



DARTBROOK MINE

MODIFICATION 7

Environmental Assessment

for
Australian Pacific Coal Limited
June 2018

DARTBROOK MINE MODIFICATION 7

KAYUGA SEAM BORD AND PILLAR MINING OPERATIONS

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For:

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EXECUTIVE SUMMARY

Background

AQC Dartbrook Management Pty Limited (AQC) is the proprietor of the Dartbrook Mine, located in the Upper Hunter Valley of New South Wales. Dartbrook Mine is located approximately 10 km north-west of the township of Muswellbrook and approximately 4.5 km south-west of the village of Aberdeen. AQC is a wholly owned subsidiary of Australian Pacific Coal Limited.

Dartbrook Mine is managed in accordance with Development Consent DA 231-7-2000 granted under the *Environmental Planning and Assessment Act 1979*. DA 231-7-2000 allows for underground longwall mining and associated surface activities to be carried out until 5 December 2022. Dartbrook Mine was placed into care and maintenance by its previous owners in December 2006.

AQC acquired Dartbrook Mine in May 2017 with the objective of reinstating mining operations at the site. AQC proposes to modify DA 231-7-2000 to allow for an alternative method of underground mining, an alternative coal clearance system and an extension to the approval period (the Modification). The modification application has been made under Section 75W of the *Environmental Planning and Assessment Act 1979*.

The Modification will assist AQC in the early recommissioning of mining operations at Dartbrook Mine by providing approval for more cost effective methods of underground mining and coal transportation.

Approved Operations

Dartbrook Mine was originally granted development consent DA N91/00424/003 in December 1991. DA N91/00424/003 allowed for longwall mining operations in the Wynn Coal Seam, as well as the development of surface infrastructure. The two surface facilities at Dartbrook Mine (namely, the East Site and West Site) were constructed in accordance with DA N91/00424/003.

The East Site includes the coal handling and preparation plant, coal stockpiles, rail loop, train loadout facility, reject emplacement area, bathhouse, administration buildings and water management structures. The West Site includes the entries to the underground mine, main administration buildings, helipad, effluent ponds and water management structures.

The current development consent (DA 231-7-2000) was granted on 28 August 2001. DA 231-7-2000 provides approval for longwall mining activities in the Kayuga, Mt Arthur and Piercefield Coal Seams, in addition to the previously approved mining activities in the Wynn Seam. DA 231-7-2000 also provided approval for the Hunter Tunnel, which is an underground passageway that connects the underground mine to the East Site. The Hunter Tunnel passes beneath the Hunter River, Dart Brook, New England Highway and Main Northern Rail Line. Prior to Dartbrook Mine being placed into care and maintenance, Run of Mine coal was transferred from the mine workings to the East Site using conveyors in the Hunter Tunnel.

Mining in the Wynn Seam commenced in 1996 and was suspended in May 2004. Ten of the approved longwall panels in the Wynn Seam were extracted during this period. Mining operations were then relocated to the overlying Kayuga Seam. Mining of the Kayuga Seam commenced in 2004 and was suspended in October 2006. Only three of the 20 approved longwall panels in the Kayuga Seam have been mined to date.

The longwall mining equipment and Hunter Tunnel conveyors were removed from the underground mine by the previous owner during the care and maintenance period. As a result, significant capital expenditure and time would be required to reinstate the approved longwall mining operations and coal clearance system (the Hunter Tunnel conveyor). For this reason, the Modification proposes alternatives to the approved mining method and coal clearance system.

Modification Description

The Modification proposes the following:

- Bord and pillar mining activities within the Kayuga Seam (as an alternative to the approved longwall mining activities),
- An alternative method of delivering Run of Mine coal from the mine workings to the East Site (i.e. an alternative coal clearance system); and
- Extending the approval period under DA 231-7-2000 by 5 years (until 5 December 2027).

The proposed bord and pillar mining will result in the extraction of up to 10 million tonnes of Run of Mine coal over a 10 year period. The maximum production rate in any given year will be 1.5 million tonnes per annum.

Bord and pillar mining involves the shearing of coal to develop a network of roadways within the coal seam. The roadways are separated by blocks of intact coal, which are referred to as “pillars”. The pillars will be designed to remain stable in the long term, thus resulting in no perceptible surface subsidence. Bord and pillar mining is undertaken using continuous miners (Bolter Miners), mobile roof bolters and shuttle cars. The equipment required for bord and pillar mining can readily be obtained.

The approved longwall mining activities in the Wynn, Kayuga, Mt Arthur and Piercefield Seams will not be altered by the Modification. The total coal production from Dartbrook Mine will remain within the approved maximum production rate of 6 million tonnes per annum.

Dartbrook Mine has been under care and maintenance since December 2006. To enable the proposed mining activities to be undertaken, the Modification seeks to extend the period of approval by an additional 5 years. The extension of the project duration facilitates the recovery of coal resources that have not yet been extracted as a result of Dartbrook Mine being under care and maintenance. The extension of the mining period will not result in the extraction of any coal that was not previously approved for extraction.

The approved coal clearance system is currently unable to be utilised because the conveyors in the Hunter Tunnel were removed by the previous mine owner. The Modification proposes that coal extracted via the bord and pillar mining method will be delivered to the surface at the West Site. It will then be hauled along an existing private road network to a new shaft site (to be constructed west of the New England Highway). The coal will be transferred down the shaft into the Hunter Tunnel, where it will be conveyed beneath the New England Highway to the East Site.

The following aspects of the approved development will not be altered by the Modification:

- Proposed mining of the Kayuga Seam will be undertaken within the Approved Kayuga Seam Mining Area (i.e. no change in mining footprint);
- Approved longwall mining activities in the Wynn, Kayuga, Mt Arthur and Piercefield coal seams will not be altered;
- Total coal production will remain within the approved maximum production rate of 6 million tonnes per annum;
- Coal will continue to be loaded onto trains using the existing train load out facilities and railed to the Port of Newcastle;
- Operating hours will remain unchanged; and
- Operational workforce will remain within the approved personnel limit.

Dartbrook Mine currently employs 11 full time personnel during care and maintenance. The Modification is expected to employ approximately an additional 26 personnel during the construction phase and a total of 99 personnel during the operational phase.

Impacts and Mitigation Measures

Air Quality

An Air Quality Impact Assessment was undertaken by ERM in accordance with the “*Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW*” (NSW EPA, 2016). The Air Quality Impact Assessment included dispersion modelling to predict particulate matter concentrations at private residences in the vicinity of Dartbrook Mine. The predicted particulate matter concentrations were assessed against the air quality criteria prescribed by NSW EPA (2016) and the *Voluntary Land Acquisition and Mitigation Policy* (NSW Government, 2014).

Dispersion modelling was undertaken to assess the air quality impacts of all operational activities proposed by the Modification, including the use of existing and approved infrastructure. The Modification is predicted to comply with all air quality criteria for the “project only” scenario. The Modification is not expected to result in any exceedances of the acquisition criteria under the *Voluntary Land Acquisition and Mitigation Policy*.

The modelling predicted that the cumulative annual average PM_{2.5} criterion of 8 µg/m³ may be exceeded at four receptors. One of these receptors (181) is entitled to mitigation (upon request) from the neighbouring Mount Pleasant Mine. At the other three receptors, the contribution from the Modification is relatively small (ranging from 0.4 to 0.7 µg/m³). The exceedances are predominantly due to the background PM_{2.5} concentration (7.6 µg/m³) being close to the criterion.

The modelling predicted that Receptor 181 may experience two additional days where the cumulative 24hr average PM₁₀ criterion of 50 µg/m³ is exceeded. This receptor is entitled to mitigation from Mount Pleasant Mine. Aside from Receptor 181, 15 other residences are predicted to experience an additional day of exceedance. It should be noted that on this worst case day, the background concentration is 48.7 µg/m³ (due to a fire in the locality). If this day is disregarded, there are no predicted exceedances of the 24hr average PM₁₀ criterion at these 15 residences.

To manage potential impacts to air quality, AQC will update its Air Quality Management Plan in consultation with the relevant regulatory authorities. The Air Quality Management Plan will outline the proposed dust controls for the Modification, including the following:

- Utilising the sealed Western Access Road for hauling of coal (with street sweepers operating along the sealed road);
- Use of water sprays on the unsealed section of the haul route;
- Trucks to be covered whilst transporting ROM coal to the new shaft site;
- Limiting truck speeds to 30 km/h on unsealed roads and 50 km/h on sealed roads;
- Sealing of the trucking surface at the new shaft site;
- Installation of an enclosure around the ROM bin at the new shaft site;
- Use of automatically triggered water sprays within the enclosure at the ROM bin;
- Use of automatic water sprays on all coal stockpiles;
- Water application at above ground conveyor transfer points; and
- Real time air quality monitoring.

Noise

An Acoustic Impact Assessment was undertaken by Bridges Acoustics. Noise modelling was undertaken to assess the potential acoustic impacts of all proposed construction and operational activities proposed by the Modification.

The modelling predicted that the Modification will comply with the intrusive noise criteria under the Development Consent (DA 231-7-2000) at all private residence, except for five residences in Aberdeen. These five residences are predicted to experience exceedances of 1 dBA during the night period only. The *Voluntary Land Acquisition and Mitigation Policy* states that exceedances of 0-2 dBA are not discernible to the average listener, and therefore do not give rise to any acquisition or mitigation requirements.

The modelling predicted that the Modification will comply with the criteria for construction noise and sleep disturbance.

Due to the operational workforce for the Modification being less than the approved maximum workforce of 292 personnel, road traffic noise generated by the Modification will be within that of the approved development.

Similarly, the Modification will not require more train movements than the currently approved development. Therefore, rail noise generated by the Modification will be within the levels associated with the approved development.

AQC will prepare a Noise Management Plan in consultation with the relevant regulatory authorities. The Noise Management Plan will include the following noise controls:

- Truck haulage of coal will be limited to the day period on weekdays only, to avoid truck noise during the more sensitive evening and night periods;
- Haul trucks will be road registered and maintained in good condition, particularly the exhaust silencers and suspension components to minimise noise from the engine and body;
- Truck engine brakes will not be used unless a trial indicates acceptable noise levels at nearest receptors;
- The unsealed section of the haulage route will be regularly maintained to minimise empty truck body noise over bumps;
- Truck speeds will be limited to 30 km/h on the unsealed sections of road and 50 km/h on sealed roads;
- The infrastructure at the new shaft site will be partially enclosed in a shed, with a solid wall on the northern side to minimise noise to the closest receptors to the north;
- The infrastructure for crushing and stockpiling of coal (i.e. stackers) will only be used during the day period. However, the infrastructure required for loading of trains will be required 24 hours per day; and
- The dozer on the circular coal stockpile (required for train loading operations) will be limited to slow speed operation in reverse during the evening and night periods.

Groundwater

A groundwater assessment was undertaken by Australasian Groundwater and Environmental Consultants. This assessment used analytical approaches to predict the magnitudes of seepage into the Kayuga Seam and drawdown of alluvial aquifers.

Compared to the approved longwall mining, the proposed bord and pillar mining method does not result in significant fracturing of the overburden strata. As a result, the magnitude of groundwater seepage and magnitude of drawdown are expected to be significantly less for bord and pillar mining.

Groundwater monitoring data indicates that the rate of seepage into the Hunter Tunnel is consistently around 3 ML/week. This seepage is primarily derived from the Hunter River alluvial aquifer. The available monitoring data also suggests that seepage from the Permian strata (hard rock aquifer) is negligible.

Based on calculations using Darcy's equation, seepage into the Kayuga Seam workings is predicted to be very low (<10 ML/year). This prediction is consistent with the low rates of seepage indicated by groundwater monitoring. AQC holds sufficient water access licences to account for the predicted taking of water from the Permian aquifer.

The existing groundwater monitoring program includes monitoring of water levels in the alluvium. Long term trends for these monitoring bores indicate that previous longwall mining operations did not result in any drawdown of alluvial aquifers. Due to the nature of bord and pillar mining, the Modification is also not expected to result in any drawdown of the alluvial aquifers. Rainfall recharge of alluvium is expected to negate any seepage associated with groundwater depressurisation.

The proposed shaft will be located near the fringe of the Hunter River alluvium. It is not known whether the alluvium bears water at this location. If water is encountered in the early stages of shaft construction, the shaft will be lined to avoid creating a conduit between the alluvial aquifer and the Hunter Tunnel.

AQC will update its Site Water Management Plan in consultation with the relevant regulatory authorities. The Site Water Management Plan includes a Groundwater Monitoring Program. Groundwater monitoring will continue to be undertaken to confirm that the Modification does not result in any significant impacts to shallow groundwater systems.

Surface Water

Historically, Dartbrook Mine has rarely required raw water from external sources or needed to discharge water from the site. An analytical water balance was undertaken to determine whether these trends can be maintained for the Modification. Due to the very low rates of seepage into the Kayuga Seam, the predicted increase in operational water demand is greater than the predicted increase in inflow. That is, the Modification is expected to result in a net reduction in storage within the water management system. As such, discharges of water from the site are unlikely to be required.

Dartbrook Mine has historically used Evaporation Ponds to passively release excess water from the site. The increase in operational water demand can partly be offset by reducing the volume of water that is released through evaporation. There is also a large volume of water stored with the Wynn Seam goaf that can be used to satisfy operational water requirements. Accordingly, the Modification is not expected to require water from external sources.

The new shaft site will be located within the catchment of the Hunter River. Runoff drains in a generally north to south direction across the site, passing beneath the Western Access Road via existing culverts. Diversion drains will be established to direct clean water runoff around the proposed infrastructure area, thereby minimising the impact on catchment flows. Direct rainfall onto the infrastructure area will be captured and treated in sediment dams.

There is the potential for erosion and sedimentation to occur during the construction of the new shaft site. AQC will implement appropriate sediment and erosion controls in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004).

The proposed bord and pillar mine workings will be designed such that they do not result in any perceptible subsidence. Therefore, the Modification is not expected to result in any impacts to stream geomorphology.

AQC will update its Site Water Management Plan to accommodate the transition from care and maintenance back to active mining operations. The updates will reflect the projected water demands for the Modification and the strategies to satisfy these requirements.

Subsidence

To minimise the risk of impacts to surface features, the objective of mine design was to limit subsidence to levels that are imperceptible for all practical purposes. In order to achieve this objective, the pillars must remain stable over the long-term. SCT Operations conducted a study to determine the pillar geometries required to maintain long term pillar stability.

The University of New South Wales pillar design guidelines (Galvin et al, 1999) recommend that in order to maintain long term stability, the pillars should be designed to a nominal factor of safety of 2.11. SCT determined that if the nominal factor of safety of 2.11 is adopted, vertical subsidence associated with the proposed bord and pillar mining can be limited to levels that are imperceptible for all practical purposes. In comparison, the approved longwall panels in the Kayuga Seam were predicted to result in up to 2.2 m of vertical subsidence (HLA-Envirosciences, 2000).

Some of the proposed bord and pillar mine workings will be located above the completed longwall panels in the Wynn Seam. In order to determine suitable pillar sizes for these workings, further work is required to determine the extent of disturbance and size of voids generated by the Wynn Seam longwall panels. AQC will develop a Bord and Pillar Subsidence Management Plan prior to undertaking bord and pillar mining. This plan will include recommended pillar sizes for the proposed workings above the Wynn Seam longwall panels. The plan will also include a subsidence monitoring program to confirm that the pillars are behaving as intended, as well as a contingency plan to manage any greater than expected subsidence effects.

Ecology

An Ecological Impact Assessment was undertaken by Cumberland Ecology. Surface disturbance required for the Modification will be limited to the construction of the new shaft site. Surface disturbance will only occur within the Infrastructure Study Area.

The desktop assessment and field survey determined that there are no native vegetation communities present within the Infrastructure Study Area. The Infrastructure Study Area consists primarily of exotic grassland, with some planted vegetation along the southern side of the Western Access Road.

The direct impact of the Modification will be limited to the clearing of up to 2.28 ha of exotic grassland. This grassland has minimal habitat value. The planted trees to the south of the Western Access Road will be retained. Therefore, the Modification will not result in the loss of any habitat features.

The Biodiversity Management Plan will be updated in consultation with the relevant regulatory authorities. The plan will be updated to include the following mitigation measures:

- The extent of clearing should be clearly demarcated and signposted to avoid clearing outside of the required disturbance area;
- Appropriate weed control measures (given that the vegetation to be cleared will be predominantly exotic species, it is recommended that the plant matter is disposed of); and
- Inductions to notify construction personnel of these mitigation measures.

Aboriginal Heritage

An Aboriginal Archaeological and Cultural Heritage Impact Assessment was undertaken by AECOM Australia. This assessment included an archaeological survey of the Infrastructure Study Area, with assistance from Aboriginal stakeholders.

There are no previously recorded sites (AHIMS sites) located within the Infrastructure Study Area. No Aboriginal sites were identified during the archaeological survey of the Infrastructure Study Area.

The potential for subsurface archaeological deposits was assessed as low due to the Infrastructure Study Area being a substantial distance from the nearest watercourse. The Infrastructure Study Area is located near the fringe of the Hunter River floodplain and is approximately 1.1 km east of the river channel.

Although no impacts to heritage items are expected to occur, the Aboriginal Heritage Management Plan will include a protocol for dealing with previously unrecorded Aboriginal objects (unanticipated finds).

Economic Benefits

An Economic Impact Assessment was undertaken by Gillespie Economics. This assessment included a Cost Benefit Analysis to estimate the potential economic benefits to NSW and Australia, as well as a Local Effects Analysis to predict the benefits to the local economy.

The net production benefits that will accrue to Australia are estimated at \$176 million (present value). The net production benefits include royalties, company tax and a portion of the net producer surplus. In addition to net production benefits, the Modification will generate benefits to employees and suppliers. When these benefits are considered, the net social benefit to Australia is estimated at \$236 million (present value).

The net production benefit to NSW is predicted to total \$82 million (present value). The predicted net production benefit to NSW is comprised of:

- \$38 million (present value) in royalties;
- \$14 million (present value) in NSW's share of Australian company tax; and
- \$30 million (present value) in net producer surplus attributed to NSW.

In addition to net production benefits, the Modification is expected to generate \$8 million (present value) of benefits to employees and \$41 million (present value) of benefits to suppliers. Therefore, the net social benefit of the Modification to NSW is estimated at \$130 million (present value).

The Local Effects Analysis predicted the following effects on the local economy during the construction phase (which will occur in only the first year of the Modification):

- \$9.5 million in output;
- \$3.1 million in value-added;
- \$3.1 million in wages, of which \$0.6 million will accrue to the local labour force; and
- 26 jobs.

The Local Effects Analysis predicted the following effects on the local economy during the operational phase (approximately 9 years of production):

- \$89 million to \$95 million in output;
- \$52 million to \$54 million in value-added;
- \$11 million to \$12 million in wages, of which \$8 million to \$9 million will accrue to the local labour force; and
- 88 to 99 jobs.

Justification

AQC acquired Dartbrook Mine with the objective of reinvigorating mining operations at the site. However, the resumption of the approved mining operations has been inhibited by the removal of the longwall mining equipment and Hunter Tunnel conveyor by the previous owner.

The bord and pillar mining method can be instituted quickly and requires much lower upfront capital expenditure than re-introducing longwall mining operations and/or establishing other mining methods. Similarly, the proposed coal clearance system (involving truck haulage of coal) is more economically efficient than renovating the Hunter Tunnel and reinstalling conveyors. Therefore, the Modification represents an economically feasible mechanism for the rapid re-commencement of mining at Dartbrook Mine

The bord and pillar mining method is also desirable from an environmental perspective, as it will result in significantly less subsidence than the approved longwall mining activities. Therefore, the Modification is justifiable from both a socio-economic and environmental perspective.

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DARTBROOK MINE MODIFICATION 7 ENVIRONMENTAL ASSESSMENT

for

Australian Pacific Coal Limited

1 INTRODUCTION

1.1 BACKGROUND

AQC Dartbrook Management Pty Limited (AQC) is the proprietor of the Dartbrook Mine, located in the Upper Hunter Valley of New South Wales (NSW). Dartbrook Mine is located approximately 10 km north-west of the township of Muswellbrook and approximately 4.5 km south-west of the village of Aberdeen (see **Figure 1**). AQC is a wholly owned subsidiary of Australian Pacific Coal Limited.

Dartbrook Mine is managed in accordance with Development Consent DA 231-7-2000 granted under the *Environmental Planning and Assessment Act 1979* (EP&A Act). DA 231-7-2000 allows for underground longwall mining and associated surface activities to be carried out until 5 December 2022. Dartbrook Mine has been in care and maintenance since December 2006.

AQC proposes to modify DA 231-7-2000 to allow for an alternative method of underground mining, an alternative coal clearance system and an extension to the approval period (the Modification). The modification application has been made under Section 75W of the EP&A Act.

1.2 OVERVIEW OF THE MODIFICATION

The Modification seeks approval for the following:

- Bord and pillar mining in part of the Kayuga Coal Seam as an alternative to the already approved longwall mining activities;
- An alternative method of transferring Run of Mine (ROM) coal to the coal handling infrastructure at the East Site; and
- Extending the approval period under DA 231-7-2000 by 5 years (until 5 December 2027).

DA 231-7-2000 authorises longwall mining activities in the Wynn, Kayuga, Mt Arthur and Piercefield coal seams. The Modification proposes bord and pillar mining in part of the Kayuga seam, as an alternative to the approved longwall mining activities. Bord and pillar mining will be designed and undertaken in a manner such that subsidence is imperceptible for all practical purposes. The proposed bord and pillar workings will be located within the Approved Kayuga Seam Mining Area (see **Figure 2**). That is, the Modification will not increase the footprint of mining operations at Dartbrook Mine.

The proposed bord and pillar mining will facilitate the extraction of up to 10 million tonnes (Mt) of ROM coal over a 10 year period. The maximum production rate that may be achieved in a single year by the proposed bord and pillar mining is 1.5 million tonnes per annum (Mtpa). This is within the approved maximum production rate of 6 Mtpa. The proposed underground mining activities are described in greater detail in **Section 4.2**.

DA 231-7-2000 allows for ROM coal to be transferred from the mine workings to the East Site via the Hunter Tunnel. The Hunter Tunnel is an underground roadway that passes beneath the Hunter River and New England Highway. The conveyors in the Hunter Tunnel were removed by the previous owners of Dartbrook Mine during the care and maintenance phase. In addition, sections of the Hunter Tunnel have deteriorated in condition due to moisture. As such, AQC has developed an alternative coal clearance system that only relies upon a small section of the Hunter Tunnel where it traverses under the New England Highway. ROM coal will be brought to the surface at the Kayuga Entry. Haul trucks will then transport ROM coal from the Kayuga Entry to a new shaft site directly above the Hunter Tunnel and adjacent to the New England Highway. The new shaft will transfer ROM coal down into the Hunter Tunnel. The coal will then be conveyed a short distance beneath the New England Highway to the East Site. The proposed coal clearance system is illustrated in **Figure 2** and described in further detail in **Section 4.3.1**.

DA 231-7-2000 allows for mining activities to be undertaken until 5 December 2022. To enable the proposed bord and pillar mining activities to be conducted, the Modification seeks to extend the period of approval by 5 years (until 5 December 2027).

1.3 DOCUMENT PURPOSE

This Environmental Assessment (EA) supports AQC's application to modify DA 231-7-2000. The purpose of the EA is to assist the consent authority in its assessment of the modification application by providing a description of the Modification and an assessment of potential environmental impacts.

1.4 PROPONENT

The relevant contact details for the proponent are provided below:

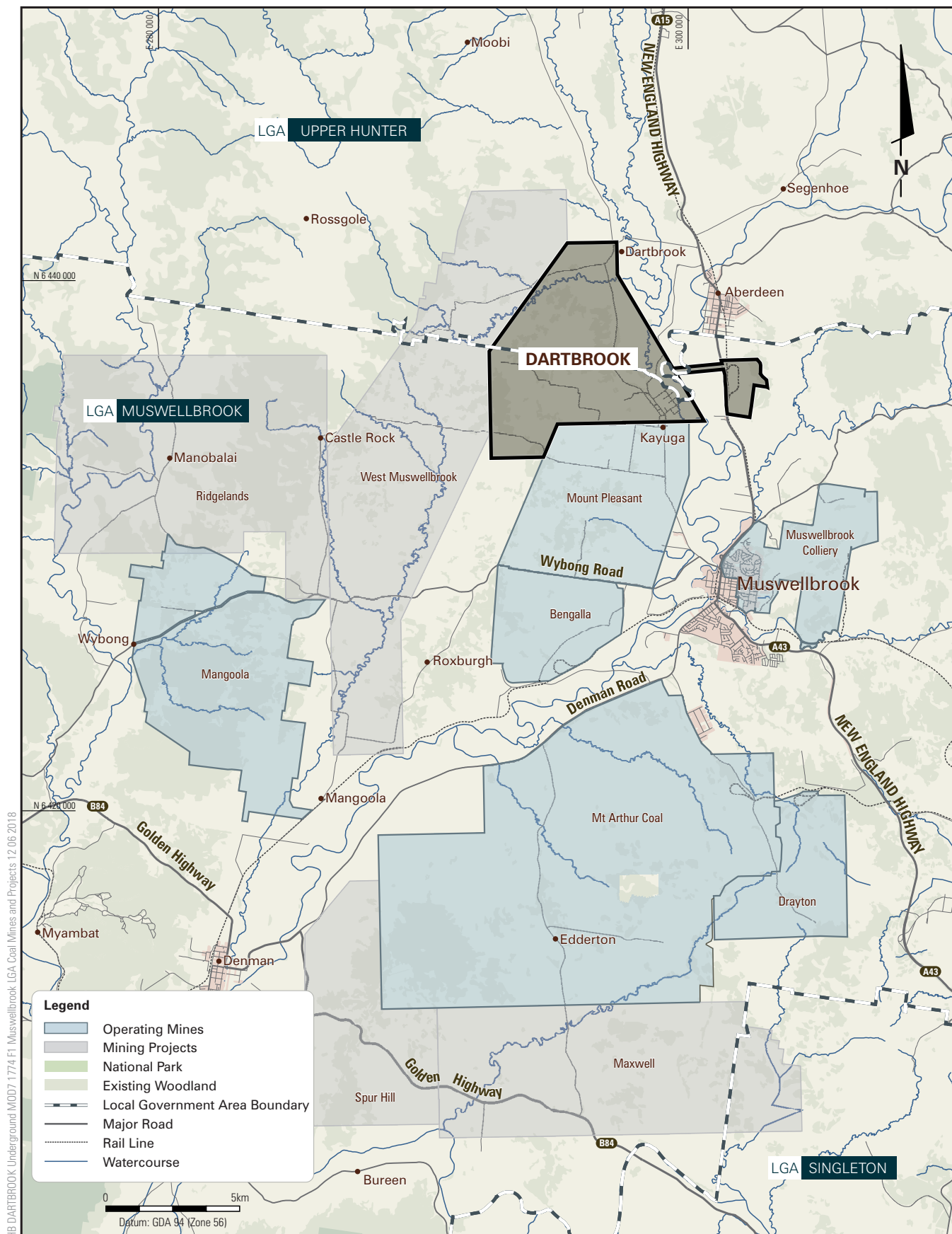
AQC Dartbrook Management Pty Limited

PO Box 16330

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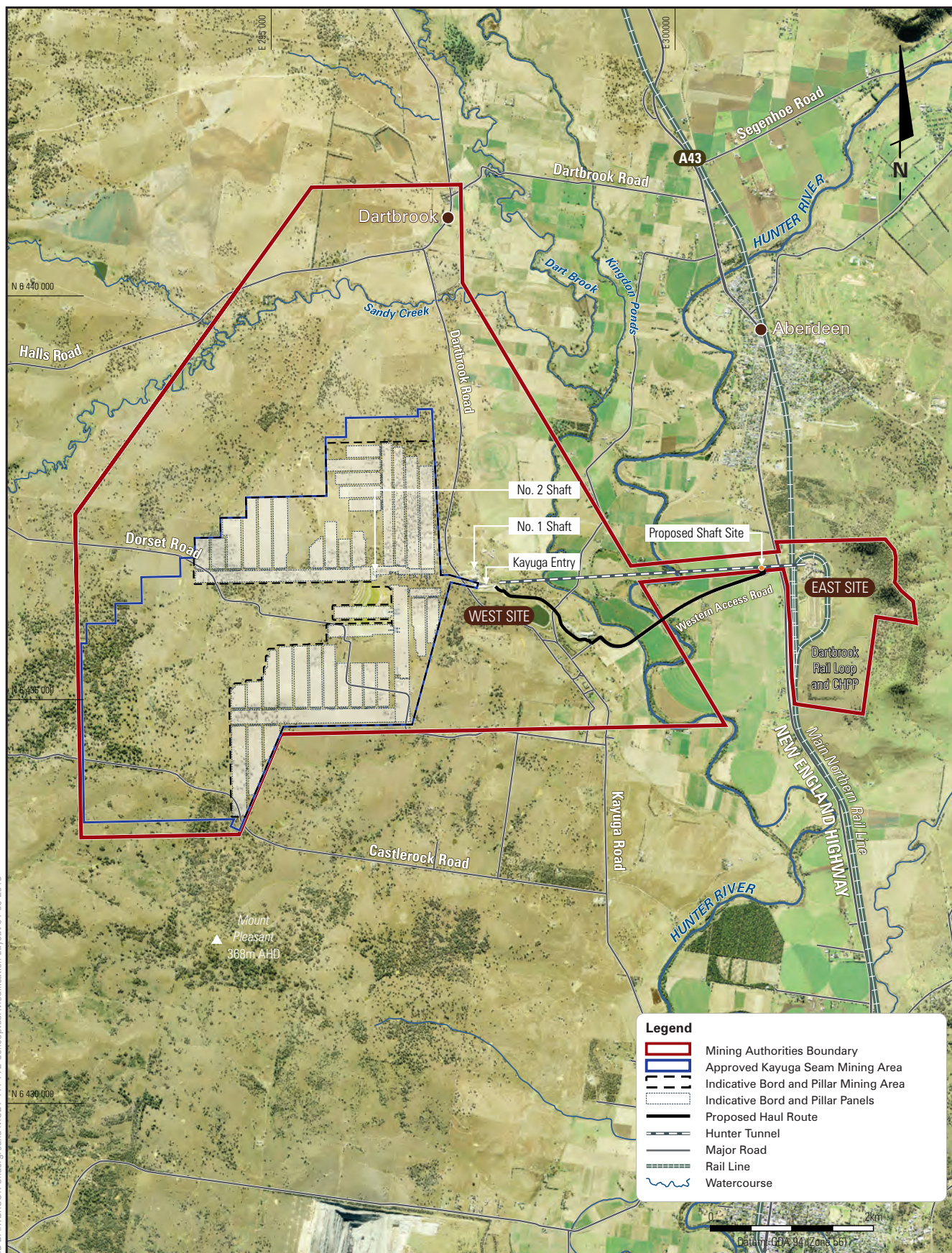
Website: <http://www.agcltd.com>



DARTBROOK MINE

Regional Locality

FIGURE 1



DARTBROOK MINE

Conceptual Modification Layout

FIGURE 2

1.5 DOCUMENT STRUCTURE

This document is structured as follows:

- **Section 2** describes the existing environment in the locality of the Modification;
- **Section 3** describes the approved mining operations at Dartbrook Mine;
- **Section 4** provides a detailed description of the Modification;
- **Section 5** describes the regulatory framework that is applicable to the Modification;
- **Section 6** outlines the stakeholder engagement that has been undertaken for the Modification and the issues raised during this process;
- **Section 7** provides a risk assessment of the potential environmental impacts of the Modification;
- **Section 8** assesses the potential environmental impacts of the Modification and describes the management and mitigation measures that will be implemented to ameliorate these impacts;
- **Section 9** presents a summary of the proposed management and mitigation measures;
- **Section 10** provides a conclusion to the assessment;
- **Section 11** defines the abbreviations and terms used in this EA; and
- **Section 12** lists the sources referenced in this EA.

