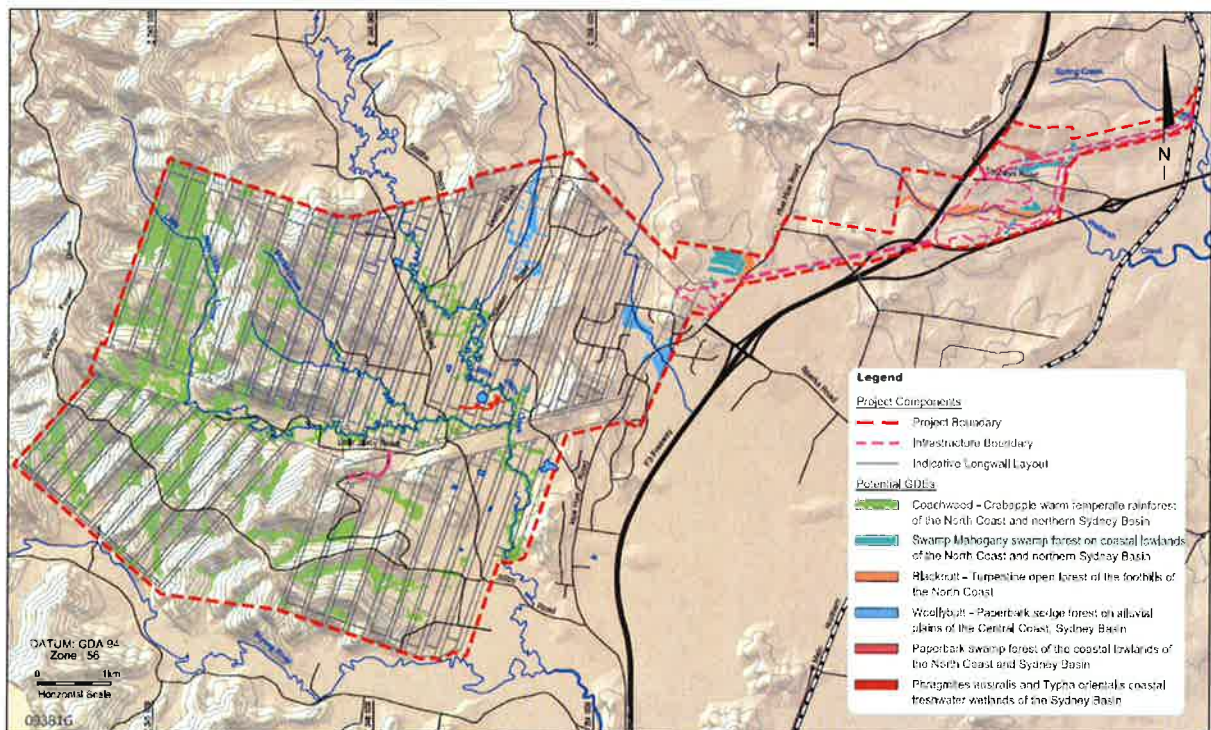


Figure 17: Groundwater Dependent Ecosystems

OEH initially raised concerns about subsidence-related impacts on GDEs, particularly in relation to changes in the level of the water table, and especially to such areas that are located within the Jilliby SCA. OEH was also concerned about associated impacts on threatened frog species that may inhabit these GDEs. However, the GDEs in the elevated areas of the Jilliby SCA are within WACJV's 42-year *conceptual* mine plan, as shown in the EIS. It is clear that this application is only for 25 years of mining and that 11 longwalls proposed within the Jilliby SCA are not part of the current project, which has eliminated many of OEH's concerns.

The Groundwater Impact Assessment (GIA) accepts that a reduction in water table levels may occur above and adjacent to subsiding longwall panels; however the process is described as 'a *continuum that would include fall and rebound of the water table in actively subsiding areas*'. The GIA also includes a series of separate groundwater model scenarios used to assess the likely rebound of the water table within the alluvium in areas of subsidence. The calculations in the GIA indicate that there would be minimal impacts on the water table due to the relatively low permeability of the alluvial

materials. It is predicted that the water in the alluvium would migrate slowly from unsubsidised areas to subsidised areas, while rainfall is also expected to rapidly recharge the system.

The areas of most concern are those where the highest predicted tilts would occur (ie in the elevated, forested hills in the west of the project area), as the migration of water from unsubsidised areas to subsidised sections of the alluvium would be most rapid in these areas. OEH and NOW have provided mapping of the water table in the project area indicating that the water table depth in the 2nd and 3rd order streams of these elevated areas would be up to 12 m deep.

In these elevated areas where the creeks are underlain by the Patonga Claystone, the GIA states that the water table would largely be deeper than the weathered rock and regolith. Consequently, the vegetation within the GDEs within these areas is likely to draw water from soil moisture within the unsaturated zone, rather than from below the water table. This unsaturated zone is sustained by rainfall and runoff and is therefore unlikely to be significantly affected by subsidence impacts.

The Department accepts that it is likely that there would be temporary, localised changes to the water table levels, particularly in elevated areas where subsidence-induced tilts are predicted to be highest. However, it also considers that there would not be any significant impacts on GDEs, given the low permeability of the alluvial materials, the low reliance on the water table in elevated areas and the rapid recharge from rainfall.

Consequently, the Department has recommended a performance criterion requiring negligible environmental consequences resulting from subsidence on threatened flora and fauna, including GDEs that are listed as EECs. The Department has also recommended conditions of consent requiring a Water Management Plan as part of an Extraction Plan that must consider any potential impacts on GDEs and other riparian vegetation, particularly within the Jilliby SCA, and describe how the relevant performance criteria would be met. This Plan must be prepared in consultation with NOW and OEH and approved by the Department prior to any longwall extraction of coal.

In addition, the Department considers that the protection of threatened frog species is important in this area and has recommended conditions of consent requiring WACJV to undertake a comprehensive Frog Research Program, which would require it to spend \$156,000 over four years. This program would be directed at research into improving the prediction, assessment, remediation and/or avoidance of subsidence impacts and environmental consequences on threatened frog species. It would involve a baseline study to identify existing populations of threatened frog species and the establishment of a monitoring program for the life of the project. WACJV would be required to submit updates within the Annual Review on the status of the research program.

5.4 BUILT FEATURES

5.4.1 Introduction

There are a number of precedents in NSW, stretching over 150 years of coal mining, for undermining all categories of infrastructure proposed to be undermined by the Wallerah 2 Coal Project while maintaining the affected structures in a safe and serviceable condition.

The Department is satisfied that the MSB's standards of 'safe, serviceable and repairable' for subsidence impacts on built features are appropriate for the project. However, it notes that these three performance measures may not always be capable of being met at the same time. For example, the Department accepts that all built features must always be kept safe for their users, although safety may be maintained in certain situations by temporarily restricting use. Key infrastructure (such as a road or a railway) must also always be 'serviceable', that is, capable of being used for its intended purpose (even with some restriction, such as a temporary speed limit). Other built features (such as a farm dam, track, house or swimming pool) may have to be repaired, because serviceability has been temporarily compromised or even lost. In certain cases, damage may be such that repairability is an uneconomic option, and the feature must be replaced or else compensated for. The MSB regularly provides for replacement or other compensation for such buildings or structures.

