



**Dartbrook Mine**

# Modification 7
# Updated Response to Contentions

for

**Sparke Helmore Lawyers**

October 2021

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

# DARTBROOK MINE
# MODIFICATION 7

## UPDATED RESPONSE TO CONTENTIONS

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# EXECUTIVE SUMMARY

## Background

AQC Dartbrook Management Pty Limited is the proprietor of the Dartbrook Mine, located in the Upper Hunter Valley of New South Wales. Dartbrook Mine is authorised by Development Consent DA 231-7-2000 granted under the *Environmental Planning and Assessment Act 1979*. AQC has made an application to modify DA 231-7-2000 under the former Section 75W of the *Environmental Planning and Assessment Act 1979*. This modification application sought approval for an alternative method of underground mining, an alternative coal clearance system and extension of mining operations by 5 years.

The Independent Planning Commission determined the application on 9 August 2019 by approving the bord and pillar mining option and alternative coal clearance system, but refusing the 5 year extension of mining operations (notwithstanding the Department of Planning and Environment's recommendation for approval). The Independent Planning Commission's determination is currently the subject of Class 1 proceedings in the NSW Land and Environment Court.

The proponent has considered the Independent Planning Commission's stated reasons for refusal and the Statement of Facts and Contentions filed in the proceedings. To address these issues, the proponent has:

(a) adjusted aspects of the Modification to reduce its environmental impacts; and
(b) engaged technical specialists to conduct further environmental studies.

These further environmental studies have confirmed that, with adjustments to the Modification, its impacts would be generally consistent with those of the approved development and can be appropriately managed through conditions of development consent.

## The Approved Development

DA 231-7-2000 authorises the extraction, processing and transportation of up to 6 million tonnes per annum of run-of-mine coal. Longwall mining is authorised to be undertaken in the Kayuga, Mt Arthur, Piercefield and Wynn coal seams.

The approved Dartbrook Mine includes two surface infrastructure sites. The West Site contains the two entries to the underground mine, main administration buildings, helipad and water management structures. The East Site contains the coal handling and preparation plant, coal and reject stockpiles, rail loop, train loadout facility, reject emplacement area, bathhouse, administration buildings and water management structures.

Run-of-mine coal is transported from the underground mine workings to the East Site via the Hunter Tunnel, which is an approximately 4 km long underground passageway. At the East Site, coal is processed and loaded onto trains for transportation to the Port of Newcastle.

DA 231-7-2000 enables the approved mining and ancillary activities to be undertaken until 5 December 2022.

### The ~~Original~~ Modification

The modification application (as originally lodged on 27 February 2018) sought approval for the following activities:

- The option of conducting bord and pillar mining of part of the Kayuga Coal Seam (as an alternative to the approved longwall mining);
- The option of using an alternative coal clearance system to transport run-of-mine coal from the underground mine workings to the East Site; and
- Extending the period of mining operations under DA 231-7-2000 by 5 years (until 5 December 2027).

These activities were proposed in addition to the approved activities under DA 231-7-2000. That is, the Modification did not affect the proponent's authority to undertake the approved longwall mining and coal processing activities.

### ~~The Revised Modification~~

Having regard to the issues raised by the IPC, the ~~scope of the Modification has been adjusted to address its potential environmental impacts. The~~ proponent ~~no longer proposes to proceed with~~will accept refusal of the alternative coal clearance system, which will have the following benefits:

- Avoidance of amenity impacts associated with road transportation of coal; and
- No additional surface infrastructure (i.e. no construction impacts).

In order to ~~reduce~~address issues associated with subsidence and groundwater impacts, the proponent will ~~not mine~~accept a condition requiring subsidence impacts to be limited to those predicted by Holt (2000) in the ~~Piercefield Seam unless further approval is obtained.~~original Environmental Impact Statement (EIS). The proponent would continue to be entitled to undertake all other approved activities authorised under DA 231-7-2000~~.~~ (subject to complying with the conditions).

~~If the Revised Modification is approved,~~ DA 231-7-2000, as modified, would authorise the following activities:

- Longwall mining and/or bord and pillar mining of the Kayuga Seam;
- Mining of the approved Mt Arthur, Wynn and Piercefield Seam longwall panels~~;~~
- ~~Mining of~~, subject to the ~~approved Wynn Seam longwall panels~~proponent being able to demonstrate that the subsidence impacts predicted by Holt in the original EIS are able to be met;
- Transportation of run-of-mine coal from the underground workings to the East Site via the Hunter Tunnel;
- Handling and processing of coal using the approved infrastructure at the East Site;
- Rail transportation of product coal to the Port of Newcastle; and
- Conducting mining operations until 5 December 2027.

~~The Revised Modification and associated~~The additional assessment that has been conducted has addressed the contentions raised by the IPC and has demonstrated that the environmental consequences of the activities that are the subject of the modification application are limited and satisfactory. Having regard to the State and regional significance of the development and the objectives of the *Environmental Planning and Assessment Act 1979*, approval of the modification application is in the public interest.

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# 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 authorised by Development Consent DA 231-7-2000 granted under the *Environmental Planning and Assessment Act 1979* (EP&A Act). DA 231-7-2000 was granted on 28 August 2001 and has been modified on six occasions. Modification 7 is the subject of this report.

DA 231-7-2000 allows for underground longwall mining and associated surface activities to be carried out until 5 December 2022. No mining activities have been conducted since Dartbrook Mine was placed under care and maintenance by the previous owner in December 2006.

AQC is seeking a further modification to DA 231-7-2000 that will facilitate the recommencement of mining operations at Dartbrook Mine.

## 1.2 APPLICATION HISTORY

The modification application was made under the former Section 75W of the EP&A Act on 28 February 2018. The application originally sought approval for the following activities in addition to the approved activities included under DA 231-7-2000 (the Original Modification):

- The option of conducting bord and pillar mining of part of the Kayuga Coal Seam (as an alternative to the approved longwall mining);
- The option of using an alternative coal clearance system to transport run of mine (ROM) coal from the underground mine workings to the East Site; and
- Extending the approval period under DA 231-7-2000 by 5 years (until 5 December 2027).

The modification application was supported by the *Dartbrook Mine Modification 7 Environmental Assessment* (Hansen Bailey, 2018a) (EA). The EA included experts' reports on the key environmental planning issues relevant to the Modification.

Following consultations and amendments, the EA was accepted by the then Department of Planning and Environment (DP&E) and placed on public exhibition from 28 June to 25 July 2018. During the public exhibition period, a total of 54 submissions were received from regulatory authorities, special interest groups, private enterprises and individuals. The Office of Environment and Heritage (OEH) and Resources Regulator provided submissions after the specified submissions period. Issues raised in submissions were addressed in the *Dartbrook Mine Modification 7 Response to Submissions* (Hansen Bailey, 2018b) (RTS).

Having regard to the EA, RTS, public submissions and advice from other government agencies, DP&E published its Assessment Report on 23 January 2019, which concluded that:

> *"On balance, the Department considers that the modification's benefit would outweigh its costs and that the modification would improve the overall viability of the mine by enabling underground mining operations to recommence, thereby allowing its potential*

*social and economic benefits to be realised. Importantly, many of the modification's impacts are reduced in comparison to the existing consent".*

Appendix G of the Assessment Report (Draft Consolidated Consent) recommended conditions of consent to manage the impacts of the Original Modification.

On 25 January 2019, the Original Modification was referred to the Independent Planning Commission (IPC) for determination. The IPC held a public meeting on 9 April 2019 to allow interested parties to express their views. A total of 45 speakers presented at the public meeting including 5 speakers in support and 40 speakers in opposition.

The IPC determined the application on 9 August 2019 by approving the bord and pillar mining option and alternative coal clearance system, but refusing the 5 year extension of the approval.

The application is currently the subject of Class 1 proceedings in the NSW Land and Environment Court (LEC).

## ~~1.3 REVISED SCOPE OF THE MODIFICATION~~

Following the IPC's determination, the proponent has carefully considered objector's comments, the stated reasons for the IPC's refusal of the 5-year extension component of the Original Modification application and the contentions raised by the Minister in the LEC proceedings. In response to those issues, ~~adjustments were made to some elements of the modification application to address those concerns (Revised Modification).~~the proponent provides the additional information contained in this document.

AQC ~~no longer proposes~~is prepared to ~~proceed with~~accept refusal of the alternative coal clearance system that was proposed by the Original Modification. The alternative coal clearance system involved truck haulage of ROM coal from the Kayuga Entry and the construction of a new shaft facility. The purpose of the alternative coal clearance system was to bypass a section of the Hunter Tunnel, which is the currently approved method of transporting ROM coal from the underground mine workings to the East Site. ~~Foregoing~~Refusal of the alternative coal clearance system will have the following benefits:

- Avoidance of amenity impacts associated with road transportation of ROM coal; and
- No additional surface infrastructure (i.e. no construction impacts).

~~DA 231-7-2000 permits longwall mining activities in the Piercefield Seam.~~ In order to ~~reduce~~address subsidence and groundwater impacts, the proponent will ~~not mine in the Piercefield Seam unless further approval is obtained~~accept a condition restricting mining to circumstances where an approved Extraction Plan has demonstrated that the subsidence impacts will be limited to those predicted by Holt (2000) in the original EIS. The proponent would continue to be entitled to undertake all other approved activities authorised under DA 231-7-2000.

The proposed mining and ancillary activities at Dartbrook Mine are described in detail in **Section 1~~2~~**.

## ~~1.4~~1.3 DOCUMENT PURPOSE

In its statement of reasons for decision, the IPC provided the following explanation for its refusal of the proposed 5 year extension:

> *"the Commission was not provided with a contemporary assessment of the potential impacts of the existing approved longwall mining and coal handling operations to support a 5 year extension of this approval (DA 231-7-2000), in the context of the significant increase in mining activity and other changes in the area since the original approval was granted in 1991".*

The Minister clarified the issues that it required further assessment of in its Statement of Facts and Contentions (dated 16 January 2020) filed in the LEC proceedings. In response, the proponent has commissioned further environmental studies to assess the proposed extension of mining operations from 5 December 2022 to 5 December 2027 (the Extension Period). This document responds to the issues raised in the Statement of Facts and Contentions.

## ~~1.5~~1.4 APPROACH TO DETERMINATION OF MODIFICATION 7 APPLICATION

The approach which a consent authority is required to take to the determination of a Section 75W modification application was considered by the NSW Court of Appeal in *Barrick Australia Ltd v Williams*[1] (*Barrick*). *Barrick* was a case involving a challenge to the determination of a Section 75W modification extending the period of operation of a gold mine. Justice Basten addressed the task of determining an application under Section 75W at paragraphs [41] and at [53] and [54]. These principles have been applied in other cases. They have also been applied by the IPC in other applications for extension of the period over which mining operations may occur (see for example the Mount Pleasant Mine Modification 3 approved in August 2018).

The effect of the decision in *Barrick* in the context of the Modification 7 application is that the consent authority is required to:

- Identify the environmental consequences that have already been the subject of assessment in respect of the whole development up to and including Modification 6;
- Identify those aspects of the development which are, by the application, sought to be changed which involve environmental consequences that have not already been assessed in the process of the determination of the approval already granted;
- Assess those environmental consequences to determine whether they are limited in the sense referred to in *Barrick*;
- Take into account any matters of State and regional significance associated with the application; and
- Determine whether the development consent should be modified and, if so, whether any further or amended conditions should be imposed having regard for the impacts of the

[1] (2009) 168 LGERA 437

changes brought about by the modification of the development as proposed in the application.

Of key relevance to the determination of the Modification 7 application is the effect of condition 1.2(a) as it was following Modification 6. Condition 1.2(a) states that "*This approval is for a period of 21 years from the date of granting of a mining lease pursuant to this consent*". The expiry period in condition 1.2(a) does not cause the consent to lapse. That would be contrary to Section 4.53 (and its predecessors) of the EP&A Act which prevents a development consent from lapsing where it has been physically commenced.

For that reason, on a proper analysis, the Modification 7 application does not seek to extend the consent but rather to extend the period over which certain activities authorised by the consent can take place. In short, it does not involve the grant of a new development consent for the period between 2022 and 2027 but the extension of the right to undertake certain activities as part of an existing approved project.

*Barrick* is authority for the proposition that assessment of the application should not be treated, in substance, as a new application. Determination of the Modification 7 application therefore involves looking at the impacts of the existing project occurring over a longer period rather than treating the consent as lapsing on 5 December 2022 (which is the approach that the IPC has effectively taken). *Barrick* supports the proposition that the consent authority must look at the environmental consequences of the activities that are the subject of the modification application (i.e. the changes to the development) and determine whether those consequences are limited. If so, and if the consent authority is satisfied that the development as modified is otherwise satisfactory having considered all relevant matters of State and regional significance, then the application may be approved if the consent authority is satisfied that it is in the public interest in terms of the EP&A Act.

## ~~1.6~~1.5 DOCUMENT STRUCTURE

This document is structured as follows:

- **Section 1~~2~~** describes the elements of the ~~Revised~~ Modification including the approved activities that will be undertaken during the Extension Period~~;~~ and provides additional information;
- **Section 3** addresses the contentions raised by the IPC in its Statement of Facts and Contentions;
- **Section 4** lists the abbreviations used in this document; and
- **Section 5** lists the sources relied upon during the preparation of this document.

# ~~2 REVISED MODIFICATION DESCRIPTION~~

# 2 ADDITIONAL INFORMATION

## 2.1 OVERVIEW

AQC has commissioned further environmental studies in response to the IPC's contentions. ~~As explained in **Section 1.3**, aspects of the Original Modification have been removed to reduce its potential environmental impacts. The Revised Modification application is now proposed to be limited to the following activities:~~

- ~~The option of conducting bord and pillar mining of part of the Kayuga Seam (as an alternative to the approved longwall mining); and~~
- ~~Extending the approval period under DA 231-7-2000 by 5 years (until 5 December 2027).~~

~~The Revised~~The Modification would enable longwall mining and/or bord and pillar mining to be undertaken until 5 December 2027. Total coal production will be limited to the approved maximum rate of 6 million tonnes per annum (Mtpa) of ROM coal. In addition, coal production via bord and pillar mining will be limited to a total of 10 Mt of ROM coal over the remaining approval duration. Based on these constraints, the indicative maximum production over the remaining approval duration is 37.4 Mt of ROM coal over a seven-year period (2021 to 2027, inclusive). The indicative production schedule is outlined in **Table 1**.

As explained in **Section ~~1.3~~1.2**, the approved mining activities ~~in the Piercefield Seam~~ will not be carried out unless ~~further approval is obtained. All other~~an Extraction Plan that demonstrates the subsidence impacts of proposed mining will be limited to those predicted by Holt (2000) in the original EIS has been approved ~~longwall mining activities will not be altered by the proposed Modification~~by the Secretary.

**Table 1**
**ROM Coal Production Schedule**

| Year | Bord & Pillar Max ROM Coal (Mtpa) | Longwall Max ROM Coal (Mtpa) | **Total ROM Coal (Mtpa) |
|---|---|---|---|
| 2021 | 1.4 | Nil Coal Produced | 1.4 |
| 2022 | 1.4 | 6 | 6 |
| 2023 | 1.4 | 6 | 6 |
| 2024 | 1.4 | 6 | 6 |
| 2025 | 1.4 | 6 | 6 |
| 2026 | 1.4 | 6 | 6 |
| 2027 | 1.4 | 6 | 6 |
| Total (Mt) | *10.0 | 36.0 | 37.4 |

**Note rounding error*
***Total production is limited to 6 Mtpa by the conditions of DA 231-7-2000*

All ROM coal is proposed to be processed through the existing Dartbrook Coal Handling and Preparation Plant (CHPP). ROM coal is approved to be transferred directly from the mine workings to the CHPP via the Hunter Tunnel. The Modification will not result in any changes to the approved Hunter Tunnel or CHPP (other than implementation of additional contemporary environmental mitigation measures).

## 2.2 CONTINUATION OF APPROVED OPERATIONS

Dartbrook Mine was originally granted DA 30/91 in December 1991. DA 30/91 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 30/91.

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 1**.

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 2**.

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 completion of the previously approved mining activities in the Wynn Seam.

DA 30/91 provided approval to construct the Hunter Tunnel. Prior to Dartbrook Mine being placed into care and maintenance, ROM coal was transferred from the mine workings to the East Site using conveyors in the Hunter Tunnel.

The approved activities under DA 231-7-2000 are described in the *Dartbrook Extended Environmental Impact Statement* (HLA-Envirosciences, 2000) (EIS).

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.