2 EXISTING ENVIRONMENT

This section provides a discussion on the existing natural features, geology, land use and land ownership relevant to the Modification.

2.1 CLIMATE

Dartbrook Mine is located in the Sydney Basin Bioregion, which exhibits a temperate climate. The regional climate is characterised by warm summers and the absence of a dry season. The nearest meteorological station that provides long term climate statistics is the Bureau of Meteorology's (BoM) Scone Soil Conservation Service (SCS) meteorological station (Site 061089), located approximately 14 km to the north-east of the Modification. Data from the BOM Scone SCS station was utilised due to its proximity and the availability of long term data (1950 to present).

Two meteorological stations (Met01 and Met02) are located at Dartbrook Mine. Meteorological data has been recorded at Dartbrook Mine since 1995. This data has been utilised in assessing the local climate at Dartbrook Mine.

2.1.1 Temperature

Data recorded from the BoM meteorological station indicate that temperatures are highest in January (mean maximum temperature 31.4°C) and lowest in July (mean minimum temperature 4.7°C).

2.1.2 Rainfall and Evaporation

Rainfall records from the BoM meteorological station indicate that the average annual rainfall is approximately 640.1 mm. The highest monthly rainfall occurs in January (mean monthly rainfall of approximately 81.8 mm) and the lowest monthly rainfall occurs in July (mean monthly rainfall of approximately 36.3 mm).

2.1.3 Wind Speed and Direction

Prevailing winds are from the south-east in Summer, north to north-west in Winter and from north and north-east in Spring and Autumn. This pattern of wind means that emissions generated by the Modification will be transported in a southerly direction for the majority of the year, changing to north-west in the Summer months.

2.2 TOPOGRAPHY AND NATURAL FEATURES

Dartbrook Mine is located within the Central Lowlands. The Central Lowlands are characterised by undulating to low rolling hills flanked by the Liverpool Ranges to the north-west, the Great Dividing Range to the west and the Mount Royal Range and Barrington Tops to the north-east.

The topography of the West Site is gently undulating, rising up from the alluvial floodplain of the Hunter River. The slope gently increases towards the West Site.

Undulating foothills (with slopes in the range of 10% to 30%) represent the most typical landscape unit at Dartbrook Mine. These slopes are the foothills of the large ridges extending down from Rossgole and Hanging Rock, located to the west of Dartbrook Mine. The slopes in the ridgeline range from 30% to 50% and the unit has a maximum height of approximately 545 m above sea level and approximately 380 m above the Hunter River alluvial plain.

The East Site is generally characterised by steeper topography associated with Browns Mountain, located to the east of the site.

2.3 GEOLOGY

2.3.1 Regional Geology

Dartbrook Mine is located in the northern part of the Hunter Coalfield and west of the Muswellbrook Anticline. The strata of the Permian Whittingham Coal Measures outcrop in the area and dip gently to the west. The underlying marine sediments of the Maitland Group outcrop approximately 3 km east of the site, on the eastern side of the Aberdeen Thrust. The Hunter Thrust, which represents the northern limit of the Sydney basin, is located further to the east (HLA-Envirosciences, 2000).

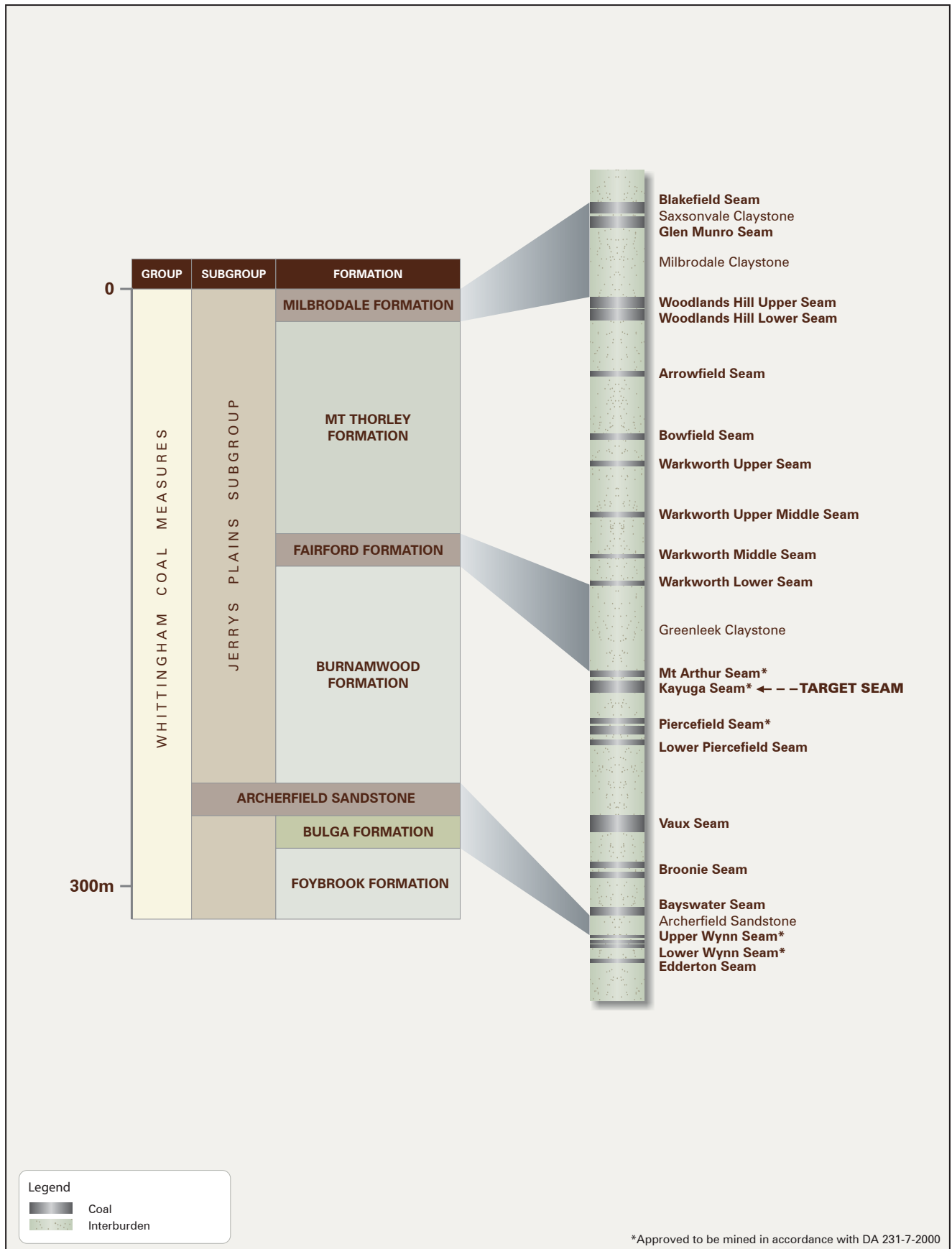
The Greta Coal Measures occur below the Maitland Group. These seams are mined by open cut operations at Muswellbrook Colliery and Drayton Mine, but occur at depths in excess of 1,000 m at Dartbrook Mine (HLA-Envirosciences, 2000).

The Whittingham Coal Measures contain the coal bearing Jerrys Plains Subgroup and Vane Subgroup. Within the basin, these two subgroups are typically separated by the Archerfield Sandstone, which is a massive, well sorted sandstone unit. However, in the vicinity of Dartbrook Mine, there is no vertical separation between these subgroups, as the Bayswater Seam (the base of the Jerrys Plains Subgroup) has coalesced with the Wynn Seam (the top of the Vane Subgroup) (HLA-Envirosciences, 2000).

Four of the five main coal bearing formations within the Jerrys Plains Subgroup (namely the Malabar, Mt Ogilvie, Mt Thorley and Burnamwood Formations) are present at Dartbrook Mine. The coal seams within the Jerrys Plains subgroup generally exhibit a high degree of splitting, and major seams are generally represented by several plies / splits (HLA-Envirosciences, 2000).

Interburden strata within the Jerrys Plains Subgroup generally include interbedded sandstones, siltstones and mudstones with minor claystones and tuffs and occasional conglomerates and thin siderite. These strata are generally coarse-grained in the upper sequence (above the Vaux Seam) and become progressively finer with depth to the Bayswater Seam. Non-coal units in the Vane Subgroup are generally fine to medium grained sandstones (HLA-Envirosciences, 2000).

Figure 3 indicatively shows the stratigraphy at Dartbrook Mine.



DARTBROOK MINE

Stratigraphic Column

FIGURE 3

2.3.2 Local Geological Characteristics

The coal seams at Dartbrook Mine are characterised by gentle dips (ranging from 3 to 6 degrees) to the north-west. Local variations of up to 15 degrees have been identified. These are generally interpreted as being due to clastic wedging, seam splitting and differential compaction (HLA-Envirosciences, 2000).

Dykes and faults are generally well defined due to their presence in historical underground workings at Dartbrook Mine. Faults trend from north-west to south-east, with significant displacements being confined to the Kayuga fault zone, its north-western branch, and the west, north-western fault zone. There are two major dykes at Dartbrook Mine. The Great Wall of China dyke is estimated to be 25 m thick and the Roman Road dyke is approximately 15 m thick. Dykes tend north-east to south-west and have cinder zones of less than 1.5 m. There are seven minor dykes south of the Roman Road dyke. These are generally 0.5 to 2.5 m thick, deeply weathered and of low strength. A number of igneous plugs have been interpreted. The Kayuga plug is approximately 200 m x 400 m in size and its location has been confirmed by exploration activities.

2.3.3 Coal Seam Geology

The target seams for underground mining at Dartbrook Mine are the Wynn, Kayuga, Mt Arthur and Piercefield Seams. To date, mining operations have been undertaken in the Wynn and Kayuga Seams. The Kayuga Seam, one of the uppermost seams, is the target seam for the Modification. At Dartbrook Mine, the Kayuga Seam lies at depths of 20 m (subcrop) to over 300 m.

The Kayuga Seam is characterised by bituminous, high-volatile and low sulphur content coal. The seam occurs as a series of plies and splits which diverge and coalesce across the site.

2.3.4 Soils

Dartbrook Mine is located within three main Soil Landscape Units:

- Dartbrook Soils Landscape;
- Brays Hill Soil Landscape; and
- Hunter Soil Landscape.

The Ogilvie and Roxburgh Soil Landscapes also occur near the boundary of Dartbrook Mine.

The Dartbrook Soils Landscape is derived from the Singleton Coal Measures of calcareous shales and sandstone parent material. The main soils include Brown Clays and some Black Earths on upper to mid slopes, Euchrozems, Non-Calcic Brown Soils on mid to lower slopes and Prairie Soils on alluvial flats (Connolly, 2000). These soils are reasonably fertile and are generally well-structured with a high pH.

The Brays Hill Soil Landscape is also derived from the Singleton Coal Measures and is characterised by steeper terrain. The main soils include Red Clays on mid to upper slopes, Black Earths and Grey Clays on mid to lower slopes and Alluvial Soils along drainage depressions. Solodic Soils occur where there is non-calcareous parent material. These soils are also reasonably fertile, well-structured and have a high pH. They also have moderate susceptibility to erosion due to the presence of Yellow Solodic Soils on lower slopes and Brown Clays on midslopes which exhibit gilgai formations.

The Hunter Soil Landscape is associated with the floodplains of the Hunter River and its tributaries. The soils are derived from Quaternary Alluvium and are associated with the Dart Brook and Sandy Creek. The main soils include Brown Clays, Black Earths and Chernozems. Sandy Creek is characterised by Alluvial Loams and Sands. The soils are generally of neutral pH and at least moderate fertility.

2.4 WATER CATCHMENT

Dartbrook Mine is located within the catchment of the Hunter River. The Hunter River traverses the site in a north to south direction and passes between the East Site and West Site. The Hunter River is a 6th order stream (under the Strahler stream classification system) with perennial flow.

Dart Brook is a tributary of the Hunter River, located west of the main channel. Dart Brook traverses the site in a generally north-south alignment and passes immediately to the north of the West Site. The confluence of Dart Brook with the Hunter River is located near the locality of Kayuga. Sandy Creek is a tributary of Dart Brook and meanders to the north of the approved mining area.

The underground mining area at Dartbrook Mine is laterally offset from the main channels and alluvial sediments of the Hunter River, Dart Brook or Sandy Creek (see **Figure 4**).

2.5 LAND USE

The Upper Hunter region has a long history of agricultural and industrial land uses. The agricultural and industrial activities primarily include grazing, dairying, thoroughbred activities and coal mining.

Mining activities are prevalent in the region surrounding the Dartbrook Mine and include the Mount Pleasant Mine, Bengalla Mine, Muswellbrook Colliery, Mt Arthur Coal Mine, Mangoola Coal Mine and West Muswellbrook Project (see **Figure 1**). The Mount Pleasant Mine (owned by MACH Energy) is an approved open cut coal mine located immediately south of Dartbrook Mine (see **Figure 5**). The Development Consent for Mount Pleasant Mine (DA 92/97) prescribes rights to acquisition of and/or rights to mitigation of land in the vicinity of Dartbrook Mine.

The township of Aberdeen, located to the north-west of Dartbrook Mine, is within the Upper Hunter Local Government Area (LGA). The Upper Hunter LGA is dominated by agricultural land uses including cattle, pig, poultry, sheep and crop production. The Upper Hunter LGA is also the largest producer of thoroughbred horses in Australia.

The gazetted locality of Kayuga is immediately south-east of the Proposed Bord and Pillar Mining Area. The majority of land in this locality is owned by AQC. Eight private residences (owned by seven landowners) currently remain within Kayuga. Six of these landowners are entitled to acquisition and the other landowner is entitled to mitigation, upon request to MACH Energy.

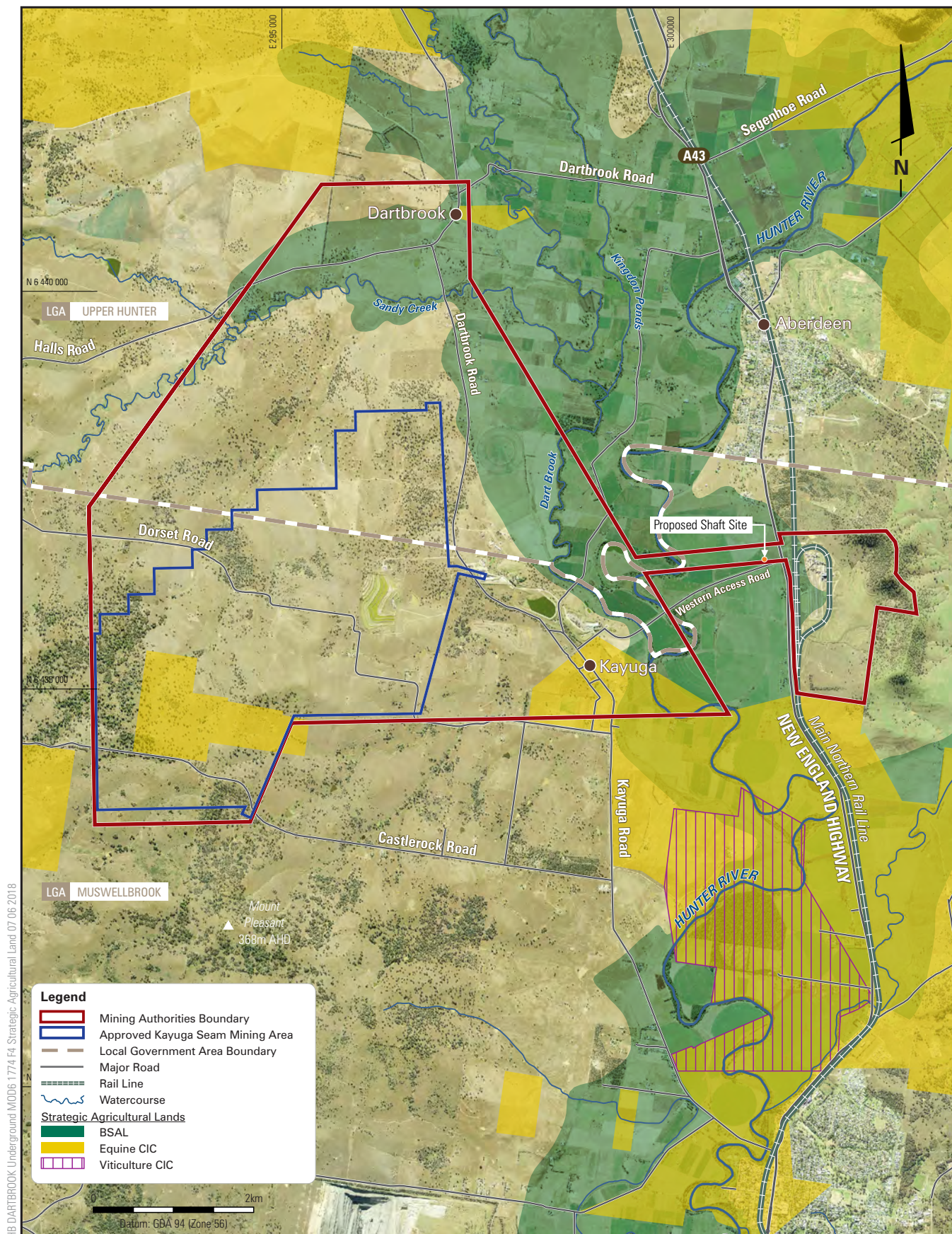
As shown in **Figure 4**, the Mining Authorities Boundary includes areas of land that are mapped as Biophysical Strategic Agricultural Land (BSAL) and Equine Critical Industry Cluster (CIC) land under *State Environmental Planning Policy (Mining, Petroleum Production and Extraction Industries) 2007* (Mining SEPP). The BSAL in the vicinity of Dartbrook Mine includes the alluvial sediments of the Hunter River, Sandy Creek and Dart Brook. The Approved Kayuga Seam Mining Area does not underlie any land mapped as BSAL (see **Figure 4**).

Small parcels of land mapped as Equine CIC are located within the Mining Authorities Boundary. A number of thoroughbred facilities are located within the Upper Hunter LGA. The closest thoroughbred facility is Brooklyn Lodge, which is situated approximately 5 km north-east of the Mining Authorities Boundary. Other thoroughbred breeding establishments in the Upper Hunter include Glastonbury Farm, Dalmore and Darley Kelvinside.

2.6 LAND OWNERSHIP

The land ownership within and surrounding the Dartbrook Mine is shown on **Figure 5**. AQC owns all the land containing the surface infrastructure for Dartbrook Mine, including the East Site, West Site and Western Access Road. The new shaft site proposed by the Modification will also be sited on land owned by AQC. The land overlying the underground mine includes land owned by AQC, MACH Energy (the proponent of Mount Pleasant Mine) and private landowners.

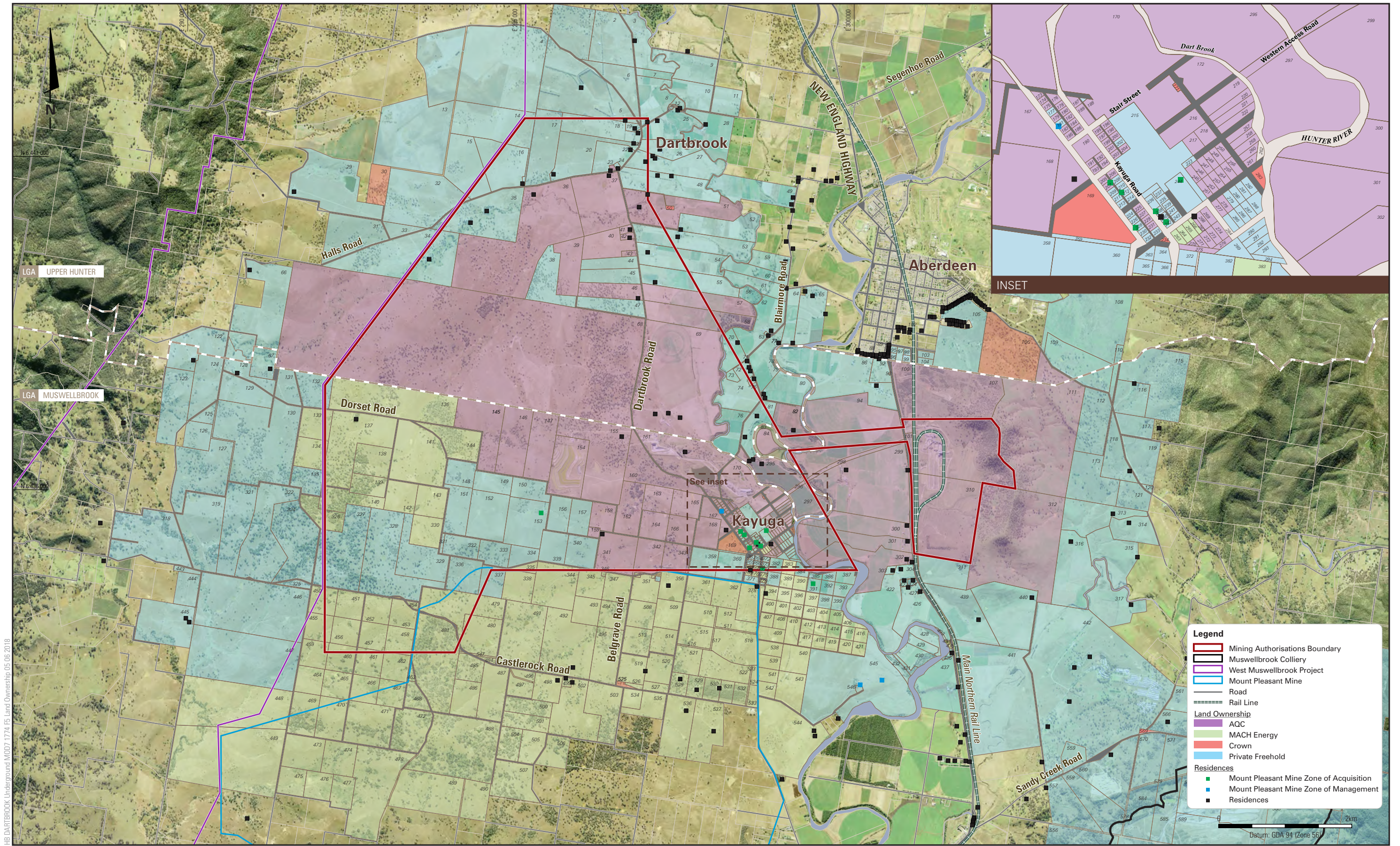
As shown on **Figure 5**, rights to acquisition or mitigation (upon request to MACH Energy) apply to some of the residences in Kayuga.



DARTBROOK MINE

Strategic Agricultural Lands

FIGURE 4



DARTBROOK MINE
Land Ownership
FIGURE 5

3 APPROVED OPERATIONS

This section briefly describes the activities that are currently approved to be carried out at Dartbrook Mine.

3.1 APPROVALS HISTORY

3.1.1 Development Consent DA N91/00424/003

Dartbrook Mine was originally granted development consent DA N91/00424/003 in December 1991 under Part 4 of the *Environmental Planning & Assessment Act 1979* (EP&A Act). DA N91/00424/003 allowed for longwall mining operations in the Wynn Seam. The approved and completed workings in the Wynn Seam are shown in **Figure 6**.

DA N91/00424/003 authorised the development of the East Site and West Site, as well as an access road linking the two sites. The East Site and West Site are also linked by the Hunter Tunnel, which facilitates the conveying of coal from the underground mine to the East Site.

3.1.2 Development Consent DA 231-7-2000

The current development consent (DA 231-7-2000) was granted on 28 August 2001. DA 231-7-2000 allows for longwall mining of the Kayuga, Mt Arthur and Piercefield Seams, in addition to the previously approved mining activities in the Wynn Seam. DA 231-7-2000 was supported by the *Dartbrook Extended Environmental Impact Statement* (HLA-Envirosciences, 2000) (Dartbrook EIS).

The approved longwall mining activities include 20 longwall panels in the Kayuga Seam and three longwall panels in the Mt Arthur Seam (see **Figure 7**). DA 231-7-2000 also provides approval for mining of the Piercefield Seam using either 200 m or 300 m wide longwall panels. The Dartbrook EIS presented indicative longwall layouts for both options. The approved longwall layout for 300 m wide panels includes 19 longwall panels (as shown in **Figure 8**). Alternatively, the approved longwall layout for 200 m wide panels includes 28 longwall panels.

DA 231-7-2000 has since been subject to six modifications:

1. 'Dartbrook Extended Coal Project Development Consent Modification Application Supporting Information' (Hansen Consulting, 2002) (MOD1);
2. 'Dartbrook Extended Coal Project Development Consent Modification Application Supporting Information' (Hansen Consulting, 2003a) (MOD2);
3. 'Dartbrook Extended Coal Project Development Consent Modification Application Supporting Information' (Hansen Consulting, 2003b) (MOD3);
4. 'Dartbrook Coal Mine Development Consent Modification Application Supporting Information' (Hansen Consulting, 2004a) (MOD4);
5. 'Dartbrook Coal Mine Statement of Environmental Effects for Modification to Rejects Disposal System' (Hansen Consulting, 2004b) (MOD5); and

6. 'Dartbrook Coal Mine Statement of Environmental Effects for New ROM Stockpiles, Underground Tailings Disposal & Nitrogen Injection Plant' (Hansen Consulting, 2005) (MOD6).

The approved modifications to DA 231-7-2000 are summarised in **Appendix A**.

Modification 1

MOD1 was an administrative modification to DA 231-7-2000 to alter the conditions regarding blasting notifications and structural inspections. MOD1 was approved on 19 June 2002.

Modification 2

MOD2 approved the construction and operation of an additional emergency tailings storage cell at the Coal Handling and Processing Plant (CHPP). MOD2 was granted on 16 June 2003.

Modification 3

MOD3 proposed the following changes to the site access arrangements:

- Continued use of Dartbrook Road to provide access to the West Site; and
- Use of local public roads by traffic associated with Dartbrook Mine.

Prior to construction of the Kayuga Mine Access Road, access to the West Site was via Dartbrook Road. It was envisaged that Kayuga Mine Access Road would replace Dartbrook Mine as the primary access to the West Site. However, the Kayuga Mine Access Road was being used by trucks to haul coal to the CHPP. To avoid interactions between haul trucks and private vehicles, MOD3 proposed that Dartbrook Road should continue to be used as the primary access road for mine personnel.

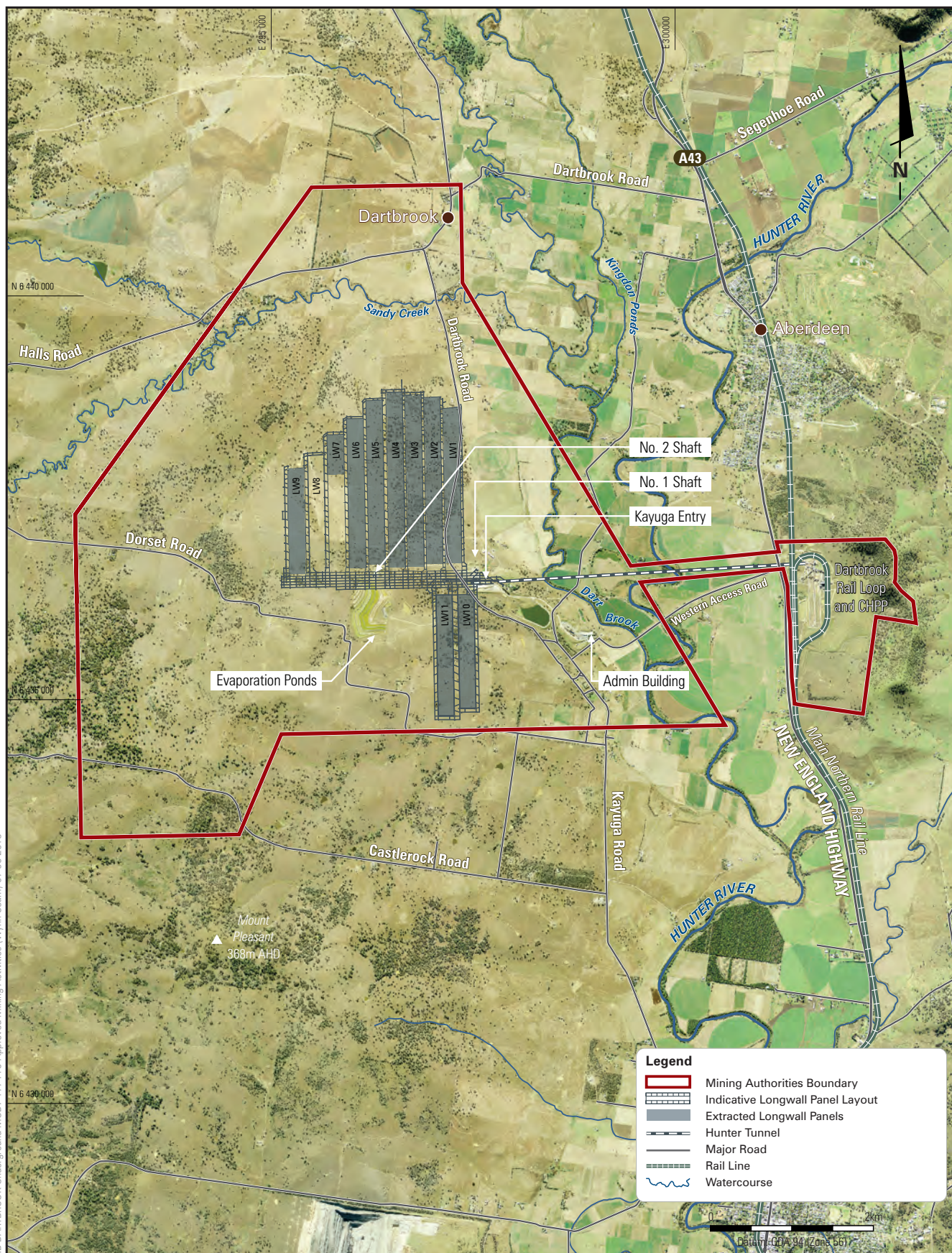
MOD3 also sought approval for locally based employees to access the West Site via local roads (Kayuga Road, Dartbrook Road and Blairmore Lane). For employees residing in the surrounding areas, these local roads provide more convenient access than the Western Access Road.