The Department has therefore proposed performance measures regarding safety, serviceability, repairability and compensation. 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 fully repaired.

The Department's proposed performance measures for minor infrastructure and other built features 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.

These criteria have been applied by the Department in other recent underground mining development consents.

5.4.2 Key Infrastructure

The M1 Motorway is located approximately 1.1 km from the nearest longwall. It is predicted to be subject to 'negligible' conventional subsidence impacts. The road pavement is also unlikely to be impacted by far-field horizontal movements; however it is possible that the freeway bridges could be sensitive to such movements.

The Main Northern Railway is even further from the proposed longwalls and would not be subject to any subsidence impacts. The Mardi to Mangrove Creek Dam Pipeline is also well outside the area of predicted subsidence impacts.

There are two 330 kV transmission lines (Lines 21 and 22) passing through the project area, which consist of single circuit steel towers at a height of approximately 28 m. There are 29 towers in total, comprising 14 tension towers and 15 suspension towers. WACJV has committed to ongoing consultation with TransGrid and the MSB, so that preventative measures and appropriate management strategies can be developed. TransGrid has confirmed with the Department that it would work with WACJV to develop mitigation and management options, including possible transmission line relocation, structural modifications and modified transmission line designs. TransGrid has further confirmed that the appropriate options would be determined via a commercial agreement and feasibility analysis, a position to which WACJV has agreed in writing. WACJV has also agreed that the associated costs of analysis, mitigation measures, adjustments, repairs, redesign, modification or relocation of the transmission lines would be fully borne by WACJV.

5.4.3 Minor Infrastructure

There are a number of roads passing over the proposed area of extraction, including sealed roads and other access roads. There are also 8 bridges and numerous drainage culverts associated with the local road network. The maximum predicted subsidence effects are summarised in **Table 7**.

Table 7: Maximum Predicted Subsidence Effects for Public Roads and Transmission Lines

Location	Vertical Subsidence (mm)	Tilt (mm/m)	Tensile Strain (mm/m)	Compressive Strain (mm/m)
Dickson Road	1350	9	2.0	2.5
Durren Road	1400	6.5	1.0	1.5
Jilliby Road	1750	7.5	1.5	1.5
Little Jilliby Road	175	1	0.5	0.5
Parkridge Drive, Crestwood Road, Sandra Street	1050	7	1.5	2.5
Transmission Line 21	2100	11	2.5	4.0
Transmission Line 22	2500	12	1.0	3.0

The SIA predicts that impacts on sealed roads would be of a nature that can be remediated using normal road maintenance techniques. It is also expected that unsealed roads can be maintained in serviceable conditions using normal road maintenance techniques (ie regrading and the like). The predicted changes in grade are unlikely to significantly affect the serviceability of the bridges and culverts. The Department is satisfied that, with appropriate monitoring and management, the impacts on all roads and bridges would be minor and would not pose a significant risk to public safety.

5.4.4 Other Built Features

There are 755 structures within the area of extraction, including 245 residences. The maximum predicted tilt is 7 mm/m or less for 722 structures and greater than 7 mm/m for 33 structures. The maximum tilt predicted to be experienced by any structure is 13 mm/m.

As indicated in section 2.3, the MSB is responsible for applying building standards to all improvements built within MSDs. This means that all new residences and other improvements built since the proclamation of the Hue Hue MSD and the Wyong MSD on 31 January 1986 and 9 April 1997 respectively, should have been built to limit potential future subsidence impacts. In addition, the recommended performance measures require that all residences always remain safe, and any damage must be fully repaired or replaced, and/or fully compensated. The SIA concludes, and the MSB agrees, that any residences affected by subsidence in the project area are likely to be repairable using modern techniques and would not require replacement or compensation.

The maximum predicted tilt for the 88 residences within the Hue Hue MSD is 4 mm/m, which MSB has indicated meets the relevant criteria and would be the sole responsibility of the MSB in terms of remediation. The remaining 157 residences are situated within the Wyong MSD. The maximum tilt is not expected to exceed 7 mm/m at 144 of these residences. However, the maximum tilt is predicted to be between 7 and 10 mm/m at 8 residences, and greater than 10 mm/m at 5 residences. The MSB initially recommended conditions of consent to ensure that WACJV (as against the MSB) would be responsible for any subsidence-related damage resulting from tilts greater than 7 mm/m, as repairing residences affected by such tilts can be difficult and expensive.

However, as there are only 13 residences that are predicted to experience tilts greater than 7mm/m, the MSB has since acknowledged that any such damage would be dealt with by the MSB, in consultation with WACJV, under the relevant provisions of the MSC Act. This process is also specifically referred to in the recommended conditions of consent relating to the rehabilitation of built features damaged by subsidence. The Department is satisfied that the considerable value of the coal resource within the project area would significantly outweigh the cost of any repairs to residences required under the MSC Act. Such compensation payments are funded by the MSB's levies on coal mining companies, and come at no cost to either the individual property owner, or to the taxpayer.

There are 107 swimming pools situated within the area of extraction, of which 25 are predicted to experience tilts exceeding the maximum permissible under AS 2783-1992 (3.2 mm/m) and would therefore require remediation measures. There are 420 farm dams located within the area of extraction; however the likelihood of impacts is relatively low due to the depth of mining. There are also 11 tennis courts located within the area of extraction. Any potential cracking of farm dams or tennis courts can be easily repaired.

Jilliby Public School and a scout camp are located on land overlying the main development headings, however neither of these facilities is expected to experience more than 20 mm of subsidence.

5.4.5 Conclusion

The Department has carefully considered potential impacts on items of key infrastructure, minor infrastructure and other built features. The Department has proposed performance measures addressing safety, serviceability, repairability and compensation. 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 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 all built features. Under the Built Features Management Plan, WACJV would be required to consult with the owners of all affected built features, address potential impacts, and recommend appropriate remedial measures and commitments for repair, replacement or compensation.

5.5 HERITAGE

5.5.1 Introduction

Aboriginal people have lived in and around the Wyong LGA for many thousands of years. When Europeans arrived in the early 19th Century, the area was occupied by the Darkinjung, Awabakal and Guringai Aboriginal people. Physical evidence of the first people in the Wyong area can be seen in rock engravings, scar trees, rock shelter drawings and middens. The area is overseen by the Darkinjung Local Area Lands Council (LALC), which remains active in the identification and management of Aboriginal heritage.

The EIS includes an Aboriginal Cultural Heritage Assessment (ACHA) and a Historic Heritage Assessment (HHA), both undertaken by OzArk Environmental & Heritage Management. The ACHA is

based on several existing studies, a literature review and targeted field surveys involving representatives of the Aboriginal community. The HHA is based on various historical heritage surveys carried out in 2001, 2006 and November 2010.