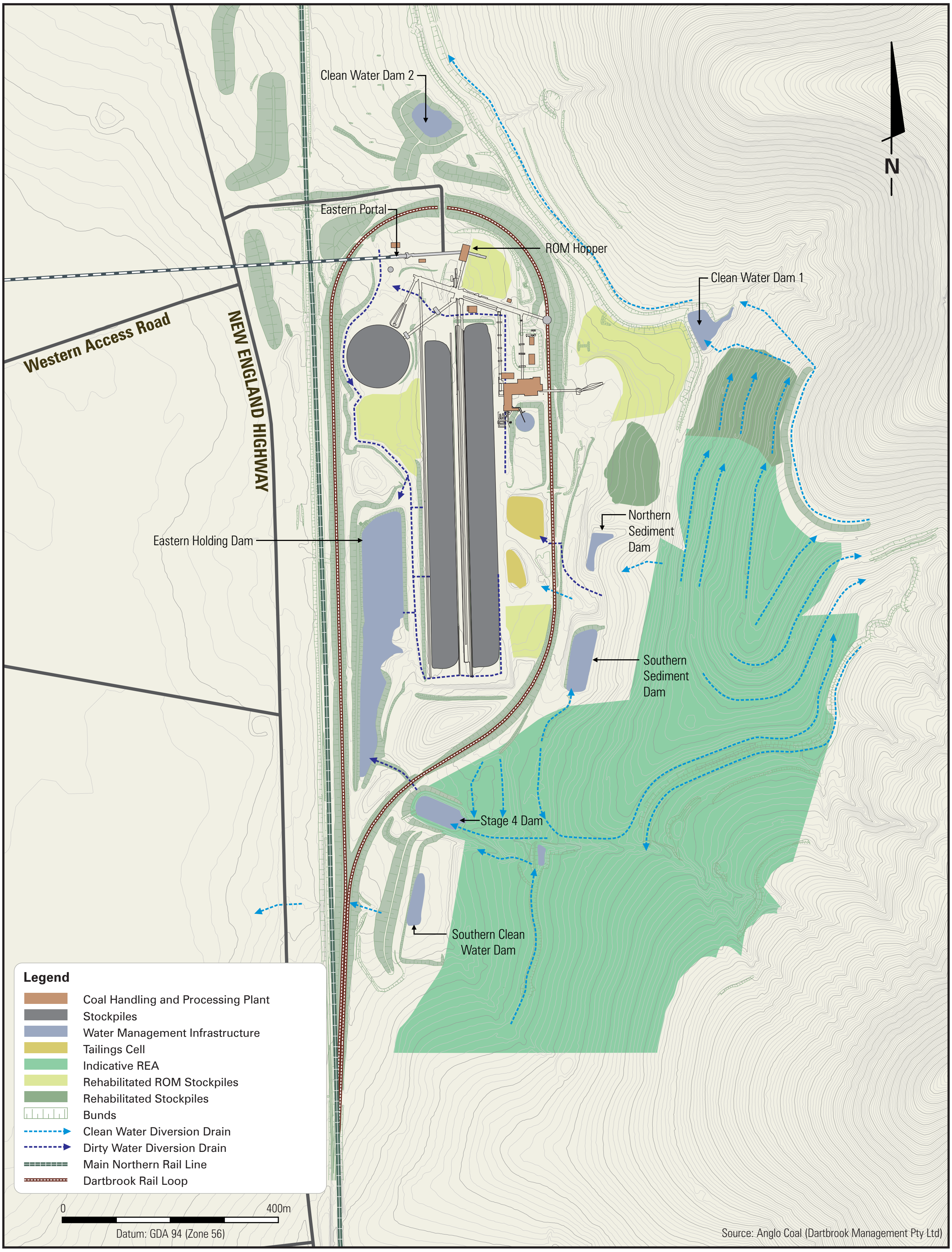
### 2.2.1 Underground Mining

Underground mining is approved to be undertaken using retreat longwall methods. 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.

The approved longwall mining activities for the Kayuga, Mt Arthur and Piercefield Seams are shown in **Figure 3** and **Figure 4**. In the western portion of the approved mining area, the Mt Arthur and Kayuga Seam are coalesced.

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 commenced in the southern longwall panels (KA101 to KA112) and was to ultimately progress to the northern longwall panels (KA113 to KA120).

**Table 2** summarises the amount of coal approved to be mined in each coal seam, the amount of coal extracted to date and the coal available to be extracted. There is approximately 61.8 Mt of ROM coal remaining in the Kayuga and Mt Arthur Seams that is approved to be extracted. Given that the indicative maximum production for the Revised Modification is 37.4 Mt of ROM coal (see **Table 1**), all mining during the Extension Period is likely to occur within this horizon.




HB DARTBROOK Surface Water Management Plan HB1804 F1 East Site Infrastructure 17 07 2020

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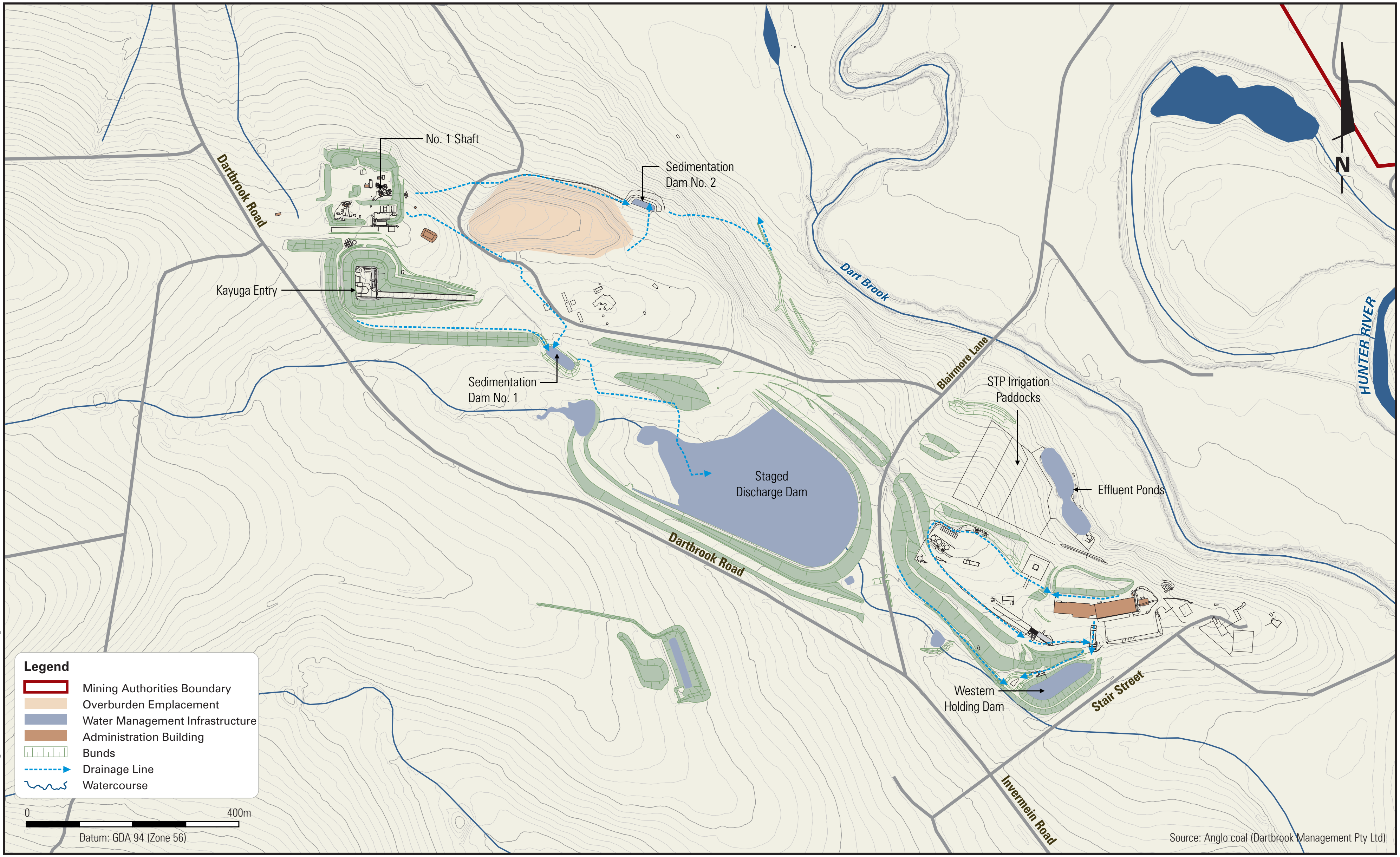
Existing East Site Infrastructure

**FIGURE 1**




HB DARTBROOK Underground MOD7 1774 F2 Existing Environment - West Site 05 05 2020

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Existing Environment - West Site Infrastructure

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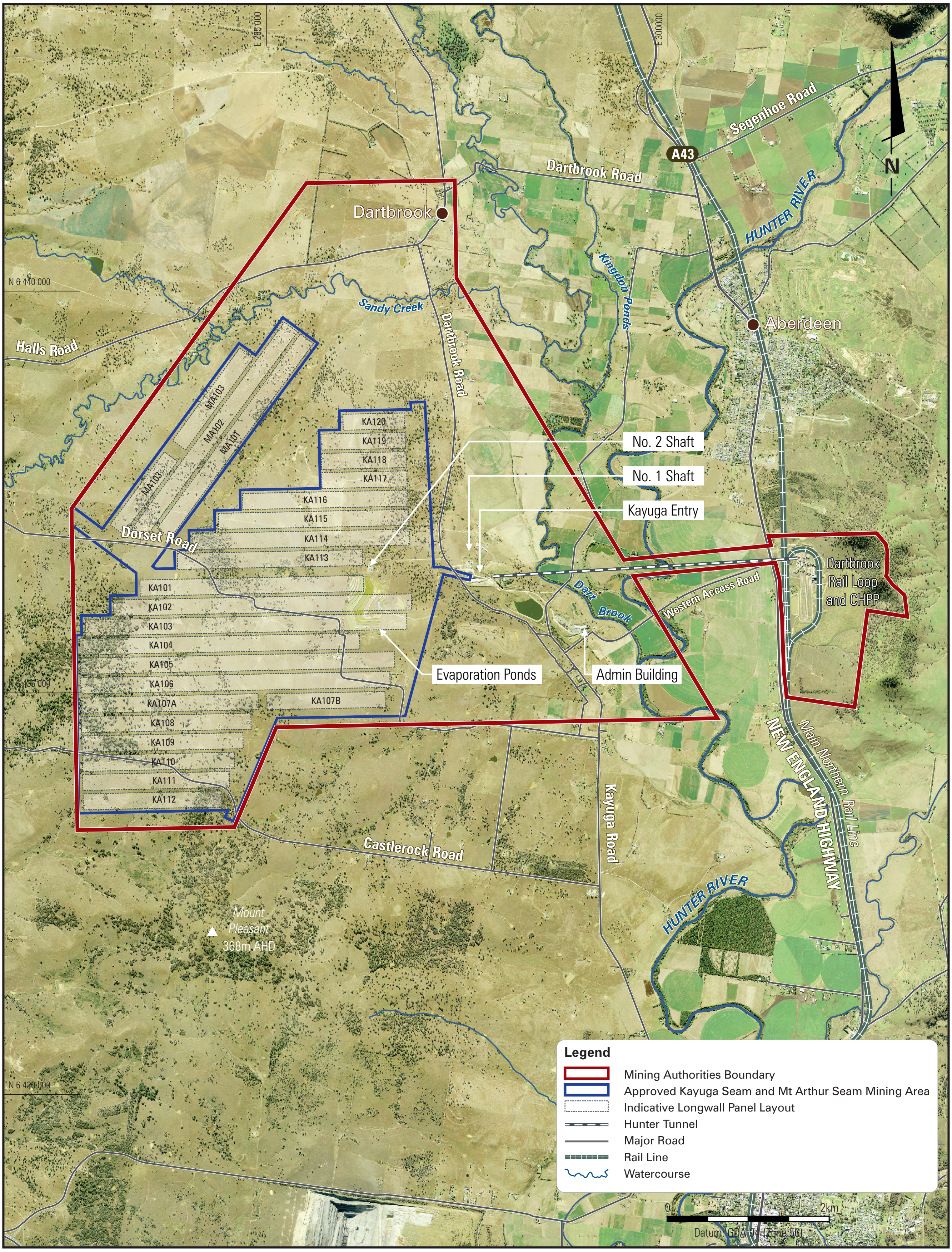
**FIGURE 2**




HB DARTBROOK Underground MOD7 1774 F3 Approved Mining Activities (Kayuga and Mt Arthur Seam) 05 05 2020

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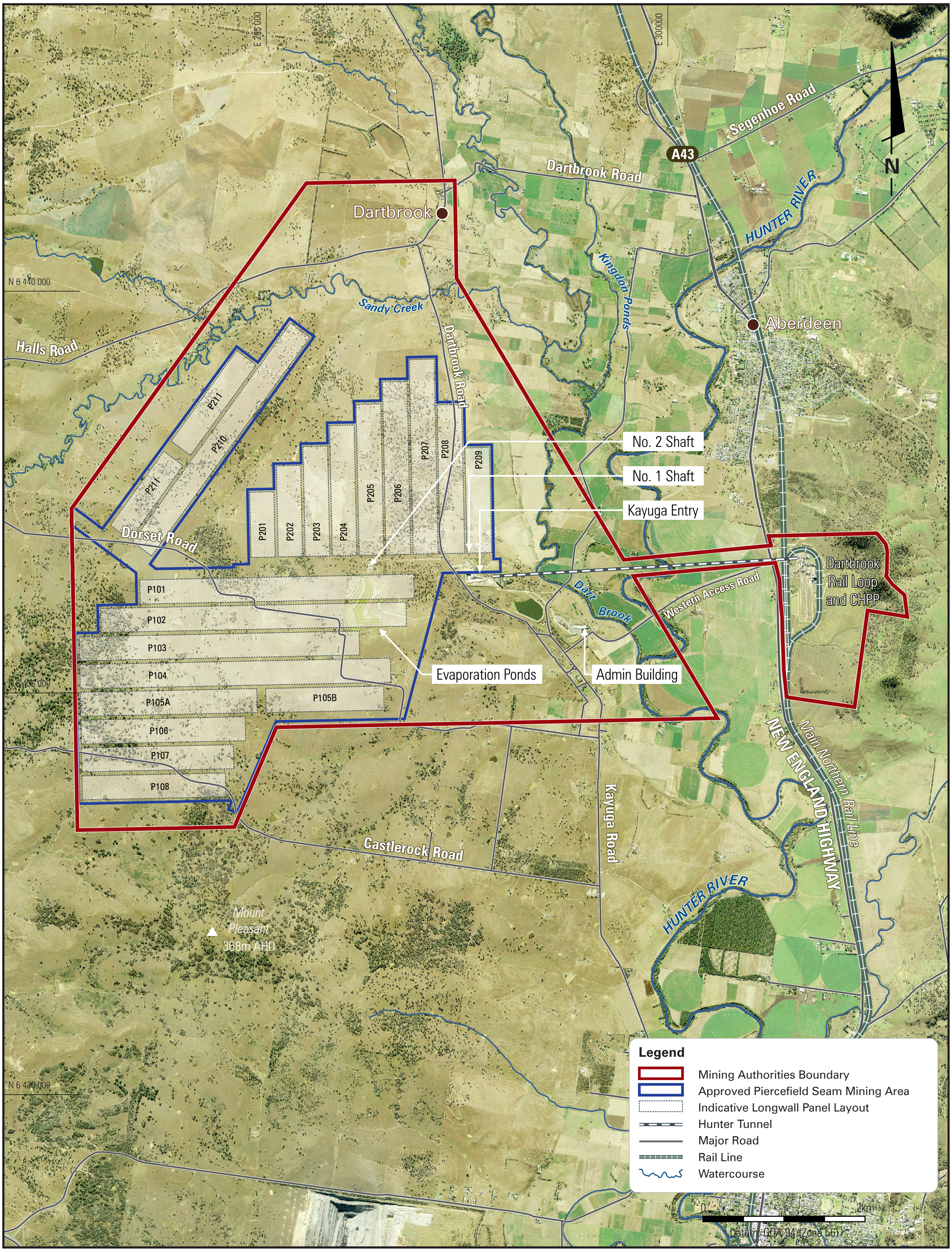
Approved Mining Activities (Kayuga and Mt Arthur Seams)

**FIGURE 3**




HB DARTBROOK Underground MOD7 1774 F4 Approved Mining Activities (Piercefield Seam) 05 05 2020

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Approved Mining Activities (Piercefield Seam)

**FIGURE 4**

**Table 2**
**Residual Approved ROM Coal Volumes**

| Coal Seam | Total Approved ROM Coal Mining (Mt) | Total ROM Coal Extracted to Date (Mt) | Remaining ROM Coal (Mt) Approved for Extraction | Comments |
|---|---|---|---|---|
| Wynn | 22.5[b] | 22.5 | 0 | Actual mining 1994 – 2004, inclusive. 2000 EIS Table 5.18 predicted working in the Wynn Seam up until the end of 2002. |
| Kayuga | 57.2 [a] | 6.7 | 50.5 | Actual mining 2002 – 2006, inclusive. 2000 EIS Table 5.18 predicted working in the Kayuga Seam up until the end of 2012. |
| Mt Arthur | 11.3[a] | 0 | 11.3 | 2000 EIS Table 5.18 predicted working in the Mt Arthur Seam from 2013 and 2014. Note that the Kayuga & Mt Arthur seams are coalesced in the western portion of the approved mining area. |
| Piercefield | 76.2 [a] | 0 | 76.2[d] | 2000 EIS Table 5.18 predicted working in the Piercefield Seam from 2016 – 2020. |

*Notes:*
*a) Dartbrook 2000 EIS, Table 5.6*
*b) Upper Wynn Mineable Reserve, Table 3.4 of 1990 EIS*
*c) Dartbrook 2000 EIS, Table 5.9*
*d) Will not be mined unless further approval is obtained*

### 2.2.2 Site Access, Workforce and Hours of Operation

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. DA 231-7-2000 also allows locally based employees and contractors to access the West Site using local public roads (such as Kayuga Road, Dartbrook Road and Blairmore Lane).