MOD3 was approved on 4 November 2003.

Modification 4

DA 231-7-2000 allowed for truck haulage of coal to the CHPP over an 18 month period. Truck haulage was to be discontinued upon completion of the conveyor system for the Kayuga Seam, which would enable coal to be transferred to the CHPP via the Hunter Tunnel. MOD4 extended the duration of truck haulage by 3 months to allow for haulage to continue until the completion of the Kayuga Seam conveyor system.

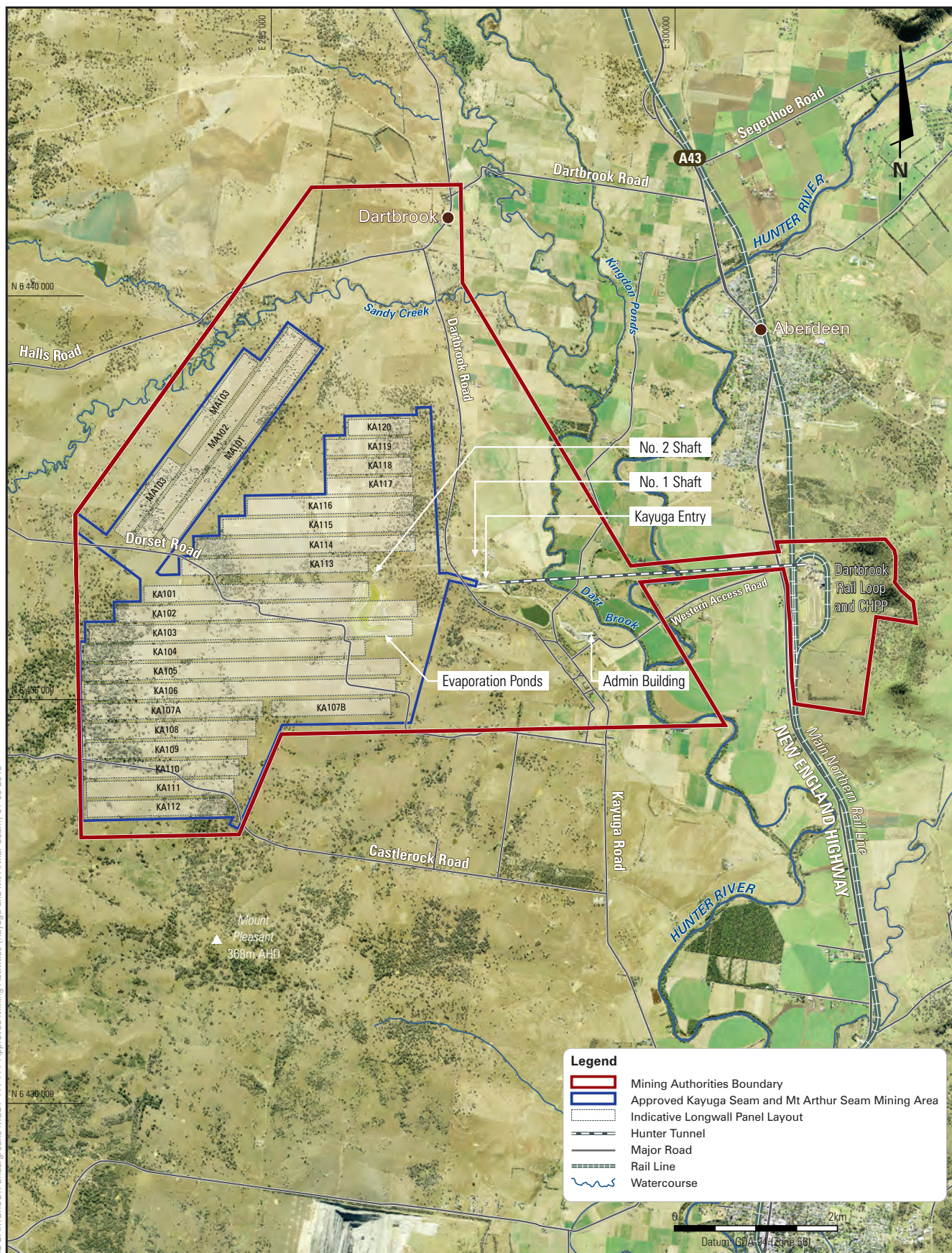
MOD4 was approved on 30 March 2004.



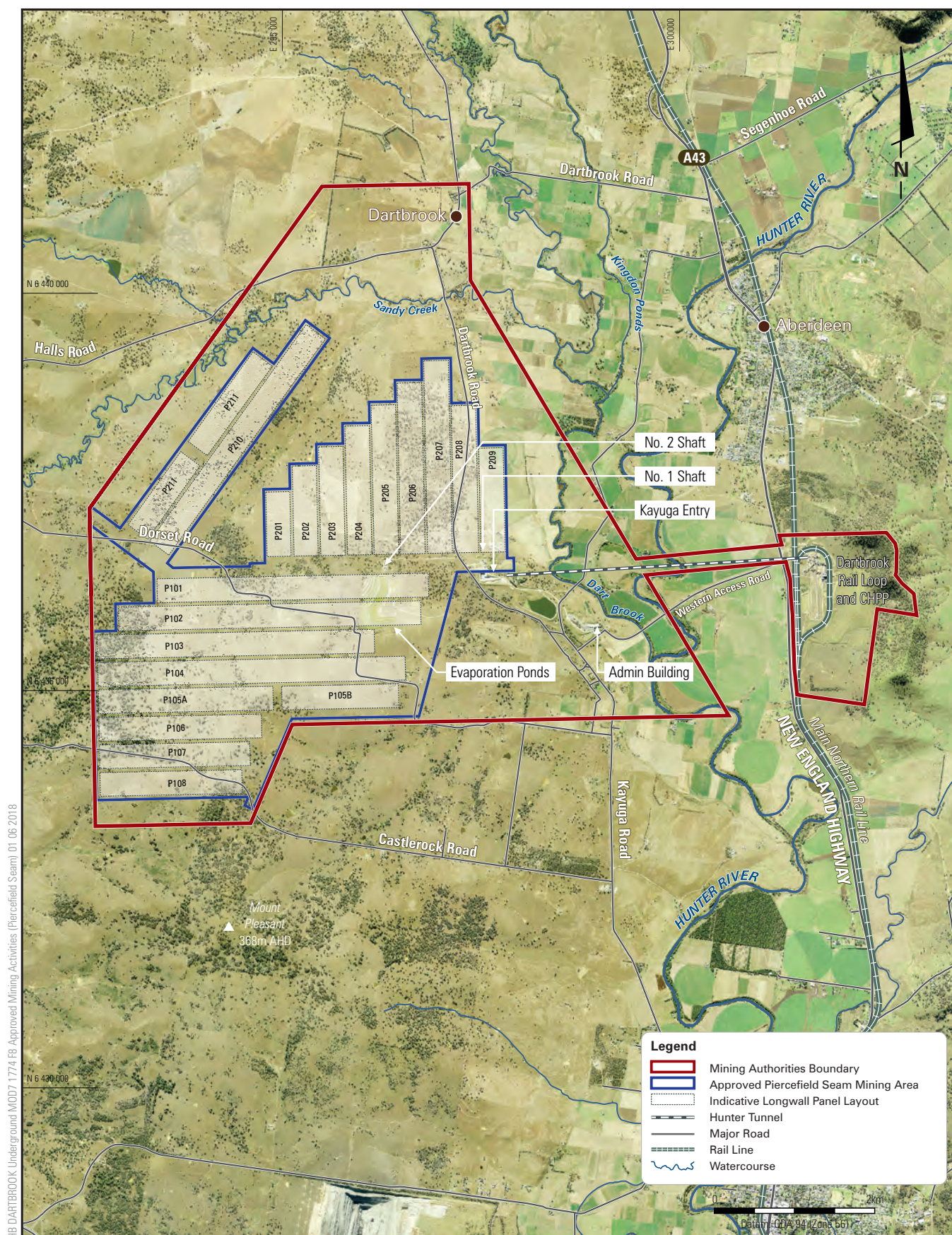
DARTBROOK MINE

Approved Mining Activities (Wynn Seam)

FIGURE 6



DARTBROOK MINE



DARTBROOK MINE

Modification 5

MOD5 was approved on 4 May 2005 and facilitated changes to the rejects disposal system at Dartbrook Mine. The approved rejects disposal system involved the commissioning of a pipeline and pumping system for the transportation and disposal of reject materials. Engineering studies indicated that this method would pose significant technical risks due to the variability in relative quantities of coarse and fine rejects produced by the CHPP. MOD5 obtained approval for rejects to be transported to the Rejects Emplacement Area (REA) using trucks.

Modification 6

MOD6 was granted on 16 November 2005 and provided approval for the following activities:

- Establishment of four new ROM coal stockpiles and expansion of the existing emergency ROM coal stockpile at the CHPP;
- Disposal of tailings within the Wynn Seam goaf; and
- Operation of a Nitrogen Injection Plant to prevent the oxidation of coal.

3.2 APPROVED OPERATIONS

3.2.1 Surface Infrastructure

The East Site includes the CHPP, ROM coal stockpile, product coal stockpiles, rail loop, train loadout facility, reject emplacement area, bathhouse, administration buildings and water management structures. The layout of the East Site is shown in **Figure 9**.

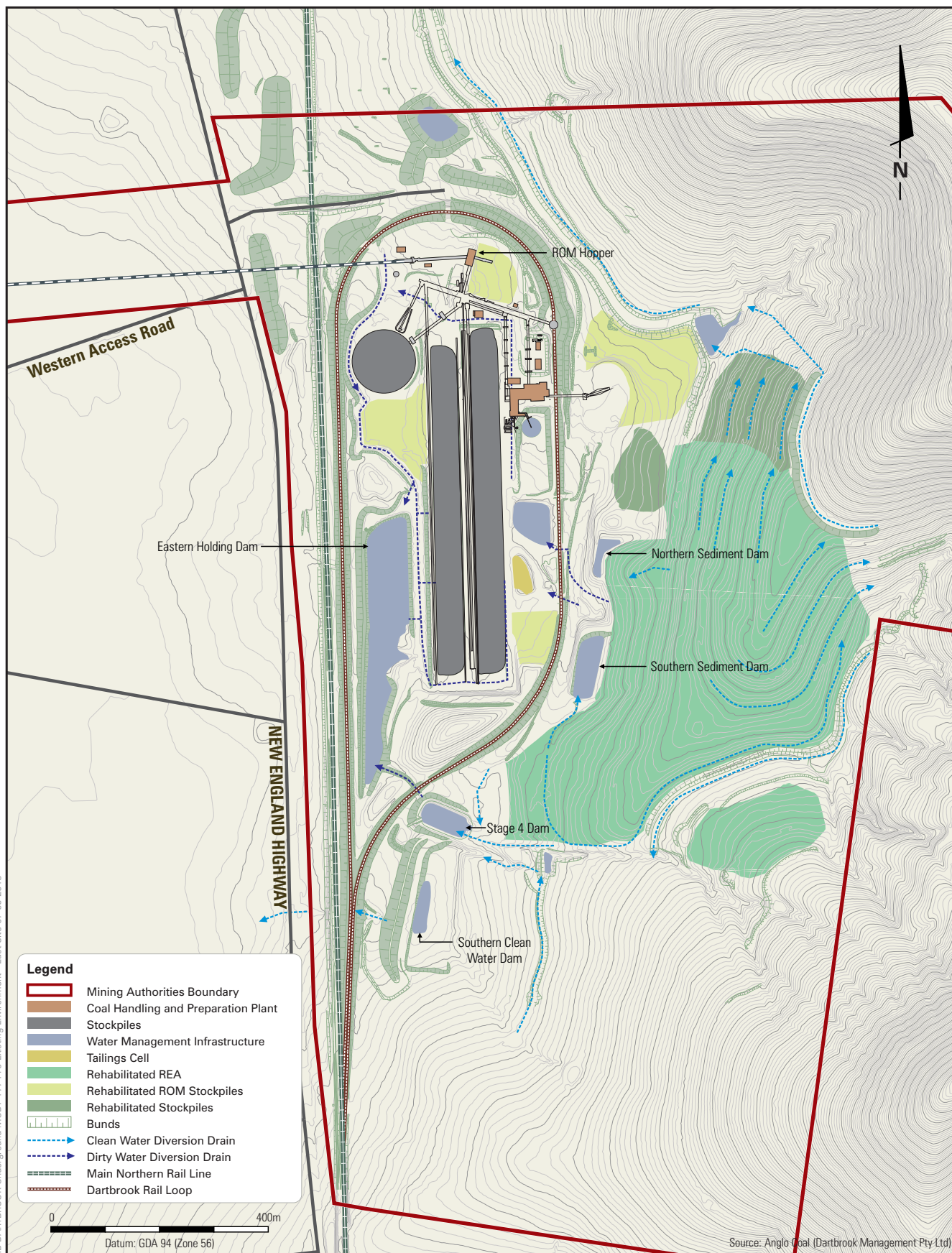
The West Site includes the entries to the underground mine (Western Drift and Kayuga Entry), main administration buildings, helipad, effluent ponds and water management structures. The layout of the West Site is shown in **Figure 10**.

3.2.2 Underground Mining

Underground mining is approved to be undertaken using retreat longwall methods. Longwall mining was first undertaken in the Wynn Seam, as approved by DA N91/00424/003. The approved mine layout for the Wynn Seam consisted of longwall panels in a north-south orientation.

DA 231-7-2000 allowed for longwall mining to be undertaken in the Kayuga, Mt Arthur and Piercefield Seam, as well as continuation of the approved Wynn Seam mining activities. The approved longwall mining activities for the Kayuga, Mt Arthur and Piercefield Seams are shown in **Figure 7** and **Figure 8**.

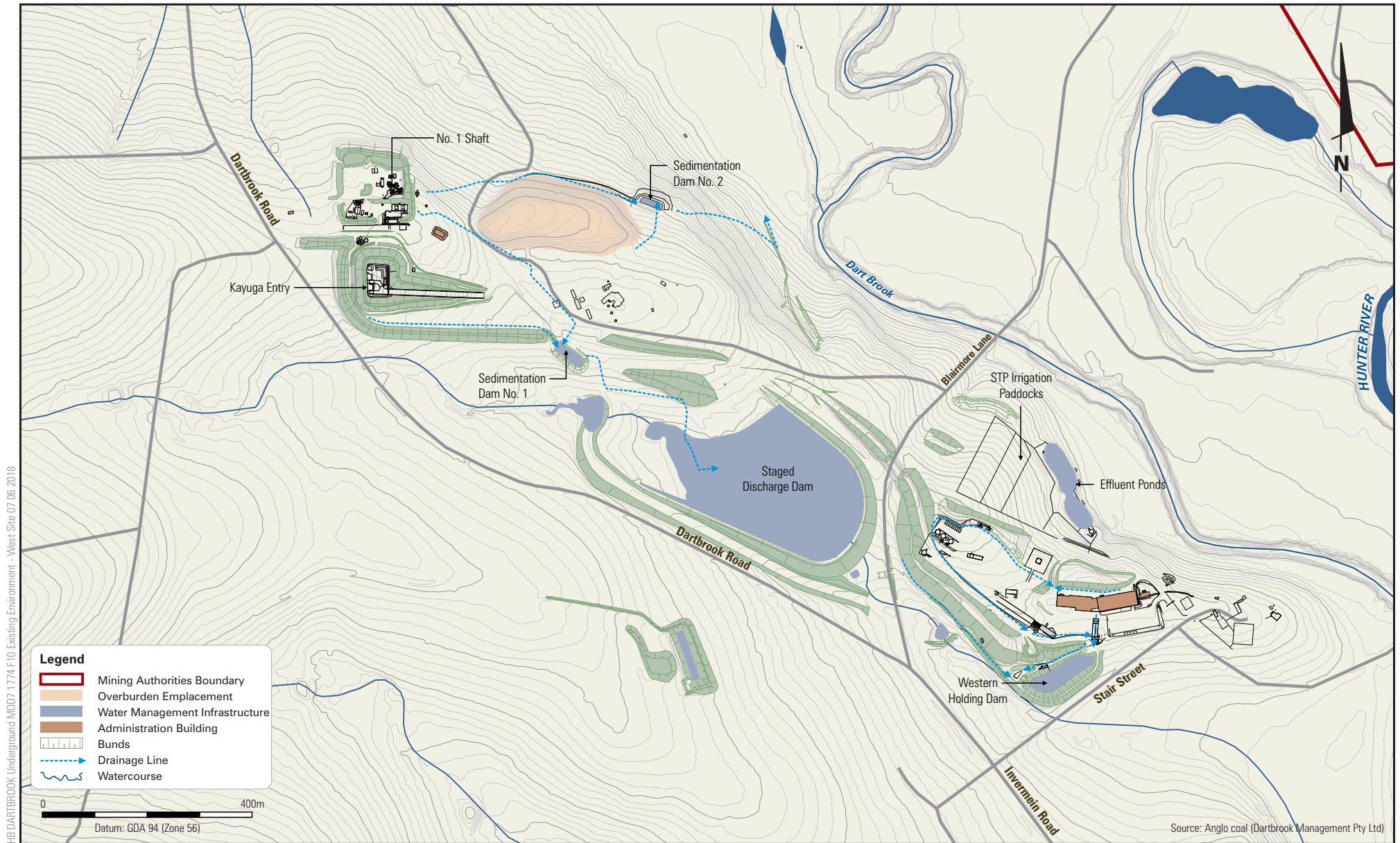
The extraction sequence involved completion of the Wynn Seam mine workings, followed by mining of the Kayuga Seam, Mt Arthur Seam and Piercefield Seam (in that order). Within the Kayuga Seam, longwall mining was scheduled to commence in the southern longwall panels (KA101 to KA112), followed by the northern longwall panels (KA113 to KA120).



DARTBROOK MINE

Existing East Site Infrastructure

FIGURE 9



HB DARTBROOK Underground MOD7 1774 F10 Existing Environment - West Site 07 06 2018

DARTBROOK MINE

Existing West Site Infrastructure

FIGURE 10

The extraction height for longwall mining ranges from 3.0 m to 4.5 m. The approved longwall panels are generally 200 m wide, although DA 231-7-2000 also provides approval for the option of 300 m wide longwall panels in the Piercefield Seam.

Mining in the Wynn Seam commenced in 1996 and was suspended in May 2004. As shown in **Figure 11**, the extent of longwall mining in the Wynn Seam was constrained by igneous intrusions. In particular, the Roman Road Dyke dictated the northern limit of longwall mining. Mining of the Kayuga Seam commenced in 2004 and was suspended in October 2006. Dartbrook Mine was placed into care and maintenance by the previous owner in December 2006.

3.2.3 Site Access, Workforce and Hours of Operation

Workforce and Hours of Operation

Dartbrook Mine has approval to conduct operations 24 hours per day, 7 days per week. The workforce operated under a five day week rotating roster comprising of three shifts per day (i.e. day, afternoon and night shifts). In addition, a weekend crew worked a four day week rotating roster comprising of 41 hours.

Dartbrook Mine has approval to employ up to 192 permanent employees and approximately 100 contractors to undertake underground mining operations and surface operations (including the CHPP). Whilst the number of employed contractors fluctuated, the operational workforce was generally in the order of 292 persons (permanent employees plus contractors).

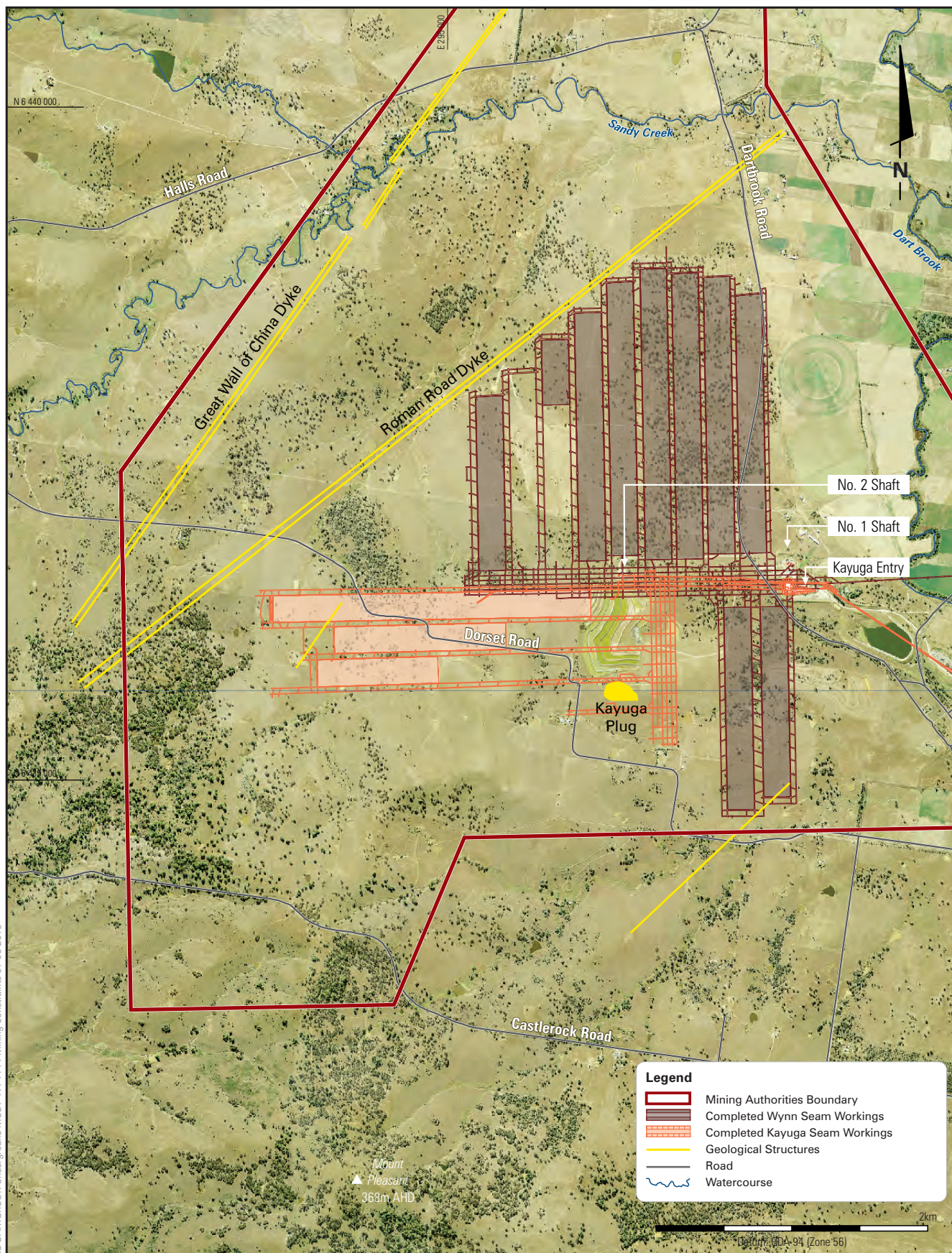
The workforce during the care and maintenance phase is comprised of a contract workforce of 15 personnel (Hansen Bailey, 2016).

Site Access

The main administration buildings at Dartbrook Mine are located at the West Site. Access to the West Site is primarily via the Western Access Road, which is owned by the proponent. MOD3 obtained approval for locally based employees and contractors to access the West Site using local public roads (Kayuga Road, Dartbrook Road and Blairmore Lane).

3.2.4 Coal Handling and Processing Infrastructure

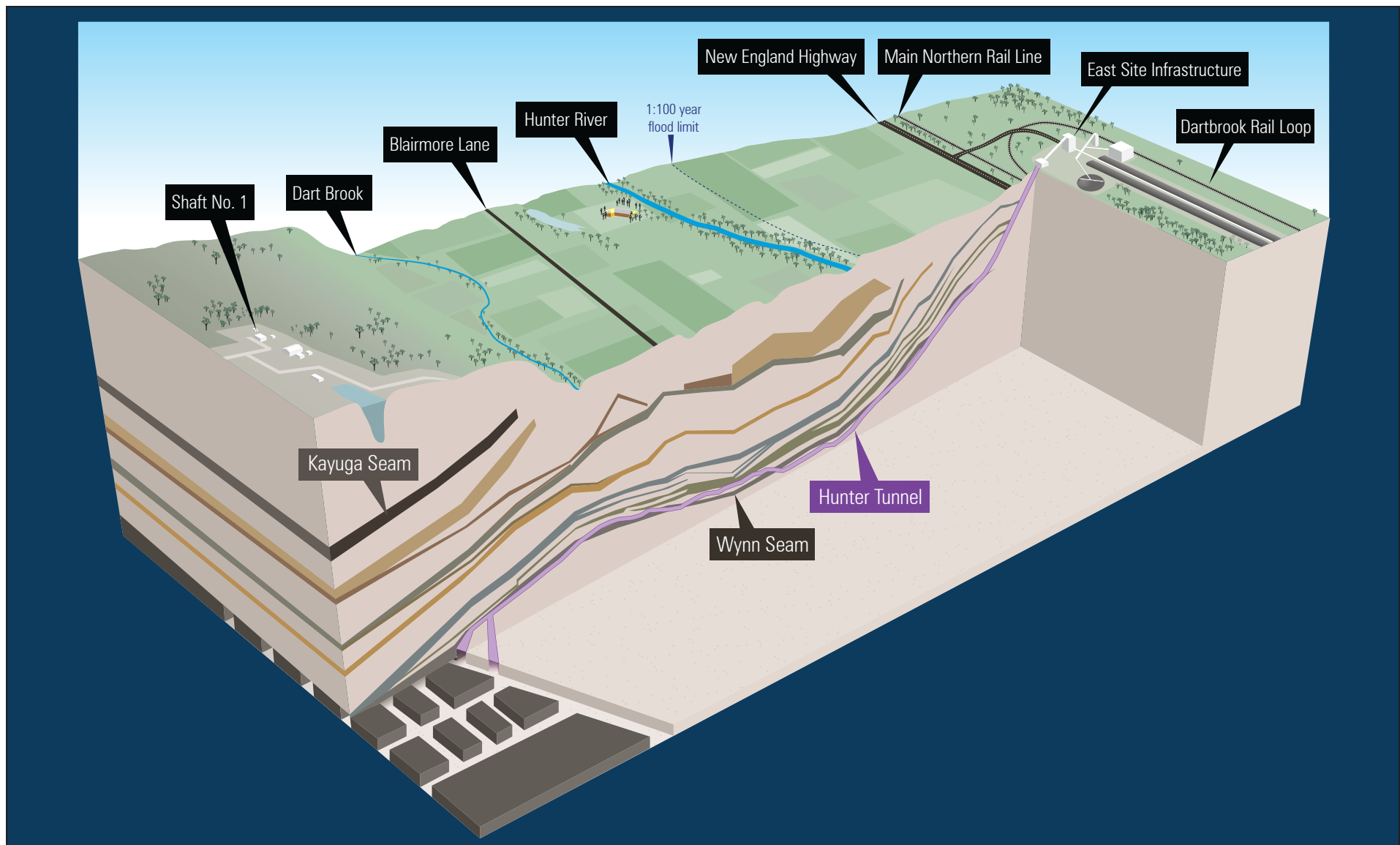
The term “coal clearance system” refers to the system of conveyors, drives, tunnels, bins and associated infrastructure used to transfer ROM coal from the underground mine workings to the CHPP. The Hunter Tunnel is the major component of the approved coal clearance system. The Hunter Tunnel is an approximately 4 km long underground passage that connects the mine workings to the CHPP, passing beneath the Hunter River, Dart Brook, New England Highway and Main Northern Rail Line (see **Figure 12**). Coal is initially delivered from the working face to the western end of the Hunter Tunnel by conveyors within the mine workings. The conveyor in the Hunter Tunnel then transfers the coal to the East Site. The coal clearance system was designed to handle up to 6 Mtpa of ROM coal (i.e. the maximum approved production rate).



DARTBROOK MINE

Mining Constraints

FIGURE 11



DARTBROOK MINE

Conceptual Schematic of the Hunter Tunnel

FIGURE 12

The CHPP was constructed pursuant to DA N91/00424/003. The construction of the CHPP enabled the extraction of the shallower coal seams (such as the Kayuga, Mt Arthur and Piercefield Seams). The CHPP was accompanied by an emergency tailings storage cell with a capacity of approximately 30 ML. MOD2 provided approval for the construction of an additional emergency tailings storage cell (approximately 20 ML capacity), adjacent to the existing cell.

The CHPP had a maximum throughput of approximately 1,000 tonnes per hour (tph) and could deliver ROM coal at a rate of approximately 4,000 tph during peak output. The raw coal was crushed to a maximum size of 150 mm for processing then screened at 16 mm. The 150 mm x 16 mm coal was then treated in a dense medium bath, the 16 mm x 1.4 mm coal was treated in a dense medium cyclone and the fine coal was treated in coal spirals. The product coal was then crushed to 50 mm in order to meet sizing specification for export markets.

The coal stockpiles at Dartbrook Mine are located at the East Site and include:

- Emergency stockpile (ROM Coal) – 5,000 t;
- Circular stockpile (ROM Coal) – 80,000 t;
- Rectangular stockpile No. 1 (saleable coal) – 200,000 t; and
- Rectangular stockpile No. 2 (saleable coal) – 200,000 t.

3.2.5 Coal Transportation

Dartbrook Mine has approval to transport product coal by rail to the Port of Newcastle. Coal is loaded onto trains via the approved train loadout facility located on the Dartbrook rail loop, adjacent to the Main Northern Rail Line. The train loadout facility has capacity to load 3,000 tph. Due to the logistics of train scheduling, the facility had a daily capacity of 45,000 t.

3.2.6 Process Waste Management

Rejects and Tailings Management

Dartbrook Mine was expected to produce approximately 18.7 Mt of rejects over its 21 year project life. Rejects and tailings generated by the CHPP were dewatered and conveyed to the reject stockpile. The reject materials were then transported (via haul trucks) to the REA. The emplaced materials were compacted by heavy equipment. If the ratio of tailings was too high for co-disposal, excess tailings would be temporarily emplaced within the emergency tailings storage cells. Once dry, these tailings were excavated from the storage cells and disposed of in the REA.

The REA was located on the western slopes of Browns Mountain and had a total storage capacity of approximately 16.3 Mt in volume (approximately 18.2 Mt at dry density). The slopes of the REA are generally less than 10°, although there is small area where the slope is up to 15°. Rejects were disposed of in accordance with a Section 126 Emplacement Area Approval under the *Coal Mines Regulation Act 1982*.

The REA incorporates the following features:

- Upstream clean water diversion drainage channels to divert clean water around the rejects area;
- Downstream drainage collection channels and sedimentation dams to cater for a 1 in 10 year average recurrence interval (ARI) storm event;
- Reject stages were constructed within an inert clay capsule to prevent leachate percolating into the groundwater aquifer and minimise aeration of reject materials;
- The reject cells were also equipped with under-cell drainage to enable units to be free draining. The leachate was fully contained within the mine water circuit by diversion drains and is used as process water by the CHPP; and
- All topsoil stockpiles were immediately seeded to promote the growth of a stabilising cover crop to reduce water and wind erosion.