5.5.2 Heritage Sites

The ACHA identifies a total of 11 sites of Aboriginal heritage significance, of which only one would be directly impacted by construction of the surface facilities and five may be subject to subsidence impacts. The ACHA found that the remaining five sites would not be affected by the project. The HHA identified 32 sites with potential historic heritage value. However, through ground-truthing, it found that nine of these had no value. The HHA also found that, of the 23 remaining sites with historic heritage value, none would be directly impacted although four may be subject to subsidence impacts.

A summary of the six sites of Aboriginal heritage significance and four sites of historic heritage significance that may be affected by the project is provided in **Table 8**. **Figure 18** shows the location of all Aboriginal and historic heritage sites identified in the project area.

Table 8: Summary of Impacts on Heritage Sites

Site Name	Site Type	Project Area	Project Impact
<i>Aboriginal</i>			
WC-OS2	Open site (artefact scatter including flakes, cores and chips)	Tooheys Road Site	Direct
WSF-AG3	Axe grinding groove site	Jilliby SCA	Indirect (subsidence)
WSF-AG4	Axe grinding groove site	Wyong State Forest	Indirect (subsidence)
45-3-3040	Axe grinding groove site	Jilliby SCA	Indirect (subsidence)
45-3-3041	Axe grinding groove site	Jilliby SCA	Indirect (subsidence)
45-3-3042	Axe grinding groove site	Jilliby SCA	Indirect (subsidence)
<i>Historic</i>			
Brick & Iron Silo '1'	Structure	Southeast corner	Indirect (subsidence)
'Bangalow' dwelling '3'	Residence	Southwest corner	Indirect (subsidence)
Little Jilliby Road 'M'	Road/Bridge	Near Little Jilliby Jilliby Creek	Indirect (subsidence)
Dwelling 'K'	Residence	Near Little Jilliby Jilliby Creek	Indirect (subsidence)

5.5.3 Aboriginal Heritage

The ACHA found that the open artefact scatter (WC-OS2) is of low archaeological and aesthetic significance because of the distribution, low density and nature of the items reflect a random scatter, rather than a concentrated site. Nevertheless, WACJV has committed to protecting this scatter as much as practicable during construction and operation of the surface facilities, through fencing and other management strategies. The Department has also recommended a condition of consent requiring an Aboriginal Cultural Heritage Management Plan (ACHMP) to be approved prior to construction. In addition to the ACHMP, WACJV has committed to preparing a Land Disturbance Protocol, which would include appropriate induction information for employees and contractors involved in ground disturbing works.

In terms of subsidence impacts, it is difficult to predict definitive impacts on Aboriginal heritage sites. However, the SIA found that it is unlikely that the five axe grinding groove sites would be affected by surface subsidence. Consequently, the Department has included a performance criterion requiring no greater than negligible subsidence impacts or environmental consequences on these sites. The Department has also included a condition of consent requiring a Heritage Management Plan to address any potential subsidence impacts (as a component of the Extraction Plan), which must be prepared in conjunction with OEH and local Aboriginal stakeholders, and approved prior to any longwall extraction of coal.

5.5.4 Historic Heritage

The HHA identified four items of heritage significance that are predicted to experience mining-induced subsidence impacts (see **Table 8** above).

According to the HHA, the Brick and Iron Silo is predicted to experience a maximum tilt of 7.5 mm/m. Normal building maintenance techniques may be required to repair the silo, including mortaring of cracks and jacking and blocking of foundations.

The 'Bangalow' dwelling is predicted to experience a maximum tilt of 7.5 mm/m. There is a low probability that significant repair work would be required.

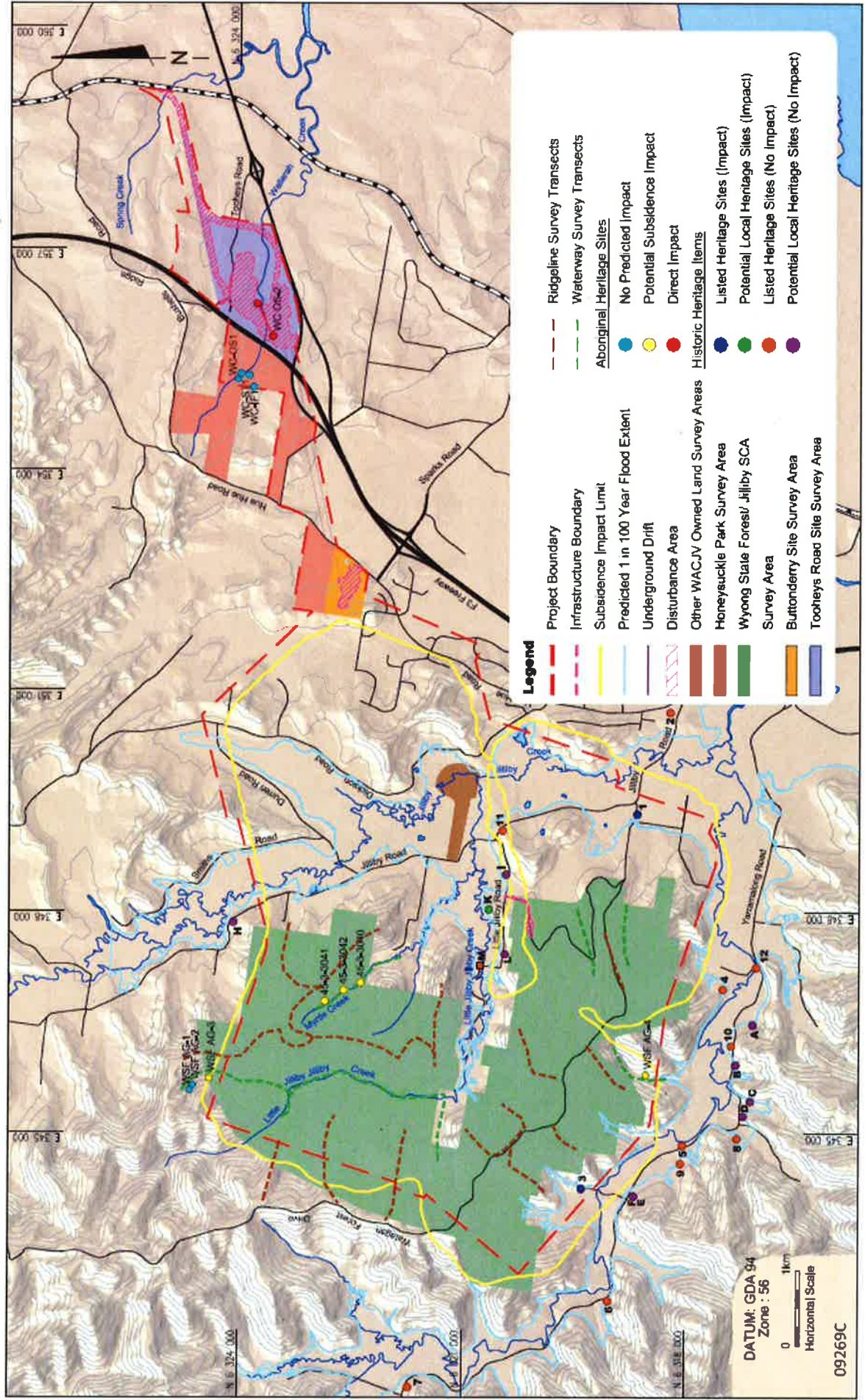


Figure 18: Location of Aboriginal and Non-Aboriginal Heritage Items

The Little Jilliby Bridge is predicted to encounter a maximum tilt of 0.8 mm/m, and upsidence and closure movements of up to 50 mm. The bridge is expected to be able to accommodate these movements due to the flexibility of its timber and steel structure. Nevertheless, WACJV has committed to undertaking structural inspections of the bridge prior to and following mining.