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 approximately 11 personnel.

Dartbrook Mine has approval to conduct operations 24 hours per day, 7 days per week.

### 2.2.3 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 5**). Coal is initially delivered from the working face to the western end of the Hunter Tunnel by conveyors within the mine workings. The Hunter Tunnel conveyor then delivers ROM coal to the existing ROM hopper at the East Site. Coal is crushed in the ROM hopper and placed onto conveyors that distribute it to the CHPP for processing. The coal clearance system was designed to handle up to 6 Mtpa of ROM coal (i.e. the maximum approved production rate).

The CHPP was constructed pursuant to DA 30/91. The construction of the CHPP enabled the extraction of the shallower coal seams (such as the Kayuga, Mt Arthur and Piercefield Seams). The CHPP is accompanied by an emergency tailings storage cell with a capacity of approximately 30 ML. Modification 2 to DA 231-7-2000 provided approval for the construction of an additional emergency tailings storage cell (approximately 20 ML capacity), adjacent to the existing cell.

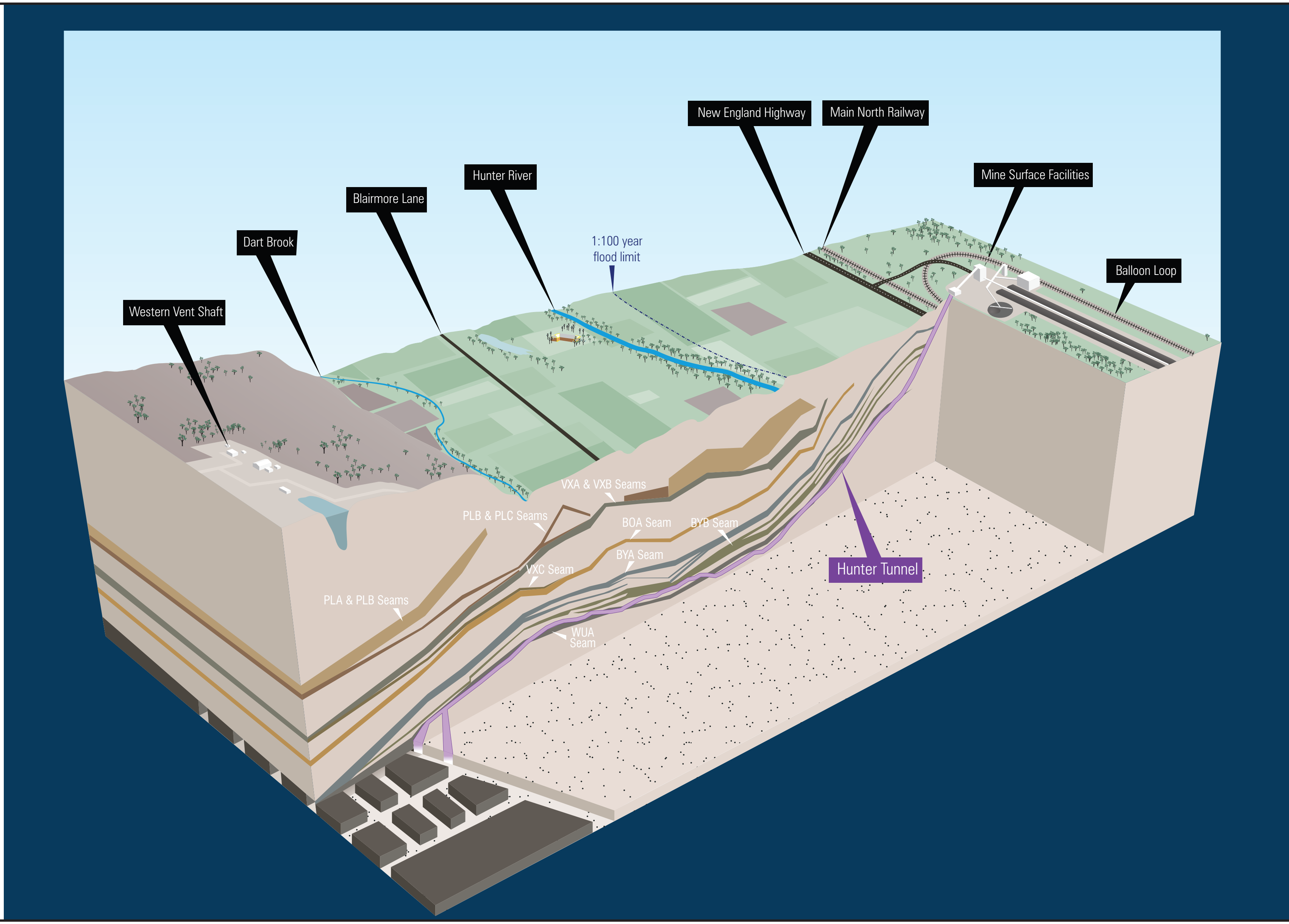
The CHPP has a maximum throughput of approximately 1,000 tonnes per hour (tph) and can deliver ROM coal at a rate of approximately 4,000 tph during peak output. The raw coal is crushed to a maximum size of 150 mm for processing then screened at 16 mm. The 150 mm x 16 mm coal is then treated in a dense medium bath, the 16 mm x 1.4 mm coal is treated in a dense medium cyclone and the fine coal is treated in coal spirals. The product coal is 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.

Acoustics experts have identified that additional noise suppression works will be required at the CHPP to minimise impacts on private receptors (see Section 3 of **Appendix B**). These works will be completed prior to undertaking any further coal beneficiation. The costs of these mitigation measures are reflected in the economic assessment conducted in relation to the ~~Revised~~ Modification (see **Section 3.7**).




HB DARTBROOK PFS 1710 F15 Hunter Tunnel 30 08 2017

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Hunter Tunnel

**FIGURE 5**

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### 2.2.4 Product 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 and rail loop at the East Site. The train loadout facility currently has capacity to load coal at rates of up to 3,000 tph. Due to the logistics of train scheduling, the facility is currently authorised for a daily capacity of 45,000 t.

### 2.2.5 Process Waste Management

Dartbrook Mine was originally authorised by DA 231-7-2000 to produce approximately 125 Mt of ROM coal, yielding 108 Mt of product coal and resulting in the generation of approximately 18.7 Mt of process waste over its 21-year project life. This equates to an average of approximately 890,000 tonnes/year of reject materials. The volume required to store the total quantity of rejects (18.7 Mt) was estimated at 11.68 million cubic metres ($Mm^3$).

Dartbrook Mine is approved to dispose of process waste in the Browns Mountain Reject Emplacement Area (REA) immediately east of the CHPP. The REA is divided into three sections: Northern, Central and Southern (as shown in the attached Figure 5.15 of the EIS). **Table 3** shows the estimated storage capacity of the REA.

**Table 3**
**Estimated REA Capacity**

| Section | Volume ($m^3$) | Storage (t) |
|---|---|---|
| South | 8,991,069 | 14,385,710 |
| North | 4,336,492 | 6,938,387 |
| Central | 3,008,102 | 4,812,963 |
| **Total** | **16,335,663** | **26,137,061** |

**Table 3** indicates that the Browns Mountain REA theoretically has 40% more capacity than required to store the process waste generated by the Project (as originally approved).

Less than 2.9 Mt of process waste has been placed in the REA to date. This has all been placed in the Central Section of the REA.

Rejects and tailings generated by the CHPP are dewatered and conveyed to the reject stockpile. The reject materials are then transported (via haul trucks) to the REA. DA 231-7-2000 also describes an alternate method of piping a combined waste product to the REA. The emplaced materials are compacted by heavy equipment. If the ratio of tailings is too high for co-disposal, excess tailings are temporarily emplaced within the emergency tailings storage cells. Once dry, these tailings are excavated from the storage cells and disposed of in the REA.

Modification 6 to DA 231-7-2000 provided approval for tailings to be disposed of in the Wynn Seam goaf. Some tailings have been 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. There is capacity to place additional tailings in the Wynn Seam goaf if required in the future.

### 2.2.6 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.

If external water supplies are required, raw water can be extracted from the Hunter River (in accordance with AQC's water licences). During wet periods, surplus water can be stored in the Wynn Seam goaf.

To minimise the demand for external water supplies, mine water is reused for operational activities (wherever possible). The surplus water in the Wynn Seam goaf and water make from the Hunter Tunnel will be sufficient to meet the water demands of the ~~Revised~~ Modification.

## 2.3 COMPONENTS OF THE ~~REVISED~~ MODIFICATION

### 2.3.1 Option of Bord and Pillar Mining

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. Through the ~~Revised~~ Modification, AQC seeks approval for the option of mining the Kayuga Seam via bord and pillar methods. The proposed bord and pillar mining will take place within the Approved Kayuga Seam Mining Area (see **Figure 6**).

Bord and pillar mining will be designed such that subsidence at the ground surface is imperceptible for all practical purposes. As a result, the environmental impacts of bord and pillar mining will be significantly less than the impacts of mining the same coal via retreat longwall mining.

Bord and pillar mining involves the shearing of coal to develop a network of roadways within the coal seam (see **Figure 7**). 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.

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

Total production from bord and pillar mining will be limited to 10 Mtpa of ROM coal over a seven-year period. Production from bord and pillar mining will also be limited by the maximum annual production rate of 6 Mtpa of ROM coal.

The proposed bord and pillar mining operations may be undertaken 24 hours per day, 7 days per week consistent with the approved operating hours under DA 231-7-2000.

### 2.3.2 Extension of the Mining Duration

DA 231-7-2000 enables mining operations to be undertaken until 5 December 2022. The Modification seeks to extend the period of approval by an additional five years until 5 December 2027.

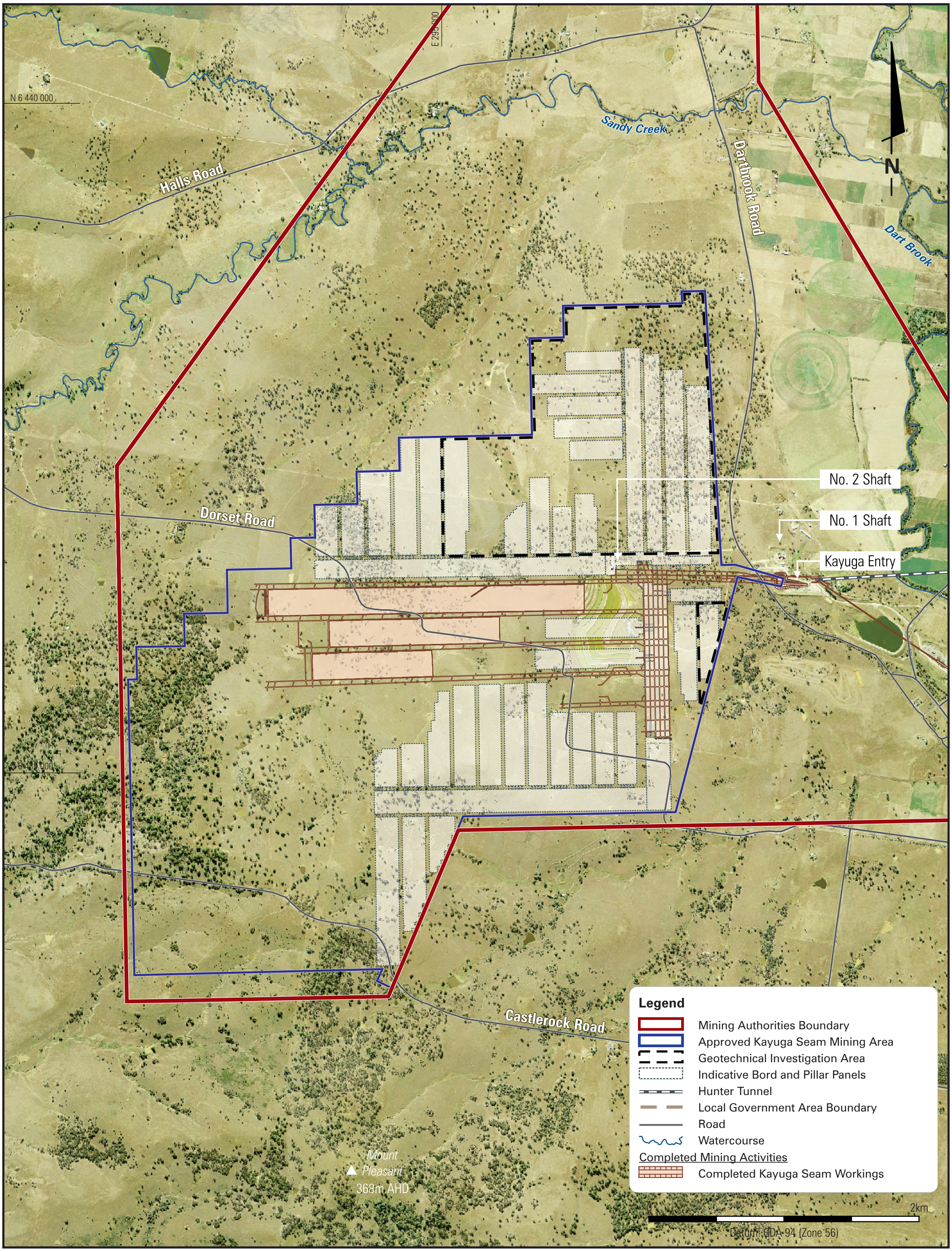
Under DA 231-7-2000 (as approved by Modification 7), the approved longwall mining and/or the proposed bord and pillar mining may be undertaken during the Extension Period. For the purposes of the further environmental assessments undertaken, it has been assumed that:

(a) Bord and Pillar mining will commence in January 2021;
(b) Longwall mining will recommence at the approved maximum rate in January 2022;
(c) Coal extraction from both methods will cease in December 2027.

The indicative production schedule is outlined in **Table 1**.

All approved surface activities are proposed to be carried out during the Extension Period including coal handling and processing, reject disposal, transportation of product coal and water management. These activities have been assessed on the basis of the maximum rates indicated in **Section 2.2**.

To minimise noise impacts on private receivers to the south of the REA, reject emplacement near the southern extent of the REA will be avoided during the night period and/or noise enhancing meteorological conditions.