The REA has not been filled to its approved maximum capacity (shortfall of approximately 400,000 t); however, it has been rehabilitated (Anglo Coal, 2012).

MOD6 obtained approval for tailings to be disposed of in Wynn Seam goaf. The tailings were pumped from the CHPP to the underground mining area. Approximately 45,000 t of fine tailings was disposed into the Wynn Seam goaf in 2006 (Anglo Coal, 2006).

3.2.7 Non-Process Waste Management

All non-process waste was managed in accordance with the Dartbrook Waste Management Plan (WMP), which was developed in consultation with Muswellbrook Shire Council (MSC). Below ground fuel tanks have been decommissioned and the above ground bulk fuel storage tanks located at the East Site have been maintained.

3.2.8 Water Management

The water management system at Dartbrook Mine operates under the following principles:

- Clean water (i.e. runoff from undisturbed catchments) is diverted away from disturbed areas using diversion drains and catch dams;
- Water that has come into contact with carbonaceous material (i.e. mine water) will be captured and contained in mine water dams;
- Water from disturbed areas (i.e. sediment laden water) will be captured and treated in sediment dams; and

- Water that is likely to be contaminated with hydrocarbons (i.e. from workshop and refuelling areas) will be treated prior to discharge into the mine water system.

To minimise the demand for external water supplies, mine water will be reused for operational activities (wherever possible). If external water supplies are required, raw water can be extracted from the Hunter River (in accordance with AQC's water licences).

East Site

Runoff from disturbed areas will be captured by diversion drains and directed to the Eastern Holding Dam (EHD). Water captured in the EHD will be used for operational purposes such as dust suppression. The EHD has a capacity of approximately 85 ML. During wet periods, water can be pumped from the EHD to the Wynn Seam goaf (underground water storage) in order to maintain sufficient freeboard in the dam.

The East Site also includes a number of sediment dams. The water management infrastructure at the East Site is illustrated in **Figure 9**.

West Site

Runoff from the industrial area is captured by the Western Holding Dam (WHD), which has a capacity of approximately 15 ML. Runoff from the Kayuga Entry and No. 1 Shaft is captured by diversion drains and directed to the Staged Discharge Dam (SDD), which has a capacity of approximately 450 ML. The locations of the WHD and SDD are shown on **Figure 10**. During wet periods, water can be pumped from the WHD and SDD to the Wynn Seam goaf in order to maintain sufficient freeboard in these dams.

The Wynn Seam goaf has significant storage capacity (approximately 2,915 ML). The storage volume is maintained so that the water level does not rise above -66 mAHD. If it is necessary to reduce the stored volume within the Wynn Seam goaf, water can be pumped to the surface (using Pleuger pumps) and directed to the Evaporation Ponds (location shown on **Figure 6**). The Evaporation Ponds facilitate the passive release of water from the site.

Dartbrook Mine is a participant in the Hunter River Salinity Trading Scheme (HRSTS), which allows for water to be discharged to the Hunter River during periods of high flow. However, discharges under the HRSTS are rarely undertaken, as the preferred water management strategy is to store surplus water within the Wynn Seam goaf and/or release passively release water via evaporation. If HRSTS discharges are required, water can be discharged from the SDD to Dart Brook, near its confluence with the Hunter River.

4 MODIFICATION DESCRIPTION

This section provides a detailed description of the Modification. It also describes the need for the Modification and the alternatives considered during the mine planning phase.

4.1 OVERVIEW

AQC is seeking to modify DA 231-7-2000 to facilitate the re-commencement of underground mining activities at Dartbrook Mine. The Modification proposes the following:

- Bord and pillar mining activities within the Kayuga Seam (as an alternative to the approved longwall mining activities),
- An alternative method of delivering ROM coal from the mine workings to the East Site; and
- Extending the approval period under DA 231-7-2000 by 5 years (until 5 December 2027).

The proposed bord and pillar mining will result in the extraction of up to 10 Mt of ROM coal over a 10 year period. The maximum production rate in any given year will be 1.5 Mtpa. The approved longwall mining activities in the Wynn, Kayuga, Mt Arthur and Piercefield Seams will not be altered by the Modification. The total coal production from Dartbrook Mine will remain within the approved maximum production rate of 6 Mtpa.

Dartbrook Mine has been under care and maintenance since December 2006. To enable the proposed mining activities to be undertaken, the Modification seeks to extend the period of approval by an additional 5 years.

Under the approved coal clearance system, ROM coal is transferred directly from the mine workings to the East Site via the Hunter Tunnel. The Hunter Tunnel is an underground pathway between the East Site and West Site, passing beneath the New England Highway, Main Northern Rail Line, Hunter River and Dart Brook (see **Figure 12**).

The Modification proposes that coal extracted via the bord and pillar mining method will be delivered to the surface via the Kayuga Entry. It will then be hauled along an existing private road network to a new shaft facility (to be constructed west of the New England Highway). The coal will be transferred down the shaft into the Hunter Tunnel, where it will be conveyed beneath the New England Highway to the East Site.

4.2 MINING ACTIVITIES

4.2.1 Mining Method

The Approved Mining Area for the Kayuga and Mt Arthur Seams is contained within CL 386 and ML 1497. DA 231-7-2000 allows for the coal reserves within the Approved Mining Area to be extracted via longwall mining methods. AQC proposes to conduct bord and pillar mining in the Kayuga Seam, as an alternative to the approved longwall mining. The proposed bord and pillar mining will take place within the Approved Kayuga Seam Mining Area (see **Figure 13**).

Bord and pillar mining will be designed such that subsidence is imperceptible for all practical purposes. As a result, the environmental impacts of the proposed bord and pillar mining activities will be significantly less than the impacts of the approved longwall mining activities.

Bord and pillar mining involves the shearing of coal to develop a network of roadways within the coal seam (see **Figure 14**). The roadways are separated by blocks of intact coal, which are referred to as “pillars”. The pillars will be designed to remain stable in the long term, thus resulting in no perceptible surface subsidence.

Due to the geotechnical conditions at Dartbrook Mine, bord and pillar mining will be undertaken using “in-place” methods. The “in-place” mining methodology involves the progressive installation of roof support as roadways are developed. This differs from the “place change” method, where roof support is installed after the roadways have been developed.

4.2.2 Mine Plan

The proposed bord and pillar mine plan within the Kayuga Seam will consist of main headings and production panels. Both the main headings and production panels are networks of parallel and perpendicular roadways, which produce square shaped pillars. All bord and pillar workings will be stable in the long-term. The dimensions of the coal pillars will need to increase as depth of mining increases. The design of the pillars is discussed further in **Section 8.5**.

The Kayuga Seam has a maximum thickness of approximately 4.5 m. The extraction height for the Modification will vary between 3.0 to 3.5 m.

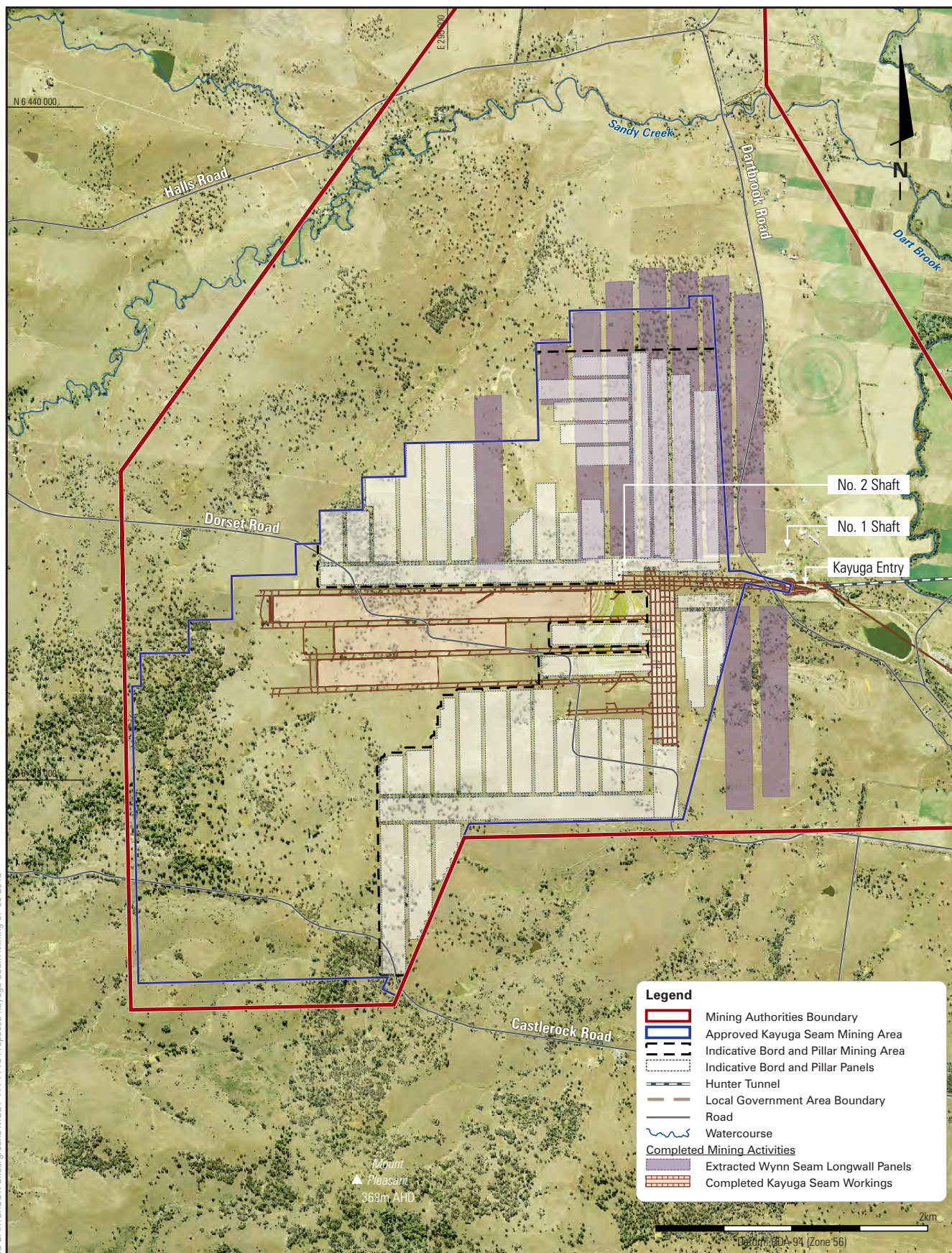
4.2.3 Coal Production

DA 231-7-2000 allows for the extraction of up to 6 Mtpa of ROM coal. The proposed bord and pillar mining will result in the extraction of 10 Mt of ROM coal over a ten year period (i.e. an average rate of 1 Mtpa). The maximum annual production rate from bord and pillar mining operations will be up to 1.5 Mtpa of ROM coal. The Modification does not seek to alter the approved maximum coal production rate at Dartbrook Mine.

4.2.4 Equipment

The “in-place” method of bord and pillar mining requires the use of Bolter Miners, which are Continuous Miners fitted with a roof bolter. The Bolter Miners will be responsible for shearing the coal and applying primary roof support. Secondary roof support will be installed by Mobile Roof Bolters.

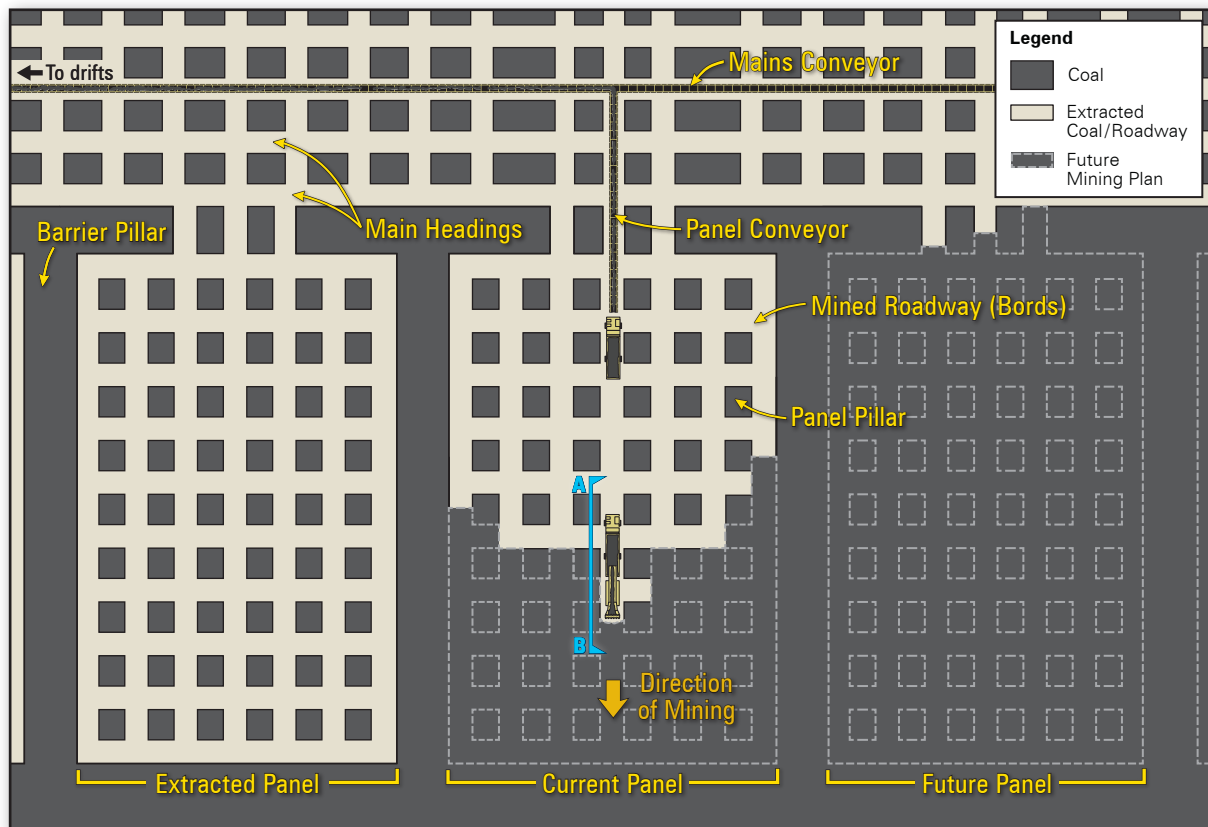
The main headings will be developed using a single Bolter Miner, supported by a single Roof Bolter. The production panels will be developed using a “super panel” configuration, which consists of two Bolter Miners and a Mobile Roof Bolter. The “super panel” configuration improves mining efficiency because it allows one Bolter Miner to relocate whilst the other is actively producing coal. The Modification may utilise up to three “super panels” simultaneously.



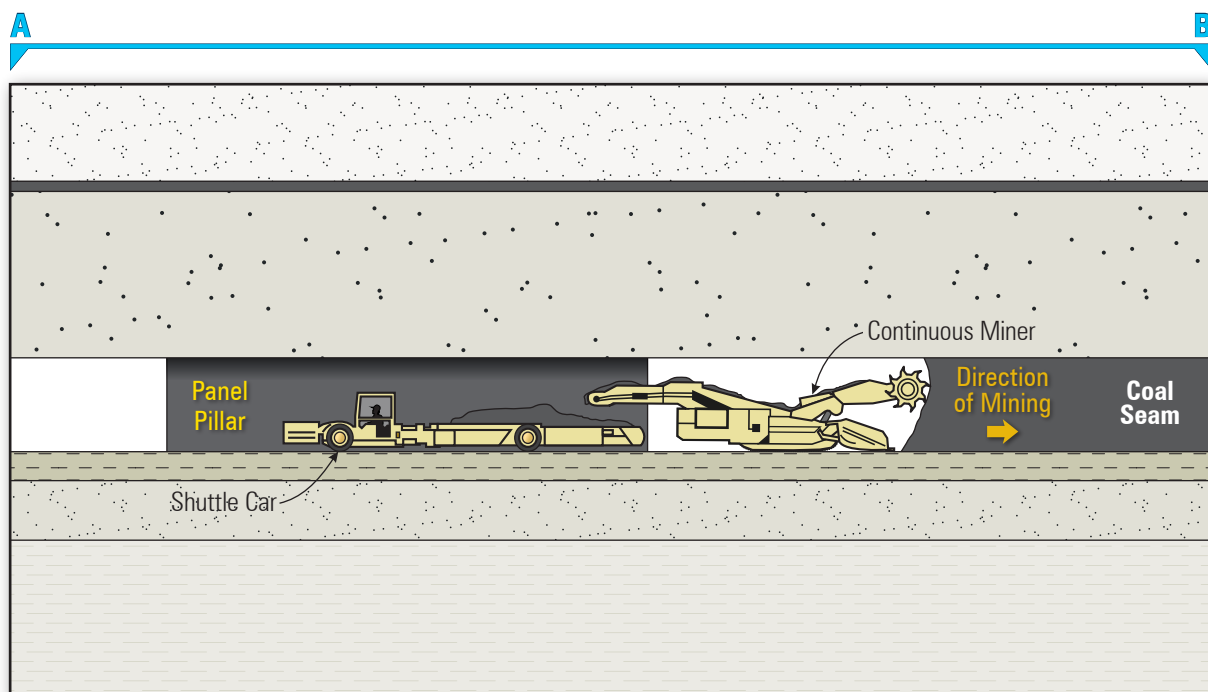
DARTBROOK MINE

Proposed Kayuga Seam Mining

FIGURE 13



Plan View of Bord and Pillar Coal Mining



Cross Section of Active Bord and Pillar Mining Roadway

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The Bolter Miners will be supported by a fleet of Shuttle Cars, which transport coal from the Bolter Miners to the underground conveyors (see **Figure 14**). The indicative fleet of underground mining equipment for the proposed bord and pillar mining is outlined in **Table 1**.

Table 1
Underground Mining Equipment

Equipment	Number of Units	
	Main Headings	Production Panels*
Bolter Miners (Continuous Miners)	1	6
Roof Bolter	1	3
Shuttle Car	3	9
Feeder Breaker	1	3

**Assumes that all three Super Panels are utilised simultaneously*

4.2.5 Mining Duration

DA 231-7-2000 enables mining operations to be undertaken until 5 December 2022. The Modification will facilitate the extraction of up to 10 Mt of ROM coal from the Kayuga Seam using the bord and pillar method.

Due to the prolonged period of care and maintenance prior to AQC's acquisition of Dartbrook Mine, the proposed mining activities cannot be completed within the current period of approval. As such, the Modification seeks to extend the period of approval under DA 231-7-2000 by an additional five years until 5 December 2027.

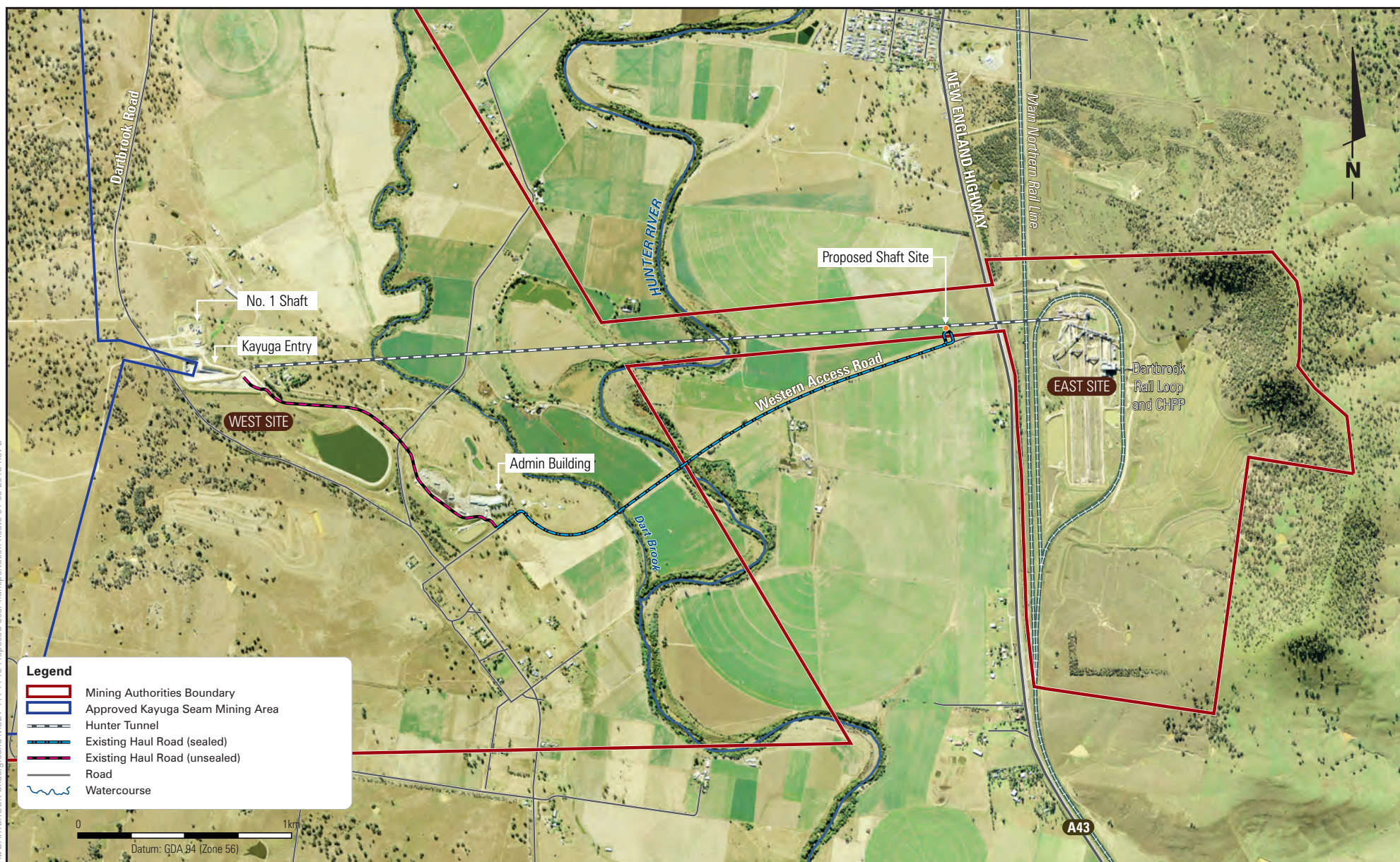
4.3 SURFACE INFRASTRUCTURE

4.3.1 Coal Clearance System

The East Site contains coal handling infrastructure, coal stockpiles, the CHPP and train load out infrastructure. Under DA 231-7-2000, ROM coal is approved to be transported from the mine workings to the East Site via the Hunter Tunnel. The conveyors in the Hunter Tunnel were removed by the former owners of Dartbrook Mine during care and maintenance. AQC has determined that it would require significant capital expenditure to replacement the Hunter Tunnel conveyors for the proposed mining activities.

The Modification proposes that the transfer of ROM coal (extracted by bord and pillar mining) to the East Site will be partly overland and partly via the eastern section of the Hunter Tunnel (as shown on **Figure 15**).

ROM coal will be brought up to the surface at the Kayuga Entry. The coal will then be hauled (using trucks) to a new shaft site to be located a short distance west of the New England Highway. The truck fleet will consist of 4 B-double trucks (road-registered) with 60 t payloads. At the proposed maximum production rate of 1.5 Mtpa of ROM coal, the Modification will require an average of 96 truck cycles per day (192 one-way movements per day).



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Proposed Coal Clearance System

FIGURE 15

The haulage route consists of sealed and unsealed private roads (see **Figure 15**). Consistent with best practice dust management, all trucks will be covered. Dust emissions associated with coal haulage will be further controlled by installing a sprinkler system along the unsealed section of the haul route, and utilising a street sweeping vehicle along the sealed section. Haulage of ROM coal will be conducted only on weekdays and will be limited to the day time period (7am to 6pm).

The new shaft will transfer coal to the Hunter Tunnel. The depth of the shaft to the Hunter Tunnel will be approximately 70 m. The eastern portion of the Hunter Tunnel will be utilised for the remainder of the delivery to the East Site. A new conveyor will be installed in this part of the Hunter Tunnel.

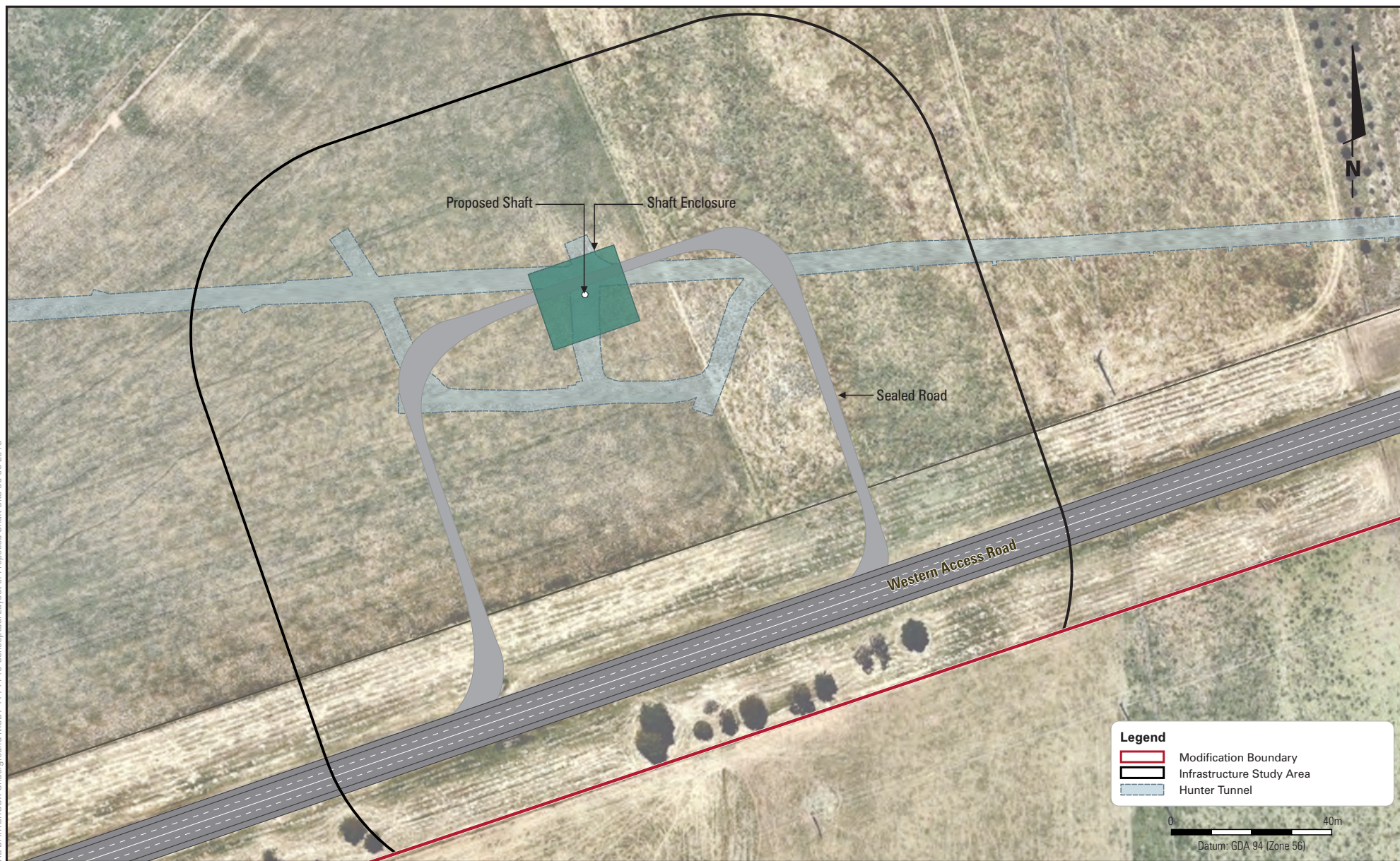
The new materials delivery shaft will be approximately 6 m in diameter. A ROM coal bin will be installed above over the shaft within a partially enclosed colorbond shed (approximately 9 m in height). The new shaft site will also include a vehicle turning bay, electricity infrastructure and water reticulation. An earthen bund will be constructed to protect the proposed infrastructure from the 1 in 100 year flood level. The indicative layout of the new shaft site is illustrated in **Figure 16**.

4.3.2 East Site Infrastructure

The Modification does not involve any material alterations to the infrastructure at the East Site. However, various refurbishments may be required.

The Hunter Tunnel conveyor will deliver ROM coal into the existing ROM hopper, where it will be crushed. The crushed coal will be placed onto existing conveyors that will deliver coal to existing stockpiles. The circular stockpile will be utilised preferentially; however, the rectangular stockpiles may be used when the circular stockpile is at full capacity. Each stockpile is serviced by a dedicated reclaim conveyor. Coal from the circular stockpile will be deposited onto its reclaim conveyor by a dozer, whereas overland reclaimers will be used for the rectangular stockpiles. The reclaim conveyors will transfer coal onto the train loadout conveyor, which feeds the train loadout bin. All conveyors are fitted with a roof and side wall, except for the conveyors at ground level.

The CHPP contains the coal washing and processing infrastructure for Dartbrook Mine. The current intention is to not utilise the CHPP for washing the coal extracted from the Kayuga Seam through bord and pillar mining. That is, the coal produced by bord and pillar mining is intended to be marketed as a crushed, unwashed product.



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Conceptual Layout of New Shaft Site

FIGURE 16

4.3.3 Coal Transportation

Raw coal will be transported from the East Site by rail, as approved under DA 231-7-2000. Coal will be loaded onto trains using the existing approved train loadout and rail spur at the East Site. The Modification does not seek to alter the existing coal transportation infrastructure. Minor refurbishments and upgrades will be required to return the infrastructure to working condition. The Modification seeks approval to continue the use of this and all other existing and approved infrastructure for an additional 5 years (i.e. until December 2027).

4.3.4 Ventilation

Prior to Dartbrook Mine being placed under care and maintenance, the No. 2 Shaft provided ventilation for both the Wynn and Kayuga Seam workings. The No. 2 Shaft is currently not operational, as a number of key components were removed during the care and maintenance period.

The No. 2 Shaft will be re-instated in order to provide ventilation for the proposed mining operations in the Kayuga Seam. The re-instated No. 2 Shaft will not differ materially from the approved shaft.

The No. 1 Shaft has been maintained throughout the care and maintenance phase and will continue to be used for the Modification.

4.3.5 Gas Management

Gas desorption testing undertaken at Dartbrook Mine has determined that the Kayuga Seam has the lowest gas content of the four seams (Wynn, Kayuga, Mt Arthur and Piercefield) that are approved to be mined. Gas drainage boreholes will not be required for most of the proposed bord and pillar mining. However, gas management will need to be considered for the proposed workings in the deeper parts of the Kayuga Seam.