Dwelling K is predicted to experience a maximum tilt of 1.5 mm/m. These predicted subsidence effects are not expected to have any significant impact on this dwelling.

The Department has included a performance criterion requiring not greater than negligible loss of heritage value on these items of heritage significance. The Department has also recommended a condition of consent requiring a Heritage Management Plan (as a component of the Extraction Plan), to be approved prior to any longwall coal extraction, which must provide details of mitigation and management measures to ensure that this criterion is met.

5.6 NOISE IMPACTS

5.6.1 Introduction

The EIS includes a Noise Impact Assessment (NIA) undertaken by Atkins Acoustics in accordance with applicable guidelines, in particular the NSW *Industrial Noise Policy* (INP).

Attended and unattended noise measurements were undertaken during November 2006 and April 2007 and were validated in March 2012, at the locations shown in **Figure 19**. These results were then evaluated in accordance with the INP's assessment procedures in order to confirm existing Rating Background Levels (RBLs) and to establish Project Specific Noise Levels (PSNLs). The Department's acoustic expert has considered the NIA and is satisfied that the data and methodologies employed are robust enough to adequately predict and allow assessment of the noise impacts of the project on surrounding receivers.

5.6.2 Location of Surface Facilities

The majority of surface operations with the potential for noise and air quality impacts would occur at the Tooheys Road Site, including coal stockpiling and train loading. The Department considers this location to be a very appropriate area for a surface facilities site given the surrounding land uses and the general lack of proximity to sensitive receivers. The Tooheys Road Site is sandwiched between the F3 Freeway and the Motorway Link Road, both of which have existing high levels of noise and disturbance, while there are also already a number of industrial land uses in the vicinity of the site, including a brick clay quarry and brickworks.

Connecting the underground mine workings to the Tooheys Road Site involves construction of an underground drift measuring nearly 4 km in length. This is an unusually long distance between the main surface facilities site and the first underground mine workings, especially for a new mine. It is also an expensive and time-consuming process. Use of the Tooheys Road Site for the primary surface facilities therefore results in considerable advantages in terms of reducing potential noise and air quality impacts, at a substantial cost to the WACJV in terms of time and money. The Department acknowledges the financial outlay that WACJV has committed to the construction of the underground drift in order to locate the surface facilities site in an appropriate location.

5.6.3 Noise Impacts

Construction Noise

The NIA predicts that construction noise levels would not exceed the noise goals set in the Interim Construction Noise Guideline (ICNG) at any sensitive receiver during normal construction hours. The Department has included a requirement that WACJV comply with the ICNG in the recommended conditions. In addition, the Department has required that a Noise Management Plan (NMP) is developed that describes the measures that would be undertaken to ensure that construction noise is minimised.

The Department has also included recommended conditions of consent that require WACJV to prepare an Out of Hours Work Protocol for any construction work outside of 7am to 6pm, Monday to Friday, and 8am to 1pm Saturday. This Protocol must be prepared in consultation with the EPA and any residents who would be affected by the noise generated by these works, and must be consistent with the requirements of the ICNG.

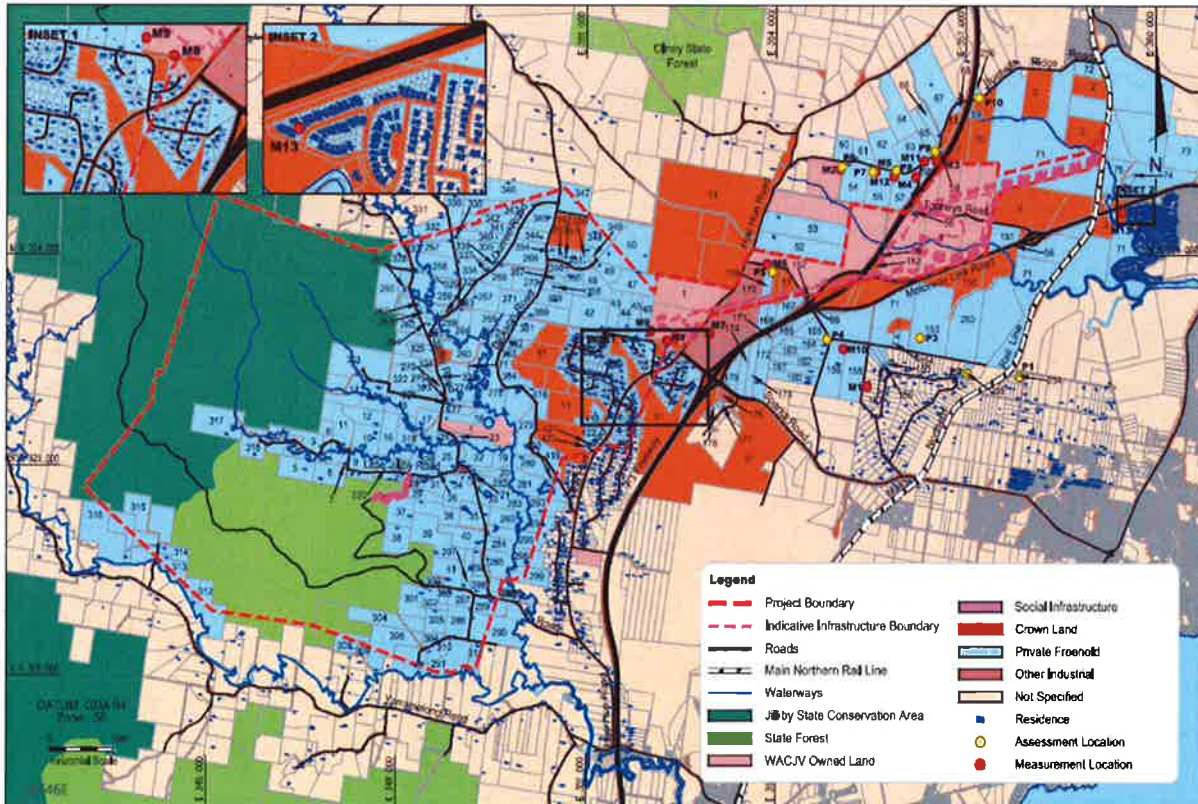


Figure 19: Receiver Locations

Operational Noise

The NIA predicts that the PSNLs would be met under all weather conditions at all residential receivers. While the NIA predicts that recommended sleep disturbance objectives at up to five receivers could be experienced under worst-case meteorological conditions, it is considered that it would be highly unlikely that either the peak L_{max} noise levels or the longer-term L_{eq} noise levels would be distinguishable against the high level of road traffic noise generated on the nearby F3 Freeway and Link Road. In addition, when noise-enhancing conditions occur, they would also enhance the propagation of noise from these roads, thereby further masking any noise generated by the project. Nevertheless, WACJV has committed to the application of appropriate noise mitigation controls, which the NIA predicts would keep the noise levels below sleep disturbance criteria.