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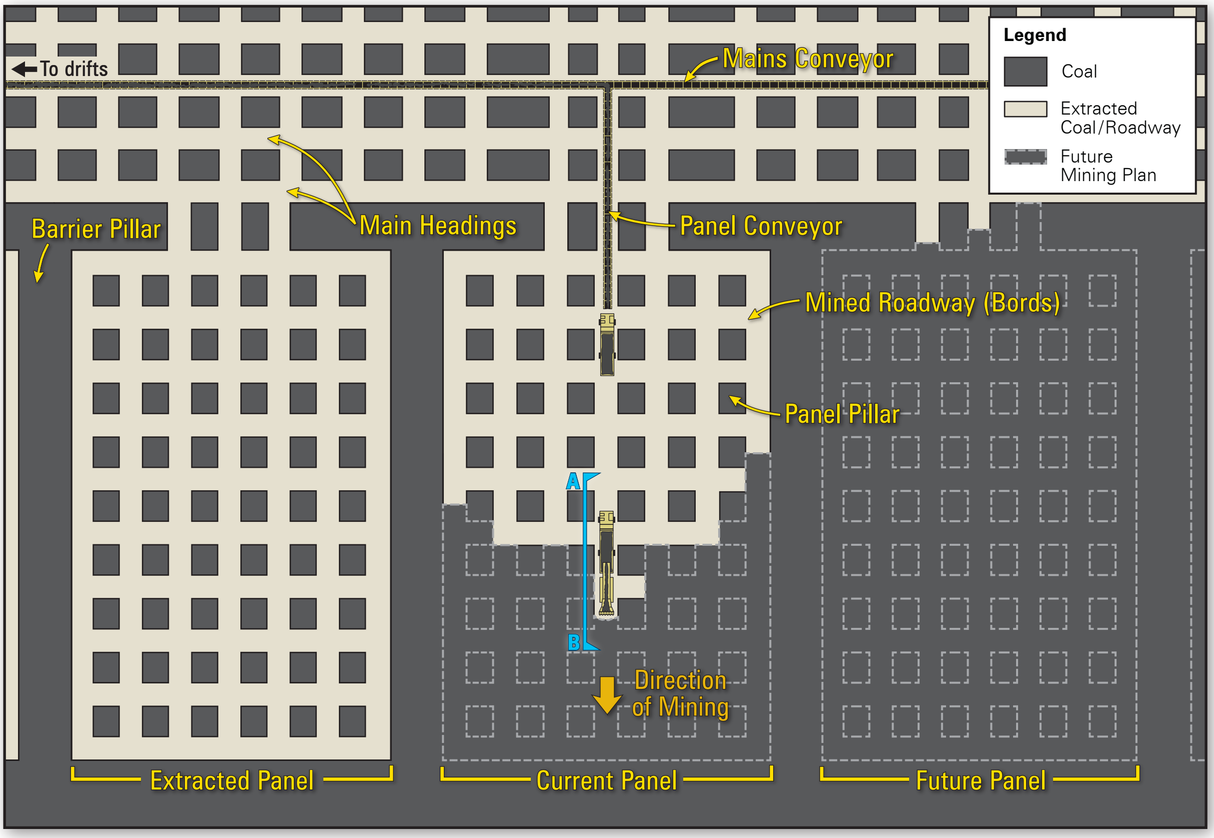
DARTBROOK MINE

HansenBailey ENVIRONMENTAL CONSULTANTS

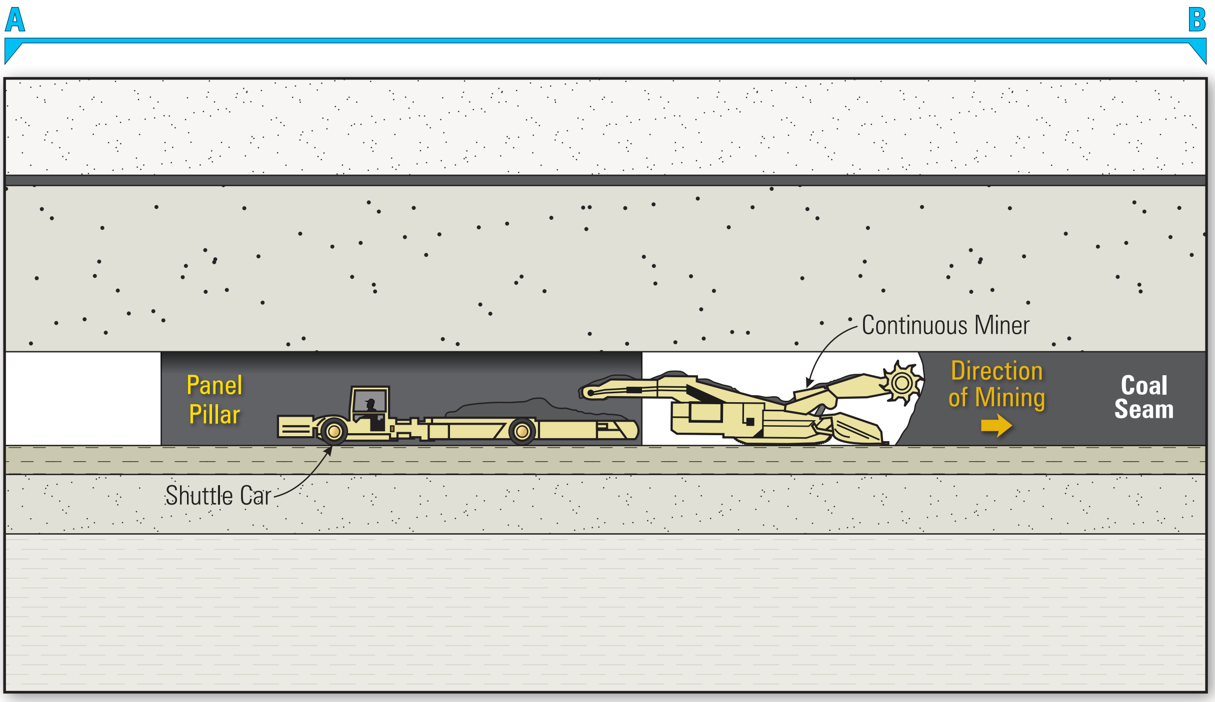
Australian Pacific Coal

Proposed Kayuga Seam Bord and Pillar Mining

**FIGURE 6**




Plan View of Bord and Pillar Coal Mining




Cross Section of Active Bord and Pillar Mining Roadway



Indicative Bord and Pillar Mining Method

**FIGURE 7**

# 3 RESPONSES TO CONTENTIONS

*This section provides responses to the contentions raised in the respondent's Statement of Facts and Contentions.*

## 3.1 AIR QUALITY

IPC's Contention

*The impacts on air quality resulting from a five year extension of mining operations under the Approval have not been appropriately considered or assessed.*

***Particulars***

*(a) The AQIA prepared for the Applicant in support of Mod 7 did not adequately assess the full impacts of the proposed extension of the Approval on air quality as:*

*(i) the impacts associated with the reopening and operation of the coal washery on the Project site were not included in the air quality modelling; and*

*(ii) it did not address the cumulative impacts on air quality of the existing approval for long wall mining being fully operational, in the context of changes in background air quality.*

Response

Additional dust dispersion modelling has been undertaken by ERM to predict the impacts of the approved operations during the Extension Period. This assessment is provided in **Appendix A**.

The model has accounted for emissions from all approved surface activities (including coal handling and processing, train loading and reject disposal) as well as emissions from ventilation shafts. To ensure that the worst-case impacts are assessed, the model has adopted the approved maximum production rate of 6 Mtpa of ROM coal.

ERM has assessed both incremental and cumulative air quality impacts. The contributions from other sources are reflected in the background levels adopted for the modelling. The Mt Pleasant Mine was not operational at the time of the background monitoring. For the purposes of the cumulative air quality assessment, the contribution of the Mt Pleasant Mine to cumulative concentrations has been modelled and added to the background concentration and the incremental impact of the ~~Revised~~ Modification.

At the maximum production rate, the ~~Revised~~ Modification is predicted to emit in the order of 72 t/year of total suspended particulate (TSP). The emissions inventory for the ~~Revised~~ Modification is significantly lower than that of the Original Modification due to its use of the existing Hunter Tunnel for transport of ROM coal instead of truck haulage (as discussed in **Section ~~1.3~~).1.2**). The dust emissions inventory for the ~~Revised~~ Modification at full operation is significantly less than those of the neighbouring open cut coal mines on an emissions per tonne of coal basis. As a result, the ~~Revised~~ Modification will result in only a minor contribution to cumulative dust concentrations during the 5-year extension period.

The model predicts that the ~~Revised~~ Modification will comply with the following criteria at all private receivers:

- Annual average TSP (incremental and cumulative);
- Annual average $PM_{10}$ (incremental and cumulative);
- Annual average $PM_{2.5}$ (incremental and cumulative);
- Annual average dust deposition (incremental and cumulative);
- 24-hour average $PM_{10}$ (incremental); and
- 24-hr average $PM_{2.5}$ (incremental and cumulative).

The only criterion that is predicted to be exceeded is the 24-hr average $PM_{10}$ criterion on a cumulative basis. Under existing conditions, private receivers experience some days where the background 24-hr $PM_{10}$ concentration is above the criterion (50 µg/m$^3$). The model predicts that seven private receivers will experience one additional day above the criterion as a result of operations at Dartbrook Mine and Mt Pleasant Mine. **Table 4** presents the contributions of the various sources on this additional day of exceedance. Neither the ~~Revised~~ Modification nor Mount Pleasant Mine are dominant contributors to the cumulative concentration. At six of these receivers (all except Receiver 29), the sum of the background concentration and the contribution of Mount Pleasant Mine is greater than the criterion (50 µg/m$^3$). As such, these exceedances would occur regardless of Dartbrook Mine. Receiver 29 is the only residence whether the emissions from Dartbrook Mine result in an additional day exceeding the 24-hr average criterion.

**Table 4**
**Predicted 24-hr Average $PM_{10}$ Exceedances**

| Receiver ID | Background (µg/m$^3$) | Mount Pleasant (µg/m$^3$) | Total excluding Dartbrook (µg/m$^3$) | ~~Revised~~ Modification (µg/m$^3$) | Total (µg/m$^3$) |
|---|---|---|---|---|---|
| 29 | 48.7 | 0.97 | 49.67 | 0.54 | 50.21 |
| 66 | 48.7 | 1.92 | 50.62 | 0.07 | 50.69 |
| 67 | 48.7 | 3.16 | 51.86 | 0.03 | 51.88 |
| 122 | 48.7 | 3.34 | 52.04 | 0.01 | 52.05 |
| 128 | 48.7 | 3.35 | 52.05 | 0.02 | 52.07 |
| 445A | 48.7 | 5.36 | 54.06 | 0.01 | 54.06 |
| 445B | 48.7 | 5.20 | 53.90 | 0.01 | 53.90 |

The *'Voluntary Land Acquisition and Mitigation Policy'* (NSW Government, 2018) (VLAMP) prescribes acquisition and mitigation criteria for state significant mining developments. The 24-hr average $PM_{10}$ criterion (50 µg/m$^3$) only gives rise to acquisition or mitigation requirements when exceeded on an incremental basis. The incremental impact of the ~~Revised~~ Modification is well below the criterion.

Recommended Conditions of Consent

Condition 6.1(f) of the Draft Consolidated Consent requires the preparation of an Air Quality and Greenhouse Gas Management Plan (AQGGMP). The AQGGMP will outline the dust controls that will be implemented to achieve compliance with contemporary regulatory air quality criteria. Exceedances of the 24-hr average $PM_{10}$ criterion can be avoided by implementing proactive management measures (such as modifying or ceasing operations) during adverse weather conditions. This is standard practice for mining operations in the vicinity.

## 3.2 NOISE

IPC's Contention

*The noise impacts resulting from a five year extension of mining operations under the Approval have not been appropriately considered or assessed.*

***Particulars***

*(a) The AIA prepared for the Applicant in support of Mod 7 did not adequately assess the full noise impacts of the proposed extension of the Approval as:*

*(i) noise impacts were substantially assessed against the bord and pillar method and the proposed coal clearance system; and*

*(ii) the noise impacts of the recommencement of longwall mining and associated operations, as permitted under the Approval, were not considered as part of the five year extension.*

Response

Additional noise modelling has been undertaken by Bridges Acoustics to predict the impacts of the approved operations during the Extension Period. This assessment is provided in **Appendix B**.

The approved mining activities and the transport of ROM coal from the West Site to The East Site will take place underground. These activities will not result in any noise at the surface. The noise model has accounted for all approved surface activities at the East Site including coal handling and processing, train loading and disposal of reject materials. To ensure that the worst-case impacts are assessed, the model has adopted the approved maximum production rate of 6 Mtpa of ROM coal.

As explained in **Section ~~1.3,~~1.2**, the proponent will accept of the truck haulage of ROM coal ~~is no longer proposed~~ and as such, has not been considered in the model. The additional noise controls proposed for the CHPP (described in Section 3 of **Appendix B**) have been accounted for in the model.

Intrusive noise criteria for existing sensitive receptors in the vicinity of Dartbrook Mine are outlined in Condition 6.4.1 of DA 231-7-2000.

The model predicts that the Modification will comply with the intrusive noise criteria at all private residences during the day and evening periods. The Modification is predicted to comply with the night-time criterion at all residences except Receivers 303, 391 and 422. Receivers 303 and 422 are predicted to experience noise levels of up to 42 LAeq,15min, which is 1 dBA greater than the relevant criterion. These exceedances can be avoided by modifying operational activities during unfavourable weather conditions. The NMP will include measures for proactive management of operational noise during unfavourable weather conditions.

Receiver 391 is predicted to experience noise levels of up to 36 LAeq,15min, which is 1 dBA greater than the relevant criterion. This receiver is currently entitled to acquisition under the development consent for Mount Pleasant Mine.

Table 1 of the VLAMP explains that exceedances of 0-2 dBA are considered negligible and would "not be discernible to the average listener and therefore would not warrant receiver based treatments or controls" (NSW Government, 2018). The predicted exceedances at Receivers 303, 391 and 422 fall into the negligible category under the VLAMP.

Recommended Conditions of Consent

Condition 6.4.2 of the Draft Consolidated Consent requires the preparation of a Noise Management Plan (NMP). The NMP will outline the noise controls that will be implemented to achieve compliance with the contemporary regulatory noise criteria. Condition 6.4.2 requires that noise impacts of the development are minimised during noise enhancing conditions. The NMP will include a protocol for proactive management of noise emissions during adverse meteorological conditions, such as avoidance of reject emplacement near the southern extent of the REA at night (see **Section 2.3.2**).

### 3.3 GREENHOUSE GAS

IPC's Contention

*The impact of the estimated GHG emissions resulting from a five year extension of mining operations under the Approval have not been appropriately considered or assessed.*

Response

Scope 1, 2 and 3 greenhouse gas (GHG) emissions were estimated by ERM (see Section 11 of **Appendix A**).

**Table 5** presents the estimated annual GHG emissions corresponding to the coal production schedule in **Table 1**.

**Table 5**
**Estimated Greenhouse Gas Emissions**

| Scope 1 Emissions ($t\ CO_2$-e) | | | | Scope 2 Emissions ($t\ CO_2$-e) | Scope 3 Emissions ($t\ CO_2$-e) |
|---|---|---|---|---|---|
| **Year** | **Diesel** | **Fugitive methane** | **Total** | **Electricity** | **Energy Production** |
| 2021 | 3,579 | 120,743 | 124,322 | 36,022 | 5,612,549 |
| 2022 | 4,866 | 131,173 | 136,039 | 77,937 | 18,035,436 |
| 2023 | 4,866 | 141,603 | 146,469 | 77,937 | 18,035,436 |
| 2024 | 4,866 | 152,033 | 156,899 | 77,937 | 18,035,436 |
| 2025 | 4,866 | 162,463 | 167,329 | 77,937 | 18,035,436 |
| 2026 | 4,866 | 172,893 | 177,759 | 77,937 | 18,035,436 |
| 2027 | 4,866 | 183,323 | 188,189 | 77,937 | 18,035,436 |
| **Total** | **32,775** | **1,064,231** | **1,097,006** | **503,644** | **113,825,161** |
| | | **Annual average** | **156,715** | **71,949** | **16,260,738** |

The following components of the total emissions are predicted to occur within the Extension Period:

- 836,645 t $CO_2$-e of Scope 1 emissions;
- 389,685 t $CO_2$-e of Scope 2 emissions; and
- 90,177,176 t $CO_2$-e of Scope 3 emissions.

In the 2017/18 and 2018/19 financial years, Dartbrook Mine reported GHG emissions of 89,453 t $CO_2$-e and 99,883 t $CO_2$-e, respectively. These values are representative of fugitive emissions during care and maintenance. As such, a large component of the fugitive emissions listed in **Table 5** ~~I~~is likely to occur in the absence of active mining.

## 3.4 SUBSIDENCE

### 3.4.1 Longwall Subsidence

IPC's Contention

*The subsidence impacts resulting from a five year extension of mining operations under the Approval have not been appropriately considered or assessed.*

*(b) The subsidence assessment prepared for the Applicant in support of Mod 7 did not adequately assess the full subsidence impacts of the proposed extension of the Approval as:*

*(i) the subsidence impacts have only been assessed against the bord and pillar methods and not, the subsidence impacts of the full operations under Mod 7, should longwall mining recommence;*

Response

The Modification does not seek to alter any aspects of the approved longwall mining. The potential subsidence impacts of the approved longwall mining were assessed by G E Holt and Associates (Holt, 2000). Byrnes Geotechnical was engaged to review Holt's assessment and advise on the potential impacts of longwall mining during the extension period. The advice of Byrnes Geotechnical is provided in **Appendix C**.

Holt predicted vertical subsidence using standard empirical relationships between maximum subsidence and extraction thickness (referred to as $S_{max}/T$). Holt adopted an $S_{max}/T$ ratio of 0.55, which was based on the Southern coalfield relationship and validated using subsidence monitoring data from the previous Wynn Seam longwall panels. Using this $S_{max}/T$ ratio, maximum vertical subsidence was predicted to be 55% of the extraction thickness (see **Table 6**).

Holt calculated the total subsidence for the Wynn, Kayuga and Piercefield Seams by adding the predicted maximum values for the individual seams. This was the standard practice at the time of the assessment. A more recent study (Li et al, 2010) suggests that multi-seam subsidence may be greater than the sum of the subsidence values for the individual seams. In a multi-seam environment, the $S_{max}/T$ ratio would be greater than 0.55 for the subsequent seams.

**Table 6** presents the maximum vertical subsidence predicted by Byrnes Geotechnical based on the current understanding of multi-seam subsidence behaviour. Due to the higher $S_{max}/T$ ratios for multi-seam mining, extraction of the coal seams overlying the Wynn seam may result in subsidence greater than the values predicted by Holt.