4.3.6 Water Management

The water management system at Dartbrook Mine has been maintained throughout the care and maintenance period. The Modification does not propose any material changes to the existing water management infrastructure.

4.3.7 Reject Materials

The Modification does not propose any washing of ROM coal extracted through bord and pillar mining. Therefore, the Modification will not generate any coarse rejects or tailings.

4.3.8 Other Infrastructure

The West Site contains the main administration building, helipad, bioremediation facility, effluent ponds and parking areas. Ancillary infrastructure at the East Site includes the bathhouse, administration buildings, storage areas and maintenance sheds. These facilities will continue to be utilised for the Modification. Aside from minor refurbishments, the Modification does not propose any material alterations to these facilities.

4.4 CONSTRUCTION

The construction of new surface infrastructure will occur over a period of approximately 12 weeks. **Table 2** lists the key construction tasks and estimated durations for these tasks. These tasks may occur in parallel (i.e. multiple tasks may occur simultaneously).

Table 2
Durations of Key Construction Tasks

Task	Estimated Duration
Site preparation (clearing and earthworks)	1 week
Construction of earthen bund	1 week
Construction of truck turning bay	4 weeks
Drilling of shaft	8 weeks
Installation of coal handling infrastructure and enclosure	5 weeks
Installation of ancillary infrastructure	3 weeks

All excavated material (including material extracted during shaft construction) will be used as fill material for the construction of the earthen bund.

The following equipment may be utilised for the proposed construction activities:

- Excavators and backhoes;
- Small loaders (“bobcats”);
- Drill rig;
- Graders;
- Rollers;
- Mobile crane;
- Elevated work platform;
- Street sweeper;
- Pumps and compressors;
- Trucks (e.g. concrete, bitumen, delivery trucks); and
- Various power tools.

The Modification is expected to employ approximately 26 full-time equivalent personnel during the short-term construction phase.

4.5 WORKFORCE AND OPERATING HOURS

The proposed bord and pillar mining operations may occur 24 hours per day, 7 days per week (consistent with DA 231-7-2000). Overland hauling of ROM coal from the Kayuga Entry to the proposed shaft site (as described in **Section 4.3.1**) will be undertaken only during the day period (7am to 6pm) on weekdays. Coal crushing and train loading will be undertaken consistent with DA 231-7-2000.

DA 231-7-2000 allows for an operational workforce of up to 292 personnel, including direct employees and contractors. The Modification will employ up to 99 full time equivalent personnel and as such will not require any increase to the existing approved operational workforce.

4.6 MINE CLOSURE

AQC will prepare a Mine Closure Plan in consultation with the appropriate regulatory authorities prior to the completion of mining. It was proposed that after cessation of bord and pillar mining, the existing mine infrastructure will be decommissioned and the land will be returned to agricultural uses (HLA-Envirosciences, 2000). The new shaft site will be constructed within an area of agricultural grassland. This site will also be decommissioned and rehabilitated to support post-mining agricultural purposes.

4.7 PROJECT NEED

AQC's extensive pre-feasibility studies have confirmed a strong international demand for the high quality thermal coal resource at Dartbrook Mine.

Previous underground longwall mining operations in both the Wynn and Kayuga Seams were impaired by challenging geological and geotechnical conditions, as well as the limitations of mining technology developed in the 1990s (when mining operations commenced at Dartbrook Mine). These challenges coincided with a period of lower international coal prices. As a consequence, Dartbrook Mine was placed under care and maintenance by its previous owners.

AQC acquired Dartbrook Mine in May 2017 with the objective of re-commencing mining operations at the site. In parallel with this modification application, AQC is investigating the feasibility of future open cut mining operations at Dartbrook Mine.

Given that Dartbrook Mine was an operational underground mine from 1994 to 2006, most of the surface infrastructure required for the continuation of underground mining is currently present at the site. Only minor refurbishments and upgrades will be required to restore these facilities to operational condition. In addition, the labour resources and suppliers required for the Modification are readily available within the region.

The longwall miner and Hunter Tunnel conveyors were removed by the previous owner during the care and maintenance period. The Modification proposes alternatives to the approved mining method and coal clearance system. These alternatives can be implemented more quickly and economically than the approved methods. Therefore, the Modification will allow AQC to re-establish coal production relatively quickly and efficiently.

The Modification will meet the NSW Government's stated objective of developing its State Significant Coal Resources. This Modification will generate economic stimulus and employment within the region and material royalties for NSW.

4.8 PROJECT ALTERNATIVES

4.8.1 'Do Nothing'

If the Modification is not granted, Dartbrook Mine would remain under care and maintenance. AQC would continue to incur the costs of maintaining the mine under a state of care and maintenance.

The economic and employment benefits that would result from the extraction of the coal resource would be forgone.

4.8.2 Longwall Mining

AQC has considered the feasibility of re-commencing longwall mining operations, as approved under DA 231-7-2000. Previous longwall mining activities (conducted by the previous owner) were affected by challenging geological and geotechnical conditions, as well as limitations associated with the mining technology available at the time. The longwall miner was removed by the previous owner during care and maintenance. AQC has determined that reinstalling a longwall miner will involve significant capital expenditure and time delays. The bord and pillar mining method requires less upfront expenditure and can be established relatively quickly. Therefore, the proposed bord and pillar mining is capable of providing positive economic returns within a shorter timeframe. Notwithstanding, the proposed bord and pillar mining is sought as an alternative to the approved longwall mining activities, rather than as a substitute.

4.8.3 Hunter Tunnel

The approved coal clearance system involves the use of the entire Hunter Tunnel for the delivery of coal to the CHPP. Due to the extended period of care and maintenance prior to AQC's acquisition of Dartbrook Mine, the Hunter Tunnel would need to be significantly upgraded and a new conveyor system would need to be installed in order for the approved coal clearance system to be recommissioned.

AQC has determined that significant capital expenditure is required to recommission the Hunter Tunnel for the purposes of the Modification. The proposed overland coal transportation (where practicable) is the more economically efficient method of ROM coal transportation. Notwithstanding, the proposed coal clearance system is sought as an alternative to the Hunter Tunnel, rather than as a substitute.

4.9 SUMMARY

Table 3 provides a comparison of the approved development with the Modification.

Table 3
Summary of the Modification

Aspect	Approved Development*	The Modification
Project Duration	Approximately 21 years after the granting of a mining lease (ML 1497) pursuant to the consent	Extension of the Project duration by 5 years (until 5 December 2027). Due to the extended period of care and maintenance, the total duration of mining will be within 21 years.
Mining Method	- Longwall mining of the Kayuga Seam - Longwall mining of the Mt Arthur Seam - Longwall mining of the Piercefield Seam	- Bord and pillar mining of the Kayuga Seam as an alternative to longwall mining - No change - No change
Coal Reserves	57.2 Mt from the Kayuga Seam 11.3 Mt from the Mt Arthur Seam 76.2 Mt from the Piercefield Seam	10 Mt from the Kayuga Seam (if bord and pillar mining is undertaken instead of longwall mining) - No change - No change
Production Rate	Maximum of 6 Mtpa of ROM coal	No change to maximum total production (maximum of 1.5 Mtpa of ROM coal from bord and pillar mining).
Surface Infrastructure	East Site - ROM Hopper - Conveyor systems - CHPP - ROM and product coal stockpiles - Rail loop and train loading facilities - Tailings storage cell - Water management infrastructure West Site - Kayuga Entry - Administration buildings - Bathhouse - Workshop - Effluent ponds - Ventilation shafts - Water management infrastructure	East Site - No change West Site - A new shaft to transfer ROM coal to the Hunter Tunnel, and ancillary infrastructure

Aspect	Approved Development*	The Modification
Mine Plan	20 longwall panels in the Kayuga Seam 3 longwall panels in the Mt Arthur Seam 19 or 28 longwall panels in the Piercefield Seam (depending on panel width)	- Bord and pillar mining in the Kayuga Seam (indicatively shown in Figure 13) - No change - No change
Coal Transportation	All coal is railed to the Port of Newcastle via the Main Northern Rail Line	No change
Water Management	- Mine water dams (EHD, WHD and SDD) - Sediment dams - Evaporation Ponds - Clean water dam	No change
Waste Management	- Coarse rejects are emplaced in the REA - Tailings are disposed of in the Wynn Seam goaf	Not applicable to the Modification
Operational Hours	24 hours per day, 7 days per week	No change to operational hours. Road haulage of ROM coal will be limited to 7am to 6pm on weekdays.
Employment	Maximum of 292 operational personnel (employees and contractors)	No change to maximum approved employment levels

* Including previous modifications to DA 231-7-2000

5 REGULATORY FRAMEWORK

This section briefly describes the relevant provisions of NSW and Commonwealth legislative instruments that are applicable to the Modification.

5.1 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

5.1.1 Objects of the EP&A Act

The objects of the EP&A Act are listed under Section 1.3 of the Act:

- (a) to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources,*
- (b) to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment,*
- (c) to promote the orderly and economic use and development of land,*
- (d) to promote the delivery and maintenance of affordable housing,*
- (e) to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats,*
- (f) to promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage),*
- (g) to promote good design and amenity of the built environment,*
- (h) to promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants,*
- (i) to promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State,*
- (j) to provide increased opportunity for community participation in environmental planning and assessment.*

The Modification will facilitate the extraction of up to 10 Mt of ROM coal. The proposed bord and pillar mining has been designed such that subsidence will be imperceptible for all practical purposes. Accordingly, the environmental impacts of the proposed bord and mining will be less than the impacts of the approved longwall mining activities. In addition, the new surface infrastructure will be sited entirely within agricultural grassland, thus avoiding impacts to native ecological communities and habitats for native species. The Modification therefore represents the proper development of NSW's natural resources.

The extraction of up to 10 Mt of ROM coal will generate royalties for the state of NSW and stimulate economic activity within the local region. The Modification represents the "orderly and economic use and development of land" and is therefore consistent with the objects of the EP&A Act.

5.1.2 Modification of Development Consents

DA 231-7-2000 was granted by the (then) Minister for Urban Affairs & Planning on 28 August 2001 under sections 76A(9) and 80 of the EP&A Act (as it was then). Section 76A(9) of the EP&A Act then provided that “The Minister is the consent authority for State significant development”. Clause 8J(8) of the EP&A Regulation provides that certain Development Consents can be modified pursuant to Section 75W of the EP&A Act. Clause 8J(8) relevantly states (emphasis added):

- (8) *For the purposes only of modification, the following development consents are taken to be approvals under Part 3A of the Act and section 75W of the Act applies to any modification of such a consent:*
- (a) *a development consent granted by the Minister under section 100A or 101 of the Act,*
 - (b) *a development consent granted by the Minister under State Environmental Planning Policy No 34—Major Employment-Generating Industrial Development,*
 - (c) *a development consent granted by the Minister under Part 4 of the Act (relating to State significant development) before 1 August 2005 or under clause 89 of Schedule 6 to the Act,*
 - (d) *a development consent granted by the Land and Environment Court, if the original consent authority was the Minister and the consent was of a kind referred to in paragraph (c).*

The development consent, if so modified, does not become an approval under Part 3A of the Act.

DA 231-7-2000 was granted under Part 4 of the EP&A Act prior to 1 August 2005. Therefore, Clause 8J(8)(c) requires the proposed modification of DA 231-7-2000 to be made under Section 75W of the EP&A Act.

The scope of section 75W was considered by the NSW Court of Appeal in *Barrick Australia Limited v Williams* [2009] NSWCA 275. The Court held that section 75W cannot be relied upon where the proposed modification would amount to a “*radical transformation of the terms of the existing development consent*”. When determining whether a modification constitutes a “radical transformation”, the proposal is to be compared to the approved development (with previous modifications) rather than the development as originally approved.

The Modification will involve changes to the method of underground mining for the Kayuga Seam, the coal clearance system for transporting ROM coal to the East Site and the total duration of all mining operations. The following aspects of the approved development will not be altered by the Modification:

- Proposed mining of the Kayuga Seam will be undertaken within the Approved Kayuga Seam Mining Area (i.e. no change in mining footprint);

- Approved mining activities within the Wynn, Kayuga, Mt Arthur and Piercefield coal seams will not be altered;
- Total coal production will remain within the approved maximum rate of 6 Mtpa;
- Coal will continue to be loaded onto trains using the existing train load out facilities and railed to the Port of Newcastle;
- Operating hours will remain unchanged; and
- Operational workforce will remain within the approved personnel limit.

The extension of the project duration facilitates the recovery of coal resources that have not yet been extracted as a result of Dartbrook Mine being under care and maintenance. The extension of the mining period will not result in the extraction of any coal that was not previously approved for extraction.

The development, as originally approved by DA 231-7-2000, is characterised as an underground coal mining operation. Although the Modification alters the methods that are used to mine and handle coal, it does not alter the character of the development. Therefore, the modified development does not represent a “radical transformation” from the original development. Accordingly, the consent authority may modify DA 231-7-2000 pursuant to Section 75W of the EP&A Act.

5.1.3 Strategic Agricultural Land

Clause 20 of Schedule 6A of the EP&A Act applies to modification applications made under Section 75W of the Act, including modifications referred to in clause 8J(8) of the EP&A Regulation. Clause 20 provides that applications relating to “*mining and petroleum development*” must be accompanied by either a Gateway Certificate or Site Verification Certificate if the development is to be located on:

- (a) Land shown on the Strategic Agricultural Land Map; or
- (b) Land that is the subject of a Site Verification Certificate.

The definition of “*mining or petroleum development*” under Clause 20 is limited to development for which “a mining lease under the *Mining Act 1992* is required to be issued to enable the development to be carried out under the modified approval or consent ... because the development is proposed to be carried out outside the mining area of an existing mining lease or there is no current mining lease in relation to the proposed development. The approved and proposed underground mining activities at Dartbrook Mine are all located within existing mining leases (CL 386 and ML 1497).

The Modification also proposes the construction of additional surface infrastructure (including a ROM coal bin and materials delivery shaft) near the intersection of the Western Access Road and New England Highway. This infrastructure will be located outside of AQC's existing mining leases. However, neither the ROM coal bin nor the shaft constitutes a mining purpose for which a new mining lease is required. Therefore, the Modification does not constitute "*mining or petroleum development*" because a new mining lease is not required to enable the modified development to be carried out. As such, the requirement for a Gateway Certificate or Site Verification Certificate does not apply to the Modification application.

5.2 OTHER NSW LEGISLATION

5.2.1 Mining Act

The mining of coal in NSW is regulated by the *Mining Act 1992* (Mining Act). Section 5 of the Mining Act states that mining can only be conducted in accordance with a mining lease (ML). The proposed mining of the Kayuga seam is authorised by CL 386 and ML 1497.

In the area of the underground workings, CL 386 applies to the strata below a depth of 20 m, which includes the Kayuga seam in that area. CL 386 also applies to the surface at the locations of the East and West Site.

The eastern portion of ML 1497 applies to the land below a depth of 20 m from the surface. The western portion of ML 1497 applies to the land below a depth of 20 m above the Mt Arthur seam (which encompasses the Kayuga seam). Therefore, ML 1497 encompasses the Kayuga seam. The mining authorities held by AQC are shown in **Figure 17**.

Section 6 of the Mining Act provides that a "designated ancillary mining activity" can only be carried out in accordance with a mining authorisation. The "designated ancillary mining activities" that require a mining authorisation include:

- (a) *the construction, maintenance or use of any reservoir, dam (including a tailings dam), drain or water race, other than any reservoir, dam, drain or water race principally used for purposes not connected with mining or any other activities regulated by or under an authorisation,*
- (b) *opal puddling,*
- (c) *the removal, stockpiling or depositing of overburden, ore or tailings to the extent that it is associated with mineral extraction or mineral beneficiation.*

The proposed ROM coal bin at the new shaft site (see **Figure 16**) may constitute a "designated ancillary mining activity" under section 6 of the Mining Act. The ROM coal bin will be constructed within the western portion of CL 386, which does not apply to the land surface (see **Figure 17**). Section 6 of the Mining Act states that if a "designated ancillary mining activity" is to be located outside of a mining lease, the activity must be undertaken in accordance with a condition of a mining lease that regulates that particular activity.

Therefore, if the proposed ROM coal bin is deemed to be a “designated ancillary mining activity”, a variation to the conditions of either CL 386 or ML 1497 will be required to enable the activity to be carried out.

5.2.2 Protection of the Environment Operations Act

Section 48 of the *Protection of the Environment Operations Act 1997* (POEO Act) provides that an Environmental Protection Licence (EPL) is required for activities listed under Schedule 1 of the Act (i.e. scheduled activities). Clause 28 of Schedule 1 declares “mining for coal” to be a scheduled activity if the daily coal production exceeds 500 tonnes or if the total disturbance area exceeds 4 ha. The proposed mining operations at Dartbrook Mine will constitute a scheduled activity. Accordingly, AQC holds EPL 4885 in respect of activities at Dartbrook Mine.

5.2.3 Biodiversity Conservation Act

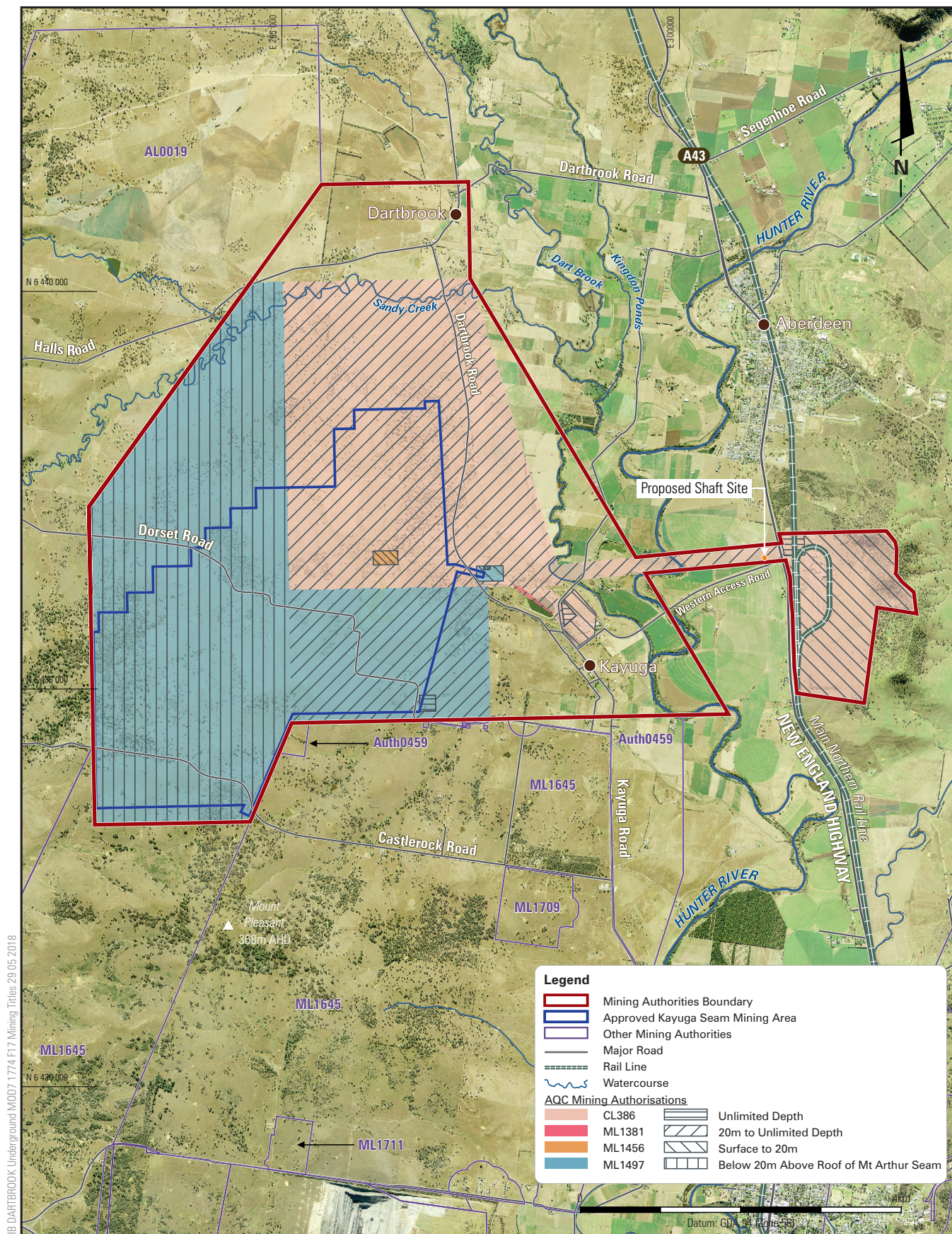
The *Biodiversity Conservation Act 2016* (BC Act) was enacted on 23 November 2016 and superseded the *Threatened Species Conservation Act 1995*. Part 7 of the BC Act imposes a framework for the assessment of impacts to threatened species and ecological communities.

Section 7.17 of the BC Act states that the assessment requirements under Part 7 only apply to proposed modifications of development consents that were granted after the commencement of the BC Act. DA 231-7-2000 was granted on 28 August 2001, prior to the commencement of the BC Act. Accordingly, the application for the Modification is not required to be accompanied by a biodiversity development assessment report.

The BC Act does not prescribe any assessment requirements for modifications to development consents that were granted before the commencement of the BC Act. To assist in the determination of this modification application, **Section 8.6** and **Appendix G** provide an assessment of the potential for the Modification to impact upon biodiversity values.

5.2.4 National Parks and Wildlife Act

Under section 86 of the *National Parks and Wildlife Act 1974* (NPW Act), it is an offence to harm or desecrate an Aboriginal object or place, except where authorised by an Aboriginal Heritage Impact Permit (AHIP) issued under Section 90. As explained in **Section 8.7**, the Modification is not expected to impact upon any Aboriginal objects or places.



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5.3 ENVIRONMENTAL PLANNING INSTRUMENTS

5.3.1 Mining SEPP

The *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (Mining SEPP) makes provisions for the “proper management and development of mineral resources of the State of NSW” and establishes appropriate planning controls. Clause 7(1) of the Mining SEPP states:

“(1) Mining

Development for any of the following purposes may be carried out only with development consent:

- (a) underground mining carried out on any land,*
- (b) mining carried out:*
 - (i) on land where development for the purposes of agriculture or industry may be carried out (with or without development consent), or*
 - (ii) on land that is, immediately before the commencement of this clause, the subject of a mining lease under the Mining Act 1992 or a mining licence under the Offshore Minerals Act 1999*

...

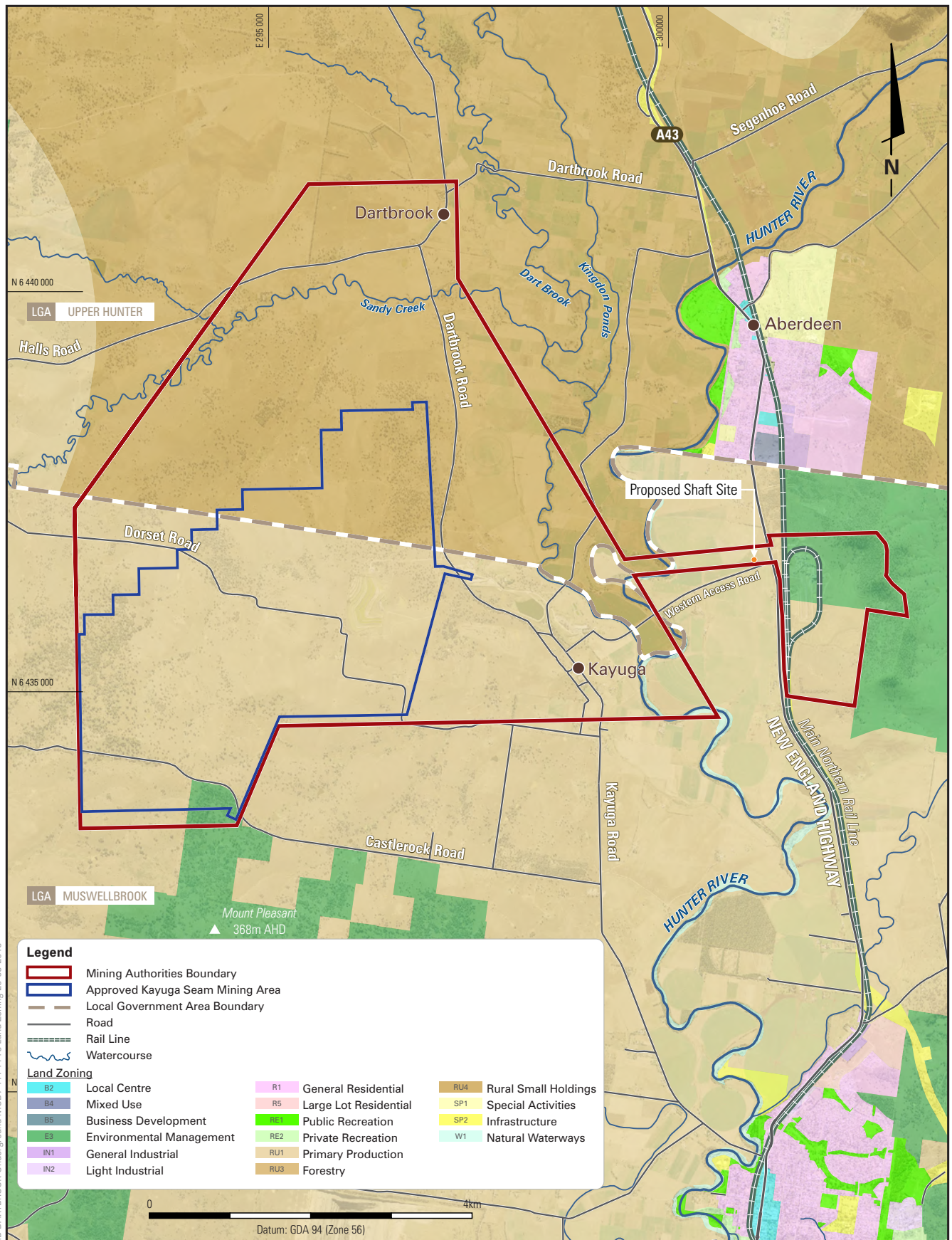
- (d) facilities for the processing or transportation of minerals or mineral bearing ores on land on which may be carried out (with or without development consent) but only if they were mined from that land or adjoining land.”*

Clause 7(1)(a) of the Mining SEPP allows for underground mining to be carried out (with development consent) on any land. In addition, clause 7(1)(b) allows for mining to be carried out on any land where agricultural development is permissible. The proposed underground mining activities will be undertaken within zones RU1 and E3 under the Muswellbrook LEP and zone RU4 under the Upper Hunter LEP. Development for the purposes of agriculture is permissible in all of these zones. Therefore, pursuant to clause 7(1)(b) of the Mining SEPP, mining may also be carried out on this land.

Clause 5(3) of Mining SEPP provides that “*if this policy is inconsistent with any other environmental planning instrument....this policy prevails to the extent of the inconsistency.*”

5.3.2 Muswellbrook Local Environmental Plan

The Modification is predominantly located within the Muswellbrook LGA. As shown in **Figure 18**, the proposed mining activities and surface development will be undertaken on land zoned as RU1 (Primary Production) or E3 (Environmental Management). The land use table in the Muswellbrook LEP lists the types of developments that are permissible in zones RU1 and E3. “Underground mining” is not listed as a permissible development in either of these zones.



DARTBROOK MINE

Land Zoning

FIGURE 18

The land use table in the Muswellbrook LEP is inconsistent with Clause 7(1) of the Mining SEPP, which provides that underground mining is permissible (with development consent) on any land. Clause 5 of the Mining SEPP states that if there is any inconsistency between the Mining SEPP and another Environmental Planning Instrument, the Mining SEPP will prevail to the extent of the inconsistency. Therefore, Clause 7(1) of the Mining SEPP prevails over the Muswellbrook LEP with respect to the permissibility of underground mining.

5.3.3 Upper Hunter Local Environmental Plan

Part of the Proposed Bord and Pillar Mining Area is located within the Upper Hunter LGA. As shown in **Figure 18**, underground mining activities will be undertaken within zone RU4 (Primary Production Small Lots). The land use table in the Upper Hunter LEP does not list “underground mining” as a permissible development within zone RU4. This is inconsistent with Clause 7(1) of the Mining SEPP, which provides that underground mining is permissible (with development consent) on “any land”. Pursuant to Clause 5 of the Mining SEPP, the Mining SEPP prevails over the Upper Hunter LEP to the extent of the inconsistency. Therefore, the proposed underground mining activities are permissible with development consent.

5.3.4 Water Management Act

The *Water Management Act 2000* (WM Act) establishes a licensing regime for the taking and use of water in NSW. The provisions of the WM Act apply to water sources that are the subject of a Water Sharing Plan (WSP). The following WSPs apply to the water sources that may be affected by the Modification:

- *Water Sharing Plan for the Hunter Regulated River Water Source 2016* (Hunter Regulated WSP);
- *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009* (Hunter Unregulated WSP); and
- *Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2009* (North Coast Groundwater WSP).

The Hunter Regulated WSP applies to the Hunter Regulated River Water Source, which includes all surface water in the Hunter River.

The Hunter Unregulated WSP applies to various surface water and groundwater sources in the Hunter region, including the Hunter Regulated River Alluvial Water Source and the Dartbrook Water Source. The Hunter Regulated River Alluvial Water Source applies to groundwater contained within the alluvial aquifer associated with the Hunter River. The Dartbrook Water Source includes all surface water within the catchments of Dart Brook, Sandy Creek and Kingdon Ponds. The Dartbrook Water Source also applies to the alluvial aquifers associated with the streams. However, the Dartbrook Water Source does not apply to any other groundwater systems (e.g. hard rock aquifers).

The North Coast Groundwater WSP applies to various groundwater sources in northern NSW, including the Sydney Basin-North Coast Groundwater Source. The Sydney Basin-North Coast Groundwater Source includes all groundwater sources at Dartbrook Mine, with the exception of unconsolidated Tertiary or Quaternary sediment (i.e. alluvial aquifers). Therefore, the North Coast Groundwater WSP applies to the Permian groundwater system.

Under section 60A of the WM Act, Water Access Licences (WALs) are required to account for water taken from water sources that are the subject of a WSP. The water licensing requirements for the Modification are discussed in **Section 8.3.3**.

Section 91(2) of the WM Act states that a controlled activity approval is required for the carrying out of specified controlled activities in, on or under waterfront land. The definition of “waterfront land” includes the bed of a river or the land within 40 m of the highest bank. The proposed shaft site will be constructed more than 1 km from the highest bank of the Hunter River. Therefore, a controlled activity approval will not be required for the Modification.

Section 91(3) of the WM Act states that an aquifer interference approval is required for any activity that involves the penetration of an aquifer. The requirements of section 91 do not apply until a proclamation has been made pursuant to section 88A of the WM Act. To date, there has not been any proclamation that triggers the requirement under section 91(3) for an aquifer interference approval.