All curves in the rail loop and spur have been designed with a radius of at least 200m, which is considered wide enough to ensure that wheel/rail interface noise would not occur, and consequently locomotive noise would not contribute to operational noise levels. The Department is satisfied that a 200m radius principle is appropriate based on experience at various other coal mines including West Wallsend, Tahmoor, Baal Bone and Charbon Collieries. The NIA predicts that additional rail traffic noise would marginally increase (1-2 dBA) the existing L_{eq} , 24 hour rail traffic noise levels on the Main Northern Rail Line, however the project is not expected to increase the existing L_{max} noise levels.

Road Traffic Noise

Total road traffic noise on Hue Hue Road and Bushells Ridge Road is not predicted to exceed road traffic noise objectives.

5.6.4 Noise Management

The Department has recommended conditions of consent including operational and construction noise criteria at various receivers and a requirement to prepare a NMP for approval prior to any construction of surface facilities. The NMP must include a description of all monitoring and mitigation measures to be implemented across the project in order to meet the specified criteria. In addition, WACJV has committed to establishing a leading practice noise monitoring network surrounding the Tooheys Road and Buttonderry Sites, including real time noise monitors.

5.7 AIR QUALITY IMPACTS AND GREENHOUSE GAS EMISSIONS

5.7.1 Air Quality Impacts

The EIS includes an Air Quality and Greenhouse Gas Assessment (AQGGA) undertaken by PAEHolmes in accordance with relevant methods and guidelines, including EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*. Because the project is an underground mine with minimal associated coal processing, coal extraction and processing it is unlikely to lead to any significant particulate emissions, as would be the case with an open cut mine. The primary sources of such emissions would be from coal stockpiles, coal transfer by conveyor, coal loading and rail movements. WACJV has committed to a variety of management measures including fixed water sprays on all stockpiles, wind shielding applied to the roof and side wall of conveyors, belt cleaning and spillage minimisation, a variable height stack and a telescopic chute with water sprayers. WACJV has committed to augmenting the existing HVAS with a continuous monitoring instrument at a location representative of receivers who may experience short term elevated dust concentrations.

Nonetheless, a number of submissions from the general public raised concerns about potential health impacts related to air quality impacts, and NSW Health's submission raised specific concerns about the EIS's predictions of health risks. The RTS and Residual Matters Report included a revised, detailed assessment of health risks associated with the project's anticipated air quality impacts, including risks of lung cancer, heart disease and other respiratory diseases. This assessment calculated that the predicted statistical increases resulting from the project would be negligible (ranging from 0.04% to 0.24% increases). NSW Health has considered this latest information and has no residual concerns.

The AQGGA found that dust deposition and suspended particulate levels would be well within the relevant criteria during the mine's operational phase, with the sole exception being at the closest residence north of Tooheys Road Site. However, this exceedance is a minor one which is not expected to have any adverse impacts on human health or amenity.

Particulate emissions during construction are estimated to be less than 35% of those during operations, which means they would be well below the relevant criteria. Emissions from rail haulage are also predicted to be below levels that are known to cause adverse impacts on amenity.

The AQGGA predicts that one privately-owned receiver in the vicinity of the Buttonderry Site is predicted to experience odour impacts above the most stringent assessment criterion of 2 odour units (OU). However, this criterion is the level that is considered to be acceptable for a whole population. Consequently, the Department considers that an isolated and occasional level of 3 OU at one privately-owned receiver is not likely to cause any significant adverse impact, especially given that there is likely to be existing odours from WSC's nearby Buttonderry waste facility.

5.7.2 Air Quality Management

The Department is satisfied that air quality impacts in terms of both community amenity and human health are likely to be very low. Both EPA and NSW Health have no residual concerns about air quality impacts, and have recommended conditions of consent that the Department has taken into account.

The Department has recommended a condition of consent requiring an Air Quality and Greenhouse Gas Management Plan (AQGGMP) to be prepared in consultation with EPA and NSW Health, which would ensure that best practice management measures are undertaken and that appropriate Trigger Action Response Plans (TARPs) are developed.

5.7.3 Greenhouse Gas Emissions

The EIS includes an assessment of greenhouse gas (GHG) emissions and potential impacts, undertaken by PAEHolmes.

The Department acknowledges the potential climate change impacts caused by the burning of coal and other fossil fuels to provide the energy needs of various human societies, but does not consider that these in themselves should necessarily preclude the approval of the project. Rather, consideration of potential GHG impacts needs to be balanced, with due consideration given to:

- the project's particular contribution to global warming/climate change;
- whether refusing the development application would reduce global GHG emissions;
- the benefits of the project, including job creation and its contribution to the NSW economy;
- the objects of the EP&A Act, including the encouragement of ESD; and
- available GHG impact mitigation measures.

The GHG assessment calculates direct and indirect GHG emissions associated with the project, including 'Scope 1' emissions (ie direct GHG emissions from sources controlled by WACJV), 'Scope 2' emissions (ie indirect emissions associated with the import of electricity for use in the project) and 'Scope 3' emissions (ie other indirect emissions, such as those associated with the downstream combustion of the product coal). The calculated GHG emissions associated with the project are shown in **Table 9**.

The assessment indicates that the vast majority (97.76%) of the total GHG emissions generated as a consequence of the project are those associated with the downstream burning of the product coal for energy production purposes – ie Scope 3 indirect emissions. The Department is satisfied that the project's contribution to annual global GHG emissions, even when assessed on a full life-cycle basis (ie including downstream GHG emissions), would be very small.

Table 9: Direct and Indirect Greenhouse Gas Emissions

Scope	GHG source(s)	Annual average GHG emissions (tonnes carbon dioxide equivalent, tCO ₂ -e)
Scope 1	Coal seam gas venting	6,700,294
	On-site fuel use	86,476
Scope 2	Upstream electricity	1,477,507
Scope 3	Downstream transport of product coal, etc	229,353
	Downstream coal use	360,636,923
Total (excluding Scope 3)		8,264,277
Total (including Scope 3)		369,130,553

It must be noted that if the project was not allowed to proceed, the resultant gap in the thermal coal supply would be almost certainly filled by another coal resource, sourced either from elsewhere in NSW, Australia or overseas. In other words, preventing GHG emissions from the project would not result in any decrease in global CO₂ emissions. This point illustrates the reality that the key response to the issue of climate change needs to be made at a national and international policy or strategic planning level, outside and above the project assessment process in NSW.