**Table 6**
**Predicted Maximum Vertical Subsidence**

| Seam | Extraction Thickness (m) | Holt (2010) Predictions (m) | Contemporary Predictions (m) | |
|---|---|---|---|---|
| | | | Excluding Piercefield Seam | Including Piercefield Seam |
| Kayuga | 4 | 2.2 | 3.0 | 3.4 |
| Piercefield | 4.5 | 2.48 | | 3.38 |
| Wynn | 4 | 2.2 | 2.2 | 2.2 |
| **Total** | | 6.88 | 5.2 | 8.98 |

As shown in **Table 6**, total subsidence would exceed the value predicted by Holt (2000) if all three coal seams were mined using longwall methods. ~~However, given that the Piercefield Seam~~The proponent will ~~not be mined under DA 231-7-2000 (without further approval),~~ accept a condition requiring the subsidence ~~due~~impact to ~~longwall mining of the Kayuga and Wynn Seams will be within the maximum value~~be limited to those predicted by Holt (2000~~).~~) in the original EIS. Accordingly, the potential subsidence impacts during the extension period will be consistent with those currently authorised by the development consent.

### 3.4.2 Baseline Conditions

IPC's Contention

> *(ii) it did not take into account the effect of the period where the Dartbrook mine was in care and maintenance and so was not impacting baseline environmental conditions to the level that might have occurred had the mine been fully operational over this period; and*

Response

Due to Dartbrook Mine being placed into care and maintenance, mining activities have not progressed as anticipated in the EIS. The EIS assessed mining of the Kayuga/Mt Arthur Seam for 12 years followed by mining of the underlying Piercefield Seam. Under the current circumstances, mining of the Kayuga/Mt Arthur Seam cannot be completed within the duration of DA 231-7-2000 (even with the proposed Extension Period). ~~As such, mining of~~The proponent will accept a condition requiring the ~~Piercefield Seam is not proposed~~subsidence impact to be ~~undertaken pursuant to DA 231-7-2000 (without further approval) (see **Section 1.3**).~~

~~Having regard to current circumstances, mining operations will be~~ limited to ~~two coal seams instead of three. The result is that overall subsidence will be less than originally assessed~~those predicted by Holt (2000) in the original EIS.

### 3.4.3 Strategic Agricultural Land

IPC's Contention

> *(iii) it did not take into account the substantial changes in the surrounding area since the Approval, in particular the impact on biophysical strategic agricultural land and Equine Critical Industry Cluster land.*

Response

There is mapped BSAL located near but not within the Approved Kayuga Seam Mining Area. The approved longwall mining activities in the Kayuga Seam will not result in any subsidence impacts on the mapped BSAL located to the east.

An area of mapped ECIC is located within the south-western extent of the Approved Kayuga Seam Mining Area. The area is not used for any equine purpose. At this location, the minimum depth to the Kayuga Seam is approximately 170 m. Mining of the Kayuga Seam directly beneath this area of ECIC may result in deformations of ground surface (such as cracking and formation of humps). Such deformations are able to be remediated and will be managed in accordance with the Extraction Plan that will be prepared in accordance with the conditions imposed on DA 231-7-2000.

Recommended Conditions of Consent

Condition 3.3 of the Draft Consolidated Consent requires the preparation of an Extraction Plan prior to commencement of secondary extraction. The Extraction Plan will include a subsidence monitoring program and contingency plan that outline the procedures for identification and remediation of subsidence impacts to natural features (including strategic agricultural land).

### 3.5 GROUNDWATER

IPC's Contention

*The impacts on groundwater seepage and drawdown resulting from a five year extension of mining operations under the Approval have not been appropriately considered or assessed.*

***Particulars***

*(a) The GIA prepared for the Applicant in support of Mod 7 did not adequately assess the full groundwater impacts of the proposed extension of the Approval as it:*

*(i) Only considered the impact of the bord and pillar methods; and*

*(ii) Did not assess the impacts on groundwater seepage and drawdown should longwall mining operations recommence.*

Response

Bord and pillar mining will result in less impact than longwall mining of an equivalent area. This is because bord and pillar mining results in a lower rate of extraction and does not induce significant subsidence (which enhances drainage of groundwater). As such, the worst-case impact of the Modification is represented by the longwall mining case. Any mine plan that partly or entirely uses bord and pillar mining methods will result in less impact than this worst case.

The Modification does not seek to alter any aspects of the approved longwall mining. The potential groundwater impacts of the approved longwall mining were assessed by Mackie Environmental Research (MER, 2000) using a numerical groundwater model. A review of the MER (2000) assessment was conducted by Australasian Groundwater and Environmental Consultants (AGE) to advise whether the predictions of the model are likely to remain plausible. AGE's report is provided in **Appendix D**.

AGE notes that the MER (2000) assessment pre-dates the introduction of groundwater modelling guidelines. Advancements in computer technology have also facilitated the development of more detailed groundwater models. Due to changes in modelling technology and practices, the MER's model would differ from a contemporary groundwater model in certain respects (as discussed in Section 4 of **Appendix D**). Notwithstanding these differences, groundwater monitoring data indicate that MER's overall conclusions based on numerical modelling continue to remain valid.

MER predicted that mine inflow will increase to 1.6 ML/day upon completion of the Kayuga Seam longwall panels. This rate includes inflows to the completed Wynn Seam workings. The model assumed that all extracted areas remain drained throughout the mining duration. This assumption maximises the predicted inflow and drawdown and is therefore appropriately conservative. Due to a number of interacting factors including conservatism of the model, calibration of the model using inflow observations, and ~~not mining~~ the ~~Piercefield Seam (without further approval),~~proposed conditions, mine inflow is expected to remain within the rates predicted by MER.

MER predicted that "*bores and wells in the alluvial lands will be unaffected by depressurisation in the coal measures*". The rate of downward leakage from the alluvium to the Permian was predicted to be 0.1 ML/day, which is significantly less than the rate of rainfall recharge. The Dartbrook groundwater monitoring network includes four bores monitoring the Hunter River alluvium and three bores monitoring the Dart Brook alluvium. These alluvial monitoring bores have not recorded any detectable decline in water levels due to past longwall mining. Changes in water levels at these bores are closely correlated with climatic conditions.

MER predicted that the Permian strata overlying the mine workings will become depressurised (but not completely drained). There are three bores monitoring the overburden strata near the completed Kayuga Seam longwall panels. All three bores recorded declines in water levels during previous mining operations. Water levels have since stabilised in bores CAS4 and TLON1, whereas the water level in bore CAS2 has continued to decline even during care and maintenance. These monitoring results are generally consistent with MER's predictions regarding depressurisation of the overburden.

The trends observed in long-term monitoring data support the conclusions of MER's assessment. Even though modelling practice has changed since this assessment, the model predictions are still likely to be a good indication of the potential impacts of the approved longwall mining.

The MER model included 16 years of mining in the Kayuga Seam followed by 3 years of mining in the Piercefield Seam. Due to the extended period of care and maintenance, the actual footprint of mining will be less than that modelled by MER. ~~In particular, the Piercefield Seam will not be mined during the extension period (without further approval). The Piercefield Seam subcrops beneath the alluvium of the Hunter River and Dart Brook. Not mining the Piercefield Seam will avoid the creation of a new hydraulic connection between the alluvium and the mine workings. Due to the smaller footprint of mining, particularly avoidance of the Piercefield Seam~~Due to the smaller footprint of mining, it is unlikely that longwall mining during the extension period will result in impacts greater than the predictions of the MER model.

Recommended Conditions of Consent

Condition 4.1 of the Draft Consolidated Consent requires the preparation of a Site Water Management Plan (SWMP). The SWMP will include a groundwater monitoring program to identify impacts to aquifers and other water users, and a contingency plan to address any impacts that are greater than the model predictions.

## 3.6 SOCIAL

### 3.6.1 Changes in the Local Area

IPC's Contention

*(a) The Social Impact Assessment prepared for the Applicant in support of Mod 7 did not adequately assess the social impacts of Mod 7 as:*

*(i) it did not take into account the changes in the areas surrounding the Project site (particularly, growth in residential use, tourism and agriculture, especially the equine industry) since mining activities were approved at Dartbrook under the Approval;*

Response

Hansen Bailey has conducted a review of available data to identify changes in the local area since the grant of DA 231-7-2000 in 2001.

Trends in population growth (and therefore residential land use) were determined primarily using data from the Australian Bureau of Statistics (ABS). The following trends were identified:

- The population of the Muswellbrook Local Government Area (LGA) increased by 8.5% (1,278 persons) from 2001 to 2019;
- The population of the Upper Hunter LGA increased by 5.5% (750 persons) from 2001 to 2019. However, within this period, the population declined by 2.3% (334 persons) from 2013 to 2019; and
- In the township of Aberdeen, the population increased by 10.9% (186 persons) and the number of dwellings increased by 164 between 2001 and 2016.

The population growth in the Muswellbrook and Upper Hunter LGAs is much slower than the state average (23.7% between 2001 and 2019).

The agriculture industry is the fourth largest employer in the Muswellbrook LGA. From 2006 to 2016, employment in this industry increased by 18% (72 persons). In contrast, employment in the agriculture industry declined by 6% (78 persons) in the Upper Hunter LGA during this period. Notwithstanding, agriculture remains the largest employer in the Upper Hunter LGA.

The equine industry (referred to in ABS data as 'horse farming') is a subcategory of the agricultural industry. From 2006 to 2016, employment in the equine industry decreased by 2.5% (5 persons) in the Muswellbrook LGA and increased by 5.9% (21 persons) in the Upper Hunter LGA. It should be noted that the ABS' horse farming subcategory does not necessarily include employment associated with specialist horse services such as training, racing, medicine and research.

The tourism industry currently employs approximately 364 persons (3.6% of total employment) in the Muswellbrook LGA, and 310 jobs (5.9% of total employment) in the Upper Hunter LGA. The tourism sector is comprised of a variety of sub-sectors including retail trade, food & accommodation services and arts & recreation services. From 2011 to 2016, employment in these sub-sectors declined in both LGAs, with the exception of arts & recreation services in the Upper Hunter LGA (which increased by 4.2%).

There have been no significant changes in the land zoning within and surrounding Dartbrook Mine since the grant of DA 231-7-2000. The dominant land uses within 2 km of Dartbrook Mine are grazing, dairy farming, horse breeding, mining and residential development. The following trends in land use have been identified:

- Grazing and dairying operations near Dartbrook Mine have not changed significantly since 2001;
- A residential subdivision in south-eastern Aberdeen was approved in 2011. Residential development in Aberdeen has occurred at a rate of 10-12 dwellings per year;
- The number of thoroughbred horse studs in the Upper Hunter region increased from approximately 77 establishments in 2006 to 86 establishments in 2011;
- The most significant change in land use near Dartbrook Mine is the commencement of the Mount Pleasant Mine; and
- Coal mining remains the largest employer in the Muswellbrook LGA.

The available data indicates that the residential, agricultural and tourism land uses in the vicinity of Dartbrook Mine have not changed significantly since the grant of DA 231-7-2000.

The aforementioned data is analysed in detail in Section 2 of **Appendix E**.

### 3.6.2 Strategic Agricultural Land

IPC's Contention

> *(ii) the social impact on the Equine Critical Industry Cluster (ECIC) was not considered, given that areas of ECIC land overlap the mining lease, and the proximity of the mine to thoroughbred industry enterprises;*

Response

ECIC mapping for the Upper Hunter region was released after the grant of DA 231-7-2000 and during the period of care and maintenance at Dartbrook Mine. There is approximately 286 ha of land within the Mining Authorities Boundary that is mapped as ECIC. Of this area, approximately 154 ha (forming one contiguous property) is located above the Approved Kayuga Seam Mining Area. Only the property overlying the approved longwall mining activities may be affected by subsidence. The potential subsidence impacts on this area of ECIC are discussed in **Section 3.4.3**. Given that subsidence impacts on the land surface are able to be remediated, the values that supported the land's designation at ECIC will not be affected.

The property designated as ECIC has not been used for equine purposes at least since the introduction of the ECIC mapping. As such, mining beneath the property will not displace any equine activities. In any event, this property represents a negligible proportion of the mapped ECIC in the Upper Hunter region (254,900 ha) and subsidence impacts on this property will affect neither the future use of this land nor the sustainability of the regional equine industry.

### 3.6.3 Five Year Extension

IPC's Contention

*(iii) no assessment has been conducted on the social and economic impact of Mod 7 in its entirety for the further five year period until 2027, as the social impacts of the Project were assessed against the mine in care and maintenance mode, or against the mine during longwall operation;*

Response

The Modification does not involve any increase to the approved operational workforce, coal production rate or mining footprint. As such, the social impacts of further mining operations will be no different to those approved under DA 231-7-2000. However, due to the proposed extension period, these social impacts will occur over a longer timeframe.

A risk assessment was undertaken to evaluate the material social impacts (positive and negative) of the extension period. This risk assessment was based on the air quality and acoustics assessments discussed in **Section 3.1** and **Section 3.2**, respectively. The findings of the risk assessment are presented in Section 4 of **Appendix E** and summarised in **Table 7**.

**Table 7**
**Risk Assessment of Extension Period**

| Impact Mechanism | Nature of Impact | Residual Risk |
|---|---|---|
| Continuation of employment and business opportunities | Positive | Significant |
| Change to character and identity of the local area | Negative | Low |
| Access to public services and infrastructure | Negative | Low |
| Health and wellbeing of employees and their families | Positive | Significant |
| Community investment | Positive | Significant |
| Prolonged dust and noise emissions (impacts on near neighbours) | Negative | Moderate – High* |
| Prolonged dust and noise emissions (impacts on the equine industry) | Negative | Low |
| Impact on future use of ECIC land for equine purposes | Negative | Low |
| Impact on water security for agricultural purposes | Negative | Low |
| Impact on property values | Negative | Moderate |
| Displacement of agricultural land uses (including equine) due to subsidence impacts on land | Negative | Low |
| Impact on the tourism values of the local area | Negative | Low |

** Risk for rural residential properties near the East Site is assessed as high. For all other receptors (including those in Aberdeen), the risk is moderate.*

### 3.6.4 Social Impact of GHG Emissions

IPC's Contention

*(iv) the information provided regarding the appropriateness of the methodology for estimating the social and economic costs of the projected GHG emissions is unsatisfactory as contended at [38] and [39] above.*

Response

The GHG emissions associated with full operations during the Extension Period are presented in **Table 5**. The economic costs of these emissions are discussed in **Section 3.7.2**.

### 3.6.5 Visual Impact

IPC's Contention

*Further, Mod 7 will have a negative visual impact on the surrounding area, as the intensity of truck movements on the haul road will detract from the visual amenity of the area.*

Response

~~Truck~~The proponent will accept refusal of truck haulage of ROM coal~~ is no longer proposed to be undertaken~~.

## 3.7 ECONOMICS

### 3.7.1 Economic Assumptions

IPC's Contention

*The economic impacts resulting from a five year extension of mining operations under the Approval have not been appropriately considered or assessed.*

***Particulars***

*(a) The cost benefit analysis prepared for the Applicant in support of Mod 7 was inadequate as:*

*(i) the costs associated with the reopening and operation of the coal washery over the proposed five year extension period were not adequately accounted for;*

*(ii) there are uncertainties, having regard to concerns raised by UHSC and members of the public in submissions, as to the viability of the assumptions relied on by the Applicant as to coal quality and price, production issues and profitability; and*

Response

Gillespie Economics has been commissioned to conduct an economic assessment of longwall mining during the extension period (provided in **Appendix F**). This supplements the economic assessment of the bord and pillar mining option that was included in the EA.

In accordance with the '*Guideline for the economic assessment of mining and coal seam gas proposals'* (NSW Government, 2015), the economic assessment includes a cost benefit analysis (CBA) and local effects analysis (LEA).

The CBA considered two base cases:

- The 'economic base case' assumes that Dartbrook Mine will remain under care and maintenance until December 2022, after which it will be decommissioned; and
- The 'legal base case' assumes that the approved mining operations will continue until December 2022, after which the mine will be decommissioned. This case has been assessed to isolate the impact of the proposed five-year extension.

Relative to the economic base case, the incremental impact of the Modification is the full production schedule outlined in **Table 1**. This scenario includes all capital expenditure required to refurbish the operational infrastructure, including the Hunter Tunnel and CHPP.

Relative to the legal base case, the incremental impact is the production schedule for years 2023-2027 (inclusive).

The coal price assumptions in the CBA were based on KPMG (2020) forecasts for Newcastle Thermal Coal. Exchange rates (AUD to USD) were also adopted from KPMG (2020) forecasts.

The predicted net production benefits to Australia and NSW are outlined in **Table 8**. These benefits are expressed in present value terms (assuming a discount rate of 7%). The net production benefits are similar for the two base cases.

**Table 8**
**Predicted Net Production Benefits**

| Net Production Benefits ($M) | Economic Base Case | | Legal Base Case | |
|---|---|---|---|---|
| | Australia | NSW | Australia | NSW |
| Royalties to Government | 129 | 129 | 97 | 97 |
| Company Tax | 120 | 38 | 139 | 44 |
| Residual Net Production Benefits | 252 | 81 | 273 | 87 |
| **Total** | ***500*** | ***247*** | ***509*** | ***229*** |

The quantifiable externality costs of the Modification include the predicted groundwater, surface water and GHG impacts. The total cost of these environmental impacts has been estimated at $7M (present value).