5.4 COMMONWEALTH LEGISLATION

5.4.1 Environment Protection and Biodiversity Conservation Act

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides for “the protection of the environment” and “recognises an appropriate role for the Commonwealth in relation to the environment by focussing Commonwealth involvement on matters of national environmental significance”. A proponent must make a Referral under Section 68 of the EPBC Act if the proposed action has the potential to result in significant impacts to Matters of National Environmental Significance (MNES). There are nine MNES that are afforded protection by the Act:

- World heritage properties;
- National heritage places;
- Wetlands of international importance;
- Listed threatened species and ecological communities;
- Listed migratory species;
- Commonwealth marine areas;
- Great Barrier Reef Marine Park;
- Protection of the environment from nuclear actions (including uranium mining); and
- Protection of water resources from coal seam gas development and large coal mining development.

Section 68(2) states that a proponent may also make a Referral even if they consider that the action will not have a significant impact on MNES.

The proposed surface infrastructure for the Modification will be sited entirely within agricultural grassland. Consequently, the Modification will not disturb any potential habitat for threatened species. The proposed bord and pillar mining will not result in any perceptible subsidence. As a result, the Modification is not expected to result in any indirect impacts to threatened species or ecological communities.

The water resources in the vicinity of the Modification are the Hunter River and its tributaries, alluvial aquifers and the Permian groundwater system. The proposed bord and pillar mining does not involve any mining directly beneath streams or alluvial aquifers. The potential impacts to water resources will be significantly mitigated by the lateral setback from alluvial aquifers and the imperceptible levels of subsidence associated with bord and pillar mining.

The Modification will be referred under section 68 of the EPBC Act to determine whether the action requires approval under the EPBC Act.

6 STAKEHOLDER CONSULTATION

This section provides a summary of the stakeholder engagement undertaken for the Modification and the outcomes of these engagements.

6.1 STAKEHOLDER ENGAGEMENT

An extensive stakeholder engagement program was implemented for the Modification, including consultation with regulatory authorities, the local community and Aboriginal stakeholders. The objectives of the stakeholder engagement program included the following:

- To introduce AQC to relevant stakeholders and to establish working relationships that can continue into the future;
- To provide relevant stakeholders with information regarding the Modification;
- To identify issues that need to be addressed in this EA; and
- To comply with regulatory requirements.

6.1.1 Regulatory Consultation

AQC consulted with NSW regulatory authorities to confirm the appropriate approvals pathway for the Modification and to identify the social, economic and environmental issues that should be assessed in this EA. Consultation was undertaken via face-to-face meetings, written correspondence and newsletters. The outcomes of consultation with regulatory authorities are summarised in **Table 4**.

Table 4
Consultation with Regulatory Authorities

Stakeholder	Method of Consultation	Issues Discussed
Department of Planning & Environment (DP&E)	• Meeting at DP&E Offices on 26 February 2018 • Letter from AQC dated 27 February 2018 • Letter from DP&E dated 6 March 2018	• Description of the Modification • Approval pathway should be a modification application under section 75W of the EP&A Act • History of mining operations at Dartbrook Mine • Scope of Environmental Assessment • Mine closure arrangements
Department of Resources and Geosciences (DRG)	• Meeting at DRG Offices on 20 February 2018 • Meeting at Dartbrook Mine on 22 May 2018 (Conceptual Project Development Plan meeting)	• Description of the Modification • Status of AQC's mining authorities • Coal resources and reserves • History of mining operations at Dartbrook Mine • Mine rehabilitation • Environmental considerations • Economic benefits to NSW

Stakeholder	Method of Consultation	Issues Discussed
Department of Industry (DoI) - Water	Meeting at DoI-Water Offices on 4 April 2018	• Description of the Modification • Water licensing • Water monitoring network • Scope of groundwater and surface water assessments for the Modification
MSC	Meeting at MSC Offices on 18 April 2018	• Description of the Modification • Scope of Environmental Assessment • Economic benefits
Upper Hunter Shire Council (UHSC)	Meeting at UHSC Offices on 27 March 2018	• Description of the Modification • Scope of Environmental Assessment • Economic benefits

6.1.2 Community Consultation

AQC publishes the “*Dartbrook Newsletter*”, which is distributed to neighbouring landowners, local businesses, members of the Dartbrook Community Consultative Committee (CCC) and regulatory stakeholders. The newsletter is also made publicly available on AQC’s website.

Two issues of the “*Dartbrook Newsletter*” (February 2018 and April 2018) were published during the preparation of the EA. The February 2018 issue provided a description of the Modification and invited any interested persons to comment on the proposal. The April 2018 issue advised that a modification application had been lodged and that an EA was being prepared. No comments have been received from members of the community in response to these newsletters.

AQC continues to facilitate regular meetings of the Dartbrook CCC, as required under Condition 10.1 of DA 231-7-2000. The members of the CCC were given written notice of the Modification on 1 March 2018. A CCC meeting was held on 21 March 2018 to discuss the Modification. The issues raised by the CCC included:

- Gas issues experienced during previous mining operations at Dartbrook Mine;
- Risk of spontaneous combustion;
- Air quality impacts associated with hauling of ROM coal;
- Accumulation of salt on the haul road, due to use of mine water for dust suppression;
- Economic viability of the Modification;
- Justification for the proposed coal clearance system as an alternative to using the full length of the Hunter Tunnel.

6.1.3 Consultation with Aboriginal stakeholders

Consultation with Aboriginal stakeholders was undertaken in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010a) (Consultation Requirements).

Stage 1 – Notification and Registration

The purpose of Stage 1 of the consultation process is to identify Aboriginal persons that may hold relevant cultural knowledge. In accordance with Section 4.1.2 of the Consultation Requirements, the following organisations were contacted (via letter dated 29 November 2017) for assistance in identifying Aboriginal persons that may hold cultural knowledge:

- Office of Environment and Heritage (OEH);
- Wonnarua Local Aboriginal Land Council (WLALC);
- National Native Title Tribunal (NNTT);
- NTSCORP Limited;
- Muswellbrook Shire Council (MSC); and
- Local Land Services.

These organisations were asked to provide contact details for Aboriginal persons that should be consulted with. Responses were received from four of these organisations, namely OEH, WLALC, MSC and NNTT. A total of 78 Aboriginal parties were identified as parties that may hold cultural knowledge. In accordance with Section 4.1.3 of the Consultation Requirements, all of these parties were contacted via letter (dated 6 February 2018) and invited to register an interest in the Aboriginal Archaeological and Cultural Heritage Impact Assessment (AACHIA) for the Modification.

Section 4.1.3 of the Consultation Requirements also requires the proponent to place a public notice in a local newspaper to invite Aboriginal parties to register an interest. In accordance with this requirement, a public notice was placed in the Muswellbrook Chronicle on 1 December 2017.

A total of 20 Aboriginal stakeholders registered an interest in the AACHIA. The Registered Aboriginal Parties (RAPs) are listed in **Table 5**.

Table 5
Registered Aboriginal Parties

Organisation	
Wanaruah Local Aboriginal Land Council	Stephen Talbott
Culturally Aware	Mindaribba Local Aboriginal Land Council
Hunter Valley Aboriginal Corporation	Jarban + Mugrebea
Wonn1 Consulting	Lower Hunter Aboriginal Incorporated
Tocomwall	Lower Hunter Wonnarua Cultural Services
Didge Ngunawal Clan	Amanda Hickey Cultural Services
Aboriginal Native Title Elders Consultants	A1 Indigenous Services

Organisation	
Upper Hunter Heritage Consultants	Yinarr Cultural Services
Divine Diggers Aboriginal Cultural Consultants	Murra Bidgee Mullangari Aboriginal Corporation
Ungooroo Aboriginal Corporation	Muragadi Heritage Indigenous Corporation

Stage 2 – Presentation of Information

The purpose of Stage 2 of the consultation process is to provide RAPs with information regarding the proposed development and cultural heritage assessment process. Relevant information was included in letters to Aboriginal persons (dated 6 February 2018) and the public notice placed in the Muswellbrook Chronicle.

Stage 3 – Gathering Information about Cultural Significance

Sections 4.3.1 and 4.3.2 of the Consultation Requirements requires that the RAPs be provided with the proposed methodology for the AACHIA, and be given the opportunity to review and provide feedback. All RAPs were provided with the proposed assessment methodology on 1 March 2018. In accordance with Section 4.3.2 of the Consultation Requirements, the RAPs were given a minimum of 28 days to review and provide feedback on the methodology.

Sixteen RAPs provided responses to the proposed assessment methodology. These responses did not identify any cultural heritage values for the Infrastructure Study Area. WLALC provided the locations of culturally significant sites in the Upper Hunter. None of these sites are located within the Infrastructure Study Area.

Stage 4 – Review of draft AACHIA

In accordance with Section 4.4.2 of the Consultation Requirements, the RAPs were provided with a draft of the AACHIA on 19 April 2018. The RAPs were invited to review and provide feedback on the draft AACHIA. The closing date for comments was 18 May 2018, which complies with the minimum review period of 28 days.

Responses were provided by five RAPs, all of whom agreed with the content in the draft AACHIA.

6.2 ISSUE SCOPING

The stakeholder consultation program identified the issues relating to the Modification that were of interest to stakeholders. The outcomes of stakeholder consultation guided the preparation of this EA. **Table 6** outlines the issues raised by stakeholders and shows where these issues have been addressed in this EA.

Table 6
Issues Raised by Stakeholders

Stakeholder	Issue	Where Addressed
DP&E	Comparison of subsidence effects for bord and pillar mining against the approved longwall mining activities	Section 8.5.3
	Quantification of water licensing requirements	Section 8.3.3
	Economic and employment benefits	Section 8.8.3
	History of mining operations at Dartbrook Mine	Section 3.2.2
	Use of excavated material generated by construction of the materials delivery shaft	Section 4.4
	Proposed mine closure strategy	Section 4.6
DRG	Challenges experienced by previous mining operations at Dartbrook Mine	Section 3.2.2
	Proposed rehabilitation measures	Section 4.6
	Resource utilisation resulting from bord and pillar mining	Section 4.2.3
Dol-Water	Peer review of groundwater impact assessment	Section 8.3.2
	Licensing of water takes	Section 8.3.3
	Management of brine generated by the Evaporation Ponds	Section 8.4.3
CCC	Management of gas levels during mining	Section 4.3.5
	Management of salt residue along haul roads	Section 8.4.3
	Dust generated by the proposed hauling of coal	Section 8.1.3
	Justification of the proposed coal clearance system	Section 10.2
	Economic viability of the Modification	Section 8.8.3
MSC	Environmental impacts associated with the Modification	Section 8
	Socio-economic considerations	Section 8.8
UHSC	Dust impacts associated with truck haulage along unsealed roads	Section 8.1.3
	Noise associated with activities at the East Site	Section 8.2.3
	Permissibility of mining under the Upper Hunter LEP	Section 5.3.3

7 RISK ASSESSMENT

This section describes the risk assessment used to scope the environmental studies included in this EA.

A preliminary risk assessment was undertaken to identify the potential environmental issues associated with the Modification. The purpose of the risk assessment was to inform the environmental impact studies undertaken for this EA.

Each of the environmental issues identified in the risk assessment have been assessed and where appropriate, management and mitigation measures have been developed. The risk assessment was based on the predicted residual impacts (i.e. assuming the implementation of appropriate management and mitigation measures). Each of the potential environmental issues was ranked as being of low, moderate, high or critical risk. **Table 7** summarises the risk ratings for the identified environmental risks.

Due to the minor nature of the Modification, no environmental issues were determined to be 'high' or 'critical' risks.

Table 7
Environmental Risk Ratings

Risk Rating	Aspect
Critical	
High	
Moderate	Air quality, Noise, Groundwater
Low	Surface water, Subsidence, Ecology, Aboriginal heritage, Visual, Traffic, Agriculture

8 IMPACTS, MANAGEMENT AND MITIGATION

This section presents the potential environmental impacts of the Modification and summaries the measures that will be implemented to manage and mitigate these impacts.

8.1 AIR QUALITY

8.1.1 Background

An Air Quality Impact Assessment (AQIA) was undertaken by ERM (formerly Pacific Environment). The Air Quality Impact Assessment is provided in full in **Appendix B**.

8.1.2 Methodology

The AQIA was undertaken in accordance with the NSW Environment Protection Authority's (EPA) "Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW" (EPA, 2016) (Approved Methods).

The AQIA focused on particulate matter (Total Suspended Particulates (TSP), Particulate Matter <10 µm (PM₁₀), Particulate Matter <2.5 µm (PM_{2.5})) and deposited dust, as these are the key pollutants associated with mining development. The potential emissions due to the Modification were assessed against the criteria in the Approved Methods and the *Voluntary Land Acquisition and Mitigation Policy* (VLAMP) (NSW Government, 2014).

Table 8 summarises the relevant air quality criteria for concentrations of particulate matter. It is important to note that the NSW EPA criteria (in the Approved Methods) are applied to cumulative impacts (due to the Modification and other sources), whereas the VLAMP criteria differentiate between incremental impacts (due to the Modification alone) and cumulative impacts.

Table 8
Air Quality Assessment Criteria

NSW EPA Impact Assessment Criteria for Particulate Matter			
Pollutant	Criteria	Averaging Period	Source
TSP	90 µg/m ³	Annual	NSW EPA (2016)
PM ₁₀	50 µg/m ³	24-Hour	NSW EPA (2016)
	25 µg/m ³	Annual	
PM _{2.5}	25 µg/m ³	24-Hour	NSW EPA (2016)
	8 µg/m ³	Annual	
NSW EPA Impact Assessment Criteria for Deposited Dust			
Pollutant	Averaging Period	Maximum Increase (due to Modification)	Maximum total level
Deposited Dust (insoluble solids)	Annual	2 g/m ² /month	4 g/m ² /month

Mitigation Criteria under the VLAMP			
Pollutant	Criteria	Averaging Period	Application
TSP	90 µg/m ³	Annual	Cumulative impact
PM ₁₀	50 µg/m ³	24-Hour	Incremental impact ^(a)
	30 µg/m ³	Annual	Cumulative impact
Deposited Dust	2 g/m ² /month	Annual	Incremental impact ^(a)
	4 g/m ² /month	Annual	Cumulative impact
Acquisition Criteria under the VLAMP			
Pollutant	Criteria	Averaging Period	Application ^(b)
TSP	90 µg/m ³	Annual	Cumulative impact
PM ₁₀	50 µg/m ³	24-Hour	Incremental impact ^(c)
	30 µg/m ³	Annual	Cumulative impact
Deposited Dust	2 g/m ² /month	Annual	Incremental impact ^(c)
	4 g/m ² /month	Annual	Cumulative impact

^(a) Zero allowable exceedances of the criterion over the life of the development.

^(b) Voluntary acquisition rights apply where the Proposal contributes to exceedances of the acquisition criteria at any residence or workplace on privately-owned land, or on more than 25% of any privately-owned land, and a dwelling could be built on that land under exiting planning controls.

^(c) Up to five allowable exceedances of the criterion over the life of the development.

Modelling

The air dispersion modelling conducted for the AQIA utilised advanced modelling system consisting of the TAPM and CALMET/CALPUFF models.

The modelling exercise included emissions from:

- Truck hauling of ROM coal on sealed and unsealed section of road;
- Dumping of coal into the ROM bin at the new shaft site;
- Conveyor transfer points;
- Crushing and screening of coal;
- Use of coal stockpiles including stacking and reclaiming;
- Train loading activities; and
- Ventilation shafts.

Best practice dust controls were identified in accordance with *NSW Coal Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (Donnelly et al, 2011). The proposed dust controls were incorporated into the dispersion model.

The dispersion modelling predicted dust levels at all sensitive receptors in the vicinity of the Modification. Receptors that are within Mount Pleasant Mine's zone of acquisition (Receptors 153, 212, 228, 238, 242, 244, 374, and 391) were excluded from the impact assessment.

Data

Meteorological data used in the modelling was derived from four nearby OEH monitoring stations and the two on-site meteorological stations (Met01 and Met02). The available data was reviewed and data from 2014 was considered to be the most representative of the local weather conditions.

The background air quality was determined using monitoring data from the four nearest OEH monitoring stations, as well as the Dartbrook air quality monitoring network. The four OEH stations measure PM₁₀ levels and of these, the Muswellbrook station also measures PM_{2.5} concentrations. Dartbrook Mine currently has a network of 17 dust deposition gauges, and five High Volume Air Samplers (HVAS) that measure PM₁₀ every sixth day.

The measured concentrations were used to determine background levels. Based on the available monitoring data, it has been assumed that the following background concentrations apply in the vicinity of the Modification:

- Annual average TSP concentration of 44.8 µg/m³;
- Annual average PM₁₀ concentration of 17.9 µg/m³;
- 24-hour average PM₁₀ concentration – varies daily (based on OEH Aberdeen 2014 daily data);
- Annual average PM_{2.5} concentration of 7.6 µg/m³;
- 24-hour average PM_{2.5} concentration – varies daily (calculated based on the application a PM_{2.5} / PM₁₀ ratio to OEH Aberdeen 2014 daily data); and
- Annual average dust deposition of 1.5 g/m²/month.

The OEH Aberdeen station does not monitor PM_{2.5} levels. To estimate the background PM_{2.5} concentration in the vicinity of Dartbrook Mine, the ratio of PM_{2.5} to PM₁₀ (as measured at the OEH Muswellbrook station) was applied to the measured PM₁₀ concentrations at the OEH Aberdeen station. The annual average PM_{2.5} concentration was estimated to be 7.6 µg/m³, which is close to the EPA's assessment criteria of 8 µg/m³.

The background levels were assumed to include the contributions from operating mines in the vicinity. The Mount Pleasant Mine was not in operation in 2014. The contribution of Mount Pleasant Mine to background concentrations was estimated using modelling.

8.1.3 Impact Assessment

Total Suspended Particulates

In relation to annual average TSP concentrations, the model predicted no exceedances of the EPA or VLAMP impact assessment criteria of $90 \mu\text{g}/\text{m}^3$ either due to the Modification alone or cumulatively.

Dust Deposition

In relation to dust deposition levels, the model predicted no exceedances of the incremental criterion of $2 \text{ g}/\text{m}^2/\text{month}$. The model also predicted that the cumulative criterion of $4 \text{ g}/\text{m}^2/\text{month}$ will not be exceeded at any sensitive receptors.

PM₁₀

In relation to annual average PM₁₀ concentrations, there are no predicted exceedances of the EPA impact assessment criterion of $25 \mu\text{g}/\text{m}^3$ or the VLAMP criteria of $30 \mu\text{g}/\text{m}^3$, either due to the Modification alone or cumulatively.

No sensitive receptors are predicted to experience 24-hour average PM₁₀ concentrations above the VLAMP criteria of $50 \mu\text{g}/\text{m}^3$ due to the Modification alone.

Based on the air quality monitoring data for 2014, there were two days where the background 24-hour average PM₁₀ concentrations were greater than the EPA impact assessment criterion of $50 \mu\text{g}/\text{m}^3$. The elevated PM₁₀ concentrations were due to a fire on one day and a state-wide dust event on the other. The exceedances of the criterion on these days were not attributable to the Modification.

The model predicted that the Modification may result in two additional exceedances of the cumulative 24-hour average PM₁₀ criterion at Receptor 181. This receptor is currently within Mount Pleasant Mine's zone of management. Another fifteen receptors are predicted to experience one additional exceedance of the 24-hour average PM₁₀ criterion. The assumed background concentration for this day was $48.7 \mu\text{g}/\text{m}^3$ which correlates with the monitored concentration on 10 February 2014. The elevated background concentration on this day was due to a large bush fire in the area. If this day is excluded from the analysis, there are no other predicted exceedances of the 24-hour average PM₁₀ criterion at these fifteen receptors.

The VLAMP criterion for 24-hour average PM₁₀ only applies to incremental impacts, not cumulative impacts. Therefore, exceedances of this criterion on a cumulative basis do not give rise to any acquisition or mitigation obligations.

PM_{2.5}

In relation to annual average PM_{2.5} concentrations, there are no predicted exceedances of the EPA impact assessment criterion of $8 \mu\text{g}/\text{m}^3$ due to the Modification alone.

When background concentrations and the predicted contribution from Mount Pleasant Mine are included, four sensitive receptors are predicted to experience annual average PM_{2.5} concentrations above the criterion of 8 µg/m³. One of these receptors (181) is currently within Mount Pleasant Mine's zone of management. At the other three receptors, the contribution from the Modification is relatively small (ranging from 0.4 to 0.7 µg/m³). The exceedances are predominantly due to the background PM_{2.5} concentration (7.6 µg/m³) being close to the criterion.

No sensitive receptors are predicted to experience 24-hour average PM_{2.5} concentrations above the EPA impact assessment criterion of 25 µg/m³, either due to the Modification alone or cumulatively.

The VLAMP does not include any criteria for PM_{2.5} concentrations. Therefore, the predicted PM_{2.5} concentrations do not give rise to any acquisition or mitigation obligations.

The full results of the air quality modelling are presented in **Appendix B**.

8.1.4 Management and Mitigation Measures

AQC will update its Air Quality Management Plan in consultation with the relevant regulatory authorities. The Air Quality Management Plan will outline the proposed dust controls for the Modification, including the following:

- Utilising the sealed Western Access Road for hauling of ROM coal (with street sweepers operating along the sealed road);
- Use of water sprays on the unsealed section of the haul route;
- Trucks to be covered whilst transporting ROM coal to the new shaft site;
- Limiting truck speeds to 30 km/h on unsealed roads and 50 km/h on sealed roads;
- Sealing of the trucking surface at the new shaft site;
- Installation of an enclosure around the ROM bin at the new shaft site;
- Use of automatically triggered water sprays within the enclosure at the ROM bin;
- Use of automatic water sprays on all coal stockpiles;
- Water application at above ground conveyor transfer points; and
- Real time air quality monitoring.

8.2 ACOUSTICS

8.2.1 Background

An Acoustic Impact Assessment was undertaken by Bridges Acoustics. The Acoustic Impact Assessment is provided in full in **Appendix C**.

Noise Criteria

Intrusive noise criteria are prescribed by Condition 6.4.1 of DA 231-7-2000. The intrusive noise criteria apply to the operational phase of a development. DA 231-7-2000 assigns different noise criteria for each of the three groups of receptors in the vicinity of Dartbrook Mine (see **Table 9**).

Table 9
Operational Noise Criteria

Receptor Group	Intrusive Noise Criteria (dBA) – Leq (15 minute)		
	Day	Evening	Night
East Site receivers	50	50	41
West Site receivers	40	40	35
Aberdeen	49	42	40

The relevant noise levels for the construction phase are prescribed by the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009). The ICNG recommends two levels for the assessment of construction noise:

- The 'noise affected level' (10 dBA above the background noise level) represents the level at which there may be some community reaction to noise; and
- The 'highly noise affected level' (75 dBA) which represents the level above which there may be a strong community reaction to noise.

The noise affected levels under the ICNG are not strict noise limits. Instead, they are trigger levels for implementing further noise control measures.

The construction activities associated with the Modification will generally occur only during the day period. Accordingly, noise affected levels were determined based on background noise levels for the day period. The East Site receivers are remote from the proposed construction activities and as such, as not expected to be affected by construction noise.

The daytime intrusive noise criteria for the West Site receivers and Aberdeen are 40 dBA and 49 dBA respectively. The intrusive noise criteria represent the noise levels that are 5 dBA above the background level. Therefore, the background noise levels for the West Site receivers and Aberdeen are approximately 35 dBA and 44 dBA respectively. In accordance with the ICNG, the noise affected levels adopted for the West Site Receivers and Aberdeen are 45 dBA and 54 dBA respectively.

8.2.2 Methodology

Noise modelling was undertaken to predict noise levels at private receptors during both the construction and operational phases of the Modification. Noise modelling was undertaken using RTA Technology's Environmental Noise Model (ENM) software. ENM is capable of providing a detailed assessment of the effects of atmospheric conditions on noise propagation. ENM is recognised as one of the most appropriate models for situations involving complex topography and a large number of individual noise sources.

The weather conditions recorded by the Dartbrook meteorological station (Met02) in 2014 were utilised for the noise model. Prevailing winds were determined using recorded wind speed and direction data, in accordance with the procedure prescribed by the *Noise Policy for Industry* (NPI, 2017).

The noise model incorporated all surface activities associated with the Modification, including:

- Truck haulage of ROM coal from the Kayuga Entry to the new shaft site and return truck movements;
- Loading of coal into the ROM bin at the new shaft site;
- Use of coal handling infrastructure at the East Site;
- Crushing of ROM coal at the East Site; and
- Loading of trains at the East Site.

Underground activities will not result in perceptible noise at sensitive receptor locations and as such, have not been considered in the noise modelling. The coal preparation plant (washery) has also not been modelled as the Modification does not propose any washing of coal.

The proposed noise controls (see **Section 8.2.4**) were incorporated into the noise model. That is, the predicted noise levels represent the residual impacts after reasonable and feasible noise controls have been implemented.

The assumptions used in the noise model are discussed in detail in the Acoustic Impact Assessment (see **Appendix C**).

8.2.3 Impact Assessment

Construction Noise

The construction of the new shaft site will involve the following construction activities:

- Earthworks;
- Excavation of the shaft;
- Roadworks associated with the sealed truck bay; and
- Construction of the ROM bin and shed enclosure.

Of these activities, the initial earthworks and excavation of the shaft have the potential to generate the highest noise levels. The equipment required for these tasks is predicted to generate a combined sound power level of 113 dBA. The noise level at the nearest receptor (located near Aberdeen) is predicted to be $43 L_{Aeq,15min}$, which is within the noise affected level of $54 L_{Aeq,15min}$. Therefore, the construction activities associated with the Modification are not expected to result in any exceedances of the noise affected levels under the ICNG.

Operational Noise

The noise model predicts that the Modification will comply with the intrusive criteria for all East Site receivers and West Site receivers. The model predicts that five receptors in Aberdeen may experience a worst case noise level of 41 L_{Aeq,15min} during the night period. This worst case noise level exceeds the intrusive criteria for the night period by 1 dBA. The worst case noise level will only eventuate if the following occur simultaneously:

- Loading of trains;
- Operation of the dozer on the northern face of the circular stockpile (such that it is not shielded from receptors to the north); and
- Worst case weather conditions including a strong temperature inversion and strong southerly or south-easterly winds.

The VLAMP states that exceedances of noise criteria by 0-2 dBA are negligible and do not warrant any acoustic treatments at the receptors.

A frequency analysis undertaken in accordance with Fact Sheet C of the NPI determined that no corrections for low frequency noise are required.

Other Noise Criteria

Sleep disturbance criteria apply to the night period (10pm to 7am). To minimise potential impacts during the evening and night periods, truck haulage of ROM coal will only occur during the day period (7am to 6pm). Surface operations during the night period will be limited to handling of coal and train loading at the East Site. These activities are currently approved under DA 231-7-2000 and therefore do not need to be re-assessed against the sleep disturbance criteria.

Road traffic noise criteria apply to noise generated by vehicle movements to and from the site. The operational workforce for the Modification (approximately 99 personnel) is substantially less than the approved maximum workforce of 292 personnel. Due to the lower number of personnel movements, road traffic noise generated by the Modification will be within that of the approved development.

Similarly, the Modification will not require more train movements than the currently approved development. Therefore, rail noise generated by the Modification will be within the levels associated with the approved development.

8.2.4 Management and Mitigation Measures

AQC will prepare a Noise Management Plan in consultation with the relevant regulatory authorities. The Noise Management Plan will include noise controls for both the construction and operational phases of the Modification. The proposed noise controls include the following:

- Truck haulage of ROM coal will be limited to the day period on weekdays only, to avoid truck noise during the more sensitive evening and night periods;

- Haul trucks will be road registered and maintained in good condition, particularly the exhaust silencers and suspension components to minimise noise from the engine and body;
- Truck engine brakes will not be used unless a trial indicates acceptable noise levels at nearest receptors;
- The unsealed section of the haulage route will be regularly maintained to minimise empty truck body noise over bumps;
- Truck speeds will be limited to 30 km/h on the unsealed sections of road and 50 km/h on sealed roads;
- The proposed ROM bin at the new shaft site will be partially enclosed in a shed, with a solid wall on the northern side to minimise noise to the closest receptors to the north;
- The infrastructure for crushing and stockpiling of coal (i.e. stackers) will only be used during the day period. However, the infrastructure required for loading of trains will be required 24 hours per day; and
- The dozer on the circular coal stockpile (required for train loading operations) will be limited to slow speed operation in reverse during the evening and night periods.

8.3 GROUNDWATER

8.3.1 Background

A groundwater assessment for the Modification was undertaken by Australasian Groundwater and Environmental Consultants (AGE). The groundwater assessment is provided in full in **Appendix D**.

Existing Groundwater Regime

There are three groundwater systems present in the vicinity of Dartbrook Mine, namely:

- Alluvial aquifers associated with the Hunter River, Dart Brook and Sandy Creek;
- Weathered bedrock (regolith); and
- Whittingham Coal Measures (Permian).

The alluvial sediments along the Hunter River, Dart Brook and Sandy Creek consist of unconsolidated sediments of Quaternary age. These alluvial sediments typically range in thickness from 4 m to 15 m. The Hunter River and Dart Brook alluvial aquifers are the main groundwater bearing units in the vicinity of Dartbrook Mine.

The regolith (immediately beneath the ground surface) is a less significant water source than the alluvial aquifers. Nonetheless, the regolith is utilised as a water source by landowners that do not have access to the alluvium. The regolith exhibits higher hydraulic conductivity than the underlying Permian strata due to weathering effects. Groundwater quality within the regolith generally varies from brackish to saline.

The Permian groundwater system has limited value due to the low hydraulic conductivities of the overburden and interburden strata. Groundwater quality within the Permian groundwater system ranges from brackish to saline.

The alluvium and regolith are directly recharged by rainfall. The regolith provides recharge to the Permian strata via areas of coal seam and interburden outcrop. The groundwater table within the regolith and Permian is a subdued reflection of the surface topography. The direction of groundwater flow is towards the low-lying alluvial floodplains to the east of the underground mining area.

Monitoring data indicates that previous mining activities at Dartbrook Mine have reduced groundwater levels and pressures within the regolith and Permian. Regional groundwater levels within the alluvium have not been perceptibly affected by previous mining activities.

8.3.2 Methodology

Previous Groundwater Modelling

The Dartbrook EIS included a groundwater assessment undertaken by Mackie Environmental Research (MER, 2000). MER developed a numerical groundwater model (using the MODFLOW code) to assess the impacts of the approved longwall panels, including the Kayuga Seam longwall panels (see **Figure 7**). The groundwater model predicted the rates of mine inflow and seepage from the alluvium.

Unlike longwall mining, the bord and pillar mining method does not result in significant fracturing of the overburden strata. As a result, the magnitude of groundwater inflows and depressurisation is expected to be significantly less for bord and pillar mining. Given that the impacts of the approved longwall mining have previously been modelled, and that the Modification will not exceed these impacts, the potential impacts of the Modification have been assessed using analytical methods.

Water Balance

An analytical water balance for the Wynn Seam goaf was undertaken to estimate the quantity of seepage from the Permian groundwater system. The inflows and outflows for the Wynn Seam water balance are listed in **Table 10**.