The EIS proposes a number of GHG mitigation measures, including using low-sulphur diesel fuel for equipment on-site, installing energy efficient appliances (eg lighting and hot water) and undertaking enclosed flaring of mine drainage gas (ie methane). WACV has also committed to undertaking an options study for methane capture and utilisation within three years of the commencement of the longwall mining production.

The Department has included conditions of consent requiring WACJV to implement all reasonable and feasible measures to minimise the release of direct GHG emissions from the project, and to prepare an AQGGMP. This would require WACJV to describe the measures to be implemented to minimise the release of GHG emissions.

5.8 SOCIO-ECONOMIC IMPACTS

The EIS includes an Economic Impact Assessment (EIA) undertaken by Gillespie Economics, which includes both an Input-Output Model (IOM) and a Cost Benefit Analysis (CBA). The project involves the extraction of a significant coal resource and would have a number of socio-economic benefits, however it also has the potential to cause a number of socio-economic costs, particularly to neighbouring rural and residential land users in the vicinity of the project.

The EaL submission questioned some of the EIA's findings. The Department notes the concerns raised by EaL about the value of the IOM methodology in general, and accepts that the methodology has limitations. Nevertheless, even if some of the EaL's criticisms are accepted, the Department is satisfied that they would not fundamentally alter the fact that the project would result in significant economic benefits for the State and the region. Further, the Department does not believe that any of the EaL's criticisms of the CBA are determinative, and consequently do not alter the broad conclusion of the CBA that the project would result a net benefit to the community.

5.8.1 Resource Significance

Following recent changes to the Mining SEPP, the consent authority is required to consider the significance of the coal resource in determining whether to grant consent to a proposed development, having regard to the matters listed within clause 12AA(1)&(2) of the SEPP. These matters include the economic benefits, both to the State and the local region, of developing the resource and any advice received from the Director-General of the Department of Trade and Investment, Regional

Infrastructure and Services (DTIRIS) as to the relative significance of the resource in comparison with other mineral resources across the State. In regard to economic benefit, the consent authority must take into account employment generation, expenditure (including capital investment), and the payment of royalties to the State.

In determining whether to grant consent to the proposed development, the significance of the resource is to be the consent authority's principal consideration under Part 3 of the Mining SEPP. This is not to say that it is the principal consideration above all others, but the principal consideration amongst those matters listed in Part 3, which are:

- significance of the resource;
- non-discretionary development standards for mining;
- compatibility with other land uses, including mining, petroleum production or extractive industry;
- natural resource management and environmental management;
- resource recovery;
- transport; and
- rehabilitation.

The Department has not received any advice from the Director-General of DTIRIS as to the relative significance of the resource in comparison with other mineral resources across the State, as the development application was lodged well before the commencement of clause 12AA.

Nevertheless, the Department has carefully considered the significance of the coal resource under clause 12AA(1) of the SEPP. This application seeks to extract up to 125 million tonnes (Mt) of high-grade, export quality thermal coal at a rate of 5 Mtpa. In addition, the project area contains additional proven coal resources, and a further 17 years of mining is proposed beyond the limits of the present project. The mine is also located immediately southwest of the Mandalong Southern Extension Project, the subject of a current development application which seeks to expand the life of the existing Mandalong Coal Mine to a total of 25 years.

The project would generate a significant number of employment opportunities within the local region and the State, including 300 direct jobs and an estimated 500 flow-on jobs in related industries. The project is estimated to involve capital investment by WACJV of approximately \$805 million. The project would have direct economic benefits to the State, including \$134 million in taxes and \$207 million in mining royalties over the life of the project. It is also important to note the proximity of the proposed mine to existing rail infrastructure and export facilities, which facilitates economic delivery of product coal while minimising environmental and other costs associated with coal transport. The coal generated from this project would also require limited processing on-site, and would be transported directly by rail from the surface facilities site to the nearby Port of Newcastle.

5.8.2 Socio-Economic Benefits

The Department recognises that thermal coal remains a highly sought-after energy source in the Asian markets, particularly the North Asian markets of Korea, China and Japan. As discussed above, the Department considers that extraction of a coal resource of this size and significance would result in a range of very significant economic benefits to the Wyong LGA, the Central Coast region, the State of NSW and to Australia.

The IOM predicts the following benefits to the regional economy:

- \$625 million in direct and indirect regional output;
- \$79 million in household income; and
- 805 direct and indirect jobs.

The IOM also predicts the following benefits to the NSW economy:

- \$900 million in direct and indirect output;
- \$154 million in household income.

The Department considers that these are significant benefits, which should be given significant weight in assessing the development's overall merits.

5.8.3 Adverse Socio-Economic Costs

The project's potential socio-economic costs include direct impacts on rural and residential buildings and other built infrastructure, due to subsidence impacts. There is also the possibility of minor impacts on agricultural and forestry uses as a result of clearing and subsidence-related flooding. The

Department has included conditions of consent to ensure that these costs are borne by WACJV through compensation requirements.

Like any other development, the project would also likely give rise to a number of indirect socio-economic benefits and costs, or 'externalities'. Such costs include impacts on ecology, groundwater, surface water, air quality, heritage and traffic. These issues have been addressed in the relevant sections of this report, above.

The Department is also aware that WACJV has undertaken extensive consultation with WSC over a proposed Voluntary Planning Agreement (VPA). WACJV and WSC have indicated that the VPA is likely to cover a range of contributions to WSC and potential benefits to the Wyong LGA, including:

- upgrade of roads affected by mine traffic;
- annual payments for road maintenance;
- community contributions;
- payments for other water, waste and sustainability programs; and
- reasonable endeavours to employ local apprentices.

The agreement has not yet been finalised, however the Department understands that the total value of the agreement may exceed \$4 million.

5.8.4 Cost Benefit Analysis

The CBA calculates the net community benefit (NCB) of the project to be \$531 million, which comprises

- \$207 million in mining royalties;
- \$134 million in taxes; and
- \$186 million in social/economic values of employment.

The Department notes that the CBA's calculation of NCB assumes a 'negligible' cost in relation to most of the key externalities. While the Department expects there to be more than negligible impacts in relation to some, if not all, of these issues, it is satisfied that the recommended conditions of consent would provide for appropriate offsets, mitigation or management of these impacts. Consequently, the Department believes that it is likely that full consideration of all externalities would only lead to a minor reduction in the predicted NCB.

While the Department accepts that the estimation of NCB is not a precise science, and will vary from one expert to another or in response to any sensitivity analysis, it is satisfied that the findings of the CBA are robust in this instance, and that any of the criticisms of this CBA would not materially change the broad conclusion that the project would result in a net benefit to the community.