The net social benefit is determined by subtracting the externality costs from the net production benefits. Accordingly, the net social benefit to NSW is estimated at $240M (present value) under the economic base case and $222M (present value) under the legal base case.

The Modification will also generate economic benefits to employees, suppliers and landholders. When these externality benefits are included, the net social benefit to NSW is estimated at $388M (present value) under the economic base case and $335M (present value) under the legal base case. The outcomes of the CBA are discussed in full in Section 2 of **Appendix F**.

The LEA predicts the following benefits to the local area:

- 196 jobs;
- Total income of $23M per annum; and
- Non-labour expenditure of $96M per annum.

It is assumed that 80% of the operational workforce (156 personnel) will be sourced from the local area. The LEA conservatively assumes full employment in the local area and as such, the 156 locally hired personnel are assumed to be diverted from other occupations. The net income generated by the Modification is difference in income between a mining job and a non-mining job. Of the total income of $23M per annum, the net increase is estimated at $5M per annum.

### 3.7.2 Cost of GHG Emissions

IPC's Contention

> *(iii) the net present value of the cost of GHG emission impacts from Mod 7 over the extended period of operation have not been considered as contended at [38] to [39] above.*

Response

The predicted GHG emissions for the ~~Revised~~ Modification are presented in **Table 5**.

The economic cost of GHG emissions is determined using shadow prices for $CO_2$-e. The average of the shadow prices used by the Australian Treasury, European Union and United States Environmental Protection Agency was adopted for this assessment. The adopted shadow price represents the global damage cost of GHG emissions. The global cost is apportioned to NSW based on its share of the global population. Using this methodology, the economic cost of the predicted Scope 1 & 2 emissions to NSW is $0.03M (present value), of which $0.02M (present value) is attributed to the Extension Period.

The economic cost to NSW of the Scope 3 emissions associated with the ~~Revised~~ Modification is $2.24M (present value), of which $1.75M (present value) is attributed to the Extension Period. Scope 3 emissions are generated by end users of the coal and are therefore not included in the CBA of the mining proposal.

For
***HANSEN BAILEY***

*Andrew Wu*
Senior Environmental Engineer

*James Bailey*
Director

# 4 ABBREVIATIONS

| Term | Definition |
|---|---|
| ABS | Australian Bureau of Statistics |
| AQC | AQC Dartbrook Management Pty Limited |
| AQGGMP | Air Quality and Greenhouse Gas Management Plan |
| BSAL | Biophysical Strategic Agricultural Land |
| CBA | Cost Benefit Analysis |
| CHPP | Coal Handling and Preparation Plant |
| DA 231-7-2000 | The current Development Consent for Dartbrook Mine |
| dB | Decibels |
| dBA | The peak sound pressure level, expressed as dB and scaled on the '*A-weighted'* scale |
| DP&E | NSW Department of Planning and Environment |
| EA | Environmental Assessment |
| EIS | Environmental Impact Statement |
| ECIC | Equine Critical Industry Cluster |
| EP&A Act | *Environmental Planning and Assessment Act 1979* |
| GHG | Greenhouse Gas |
| IPC | Independent Planning Commission |
| LEA | Local Effects Analysis |
| LEC | Land and Environment Court |
| LGA | Local Government Area |
| Mt | Million tonnes |
| Mtpa | Million tonnes per annum |
| NMP | Noise Management Plan |
| OEH | NSW Office of Environment and Heritage |
| REA | Reject emplacement area |
| ROM | Run of Mine |
| RTS | Response to Submissions |
| SWMP | Site Water Management Plan |
| t | Tonne |
| tph | Tonnes per hour |
| TSP | Total suspended particulates |
| VLAMP | Voluntary Land Acquisition and Mitigation Policy |

# 5 REFERENCES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- Hansen Bailey (2018b), *Dartbrook Mine Modification 7 Response to Submissions.*
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- Li. G, Steuart. P, Paquet. R and Ramage. R (2010) *A case study on mine subsidence due to multi-seam longwall extraction*.
- Mackie Environmental Research (2000), *Dartbrook Extended – Underground Coal Mine Water Management Studies*.
- NSW Government (2015), *Guideline for the economic assessment of mining and coal seam gas proposals.*
- NSW Government (2018), *Voluntary Land Acquisition and Mitigation Policy*.

***APPENDIX A***

***Air Quality Assessment***

# Dartbrook Mine Modification 7

Air Quality Assessment

21 July 2020

Project No.: 0559834

*The business of sustainability*

ERM

| **Document details** | |
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21 July 2020

# Dartbrook Mine Modification 7

## Air Quality Assessment


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## Acronyms and Abbreviations

| Name | Description |
|---|---|
| CHPP | Coal Handling and Preparation Plant |
| EA | Environmental Assessment |
| EIS | Environmental Impact Statement |
| EP&A Act | Environmental Planning and Assessment Act |
| DPIE | (NSW) Department of Planning, Industry and Environment |
| NEPM | National Environment Protection Measures |
| NSW | New South Wales |
| NSW EPA | (NSW) Environment Protection Authority |
| PM | (airborne) particulate matter |
| $PM_{10}$ | Airborne particulate matter with an aerodynamic diameter of less than 10 µm |
| $PM_{2.5}$ | Airborne particulate matter with an aerodynamic diameter of less than 2.5 µm |
| REA | Reject Emplacement Area |
| ROM | Run of mine |
| TSP | Total Suspended Particulate (matter) |
| Tpa | Tonnes per annum |
| $\mu g/m^3$ | Micrograms per cubic metre |
| VLAMP | Environment Voluntary Land Acquisition and Mitigation Policy |

# 1. INTRODUCTION

ERM has been engaged by Sparke Helmore Lawyers on behalf of Australian Pacific Coal Limited to undertake an air quality and greenhouse gas assessment for the proposed Dartbrook Mine Modification 7 under section 75W of the *Environmental Planning & Assessment Act 1979* (EP&A Act) to Dartbrook Mine's existing development consent DA 231-7-2000.

The assessment uses the computer-based dispersion model, CALPUFF, to predict ground-level dust concentrations for the Modification scenario. An emissions inventory was developed and modelled, and predictions of particulate matter were compared against regulatory air quality criteria. Predictions were made across a model domain and at sensitive receptors identified by Hansen Bailey (see Section 3).

The assessment is based on a conventional approach following the procedures outlined in the NSW Environment Protection Authority's (EPA) document titled "*Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW*" (NSW EPA, 2016), hereafter referred to as the 'Approved Methods'.

# 2. MODIFICATION DESCRIPTION

AQC Dartbrook Management Pty Limited (AQC) is the proprietor of the Dartbrook Mine, located in the Upper Hunter Valley of NSW. 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 longwall mining operations to be carried out until 5 December 2022. However, Dartbrook Mine has been in care and maintenance since December 2006.

The Modification originally consisted of the following components:

- 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 (ROM) 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 Modification 7 Environmental Assessment (EA) assessed the extraction of 10 Mt of ROM coal via bord and pillar mining and the handling (but not washing) of this coal. These aspects of the Modification were approved by the IPC. The IPC refused the proposed 5-year extension arguing that the impacts of longwall mining during the extension period (2023-2027, inclusive) had not been assessed.

In light of the IPC's decision and AQC's ensuing consideration of its position, the scope of the Modification has been altered in the following respects:

- Extraction of up to 37.4 Mt of ROM coal using bord & pillar and/or longwall mining methods between 2021 and 2027 (inclusive). All mining will occur within the currently approved mining footprint and maximum production rate of 6 Mtpa;
- Delivery of ROM coal from the mine workings to the East Site using the Hunter Tunnel (i.e. truck haulage of coal is no longer proposed);
- Use of the existing Coal Handling and Preparation Plant (CHPP) at the East Site to wash all ROM coal extracted (including washing of coal extracted through bord & pillar mining);
- Disposal of rejects and tailings using the already approved methods; and
- No new surface infrastructure (i.e. the shaft facility adjacent to the Western Access Road is no longer proposed).

# 3. LOCAL SETTING

Dartbrook Mine is located approximately 10 km north-west of Muswellbrook and 4.5 km west of Aberdeen in the Hunter Valley of New South Wales (NSW) and lies within the Muswellbrook and Upper Hunter Local Government Areas (LGA).

Agriculture and coal mining are the predominant industries in the Hunter Valley. Agricultural activities comprise cropping, horse breeding, some viticulture and pastoral activities. There are a number of approved mining operations located in the vicinity of the Modification. Approved operations include Mount Pleasant, Bengalla, Muswellbrook Colliery, Mount Arthur Coal and Mangoola (see Figure 3-1). The West Muswellbrook Project is located immediately to the west. Section 5.2.6 provides further details of the approved mining operations located in the vicinity of the Modification and how they were considered within the air quality assessment.

Nearby sensitive receptors are shown in Figure 3-2 and a detailed list is provided in Table 3-1.

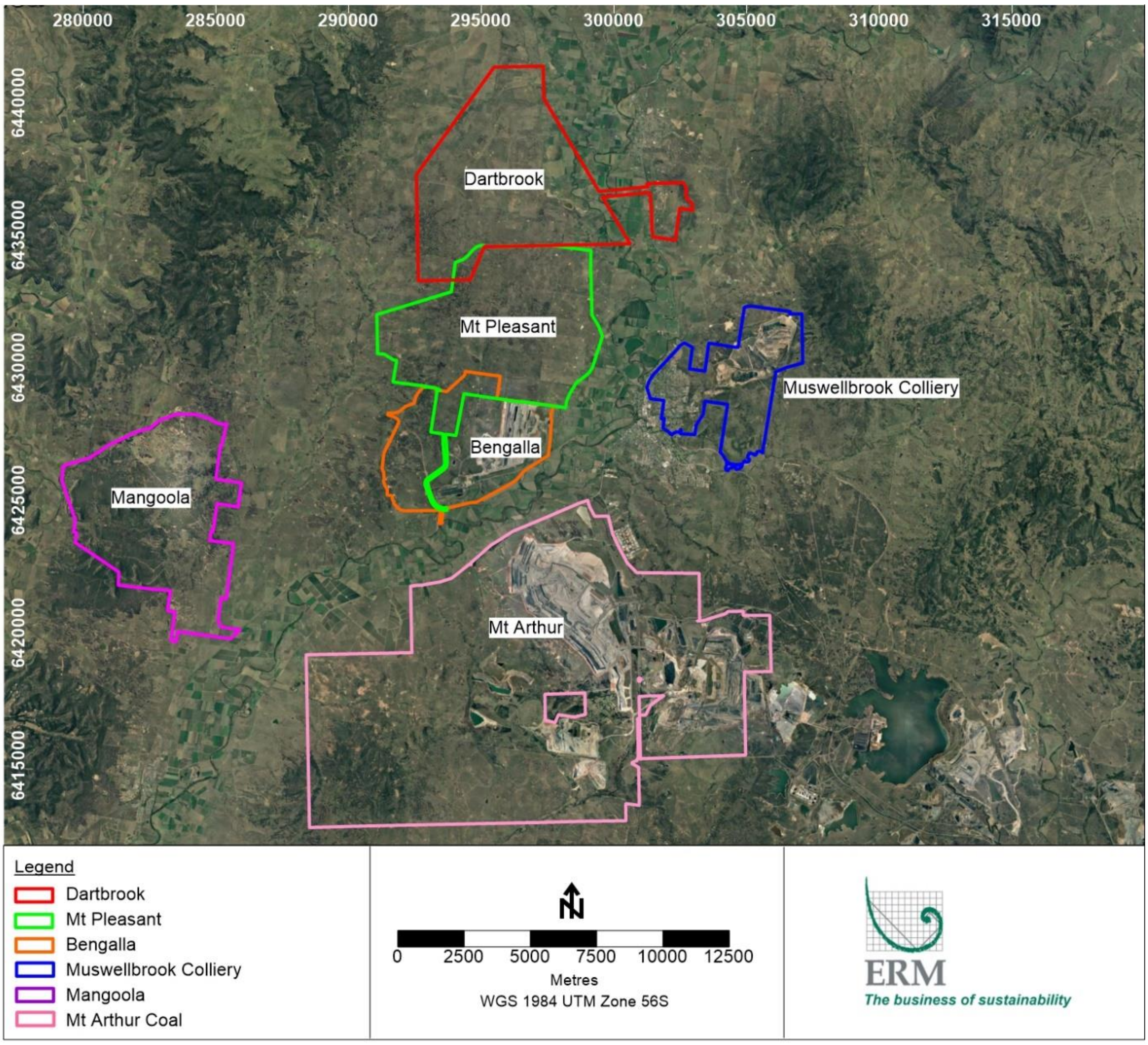



**Figure 3-1: Modification location including local mines**

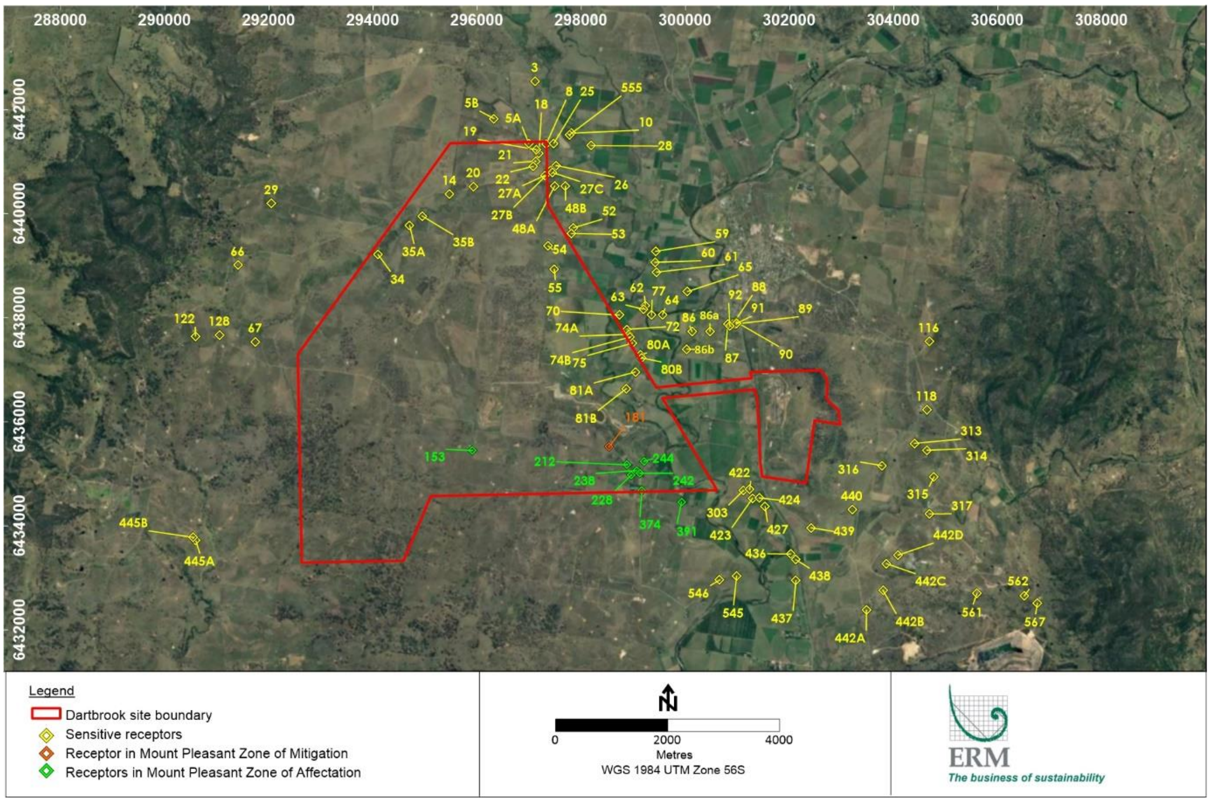



**Figure 3-2: Site location and sensitive receptors**

Figure 3-3 presents a pseudo three-dimensional representation of the local topography in the Modification area and across the model domain. The map also shows the locations of the meteorological stations as discussed further in Section 5.