Table 10
Wynn Seam Goaf Water Balance

Inflows	Outflows
Water pumped from the Hunter Tunnel	Water pumped to the surface (using Pleuger pumps)
Inflow from the overlying Kayuga Seam	
Seepage from the Permian groundwater system	

The water management system for the underground workings is conceptually illustrated in **Figure 19**. Groundwater seepage into the Hunter Tunnel accumulates at a low point along its length. The accumulated water is pumped to the Wynn Seam goaf for storage.

The No. 2 Shaft intersects both the Kayuga and Wynn Seams. The shaft intersects the Kayuga Seam at approximately 100 mAHD. If the water level in the Kayuga Seam reaches 100 mAHD, the stored water will flow down the No. 2 shaft into the Wynn Seam goaf.

Outflows from the Wynn Seam goaf only occur via pumping of water to the surface facilities. When the water level in the Wynn Seam reaches -66 mAHD, the Pleuger pumps are activated to pump water to the surface.

AQC monitors the volumes of water that are actively pumped into and out of the Wynn Seam goaf. Using these monitored values, the contributions of the Kayuga Seam and Permian groundwater system were able to be estimated.

Analytical Groundwater Model

AGE used an analytical groundwater model to estimate inflows to the Kayuga Seam as a result of the proposed bord and pillar mining. The rate of seepage from the Kayuga Seam was estimated using Darcy's equation for steady state groundwater flow:

$$Q = K * i * A$$

Q – Seepage from the coal seam face (m³/day)

K – Hydraulic conductivity (m/day)

i – Steady state hydraulic gradient

A – Cross sectional area of the aquifer (m²)

The proposed bord and pillar mine plan was represented in the analytical model as a series of rectangular prisms with a length of 3,500 m and height of 3.2 m (the average extraction height).

The analytical method was applied to two scenarios based on different assumptions regarding hydraulic conductivity:

- Scenario 1 assumed a constant hydraulic conductivity (K) of 0.19 m/day (which was the value used in the MER model); and
- Scenario 2 assumed K values ranging from 0.03 to 0.0002 m/day, with hydraulic conductivity decreasing with depth.

The hydraulic gradient was calculated relative to the groundwater level at monitoring bore DDH193.

The analytical method is described in further detail in **Appendix D**.

Drawdown Predictions

Monitoring of groundwater levels has been undertaken at Dartbrook Mine since active mining operations in the late 1990s. This monitoring has continued throughout the care and maintenance period. Long term trends in water levels were used to identify impacts due to previous mining activities and to assess the potential for drawdown as a result of the Modification.

Peer Review

To provide confidence in the analytical methods used for the groundwater assessment, Dr Noel Merrick of HydroSimulations was engaged to undertake an independent peer review of the assessment conducted. The analytical methodology was reviewed and supported by the peer reviewer.

The peer reviewer concluded that “the groundwater assessment performed by AGE, though non-conventional, is competent and sufficient for the purpose of assessing relative impacts compared with previous predictions”. The groundwater peer review is provided in full in **Appendix E**.

8.3.3 Impact Assessment

Water Balance

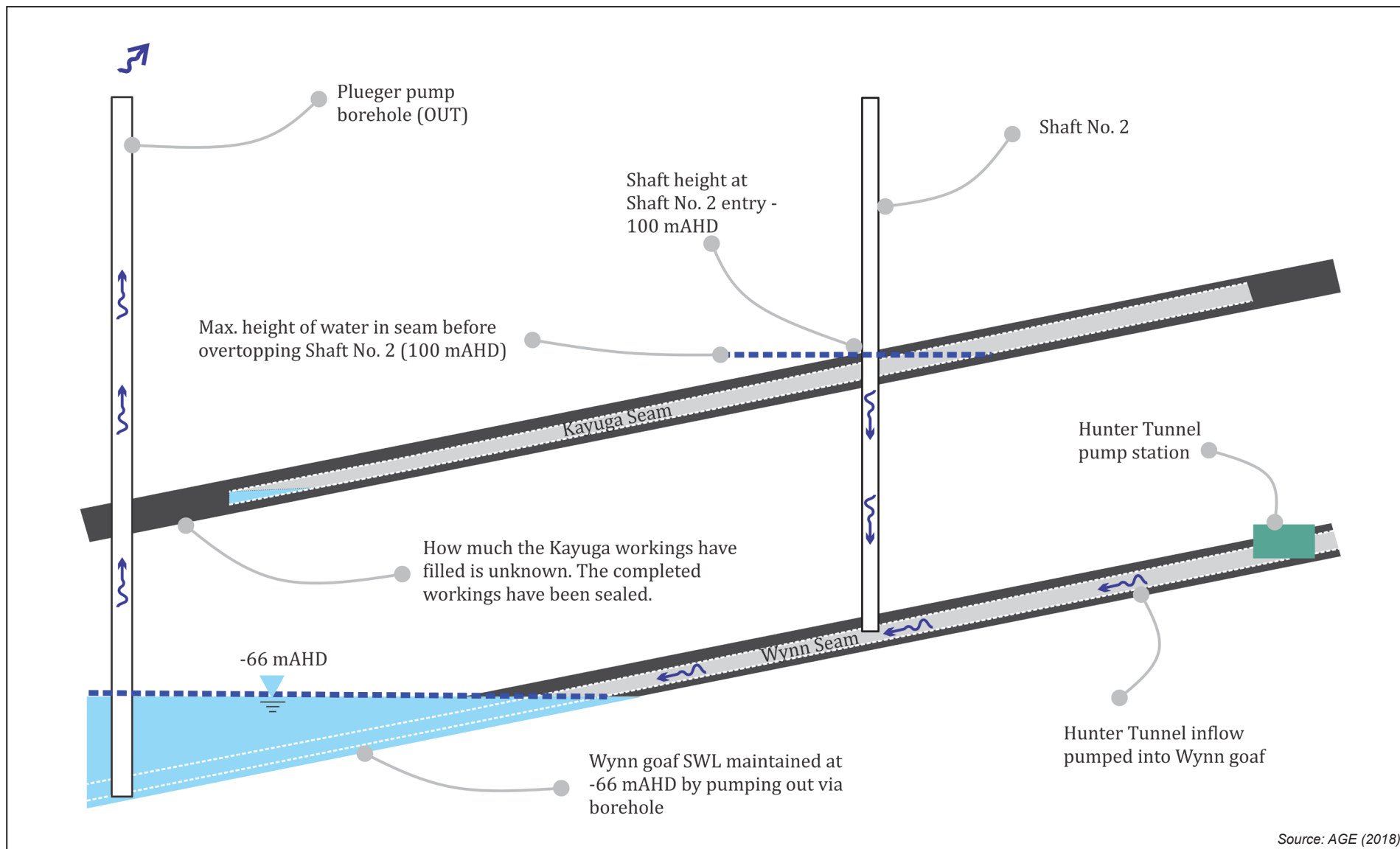
Volumes of water pumped into and out of the Wynn Seam goaf have been monitored throughout the care and maintenance phase. The available monitoring data indicates that the rate of seepage into the Hunter Tunnel is consistently around 3 ML/week. This seepage is primarily derived from the Hunter River alluvial aquifer.

The available monitoring data indicates that the volume of water pumped out of the Wynn Seam goaf is approximately equal the volume of water pumped from the Hunter Tunnel into the goaf. This suggests that seepage from the Kayuga Seam and Permian strata are negligible. If there was material seepage from these groundwater systems, the volume of water pumped out of the goaf would exceed the volume of water pumped in.

Analytical Groundwater Model

Under both Scenarios 1 and 2, the analytical method (using Darcy’s equation) predicted that the rate of seepage into the Kayuga Seam will be very low (<10 ML/year).

MER (2000) predicted that inflow to the Kayuga Seam (as a result of the approved longwall mining) would range from 0.2 to 1.2 ML/day (73 to 438 ML/day). Therefore, the proposed bord and pillar mining will result in substantially less seepage than the approved longwall mining activities in the Kayuga Seam.



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Water Management System – Underground Workings

FIGURE 19

Drawdown Predictions

Groundwater levels in the Kayuga Seam are monitored at three locations (DDH183, DDH193 and Kayuga 1). Long term trends for these bores indicate that some drawdown occurred during longwall mining of the Kayuga Seam in 2005-6. Since the commencement of care and maintenance, water levels have stabilised and fluctuations are reflective of climatic conditions. The relatively stable water levels since 2007 suggests that there is very limited drainage of groundwater into the Kayuga Seam workings and that the zone of drawdown does not extend significantly beyond the completed mine workings.

Groundwater levels in the alluvium are monitored at four locations (JOR1, FRA1, KAI1 and WAL2). Long term trends for these monitoring bores indicate that previous longwall mining operations did not result in any drawdown of alluvial aquifers. This observation is consistent with the predictions of the MER (2000) model. The Modification is also not expected to result in any drawdown of the alluvial aquifers. Rainfall recharge of alluvium is expected to negate any seepage associated with groundwater depressurisation.

Water Licensing

The groundwater systems in the vicinity of Dartbrook Mine are all subject to WSPs. Consequently, WALs are required to account for all groundwater taken by Dartbrook Mine. The Modification is predicted to take less than 20 ML/year from the Permian groundwater system. This nominal value is a conservative estimate given that the water balance indicates minimal seepage into the Wynn Seam goaf and the application of Darcy's equation indicates minimal seepage into the Kayuga Seam workings.

Seepage into the Hunter Tunnel is currently in the order of 156 ML/year. Although this rate of seepage is not expected to increase as a result of the Modification, these inflows will continue to occur. **Table 11** compares the licensing requirements for the Modification with the share component currently held by the proponent. AQC currently holds sufficient WALs under the relevant WSPs to account for all predicted groundwater take.

Table 11
Water Licensing Requirements

Aquifer System	WSP	Water Source	Predicted Take (ML/year)	Existing WAL Entitlement
Permian	North Coast Groundwater	Sydney Basin-North Coast Groundwater Source	<20	180 units
Alluvium	Hunter Unregulated	Hunter Regulated River Alluvial Water Source	156	1,249 units

Impacts on Other Groundwater Users

There are 344 registered bores located within 2 km of the Mining Authorities Boundary. The majority of these bores draw water from the Hunter River and Dart Brook alluvial aquifers. The Modification is not expected to cause any detectable drawdown of shallow aquifers. Therefore, bores in the alluvium are not expected to be affected.

The Permian groundwater system may experience declines in water levels or pressures as result of the Modification. The modelling undertaken by MER (2000) estimated the region where drawdown will exceed 1 m. There are five private bores located within the modelled 1 m drawdown contour. However, it should be noted that the predictions of the MER (2000) model relate to longwall mining. The proposed bord and pillar mining is less likely to impact upon bore yields than the approved longwall mining activities.

Groundwater monitoring will be undertaken to determine if any private bores are impacted. If impacts are confirmed by monitoring data, AQC will continue to consult with affected landowners and 'make good' on the impacts to their water supply. Measures to restore water supplies may include deepening or replacing bores and / or providing a compensatory water supply.

Shaft Construction

The proposed materials delivery shaft will be located near the fringe of the Hunter River alluvium. It is not known whether the alluvium bears water at this location. If water is encountered in the early stages of shaft construction, the shaft will be lined to avoid creating a conduit between the alluvial aquifer and the Hunter Tunnel.

8.3.4 Management and Mitigation Measures

The proposed bord and pillar mining method minimises the potential for impacts on groundwater systems because it does not result in significant cracking of the overlying bedrock strata.

AQC will update its Site Water Management Plan to include the predicted lesser impacts of the Modification. This update will be undertaken in consultation with the relevant regulatory authorities. The Site Water Management Plan includes a Groundwater Monitoring Program. Groundwater monitoring will continue to be undertaken to confirm that the Modification does not result in any significant impacts to shallow groundwater systems. The Groundwater Monitoring Program will also determine if there are any impacts to private bores. If required, AQC will implement measures to 'make good' on impacts to third parties' water supplies.

During construction of the new shaft, inspections will be undertaken in the early stages of excavation to determine if the alluvial aquifer is intercepted at this location. If groundwater is identified, the perimeter of the shaft will be lined to prevent leakage of water down the shaft.

8.4 SURFACE WATER

8.4.1 Background

The existing water management system at Dartbrook Mine is described in **Section 3.2.8**. The water management system has been maintained throughout the care and maintenance phase. From a water management perspective, Dartbrook Mine has historically been self-sufficient. That is, it has rarely required raw water from external sources or needed to discharge water from the site. The key objectives of water management for the Modification will be to minimise offsite discharges and demands on external water supplies.

8.4.2 Methodology

An analytical water balance was undertaken to identify changes to the onsite water balance that may result from the Modification. The Modification will not involve any changes to the existing water management system. However, the volumes of inflows and outflows are expected to change once mining operations re-commence. The inflows and outflows that are relevant to the water balance for Dartbrook Mine are listed in **Table 12**.

Table 12
Water Management System Inflows and Outflows

Inflows	Outflows
Seepage into the Hunter Tunnel	Use of water for operational activities*
Seepage into mine workings*	Evaporation (from surface dams and Evaporation Ponds)
Runoff captured by dams	Discharges in accordance with the HRSTS
Raw water from external water sources	

** The magnitude of these flows is expected to change as a result of the Modification*

The water balance during care and maintenance has generally not included external water supplies or offsite discharges. Since this is the desirable outcome, the water balance for the care and maintenance phase was adopted as the base case. As indicated in **Table 12**, the Modification is expected to increase seepage to the mine workings, as well as operational water demands (due to additional dust suppression requirements). The water balance undertaken for the Modification has determined the net change to the base case. The results of the water balance were used to formulate management strategies to maintain the base case (as far as practicable).

8.4.3 Impact Assessment

Changes to Catchment Areas

The additional surface infrastructure proposed for the Modification will be located remote from the catchments of the East Site and West Site. Accordingly, the Modification will not alter the catchment areas draining to the East Site or West Site.

The new shaft site will be located within the catchment of the Hunter River. Runoff drains in a generally north to south direction across the site, passing beneath the Western Access Road via existing culverts. Diversion drains will be established to direct clean water runoff around the proposed infrastructure, thereby minimising the impact on catchment flows. Direct rainfall onto the infrastructure area will be captured and treated in sediment dams.

Water Balance

The water balance for Dartbrook Mine is schematically illustrated in **Figure 20**. Given that the Modification does not alter the catchments of the East Site and West Site, the volumes of runoff to the EHD, WHD and SDD are not expected to change.

The groundwater assessment undertaken by AGE predicted that the proposed bord and pillar mining will not result in significant drawdown of alluvial aquifers. Given that seepage into the Hunter Tunnel is primarily derived from the Hunter River alluvium, the volume of inflow is not expected to be altered by the Modification. The groundwater assessment also predicted that seepage into the Kayuga Seam workings will be low (<10 ML/year).

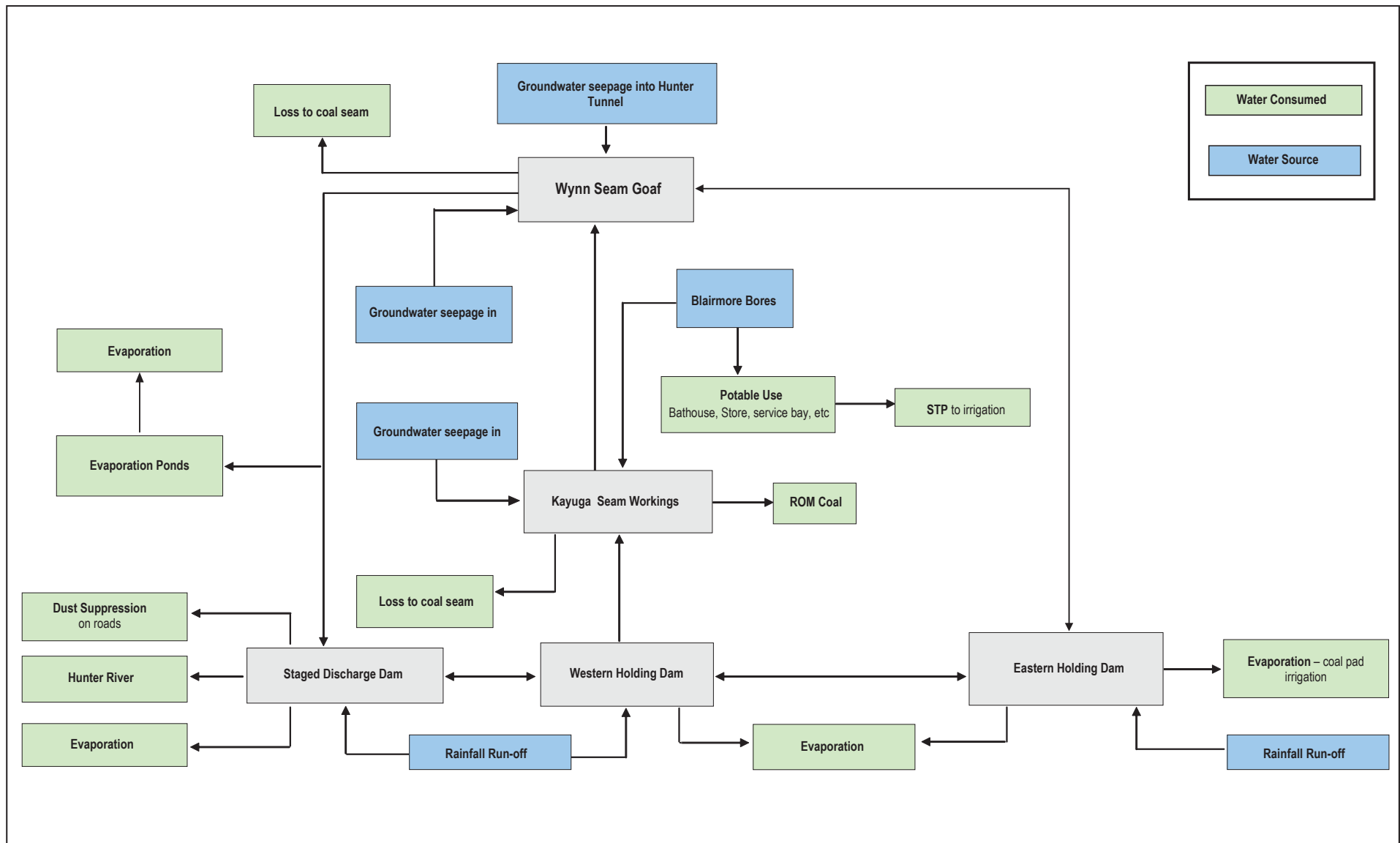
Compared to care and maintenance, the Modification is expected to increase operational water demands by approximately 0.5 ML/day (183 ML/year). The projected increase in water demand is predominantly due to dust suppression requirements.

The predicted increase in operational water demand is greater than the predicted seepage into the Kayuga Seam workings. That is, the additional outflows due to the Modification are greater than the additional inflows. As a result, the Modification is expected to result in a net decrease in water inventory (relative to the base case) of up to approximately 183 ML/day.

Under the base case, excess water in the Wynn Seam goaf is pumped to the surface and passively released using the Evaporation Ponds. During care and maintenance, Dartbrook Mine typically released 100 to 150 ML/year (depending on climatic conditions) through evaporation. It is expected that upon recommencement of mining, this volume of water will be used for operational purposes rather than being released through evaporation.

The Wynn Seam goaf has capacity to store approximately 2,915 ML of water. The stored volume is generally maintained so that the water level is at approximately -66 mAHD. At this water level, the stored volume within the goaf is estimated at 2,467 ML. The stored water can be used to satisfy the operational demands of the Modification. The current storage inventory at Dartbrook Mine is sufficient to meet the water demands of the Modification.

The water balance indicates that external supplies are not likely to be required. However, if raw water is required, AQC holds WALs that enable the taking of up to 3,053.8 ML from the Hunter River.



DARTBROOK MINE

Water Balance Schematic

FIGURE 20

Impacts to Water Quality

Given that the Modification is expected to create a net water deficit (compared to the base case), discharges of water from the site are unlikely to be required. However, if discharges are required, they will be undertaken in accordance with the conditions of the HRSTS and EPL 4885.

The unsealed section of the haul road is within the catchment of the West Site. Runoff from the unsealed road will be captured by the WHD, SDD or smaller sediment dams at the West Site. Therefore, the haul road will not result in any sediment-laden water leaving the site.

There is the potential for erosion and sedimentation to occur during the construction of the new shaft site. To mitigate these risks, AQC will implement appropriate sediment and erosion controls in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004).

Salt will accumulate in the Evaporation Ponds as a result of the evaporation process. Water levels are carefully managed so that the accumulated salt is not released into the surrounding catchment. If the ponds are dry, there is the risk that salt may be transported by wind. For this reason, low water levels are maintained in the Evaporation Ponds wherever practicable. To minimise the risk of overflows, diversion drains have been established around the ponds to minimise the volume of rainfall runoff reporting to the ponds. Water can also be actively pumped from the Evaporation Ponds if it is necessary to control water levels.

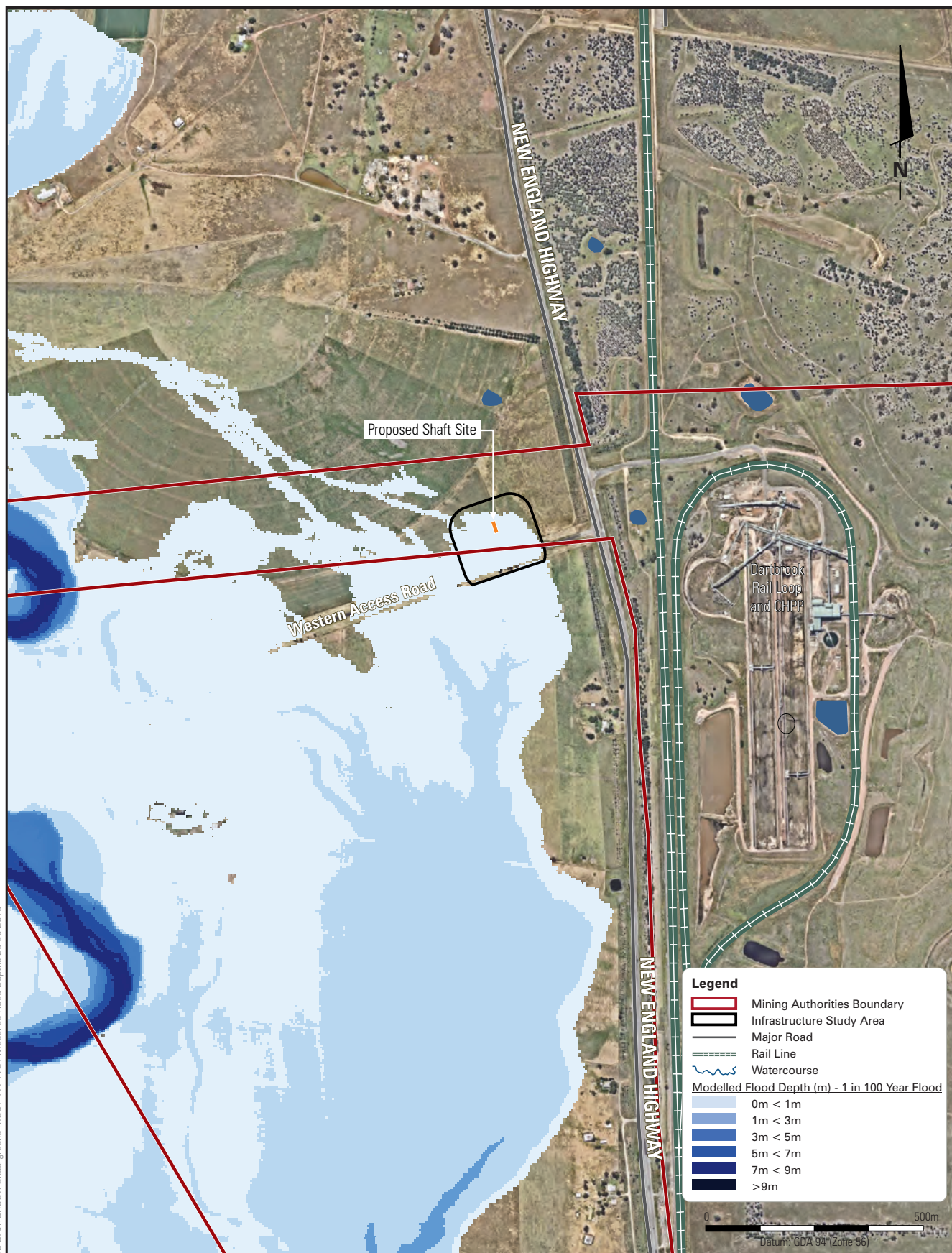
Stream Geomorphology

As shown in **Figure 13**, the proposed bord and pillar mining does not directly underlie the main channels of any streams. Furthermore, the bord and pillar workings will be designed such that they do not result in any perceptible subsidence. Therefore, the proposed mining activities are not expected to result in any impacts to stream geomorphology.

Flooding Impacts

A flood study for the Hunter River and Dart Brook was undertaken by WRM (2011). The study utilised hydraulic modelling to determine the extent of a 1 in 100 year flood event. As shown in **Figure 21**, the new shaft site will be located within the 1 in 100 year flood extent, albeit within the flood fringe. At the location of the proposed site, flood depths are expected to be less than 1 m. As explained in **Section 4.3.1**, an earthen bund will be constructed to protect the proposed shaft and ROM bin from the 1 in 100 year flood level.

All underground mining activities at Dartbrook Mine are located outside of the 1 in 100 year flood extents of the Hunter River and Dart Brook. Therefore, mining activities will not affect flood extents or levels.



DARTBROOK MINE

Modelled Flood Depths

FIGURE 21

8.4.4 Management and Mitigation Measures

AQC will update its Site Water Management Plan to accommodate the transition from care and maintenance back to active mining operations. The updates will reflect the projected water demands for the Modification and the strategies to satisfy these requirements. The update of the Site Water Management Plan will be undertaken in consultation with the relevant regulatory authorities.

The Site Water Management Plan will include an Erosion and Sediment Control Plan to mitigate potential impacts during the construction phase of the Modification. The Erosion and Sediment Control Plan will be designed in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004).

8.5 SUBSIDENCE

8.5.1 Background

To minimise the risk of impacts to surface features, the objective of the mine design was to limit subsidence to levels that are imperceptible for all practical purposes. In order to achieve this objective, the pillars must remain stable over the long term. SCT Operations (SCT) conducted a study to determine the pillar geometries required to limit surface subsidence and maintain long term pillar stability. The study undertaken by SCT is provided in full in **Appendix F**.

8.5.2 Methodology

The Modification proposes limited bord and pillar mining activities within the Kayuga seam, as an alternative to the approved longwall mining activities. The proposed bord and pillar panel layout is shown in **Figure 13**. The proposed mine plan can roughly be divided into two areas:

- The northern panels, which will overlie the completed longwall panels in the Wynn Seam (see **Figure 13**); and
- The southern panels, which will be remote from the longwall panels in the Wynn Seam.

For the southern panels, SCT used the University of New South Wales (UNSW) pillar design guidelines (Galvin et al, 1999) to determine the minimum pillar sizes required to achieve long term pillar stability. The UNSW pillar design guidelines recommend that in order to maintain long term stability, the pillars should be designed to a nominal factor of safety of 2.11.

The design of the pillars in the northern panels (above and adjacent to extracted longwall panels in the Wynn Seam) will require additional work. Previous longwall mining in the Wynn Seam has resulted in subsidence of up to 1.6 m and is expected to have caused variable stress conditions and voids within the strata. In order to design the pillars in the northern panels, the extent of the disturbance and the size of voids that are likely to be encountered in the Kayuga Seam will need to be confirmed. Numerical modelling, drilling of exploration boreholes and the development of exploratory headings in the Kayuga Seam will be relied upon to determine the nature of the disturbance, the stress field and the extent of open voids.

8.5.3 Impact Assessment

In the case of bord and pillar mining, subsidence may occur through two mechanisms:

- Elastic strata compression; and
- Pillar failure.

Elastic strata compression subsidence is caused when vertical stresses are concentrated on the pillars, resulting in compression of the pillars. The magnitude of subsidence due to elastic strata compression is typically less than 100 mm.

If vertical loads result in pillar failure, higher levels of subsidence (typically 0.5-1.5 m) would be expected to occur. Maintaining a nominal factor of safety of 2.11 is generally considered sufficient to provide long-term stability of pillars (i.e. avoid pillar failure).

By adopting the nominal factor of safety of 2.11, the pillars can be designed such that pillar failure does not occur. As a result, subsidence can be maintained at the low levels associated with elastic strata compression subsidence. As outlined in **Table 13**, SCT has recommended minimum pillar sizes for the pillars in the southern panels and predicted the vertical subsidence that may be experienced.

Table 13
Recommended Pillar Sizes for Southern Panels

Depth of Cover (m)	Pillar Size (m)*	Maximum Subsidence Estimated (mm)
140	23	30
160	29.5	60
180	31.5	60
200	33	70
220	34.5	80
240	36	80

* The size of a pillar is the distance between the centres of the roadways on either side of the pillar

Where the depth of cover is less than 150 m, the pillars will be 23 m wide. The maximum subsidence at depths of less than 150 m is expected to be less than 30 mm. The pillar size recommendations on a panel by panel basis are shown in **Appendix F**.

The predicted levels of subsidence are considered to be imperceptible for all practical purposes. The predicted levels of subsidence are not expected to result in any significant impact on surface features overlying the mine workings. The predicted vertical subsidence will also be significantly less than the subsidence that would occur if the approved longwall mining was carried out. **Table 14** compares the subsidence predictions for the proposed bord and pillar mining with the approved longwall mining in the Kayuga Seam.

Table 14
Comparison of Proposed and Approved Mining

Mining Method	Maximum Vertical Subsidence (m)	Maximum Tilt (mm/m)	Maximum Tensile Strain (mm/m)	Maximum Compressive Strain (mm/m)
Proposed bord and pillar mining	<0.1	Negligible	Negligible	Negligible
Approved longwall mining	2.2	61.0	13.5	20.3

8.5.4 Management and Mitigation

AQC will develop a Bord and Pillar Subsidence Management Plan (SMP) prior to undertaking bord and pillar mining. The SMP will be prepared in consultation with the appropriate regulatory authorities.

Numerical modelling and further field work will be undertaken to facilitate the design of the pillars in the northern panels. Recommended pillar sizes for the northern panels will be included in the SMP. All pillars will be constructed to the recommended sizes to ensure long term stability, thereby controlling subsidence to levels that are imperceptible for all practical purposes.

The SMP will also include a subsidence monitoring program to confirm that the pillars are behaving as intended, as well as a contingency plan to manage any greater than expected subsidence effects (if they occur).

8.6 ECOLOGY

8.6.1 Background

An Ecological Impact Assessment was undertaken by Cumberland Ecology. The Ecological Impact Assessment is provided in full in **Appendix G**.