5.9 OTHER ISSUES

Table 10: Other Issues

Issue	Potential Impact and Consideration	Conclusion and Recommendation
<i>Cliffs, Minor Cliffs, and Rock Face Formations</i>	<ul style="list-style-type: none"> • The EIS includes a Subsidence Impact Assessment (SIA) that considers potential impacts on cliffs and other rock formations. • The EIS defines a 'cliff' as a rock face with a minimum 63° angle, minimum height of 10 m and minimum length of 20 m. The Department accepts this definition as it aligns with definitions previously accepted or applied by the Department for other mining projects. • Under this definition, there are no cliffs within the project area. • However, there are some isolated rock formations with angles of 63° or greater, but not reaching a height of 10 m or length of 20 m. • The Department has therefore applied its other standard definitions to these smaller features, as follows: <ul style="list-style-type: none"> - 'minor cliff' - a continuous rock face, including overhangs, having a minimum height of 5 m and a slope of 63° or greater; and 	<ul style="list-style-type: none"> • The Department accepts that it is extremely difficult to predict the precise locations of rock falls and other damage to rock formations. • Nonetheless, it is likely that some such impacts would occur. • However, due to the high depth of cover (between 400 and 690 m) and the low height and length of the identified rock formations, the Department considers the risk of rock instability to be low. • Based on previous mining experience in the Southern Coalfield and elsewhere with lesser depths of cover, the Department is satisfied that less than 3% of the total rock face area of the minor cliffs and rock face formations is likely to

Cliffs, Minor Cliffs, and Rock Face Formations	<ul style="list-style-type: none"> - 'rock face formation' - a continuous rock face having a minimum length of 20 m, heights of 3 - 5 m and a slope of 63° or greater. • There are a number of minor cliffs and rock face formations located over the proposed longwalls, which are expected to be subject to the full range of subsidence movements. • The SIA predicts maximum vertical subsidence of 2,575 mm, maximum tilt of 5 mm/m, and maximum tensile and compressive strains of 3 mm/m and 4.5 mm/m, respectively. 	<p>experience fracturing, displacement or rock falls.</p> <ul style="list-style-type: none"> • The Department has recommended performance measures in the conditions of consent which restrict potential impacts to these limits.
Agricultural Resources	<ul style="list-style-type: none"> • The EIS includes an Agricultural Impact Statement (AIS) undertaken by Scott Barnett & Associates. • The main agricultural land uses identified are turf farming, beef cattle grazing/breeding, and equine breeding, training and agistment. • The AIS predicts that there may be potential subsidence impacts on one turf farm for up to 2 years (occurring no earlier than 22 years into the project). However, the AIS considers that the subsidence impacts could be mitigated and/or remediated once subsidence has settled through re-leveling of the land, such that that the farm would return to pre-mining conditions. • The AIS calculates the total gross value of production from the impacted turf farming properties is \$1.3 M per annum for any period that the turf farm is out of operation. • The AIS predicts that there would also be a minor loss of agricultural value (\$17,636 per annum) resulting from the cleared land required for the surface facilities sites (\$14,897 per annum) and the biodiversity offset (\$2,739 per annum). 	<ul style="list-style-type: none"> • The Department accepts that there may be impacts to turf farming for up to 2 years well into the life of the project, however is satisfied that any impacts could be readily remediated. • The Department is also satisfied that these impacts could be adequately managed under the Extraction Plan required under recommended conditions, and that any compensation to the affected farmer would be dealt with through the either the requirements of the consent, or the compensation provisions of the <i>Mining Act 1992</i>. • The Department considers the loss of agricultural value due to the surface facilities sites and biodiversity offsets to be minor, compared with the economic benefits offered by the mine.
Road Transport	<ul style="list-style-type: none"> • The EIS includes a Traffic and Transport Impact Assessment undertaken by Parsons Brinkerhoff. • Design of the access points at the Tooheys Road Site, Buttonderry Site and Western Shaft Site has taken road safety into consideration. • The peak construction period (Year 2 of the project) is expected to generate 600 two-way trips per day at the Tooheys Road Site and 300 two-way trips per day at the Buttonderry Site. • The peak operational period (Year 12) is expected to generate 500 two-way trips per day at the Tooheys Road Site and 42 two-way trips per day at the Buttonderry Site. • The ability of each of the key intersections to cater for existing and future traffic forecasts was investigated using the SIDRA software modelling package. • While there are various intersections that would not perform at acceptable levels during peak times, this is primarily due to overall peak traffic volumes. The contribution of the project is very low with a maximum of 4.6% during construction and 0.9% during operation. • There are a number of approved and proposed developments in the area surrounding the surface facilities sites, including the Woolworths Retail Facility, Wyong Employment Zone and Warner Industrial Park. These approvals and background growth rates will force many of the intersections in the area to perform or continue to perform at unacceptable levels in the future. 	<ul style="list-style-type: none"> • The Department is satisfied that the project would not in itself be responsible for predicted poor performance at various intersections in the vicinity of the surface facilities sites. At most, it provides a minor contribution to traffic volumes. • The Department has recommended a condition of consent requiring a Traffic Management Plan to be prepared in consultation with RMS and WSC. This would include details about WACJV's contribution to mitigation measures for road deficiencies.
Rail Transport	<ul style="list-style-type: none"> • The EIS includes a Rail Study undertaken by Rail Management Consultants Australia. • The main rail network to the coal export terminals at Newcastle is managed by ARTC, while the rail 	<ul style="list-style-type: none"> • The Department is satisfied that the project would have limited impacts on the existing rail network, which is subject to a