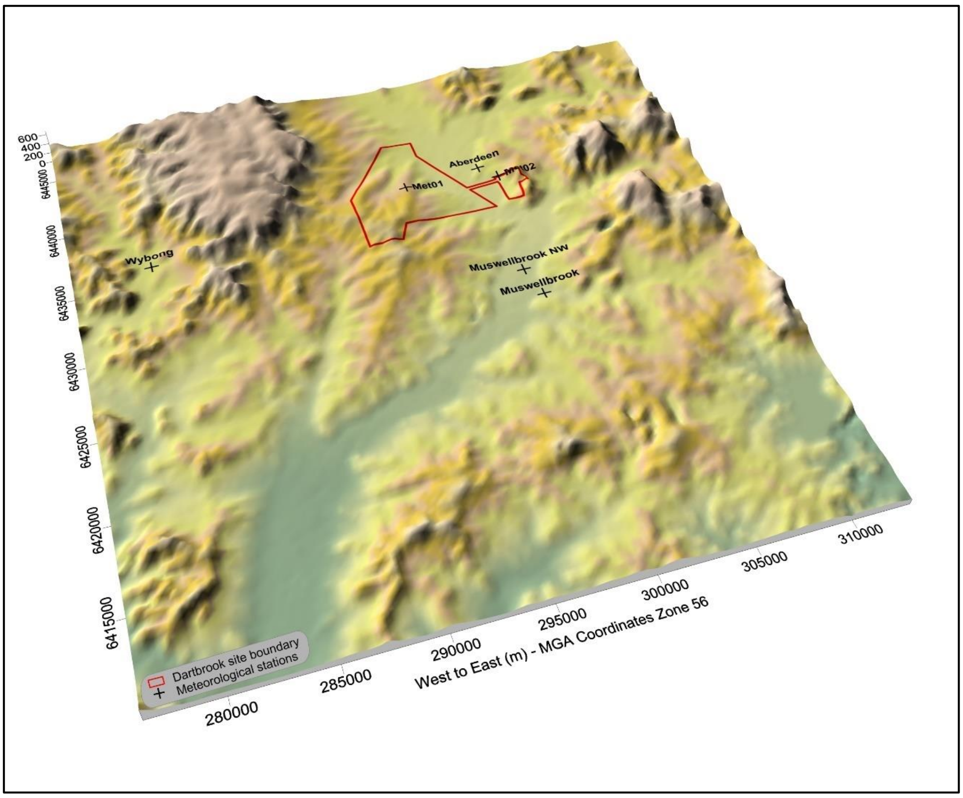



**Figure 3-3: Pseudo 3-dimensional plot of the local topography**

**Table 3-1: Sensitive receptor locations**

| Receptor ID | x | y |
|---|---|---|
| 3 | 297111 | 6442543 |
| 8 | 297323 | 6441329 |
| 10 | 297807 | 6441545 |
| 14 | 295469 | 6440374 |
| 18 | 297185 | 6441161 |
| 19 | 297135 | 6441228 |
| 20 | 295931 | 6440522 |
| 21 | 297122 | 6441006 |
| 22 | 297076 | 6440909 |
| 25 | 297471 | 6441351 |
| 26 | 297516 | 6440924 |
| 28 | 298195 | 6441307 |
| 29 | 292051 | 6440195 |
| 34 | 294092 | 6439218 |
| 52 | 297849 | 6439728 |
| 53 | 297807 | 6439618 |
| 54 | 297361 | 6439379 |
| 55 | 297480 | 6438933 |
| 59 | 299427 | 6439275 |
| 60 | 299415 | 6439064 |
| 61 | 299447 | 6438875 |
| 62 | 299231 | 6438238 |
| 63 | 299189 | 6438163 |
| 64 | 299558 | 6438059 |
| 65 | 300040 | 6438503 |
| 66 | 291406 | 6439011 |
| 67 | 291739 | 6437536 |
| 70 | 298731 | 6438049 |
| 72 | 298877 | 6437777 |
| 75 | 298987 | 6437512 |
| 77 | 299346 | 6438056 |
| 87 | 300811 | 6437878 |
| 88 | 300914 | 6437883 |
| 89 | 300955 | 6437878 |
| 90 | 300985 | 6437912 |
| 91 | 300987 | 6437891 |
| 92 | 300851 | 6437842 |
| 116 | 304681 | 6437541 |
| 118 | 304634 | 6436229 |
| 122 | 290589 | 6437645 |
| 128 | 291049 | 6437670 |
| 303 | 301113 | 6434680 |
| 313 | 304395 | 6435586 |
| 314 | 304638 | 6435454 |
| 315 | 304773 | 6434943 |
| 316 | 303772 | 6435158 |
| 317 | 304691 | 6434230 |
| 422 | 301234 | 6434700 |

| Receptor ID | x | y |
|---|---|---|
| 423 | 301289 | 6434533 |
| 424 | 301419 | 6434537 |
| 427 | 301529 | 6434372 |
| 436 | 302020 | 6433460 |
| 437 | 302121 | 6432952 |
| 438 | 302120 | 6433352 |
| 439 | 302411 | 6433965 |
| 440 | 303203 | 6434310 |
| 545 | 300981 | 6433036 |
| 546 | 300655 | 6432960 |
| 555 | 297774 | 6441515 |
| 561 | 305599 | 6432700 |
| 562 | 306504 | 6432653 |
| 567 | 306757 | 6432513 |
| 27A | 297305 | 6440735 |
| 27B | 297412 | 6440821 |
| 27C | 297447 | 6440787 |
| 35A | 294702 | 6439776 |
| 35B | 294941 | 6439955 |
| 442A | 303475 | 6432381 |
| 442B | 303792 | 6432764 |
| 442C | 303858 | 6433275 |
| 442D | 304086 | 6433439 |
| 445A | 290594 | 6433724 |
| 445B | 290544 | 6433780 |
| 48A | 297488 | 6440530 |
| 48B | 297698 | 6440527 |
| 5A | 296990 | 6441346 |
| 5B | 296323 | 6441826 |
| 74A | 298907 | 6437682 |
| 74B | 298929 | 6437626 |
| 80A | 299137 | 6437286 |
| 80B | 299156 | 6437228 |
| 81A | 299039 | 6436957 |
| 81B | 298866 | 6436639 |
| 86 | 300126 | 6437730 |
| 181 | 298536 | 6435522 |
| 212 | 298881 | 6435173 |
| 228 | 298964 | 6434981 |
| 238 | 299063 | 6435063 |
| 242 | 299128 | 6435012 |
| 244 | 299210 | 6435242 |
| 374 | 299164 | 6434676 |
| 391 | 299924 | 6434460 |
| 153 | 295900 | 6435448 |
| 86a | 300470 | 6437740 |
| 86b | 300028 | 6437398 |

# 4. LEGISLATIVE SETTING AND AIR QUALITY CRITERIA

## 4.1 Introduction

Mining activities proposed by the Modification (described in Section 2) have the potential to generate fugitive dust emissions in the form of particulate matter described as total suspended particulate matter (TSP), particulate matter with an equivalent aerodynamic diameter of 10 micrometres (µm) or less ($PM_{10}$), particulate matter with an equivalent aerodynamic diameter of 2.5 micrometres (µm) or less ($PM_{2.5}$) and deposited dust. In addition, combustion engines of generators and vehicles release emissions through engine exhausts including carbon monoxide (CO), minor quantities of sulphur dioxide ($SO_2$) and nitrogen dioxide ($NO_2$). Diesel combustion also results in the emission of fine particulate matter and fumes from blasting will result in emissions of oxides of nitrogen.

The following sections provide information on the relevant government requirement guidelines and air quality criteria used to assess the impact of pollutant emissions. Some background discussion has been provided to assist in interpreting the predicted pollutant levels.

## 4.2 Air quality issues and effects

From an air quality perspective, it is important to consider the potential emissions that would occur during the operation of the Modification.

The focus of this assessment is particulate matter – TSP, $PM_{10}$, $PM_{2.5}$ and deposited dust.

### *4.2.1 Particulate matter*

Particulate matter has the capacity to affect health and to cause nuisance effects, and is categorised by size and/or by chemical composition. The potential for harmful effects depends on both. The particulate size ranges are commonly described as:

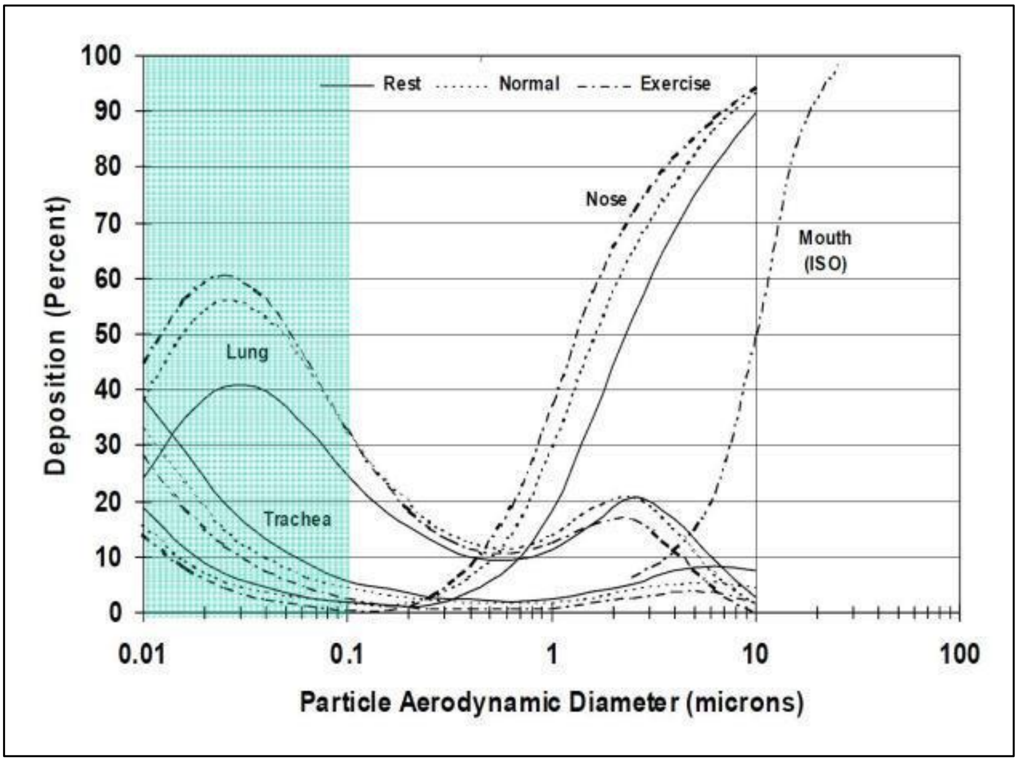
- Total Suspended Particulates (TSP) – refers to all suspended particles in the air. In practice, the upper size range is typically 30 µm.
- $PM_{10}$ – refers to all particles with equivalent aerodynamic diameters of less than 10 µm, that is, all particles that behave aerodynamically in the same way as spherical particles with diameters less than 10 µm and with a unit density. $PM_{10}$ are a sub-component of TSP.
- $PM_{2.5}$ – refers to all particles with equivalent aerodynamic diameters of less than 2.5 µm diameter (a subset of $PM_{10}$). These are often referred to as the fine particles and are a sub-component of $PM_{10}$.
- $PM_{2.5-10}$ – defined as the difference between $PM_{10}$ and $PM_{2.5}$ mass concentrations. These are often referred to as coarse particles.

Evidence suggests that health effects from exposure to airborne particulate matter are predominantly related to the respiratory and cardiovascular systems (WHO, 2011). The human respiratory system has in-built defensive systems that prevent larger particles from reaching the more sensitive parts of the respiratory system. Particles larger than 10 µm, while not able to affect health, can soil materials and generally degrade aesthetic elements of the environment. For this reason, air quality goals make reference to measures of the total mass of all particles suspended in the air, referred to as TSP. In practice particles larger than 30 to 50 µm settle out of the atmosphere too quickly to be regarded as air pollutants. The upper size range for TSP is usually taken to be 30 µm.

Both natural and anthropogenic processes contribute to the atmospheric load of particulate matter. Coarse particles ($PM_{2.5-10}$) are derived primarily from mechanical processes resulting in the suspension of dust, soil, or other crustal materials from roads, farming, mining and dust storms.

Fine particles or $PM_{2.5}$ are derived primarily from combustion processes, such as vehicle emissions, wood burning and natural processes such as bush fires. Fine particles also consist of transformation products, including sulphate and nitrate particles, and secondary organic aerosol from volatile organic compound emissions. $PM_{2.5}$ may penetrate beyond the larynx and into the thoracic respiratory tract and evidence suggests that particles in this size range are more harmful than the coarser component of $PM_{10}$.

The size of particles determine their behaviour in the respiratory system, including how far the particles are able to penetrate, where they deposit, and how effective the body's clearance mechanisms are in removing them. This is demonstrated in Figure 4-1, which shows the relative deposition by particle size within various regions of the respiratory tract. Additionally, particle size is an important parameter in determining the residence time and spatial distribution of particles in ambient air and is a key consideration in assessing exposure.




Source: Phalen et.al, 1991

**Figure 4-1: Particle deposition within the respiratory tract**

The health-based assessment criteria used by NSW EPA have, to a large extent, been developed by reference to epidemiological studies undertaken in urban areas with large populations where the primary pollutants are the products of combustion (National Environment Protection Council [NEPC], 1998a; NEPC, 1998b). This means that, in contrast to dust of crustal origin, the particulate matter from urban areas would be composed of smaller particles and would generally contain substances that are associated with combustion.

## 4.3 NSW EPA impact assessment criteria

The Approved Methods specify air quality impact assessment criteria relevant for assessing impacts from air pollution (NSW EPA, 2016). The impact assessment criteria for pollutants relevant to this assessment refer to the total pollutant load in the environment and impacts from new sources of these pollutants must be added to existing background levels for compliance assessment. In other words, consideration of background dust levels needs to be made when using the goals outlined in the Approved Methods to assess potential impacts.

These criteria are health-based (i.e. they are set at levels to protect against health effects) and for $PM_{10}$ and $PM_{2.5}$ are consistent with Amended National Environment Protection Measure for Ambient Air Quality (Ambient Air-NEPM) (NEPC, 2016). In addition, the Approved Methods include other measures of air quality, namely dust deposition and Total Suspended Particulates (TSP), which are not stated in the Ambient Air-NEPM.

Table 4-1 summarises the air quality criteria for concentrations of particulate matter that are relevant to this study. It is important to note that these criteria have been applied to the cumulative impacts due to the Modification and other sources.

**Table 4-1: NSW EPA impact assessment criteria for particulate matter concentrations**

| Pollutant | Criteria | Averaging period |
|---|---|---|
| TSP | 90 µg/m$^3$ | Annual |
| $PM_{10}$ | 50 µg/m$^3$<br>25 µg/m$^3$ | 24-Hour<br>Annual |
| $PM_{2.5}$ | 25 µg/m$^3$<br>8 µg/m$^3$ | 24-Hour<br>Annual |

Airborne dust also has the potential to cause nuisance dust effects by depositing on surfaces, including vegetation. Larger particles do not tend to remain suspended in the atmosphere for long periods of time and will fallout relatively close to source. Dust fallout can soil materials and generally degrade aesthetic elements of the environment, and are assessed for nuisance amenity impacts.

Table 4-2 shows the maximum acceptable increase in dust deposition over the existing dust levels from an amenity perspective. These criteria for dust fallout levels are set to protect against nuisance impacts.

**Table 4-2: NSW EPA impact assessment criteria for deposited dust**

| Pollutant | Averaging period | Maximum increase (due to Modification) | Maximum total level |
|---|---|---|---|
| Deposited dust (insoluble solids) | Annual average | 2 g/m$^2$/month | 4 g/m$^2$/month |

## 4.4 NSW Department of Planning, Industry and Environment Voluntary Land Acquisition and Mitigation Policy (VLAMP)

In December 2014, the NSW Department of Planning and Environment (now Department of Planning, Industry and Environment (DPIE)) released a policy relating to Mining, Petroleum Production and Extractive Industries and including the identification of voluntary mitigation and land acquisition criteria for air quality and noise (NSW Government, 2014). This is reflected in State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (the Mining SEPP) at Clause 12A.

The policy sets out voluntary mitigation and land acquisition rights where it is not possible to comply with the NSW EPA impact assessment criteria even with the implementation of all reasonable and feasible avoidance and/or mitigation measures.

The DPIE voluntary mitigation and acquisition criteria are summarised in Table 4-3 and Table 4-4, respectively. The Modification has been assessed against these criteria, in addition to the NSW EPA impact assessment criteria discussed in Section 4.3.

The VLAMP was revised by DPIE and reissued in September 2018.

**Table 4-3: DPIE particulate matter mitigation criteria**

| Pollutant | Criterion | Averaging period | Application |
|---|---|---|---|
| $PM_{2.5}$ | 8 µg/m$^3$<br>25 µg/m$^3$ | Annual-mean<br>24-hour average | Total impact *<br>Incremental impact ** |
| $PM_{10}$ | 30 µg/m$^3$<br>50 µg/m$^3$ | Annual-mean<br>24-hour average | Total impact *<br>Incremental impact ** |
| TSP | 90 µg/m$^3$ | Annual-mean | Total impact |
| Deposited dust | 2 g/m$^2$/month<br>4 g/m$^2$/month | Annual-mean<br>Annual-mean | Incremental impact **<br>Total impact * |

* Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources)

** Incremental impact (i.e. increase in concentrations due to the development alone), **with zero allowable exceedances of the criteria over the life of the development.**

**Table 4-4: DPIE particulate matter acquisition criteria**

| Pollutant | Criterion | Averaging period | Application |
|---|---|---|---|
| $PM_{2.5}$ | 8 µg/m$^3$<br>25 µg/m$^3$ | Annual-mean<br>24-hour average | Total impact *<br>Incremental impact ** |
| $PM_{10}$ | 30 µg/m$^3$<br>50 µg/m$^3$ | Annual-mean<br>24-hour average | Total impact *<br>Incremental impact ** |
| TSP | 90 µg/m$^3$ | Annual-mean | Total impact |
| Deposited dust | 2 g/m$^2$/month<br>4 g/m$^2$/month | Annual-mean<br>Annual-mean | Incremental impact<br>Total impact |

* Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources)

** Incremental impact (i.e. increase in concentrations due to the development alone), **with up to five allowable exceedances of the criteria over the life of the development.**

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 existing planning controls.