8.6.2 Methodology

As explained in **Section 5.2.3**, the BC Act applies to proposed modifications of development consents granted under Part 4 of the EP&A Act. Section 7.17 of the BC Act states that a BDAR is required to be prepared for a proposed modification, but only if the development consent was granted after the commencement of the BC Act. The requirement for a BDAR does not apply to the Modification because DA 231-7-2000 was granted prior to the commencement of the BC Act. Nevertheless, the Ecological Impact Assessment has identified the potential impacts of the Modification on fauna, flora and ecological communities.

Study Area

Surface disturbance associated with the Modification will only occur within the Infrastructure Study Area. Accordingly, the assessment of direct impacts has been limited to the Infrastructure Study Area. The proposed bord and pillar mining will not result in perceptible subsidence. As such, detailed ecological assessments have not been undertaken for the area overlying the Proposed Bord and Pillar Mining Area.

Desktop Assessment

Cumberland Ecology conducted searches of the “BioNet Atlas” (OEH, 2018) and “Protected Matters Search Tool” (DoEE, 2018) to identify the threatened species (listed under the BC Act and/or EPBC Act) that have been recorded in the locality. The locality was defined as the area within a 5 km radius of the Infrastructure Study Area. The desktop assessment also included a review of previous ecological assessments undertaken at Dartbrook Mine.

Field Survey

The Infrastructure Study Area was surveyed by ecologists on 2 February 2018. The field survey verified the vegetation mapping for the Infrastructure Study Area. Photographs were taken to record the condition of the vegetation within the Infrastructure Study Area.

The floristic survey consisted of a single quadrat (20 m x 20 m) within the Infrastructure Study Area. The flora species present within the quadrat and their abundances were recorded. The Infrastructure Study Area consists primarily of agricultural grassland, which does not provide habitat for threatened flora species. As a result, threatened flora searches were not conducted during the field survey.

The field survey also included a fauna habitat assessment, which involved evaluations of habitat condition and complexity. The fauna habitat assessment also included searches for microhabitats (such as tree hollows, fallen logs, riparian areas etc).

8.6.3 Impact Assessment

Vegetation Communities

Due to previous agricultural development, there are no native vegetation communities present within the Infrastructure Study Area. The Infrastructure Study Area consists primarily of exotic grassland, with some planted vegetation along the southern side of the Western Access Road (see **Figure 22**).

The grassland areas are dominated by exotic species such as *Bromus catharticus* (Prairie Grass), *Urochloa* spp. and *Lolium rigidum* (Ryegrass). The occurrence of native grasses is limited to *Cynodon dactylon*, which is commonly used for improved pastures. The occurrence of native forbs is limited to scattered and isolated occurrences of *Einadia trigonos* (Fishweed), *Sida corrugata* (Corrugated Sida) and *Portulaca oleracea* (Pigweed). There are no trees within the paddocks to the north of the Western Access Road.

The treed vegetation within the Infrastructure Study Area consists of planted Eucalypts and *Casuarina cunninghamiana*.



DARTBROOK MINE

Vegetation Communities

FIGURE 22

Flora

The field survey identified 26 flora species within the Infrastructure Study Area. The majority of these flora species (20) are exotic species.

No threatened species were recorded within the Infrastructure Study Area during the field survey. Three threatened flora species have previously been recorded at Dartbrook Mine, namely:

- *Thesium australe* (listed under BC Act and EPBC Act);
- *Cymbidium canaliculatum* (listed under BC Act); and
- *Eucalyptus camaldulensis* (listed under BC Act).

However, these species are unlikely to occur within the Infrastructure Study Area due to the removal of suitable habitat by past agricultural land uses.

Fauna

No fauna species were identified during the survey of the Infrastructure Study Area. Ten threatened fauna species have previously been recorded at Dartbrook Mine. The threatened fauna species that have the potential to occur at Dartbrook Mine are highly mobile species, such as avifauna and bats. These species may fly-over the Infrastructure Study Area as part of a wider foraging or migratory range. However, there is no breeding or roosting habitat for these species within the Infrastructure Study Area.

The exotic grassland within the Infrastructure Study Area provides limited habitat for fauna species. There are no ground level habitat features (such as logs, bush rock, soaks or dams) present within the Infrastructure Study Area.

Direct Impacts

Surface disturbance associated with the construction of the new shaft site will be limited to the area north of the Western Access Road. The planted trees to the south of the Western Access Road will be retained. Therefore, the Modification will not result in the loss of any habitat features.

The direct impact of the Modification will be limited to the clearing of up to 2.28 ha of exotic grassland. Given that this grassland has minimal habitat value, the Modification will not result in any significant impacts to threatened species.

Indirect Impacts

The construction and operational of the proposed shaft site will generate dust emissions. Dust that settles on leaves may impair plant functions such as photosynthesis, respiration and transpiration. AQC will implement dust controls (as listed in **Section 8.1.4**) to minimise depositional dust levels during construction and operations. With the implementation of these dust controls, indirect impacts associated with dust are not expected to be significant.

Noise has the potential to adversely affect animal physiology and behaviour. As discussed in **Section 8.2.3**, noise levels generated by construction of the new shaft site and truck hauling operations are predicted to be within the regulatory noise criteria. Furthermore, due to the limited fauna habitat within the Infrastructure Study Area, noise levels generated by the Modification are unlikely to impact upon wildlife populations.

Artificial light has the potential to result in adverse impacts to fauna. The lighting at the new shaft site will be localised. Given that the Infrastructure Study Area provides minimal fauna habitat, lighting associated with the Modification is unlikely to result in any significant impacts to fauna.

8.6.4 Management and Mitigation Measures

The Modification has been designed to minimise impacts to biodiversity values. The proposed surface infrastructure has been sited entirely within a paddock, thus avoiding the need to disturb native vegetation. As such, the Modification has avoided ecological impacts to the greatest extent possible.

The following mitigation measures will be implemented to manage impacts during the construction phase of the Modification:

- The extent of clearing should be clearly demarcated and signposted to avoid clearing outside of the required disturbance area;
- Appropriate weed control measures (given that the vegetation to be cleared will be predominantly exotic species, it is recommended that the plant matter is disposed of); and
- Inductions to notify construction personnel of these mitigation measures.

These mitigation measures will be included in the Biodiversity Management Plan.

8.7 ABORIGINAL ARCHAEOLOGY

8.7.1 Background

An Aboriginal Archaeological and Cultural Heritage Impact Assessment (AACHIA) was undertaken by AECOM Australia (AECOM). The AACHIA is provided in full in **Appendix H**.

8.7.2 Methodology

The AACHIA was undertaken in accordance with the following guidelines:

- *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH, 2011); and
- *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b).

The AACHIA was undertaken in consultation with Aboriginal stakeholders, in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010a). Consultation with Aboriginal stakeholders is summarised in **Section 6.1.3**.

Study Area

Surface disturbance associated with the Modification will be limited to within the Infrastructure Study Area. Accordingly, the scope of the AACHIA was limited to the assessment of Aboriginal heritage values within the Infrastructure Study Area.

The proposed bord and pillar mining will not result in perceptible subsidence. As such, there is no potential for indirect impacts to Aboriginal items.

Desktop Assessment

The Hunter Valley has been extensively surveyed, with archaeological studies dating back to the 1930s. A literature review was undertaken to gain an understanding of past Aboriginal occupation in the region. Previous archaeological studies have formulated “occupation models”, which predict the nature and distribution of Aboriginal sites based on the occupation habits of Aboriginal populations.

A search of the Aboriginal Heritage Information Management Service (AHIMS) database was undertaken to identify previously recorded Aboriginal sites. The database search was undertaken for a 10 km x 10 km area around the Infrastructure Study Area.

Archaeological Survey

An archaeological survey of the Infrastructure Study Area was undertaken on 6 April 2013. The survey team included one archaeologist and three RAP representatives. Seven pedestrian transects were conducted within the Infrastructure Study Area. These transects investigated all parts of the Infrastructure Study Area and resulted in coverage of 96.9%.

8.7.3 Impact Assessment

The Infrastructure Study Area is approximately 3.2 ha in size and consists primarily of agricultural grassland. The land within the Infrastructure Study Area has been substantially modified by historical vegetation clearance, grazing and ploughing. The land is currently used for grazing associated with the Garoka Dairy (owned by AQC). Due to highly modified nature of the Infrastructure Study Area, Aboriginal materials are unlikely to be present.

The AHIMS search identified 119 valid sites within the 10 km x 10 km search area. The identified sites included 115 open artefact sites (isolated artefacts or artefact scatters) and 4 scarred trees. None of these sites are located within the Infrastructure Study Area.

No Aboriginal sites were identified during the archaeological survey of the Infrastructure Study Area. The potential for subsurface archaeological deposits was assessed as low due to the Infrastructure Study Area being a substantial distance from the nearest watercourse. The Infrastructure Study Area is located near the fringe of the Hunter River floodplain, and is approximately 1.1 km east of the river channel.

Given that there are no Aboriginal sites located within the Infrastructure Study Area, the Modification is not expected to result in any impacts to Aboriginal heritage values.

8.7.4 Management and Mitigation Measures

Given that the Modification is not expected to impact upon any Aboriginal sites, no management or mitigation measures are required. However, the Aboriginal Heritage Management Plan will be updated to include procedures for dealing with previously unrecorded Aboriginal objects (i.e. unanticipated finds) and human skeletal remains.

The procedure for dealing for previously unrecorded Aboriginal objects will be:

1. Cease work immediately to prevent any further impacts to the site;
2. Notify the person supervising the construction work;
3. Engage a suitably qualified archaeologist and RAP representative to determine the nature, extent and significance of the site and provide appropriate management advice. Management action(s) will vary according to the type of evidence identified, its significance (both scientific and cultural) and the nature of potential impacts; and
4. Prepare and submit an AHIMS site card for the site.

The procedure for dealing with human skeletal remains will be:

1. Cease work in vicinity of the remains immediately;
2. Cordon off the site and notify the NSW Police Force; and
3. If the Police suspect the remains are Aboriginal, they will contact OEH and arrange for a forensic anthropologist or archaeological expert to examine the site. If the remains are determined to be human and modern, the area will be treated as a crime scene under the jurisdiction of the NSW Police Force.

8.8 ECONOMICS

8.8.1 Background

An Economic Impact Assessment was undertaken by Gillespie Economics to predict the economic benefits that may be generated by the Modification. The Economic Impact Assessment is provided in full in **Appendix I**.

8.8.2 Methodology

The Economic Impact Assessment included a Cost Benefit Analysis (CBA) and Local Effects Analysis (LEA) undertaken in accordance with the following guidelines:

- *Guideline for the economic assessment of mining and coal seam gas proposals* (Economic Guideline) (NSW Government, 2015); and
- *NSW Government Guide to Cost-Benefit Analysis* (NSW Treasury, 2017).

Cost Benefit Analysis

The CBA predicted the net benefits of the Modification to Australia and NSW. The net benefit of a development is determined relative to the base case (or 'no development' scenario). If the Modification was not undertaken, it is likely that Dartbrook Mine would remain under care and maintenance until the expiry of the approval period (December 2022). The continuation of care and maintenance until 2022 was therefore adopted as the base case for this CBA.

Revenues were calculated based on an assumed coal price of US\$73 per tonne and an exchange rate (Australian Dollar to US Dollar) of 0.77. Due to the inherent variability of these parameters, sensitivity analyses were undertaken for +/- 30% revenues.

The costs of the Modification include capital expenditure, operating costs and external costs (which includes the costs attributed to the predicted environmental impacts). Sensitivity testing was also undertaken for all calculated costs.

The CBA was conducted using the standard discount rate of 7%. In addition, discount rates of 4% and 10% were used for sensitivity testing.

Local Effects Analysis

The LEA was undertaken to predict the economic benefits to the local economy. The Local Area was defined as the Singleton, Muswellbrook and Upper Hunter LGAs. The LEA was conducted in accordance with the methodology prescribed by the Economic Guideline. Compared to other methods (such as input-output or computable general equilibrium modelling), the methodology prescribed by the Economic Guideline generally provides a conservative estimate of local economic impacts.

8.8.3 Impact Assessment

Cost Benefit Analysis

The CBA predicted that the Modification will result in net production benefits valued at \$187M (present value at 7% discount rate). AQC is estimated to be 90% Australian owned. Hence, the components of the net production benefits that accrue to Australia are royalties, company tax (assuming a 30% company tax rate) and 90% of the residual net production benefits. On this basis, the net production benefits that accrue to Australia are estimated at \$176M (present value).

In addition to net production benefits, the Modification will generate benefits to employees and suppliers. When these benefits are considered, the net social benefit to Australia is estimated at \$236M (present value).

The component of the net benefits that will accrue to NSW was generally calculated based on NSW's share of the Australian population (32%). The net production benefit to NSW is predicted to total \$82M (present value). The predicted net production benefit to NSW includes:

- \$38M (present value) in royalties;
- \$14M (present value) in NSW's share of Australian company tax; and
- \$30M (present value) in net producer surplus attributed to NSW.

In addition to net production benefits, the Modification is expected to generate \$8M (present value) of benefits to employees and \$41M (present value) of benefits to suppliers. Therefore, the net social benefit of the Modification to NSW is estimated at \$130M (present value).

The CBA also estimated external costs associated with predicted environmental impacts. The predicted greenhouse gas emissions were valued using shadow prices for CO₂-e from three different sources:

- Forecast European Union Emission Allowance Units price;
- Australian Treasury Clean Energy Future Policy Scenario; and
- US Environmental Protection Agency Social Cost of Carbon.

Based on these shadow prices, the cost of greenhouse gas emissions to Australia was valued at between \$0.1M and \$0.4M (present value). Proportionate to NSW's share of the Australian population, 32% of the emissions were apportioned to NSW. The cost of greenhouse gas emissions to NSW was estimated between \$0.0M to 0.1M (present value).

The cost of the predicted groundwater take due to the Modification was calculated based on the market value of the WALs that are required. The cost of the predicted groundwater take was estimated at \$0.1M (present value). The other potential impacts of the Modification are not expected to be material from an economic perspective.

The quantified environmental costs are significantly less than the predicted net social benefits to Australia and NSW. Therefore, the Modification is justifiable from an economic efficiency perspective.

Sensitivity Analysis

The sensitivity analysis indicated that the CBA is most sensitive to changes in revenue, which is affected by coal production rates, coal prices and exchange rates. Under the +30% revenue scenario, the net social benefit to NSW is predicted to be \$190M (present value) whereas under the -30% revenue scenario, the predicted net social benefit is \$71M (present value).

The CBA is also sensitive to changes in operating costs, but to lesser degree than the sensitivity to revenue. The sensitivity analysis indicated that changes in capital costs or environmental costs will not significantly alter net social benefits to NSW.

Local Effects Analysis

The Modification is expected to provide employment for a construction workforce of 26 personnel and operational workforce of 99 personnel. Dartbrook Mine currently employs 11 persons for care and maintenance activities (i.e. the base case). The LEA considers only the incremental jobs generated by the Modification. Under the base case, Dartbrook Mine would employ 11 persons until 2022. Therefore, the number of jobs generated in the first four years of the operational phase would be 88. After 2022, the incremental jobs will increase to 99, as the mine would have been decommissioned under the base case.

The LEA predicted the following effects on the local economy during the construction phase (which will occur in only the first year of the Modification):

- \$9.5M in output;
- \$3.1M in value-added;
- \$3.1M in wages, of which \$0.6M will accrue to the local labour force; and
- 26 jobs.

The LEA predicted the following effects on the local economy during the operational phase (approximately 9 years of production):

- \$89M to \$95M in output;
- \$52M to \$54M in value-added
- \$11M to \$12M in wages, of which \$8M to \$9M will accrue to the local labour force; and
- 88 to 99 jobs.

8.9 OTHER ENVIRONMENTAL ASPECTS

8.9.1 Greenhouse Gas

Scope 1 and 2 greenhouse gas (GHG) emissions may occur through fugitive emissions, electricity use and fuel combustion. The potential GHG emissions associated with the Modification were estimated based on previously reported GHG emissions.

The most recent year of active mining at Dartbrook Mine was 2006. During that year, Dartbrook Mine generated an estimated 367,551 tonnes of CO₂-equivalent (CO₂e) and extracted approximately 1.2 Mt of ROM coal. The Modification will produce an average of 1 Mtpa of ROM coal over a 10 year period. Therefore, it is expected that GHG emissions associated with fugitive emissions and approval operational activities will not exceed 367,551 t CO₂e.

In addition to the approved operational activities, the Modification will involve truck haulage of ROM coal. The diesel combustion associated with the proposed trucking operations has been estimated at 536.9 kL/year. GHG emissions factors for diesel consumption were sourced from the National Greenhouse Accounts Factors (DoEE, 2017).

Based on an energy content factor of 38.6 GJ/kL and emissions factor of 69.9 kg CO₂-e/GJ, the annual GHG emissions due to diesel consumption are estimated at 1,449 t CO₂-e/year.

$$\begin{aligned}\text{GHG emissions per year} &= 536.9 \text{ kL/year} \times 38.6 \text{ GJ/kL} \times 69.9 \text{ kg CO}_2\text{-e/GJ} \\ &= 1,448,631 \text{ kg CO}_2\text{-e/year} \\ &= 1,449 \text{ t CO}_2\text{-e/year}\end{aligned}$$

If the estimated emissions associated with truck haulage are simply added to the previously reported emissions for coal production, Dartbrook Mine is expected to generate approximately 369,000 t CO₂-e/year. This is a conservative estimate as the previously report emissions (367,551 t CO₂-e) includes electricity use associated with the Hunter Tunnel conveyor, which will be used to a lesser extent if truck haulage is undertaken.

In light of the above, over the 10 year duration of the Modification, the total GHG emissions are estimated to be slightly less than 3.69 Mt CO₂-e.

8.9.2 Visual

The new shaft site for the Modification will be located a short distance to the west of the New England Highway. The new shaft site will be constructed on land owned by AQC, and there are no private residences in the vicinity. The New England Highway is the only public area from which the new shaft site may be visible. The infrastructure will be partially shielded by tree screens established along the New England Highway; however, limited views will be available. Given that motorists will be travelling along the New England Highway at high speeds (up to 100 km/h), views of the new shaft site will be very limited in duration. Furthermore, proposed shaft and ROM coal bin will be enclosed within a heritage green colorbond shed (approximately 9 m in height). This shed will be similar in appearance to many agricultural structures in the region. Therefore, the visual effect (i.e. contrast with the surrounding landscape) will be low.

8.9.3 Traffic

The Modification will employ approximately 26 construction personnel during the short-term construction phase. Traffic movements associated with the construction workforce will be negligible compared to background traffic volumes.

The operational workforce for the Modification is expected to be approximately 99 personnel. This is well within the approved operational workforce of 292 personnel. Dartbrook Mine personnel will primarily access the site via the New England Highway and Western Access Road. Traffic movements associated with the 99 operational personnel will be negligible compared to the background traffic volumes on the New England Highway. The Western Access Road is a private road owned by AQC and is primarily used only for access to Dartbrook Mine. Therefore, the numbers of vehicles utilising the New England Highway / Western Access Road intersection will be relatively low, and the performance of the intersection is expected to be good.

View from New England Highway, north of Western Access Road



View from New England Highway, south of Western Access Road



DARTBROOK MINE

8.9.4 Agriculture

The new shaft site will be located within the Garoka Dairy, which is operated under licence with AQC. The land that will be disturbed for construction of the shaft site (approximately 2.28 ha) will no longer be available for agricultural purposes. This is negligible compared to the total operational area of Garoka Dairy (approximately 350 ha) and the overall output of the dairy will not be affected.

9 SUMMARY OF MANAGEMENT AND MITIGATION MEASURES

Table 15 lists the key management and mitigation measures that will be undertaken to minimise the potential environmental impacts of the Modification.

Table 15
Management and Mitigation Measures

Ref.	Commitment	Relevant Sections
1.	Truck haulage of ROM coal will only be undertaken during the day period (7am to 6pm) and only on weekdays.	Section 4.3.1
2.	The Air Quality Management Plan will be updated to include mitigation measures relevant to the Modification. The plan will be updated in consultation with the relevant regulatory authorities.	Section 8.1.4
3.	The Noise Management Plan will be updated to include mitigation measures relevant to the Modification. The plan will be updated in consultation with the relevant regulatory authorities.	Section 8.2.4
4.	The Groundwater Monitoring Program (which forms a component of the Site Water Management Plan) will be updated to reflect the predictions for the Modification. If impacts to private bores are identified by monitoring, AQC will consult with the affected landowners regarding measures to 'make good' on impacts to water supply. The update of the Groundwater Monitoring Program will be undertaken in consultation with the relevant regulatory authorities.	Section 8.3.4
5.	If groundwater is encountered during excavation of the new shaft, the perimeter of the shaft will be lined to prevent leakage of water down the shaft.	Section 8.3.4
6.	The Site Water Management Plan will be updated to include revised water management strategies for the Modification. The plan will be updated in consultation with the relevant regulatory authorities.	Section 8.4.4
7.	During construction, appropriate erosion and sediment controls will be implemented in accordance with <i>Managing Urban Stormwater: Soils and Construction</i> (Landcom, 2004).	Section 8.4.4
8.	A Bord and Pillar Subsidence Management Plan will be prepared prior to undertaking bord and pillar mining within the Kayuga Seam. The plan will outline the mining parameters required to ensure that the coal pillars remain stable in the long-term. The plan will be developed in consultation with the relevant regulatory authorities.	Section 8.5.4
9.	The Biodiversity Management Plan will be updated to include mitigation measures relevant to the Modification. The plan will be updated in consultation with the relevant regulatory authorities.	Section 8.6.4
10.	The Aboriginal Heritage Management Plan will be updated to include mitigation measures relevant to the Modification. The plan will be updated in consultation with the relevant regulatory authorities.	Section 8.7.4
11.	The shed enclosure for the new shaft and ROM bin will be a heritage green colour, in order to minimise contrast from the surrounding landscape.	Section 8.9.2

10 JUSTIFICATION

10.1 NEED FOR THE MODIFICATION

DA 231-7-2000 currently enables the following activities to be undertaken at Dartbrook Mine:

- Longwall mining activities in the Wynn, Kayuga, Mt Arthur and Piercefield Coal Seams;
- Coal handling and processing and transportation at the East Site;
- Transportation of coal by rail to the Port of Newcastle;
- Ancillary surface activities at the West Site; and
- Transfer of ROM coal from the underground mine workings to the East Site via the Hunter Tunnel.

DA 231-7-2000 provides approval for these activities until 5 December 2022. To date, longwall mining operations have been conducted in the Wynn and Kayuga Seams. Due to challenging geotechnical conditions experienced and the unfavourable economic factors at the time, Dartbrook Mine was placed into care and maintenance by its previous owners in December 2006. AQC acquired Dartbrook Mine in May 2017, with the objective of reinvigorating mining operations at the site. However, the extended period of care and maintenance has given rise to the following complications:

- The longwall mining equipment was removed by the previous owners;
- The coal clearance conveyors in the Hunter Tunnel were removed by the previous owner and the structural integrity of the tunnel has deteriorated; and
- A substantial portion of the approved period of mining has been foregone.

To overcome these complications, the Modification proposes the following:

- Bord and pillar mining in the Kayuga Seam (as an alternative to the approved longwall mining);
- Delivery of ROM coal (extracted via bord and pillar mining) to the East Site via predominantly overland methods (truck haulage) as an alternative to the approved coal clearance system (i.e. Hunter Tunnel conveyor); and
- Extending the approval period under DA 231-7-2000 by 5 years (until 5 December 2027).

10.2 ECONOMIC JUSTIFICATION

The proposed bord and pillar mining method is desirable as a mechanism to re-establish mining at Dartbrook Mine. The bord and pillar mining method can be instituted quickly and requires much lower upfront capital expenditure compared to re-introducing longwall mining operations and/or establishing other mining methods.

Due to the limited scale of mining proposed by the bord and pillar method, the proposed coal clearance system (involving truck haulage of ROM coal) is more economically efficient than renovating the Hunter Tunnel and reinstalling conveyors. The alternative method of mining and coal clearance system proposed by the Modification represents an economically feasible mechanism for the rapid re-commencement of mining at Dartbrook Mine, thereby returning the socio-economic benefits of mining to the Upper Hunter Region and NSW more broadly.

The Modification will facilitate the recovery of up to 10 Mt of ROM coal over a period of approximately 10 years. The predicted economic benefits include:

- Approximately \$38M (present value) in royalties to NSW;
- Approximately \$14M (present value) in NSW's share of Australian company tax; and
- Approximately 99 operational jobs.

The Modification will enable substantive socio-economic benefits to be realised quickly. These benefits will be sustained over a ten year period. The Modification is the only economically mechanism for rapidly delivering further employment and economic stimulus to the Upper Hunter region through the development of the state-owned coal resource. In addition to the realisation of the predicted socio-economic benefits of the Modification, AQC will continue to examine the feasibility of further developing this tier one NSW State Significant Coal Resource.

10.3 ENVIRONMENTAL JUSTIFICATION

The proposed bord and pillar mining method is also desirable from an environmental perspective. The approved longwall mining of the Kayuga Seam was predicted to result in up to 2.2 m of vertical subsidence (HLA-Envirosciences, 2000). The proposed bord and pillar mining will be designed such that subsidence is imperceptible for all practical purposes. Therefore, the proposed bord and pillar mining can be undertaken without resulting in any material impacts to the overlying surface features.

The groundwater assessment predicted that the proposed bord and pillar mining will result in minimal seepage into the mine workings and drawdown of shallow aquifers. The bord and pillar mining method does not result in substantial fracturing of the overlying rock strata. For this reason, the predicted impacts on groundwater systems are expected to be well within the impacts that would result from the approved longwall mining.

The Modification will not result in significant disturbance of land. The new surface infrastructure proposed for the Modification will be sited within an area of exotic grassland, thereby avoiding any impacts to native vegetation. The exotic grassland is also of low archaeological sensitivity. Therefore, the Modification will not result in any material impacts to biodiversity or heritage values.

10.4 CONCLUSION

The Modification will facilitate the re-commencement of mining operations at Dartbrook Mine, thus allowing for the potential economic benefits of mining to be realised. The environmental impacts of the proposed bord and pillar mining will be less than the impacts of the approved longwall mining, due to the imperceptible levels of subsidence associated with the bord and pillar mining method. The additional surface disturbance required for the Modification is immaterial (approximately 2.28 ha) and will be limited to temporary impacts on exotic grassland. Therefore, the Modification is justifiable from both a socio-economic and environmental perspective.

The Modification has been specifically designed to ensure that any environment impacts from the proposed activities will be minimised. At the same time it will facilitate the early recommissioning of Dartbrook Mine on a stand-alone economically viable footing.

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For

HANSEN BAILEY



Andrew Wu
Senior Environmental Engineer



James Bailey
Director

11 ABBREVIATIONS

Term	Definition
%	Percentage
µg	Microgram
µg/m ³	Micrograms per cubic metre
AACHIA	Aboriginal Archaeological and Cultural Heritage Impact Assessment
AECOM	AECOM Australia Pty Limited
AGE	Australasian Groundwater and Environmental Consultants
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
AQC	Australian Pacific Coal Limited
AQIA	Air Quality Impact Assessment
ARI	Average Recurrence Interval
BC Act	<i>Biodiversity Conservation Act 2016</i>
BoM	Bureau of Meteorology
BSAL	Biophysical Strategic Agricultural Land
CBA	Cost benefit analysis
CCC	Community Consultation Committee
CHPP	Coal Handling and Preparation Plant
CIC	Critical Industry Cluster
CL	Coal License
CO ₂ -e	Carbon Dioxide Equivalent
DA	Development Application
DA	Development Consent
dB	Decibels
dBA	The peak sound pressure level, expressed as decibels (dB) and scaled on the 'A-weighted' scale, which attempts to closely approximate the frequency response of the human ear
DoEE	Commonwealth Department of the Environment
Dol-Water	Department of Industry - Water
DP&E	NSW Department of Planning and Environment
DRG	Division of Resources and Geoscience
EA	Environmental Assessment
EHD	Eastern Holding Dam
EIS	Environmental Impact Statement
ENM	Environmental Noise Model
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EP&A Regulation	<i>Environmental Planning and Assessment Regulation 2000</i>
EPA	NSW Environmental Protection Authority
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i>

Term	Definition
EPL	Environment Protection Licence
g/m ² /month	Grams per square metre per month
GHG	Greenhouse Gas
ha	Hectare
Hansen Bailey	Hansen Bailey Environmental Consultants
HRSTS	Hunter River Salinity Trading Scheme
Hunter River WSP	<i>WSP for the Hunter Regulated River Water Source 2003</i>
Hunter Unregulated WSP	<i>WSP for the Hunter Unregulated and Alluvial Water Sources 2009</i>
HVAS	High Volume Air Sampler
ICNG	<i>Interim Construction Noise Guideline 2009</i>
kg	Kilogram
km	Kilometres
LA _{eq}	The A-weighted equivalent continuous, or logarithmic average, noise level over a defined time period either measured or predicted at a specific location
LEP	Local Environment Plan
LEA	Local Effects Analysis
LGA	Local Government Area
m ³	Cubic metre
mAHD	Australian Height Datum in metres
Met01	Meteorological monitoring station located in the west of the Project Boundary
Met02	Meteorological monitoring station located in the east of the Project Boundary
Mining Act	<i>Mining Act 1992</i>
Mining SEPP	<i>State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007</i>
ML	Mining Lease
ML	Megalitre
ML/Year	Megalitre per year
mm	Millimetres
MNES	Matters of National Environmental Significance
MOD	Modification
MSC	Muswellbrook Shire Council
Mt	Million tonnes
Mtpa	Million tonnes per annum
Muswellbrook LEP	<i>Muswellbrook Local Environment Plan 2009</i>
NNTT	National Native Title Tribunal
North Coast Groundwater WSP	<i>WSP for the North Coast Fractured and Porous Rock Groundwater Sources 2016</i>
NPI	<i>Noise Policy for Industry 2017</i>
NPW Act	<i>National Parks and Wildlife Act 1974</i>
NSW	New South Wales

Term	Definition
NSWCA	NSW Court of Appeal
°C	Degrees Celsius
OEHL	NSW Office of Environment and Heritage
PM	Particulate Matter
PM ₁₀	Particulate Matter with a diameter less than 10 µm
PM _{2.5}	Particulate Matter with a diameter less than 2.5 µm
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
RAP	Registered Aboriginal Party
REA	Rejects Emplacement Area
ROM	Run of Mine
SCS	Soil Conservation Service
SDD	Staged Discharge Dam
SEPP	State Environmental Planning Policy
t	Tonne
tph	Tonnes per hour
TSP	Total Suspended Particulates
UHSC	Upper Hunter Shire Council
Upper Hunter LGA	Upper Hunter Shire Council Local Government Area
Upper Hunter LEP	<i>Upper Hunter Local Environment Plan 2013</i>
VLAMP	Voluntary Land Acquisition and Mitigation Policy
WAL	Water Access Licence
WLALC	Wonnarua Local Aboriginal Land Council
WHD	Western Holding Dam
WM Act	<i>Water Management Act 2000</i>
WMP	<i>Dartbrook Waste Management Plan</i>
WSP	Water Sharing Plan

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