<i>Rail Transport</i>	<p>network from Wyong to Newcastle (Main Northern Rail Line) is managed by RailCorp.</p> <ul style="list-style-type: none"> The project would occur at the same time as the Northern Sydney Freight Corridor (NSFC) Stage 1 project, which aims to improve capacity and reliability for freight trains on the Main Northern Rail Line between Sydney and Newcastle. The EIS predicts that the project would generate an average of 4.33 train movements per day, which is within the line's capacity for a maximum of 6 trains per day. RailCorp (part of TNSW) and ARTC have both been consulted over the project and have no residual concerns. 	<p>project which will provide capacity and reliability improvements in the near future.</p>
<i>Forest Resources</i>	<ul style="list-style-type: none"> The EIS includes a Forestry Assessment for the project undertaken by GHD. This assessment notes that 3.2 ha of the Wyong State Forest would be cleared for the construction of the Western Ventilation Shaft. Timber in this area has an approximate commercial value of \$23,000, which is a very small value. WACJV has committed to continue consultation with the Forestry Corporation to ensure that any impacts to forestry resources and activities are managed or appropriately compensated. The Forestry Corporation has no residual concerns about impacts to forestry resources or forestry activities. 	<ul style="list-style-type: none"> The Department is satisfied that forestry impacts would be minimal. WACJV has committed to a range of appropriate mitigation and management measures and calculated compensation arrangements, based on its consultations with the Forestry Corporation.
<i>Visual Impacts</i>	<ul style="list-style-type: none"> The EIS includes a Visual Impact Assessment (VIA) undertaken by Design Partnership. The VIA concludes that the visual impacts associated with the Tooheys Road Site would be generally restricted to motorists on the F3 Freeway and the Motorway Link Road. However, two private residences (209 and 235 Bushells Ridge Road) would have limited views of the uppermost section of the coal stockpile. WACJV has committed to landscape mitigation measures at the perimeter zones of the site, and additional measures if requested by affected landowners. The Buttonderry Site would not be viewed by adjoining rural and rural residential properties due to both vegetation and topography. It may be visible from parts of the proposed Wyong Employment Zone (WEZ), however the visual character of the site would be light industrial, which is similar to the character of the WEZ. 	<ul style="list-style-type: none"> The Department has recommended a condition of consent requiring WACJV to implement additional visual impact mitigation measures (such as landscaping treatments or vegetation screens) in consultation with any owner of privately-owned land with direct views to the Tooheys Road Site from a residence within 2 km, to the satisfaction of the Department. The Department is satisfied that the visual impact from the Buttonderry Site on the proposed WEZ would be minimal.
<i>Contamination</i>	<ul style="list-style-type: none"> The EIS includes a Contamination Impact Assessment (CIA) undertaken by DLA Environmental. Hansen Bailey has also completed a Preliminary Hazard Assessment (PHA) for the project. The CIA notes that the Tooheys Road Site has previously been used for small scale, semi-rural farming and the Buttonderry Site has been previously used for cattle grazing. The CIA found hydrocarbon contamination associated with a minor motor oil spill, which would require removal of soil to a depth of 0.15 m. WACJV has committed to removing this soil and disposing of it at a suitable licensed landfill facility in accordance with the relevant guidelines. Asbestos containing materials were also identified and have already been removed in accordance with the relevant regulations. The CIA found no evidence of contamination by other heavy metals, PAH compounds, pesticides or PCBs. 	<ul style="list-style-type: none"> The Department is satisfied that the previous land uses on the site have had very low impacts in terms of existing land contamination, and that the project is not itself a hazardous or offensive development. WACJV has committed to management procedures to ensure that any potential hazards are minimised in accordance with relevant legislation, regulations and guidelines.

Contamination	<ul style="list-style-type: none"> WACJV has committed to constructing an explosives storage facility and fuel storage facilities at the Tooheys Road Site, in accordance with the relevant legislation and standards. 	
Waste	<ul style="list-style-type: none"> The EIS includes a Waste Assessment. As the project does not include a coal handling and preparation plant (CHPP), no coarse coal rejects or fine coal tailings would be produced. The Waste Assessment notes that other waste products, including scrap metal, batteries, empty drums, wooden pallets, timber, green waste and mixed recyclables would be separated into appropriate receptacles for reuse, recycling or disposal. 	<ul style="list-style-type: none"> The Department has recommended a condition of consent requiring WACJV to prepare a Waste Management Plan to ensure minimisation and appropriate handling of waste materials.
Rehabilitation	<ul style="list-style-type: none"> Some minor rehabilitation activities would be required during construction and during mining operations. Rehabilitation of disturbed areas would take place after construction is complete to develop a stable, non-polluting landform to reduce potential impacts of the project. Clean excavated waste rock would be created during the construction of the drift and shafts, with approximately 160,000 m³ from the Tooheys Road Site and approximately 20,000 m³ from the Buttonderry Site. WACJV has proposed to use this material for the creation of perimeter bunding and landscaping features. 	<ul style="list-style-type: none"> Complete rehabilitation of the surface facilities sites would take place after mine closure. DRE has no residual concerns about rehabilitation. The Department has recommended a condition of consent requiring WACJV to prepare a Rehabilitation Management Plan, in consultation with DRE.

6 CONCLUSION

The Department has assessed the development application, EIS, RTS, Residual Matters Report, and all public and agency submissions on the project. The Department has carefully considered all environmental, social and economic impacts of the project, in accordance with the relevant requirements of the EP&A Act. It has also undertaken an extensive consultation process with Government agencies and other relevant stakeholders.

The project seeks to extract up to 125 million tonnes of high-grade, export quality thermal coal. The Department considers that extraction of a coal resource of this size and significance would result in a range of very significant economic benefits to the Wyong LGA, the Central Coast region, the State of NSW and to Australia. The project would have direct economic benefits to the State, including \$134 million in taxes and \$207 million in mining royalties over the life of the project. The project would also generate approximately 800 jobs, which would be a significant boost to both the Wyong LGA and the Central Coast region, which have relatively high unemployment levels compared to the rest of NSW. These are significant benefits, which must be given significant weight in assessing the project's overall merits.

In relation to the social and environmental impacts of the project, the Department has concluded that amenity and health impacts are likely to be minor, and can be managed through the recommended conditions of consent, including appropriate noise and air quality performance criteria. It must be noted that the project's two key surface facilities are both located in areas that are earmarked for current and future industrial uses, and are therefore generally unlikely to cause any significant amenity issues for nearby residents. In terms of subsidence impacts, the Department has concluded that impacts on creeks and rivers are likely to be minor, and there is a very low risk to groundwater resources. In this context, it is important to consider that the Yarramalong and Dooralong Valleys have been highly altered over the past century and many of the streams are regularly subject to flooding, erosion and scouring. The Department is also satisfied that the great majority of impacts to built features are likely to be minor, and can be managed through the recommended conditions of consent. In addition, both new and older houses are covered by the MSB in respect of compensation for any mining-induced subsidence impacts.

Overall, the Department has recommended a robust set of conditions of consent based on an adaptive management approach, which accepts that knowledge and understanding of underground mining in this 'greenfields' area would substantially increase over the life of the project, and allows for

appropriate alterations to mining operations to reflect this improved knowledge. The recommended conditions incorporate a range of checks and balances as the project develops and progresses, and provide various safeguards to prevent and/or mitigate potential impacts. These conditions are broadly based on three key features: a strict set of performance criteria; a requirement for various management plans to monitor and mitigate potential impacts; and stringent reporting and auditing requirements.

In terms of performance criteria, the Department has set a range of performance measures that WACJV must not exceed for all key types of impact by the project, including water, biodiversity, built features, heritage, noise and air quality. Any exceedance of the performance criteria would constitute a breach of the development consent and may be subject to penalties under the EP&A Act. In relation to management plans, WACJV would be required to prepare two sets of plans that together address each of the areas of impact identified in the performance criteria, and describe appropriate monitoring and mitigation measures to ensure that the criteria are met. Both sets of management plans must be approved by the Department in consultation with the relevant agencies. In terms of reporting and auditing, the Department has included a range of conditions to ensure that WACJV provides regular updates on its operations and monitoring results, through management plans, incident reports, independent audits and annual reviews. To ensure transparency and accountability, the recommended conditions also require that all reports, plans, reviews and audits must be available on WACJV's website.

The Department has carefully weighed the key areas of concern, including subsidence and amenity impacts, against the significance of the resource and the socio-economic benefits. On balance, the Department has concluded that the project's benefits outweigh its potential impacts and it is therefore in the public interest. Consequently, the Department believes it should be approved subject to the recommended conditions of approval.

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