Total impact includes the impact of the Modification and all other sources, whilst incremental impact refers to the impact of the Modification considered in isolation. The incremental impact for the DPIE mitigation criteria also applies to areas where more than 25% of the land has been predicted to exceed.

At Clause 12AB(4), the Mining SEPP also sets a non-discretionary development standard of cumulative annual average $PM_{10}$ concentration for private dwellings of 30 µg/m$^3$.

## 5. EXISTING ENVIRONMENT

In 2017, Pacific Environment (now ERM) prepared an air quality assessment for a pre-feasibility study into further mining at Dartbrook Mine (Pacific Environment, 2017). That assessment included a thorough five-year review of the local meteorological and background data for 2012 to 2016. The review found that the most representative year for the assessment was 2014. For more details of the five-year review, please see Pacific Environment, 2017.

In addition, the previous Dartbrook Underground Modification 7 air quality assessment was prepared using the 2014 meteorological and background data (ERM, 2018).

The following sections present the most recently available data for comparison with 2014.

## 5.1 Meteorology

### 5.1.1 Introduction

There are several meteorological stations located in the vicinity of the Modification. These include Department of Planning, Industry and Environment (DPIE) stations and two on-site meteorological stations. There is also a meteorological station located at the neighbouring Mount Pleasant Mine site.

The most recent data for the two on-site meteorological stations and Mount Pleasant Mine meteorological station are not considered in this review as these data were not available.

The closest Bureau of Meteorology (BoM) stations are Scone Airport AWS (061363), Merriwa (Roscommon) (061287) and Murrurundi Gap AWS (061392), all of which are a considerable distance (in excess of 22 km) from the Modification. As per the original pre-feasibility study, the meteorological data from these stations have been excluded from this review.

### 5.1.2 DPIE Stations

As shown on Figure 5-1, there are four DPIE stations located within 12 km of the Modification at Aberdeen, Muswellbrook, Muswellbrook NW and Wybong. For this review, the data was collected for 2015 to 2019 to compare with the 2014 data used in the pre-feasibility study and the previous Dartbrook Underground Modification 7 air quality assessment.

Table 5-1 presents a summary of the percentage completeness of data for each site for 2014 to 2019.

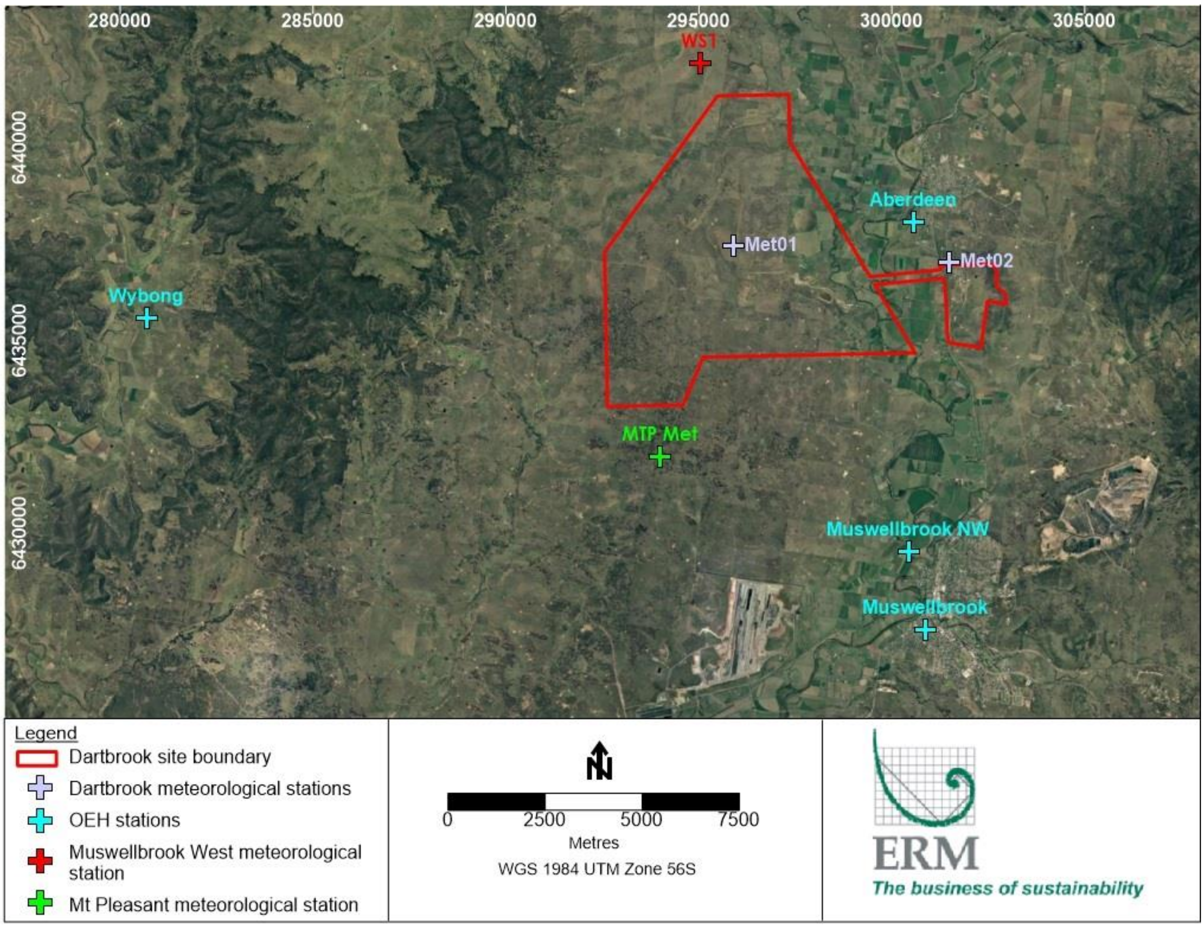



**Figure 5-1: Location of DPIE and on-site meteorological stations**

**Table 5-1: Percentage completeness of meteorological data at each of the DPIE stations**

| Parameter | Year | DPIE Stations | | | |
|---|---|---|---|---|---|
| | | Aberdeen | Muswellbrook | Muswellbrook NW | Wybong |
| Wind Speed | **2014** | **99.7** | **99.7** | **98.8** | **99.9** |
| | 2015 | 99.6 | 99.7 | 99.2 | 99.3 |
| | 2016 | 97.2 | 97.3 | 98.3 | 99.5 |
| | 2017 | 99.7 | 99.8 | 98.8 | 99.8 |
| | 2018 | 99.8 | 98.6 | 98.6 | 99.9 |
| | 2019 | 99.8 | 99.2 | 99.7 | 99.8 |
| Wind Direction | **2014** | **99.7** | **99.7** | **98.8** | **99.9** |
| | 2015 | 99.6 | 99.7 | 99.2 | 99.3 |
| | 2016 | 97.2 | 97.3 | 98.3 | 99.5 |
| | 2017 | 99.7 | 99.8 | 98.8 | 99.8 |
| | 2018 | 99.8 | 98.6 | 98.6 | 99.9 |
| | 2019 | 99.8 | 99.2 | 99.7 | 99.8 |
| Temperature | **2014** | **98.9** | **99.8** | **99.9** | **99.9** |
| | 2015 | 99.9 | 99.8 | 99.9 | 99.7 |
| | 2016 | 99.3 | 97.6 | 99.9 | 99.9 |
| | 2017 | 99.1 | 99.9 | 100.0 | 99.9 |
| | 2018 | 98.9 | 98.1 | 99.0 | 99.0 |
| | 2019 | 98.7 | 98.4 | 98.7 | 98.7 |
| Relative Humidity | **2014** | **98.9** | **99.8** | **99.9** | **99.9** |
| | 2015 | 99.9 | 99.8 | 99.9 | 99.7 |
| | 2016 | 99.3 | 97.6 | 99.9 | 99.9 |
| | 2017 | 97.3 | 99.9 | 100.0 | 99.9 |
| | 2018 | 99.0 | 98.1 | 99.0 | 99.0 |
| | 2019 | 98.5 | 98.3 | 98.5 | 97.9 |

Annual wind roses for each of the DPIE stations from 2014 through to 2019 are provided in Figure 5-2 to Figure 5-5. For Muswellbrook and Aberdeen, the prevailing wind directions are from the north-north-west, south-south-east and/or the south. The Muswellbrook NW site shows a dominant wind from the north-east and also shows prevailing wind directions from the south-east. Wybong shows a dominant wind from the north-north-west and south-south-east.

For all stations the wind roses show consistency across all years presented and shows that the use of 2014 meteorological data is still appropriate.

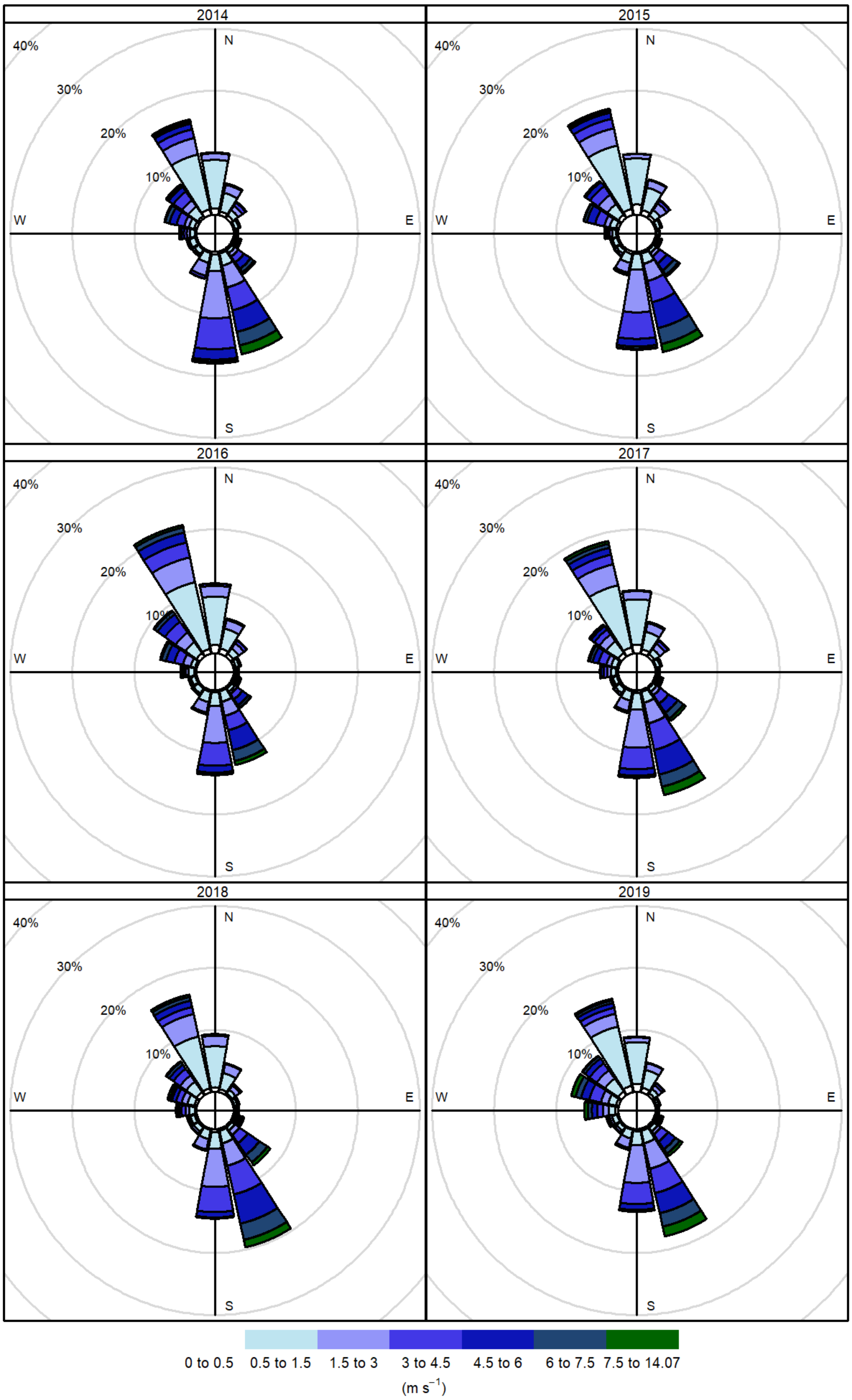



**Figure 5-2: Annual wind roses for Aberdeen from 2014 to 2019**

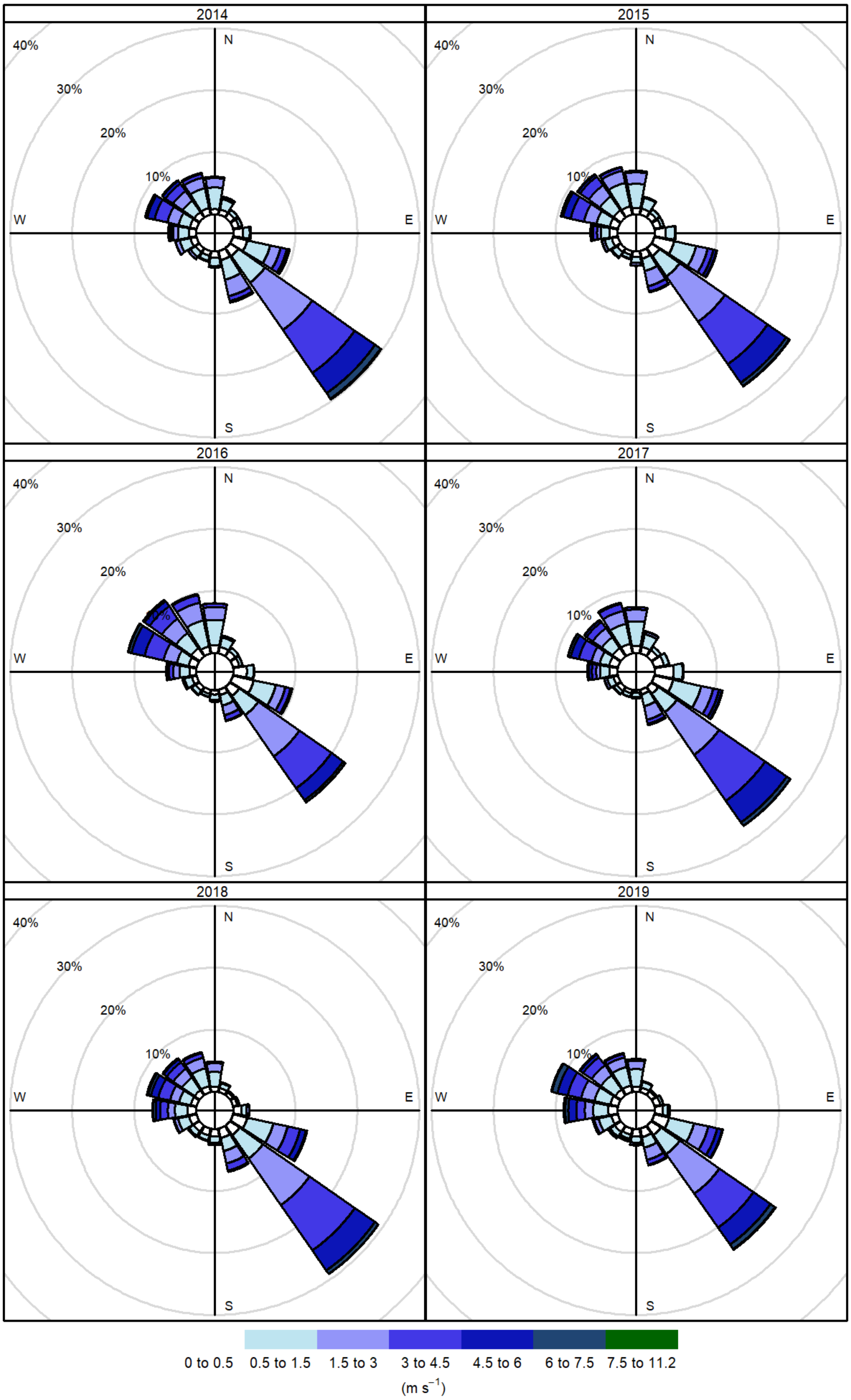



**Figure 5-3: Annual wind roses for Muswellbrook from 2014 to 2019**

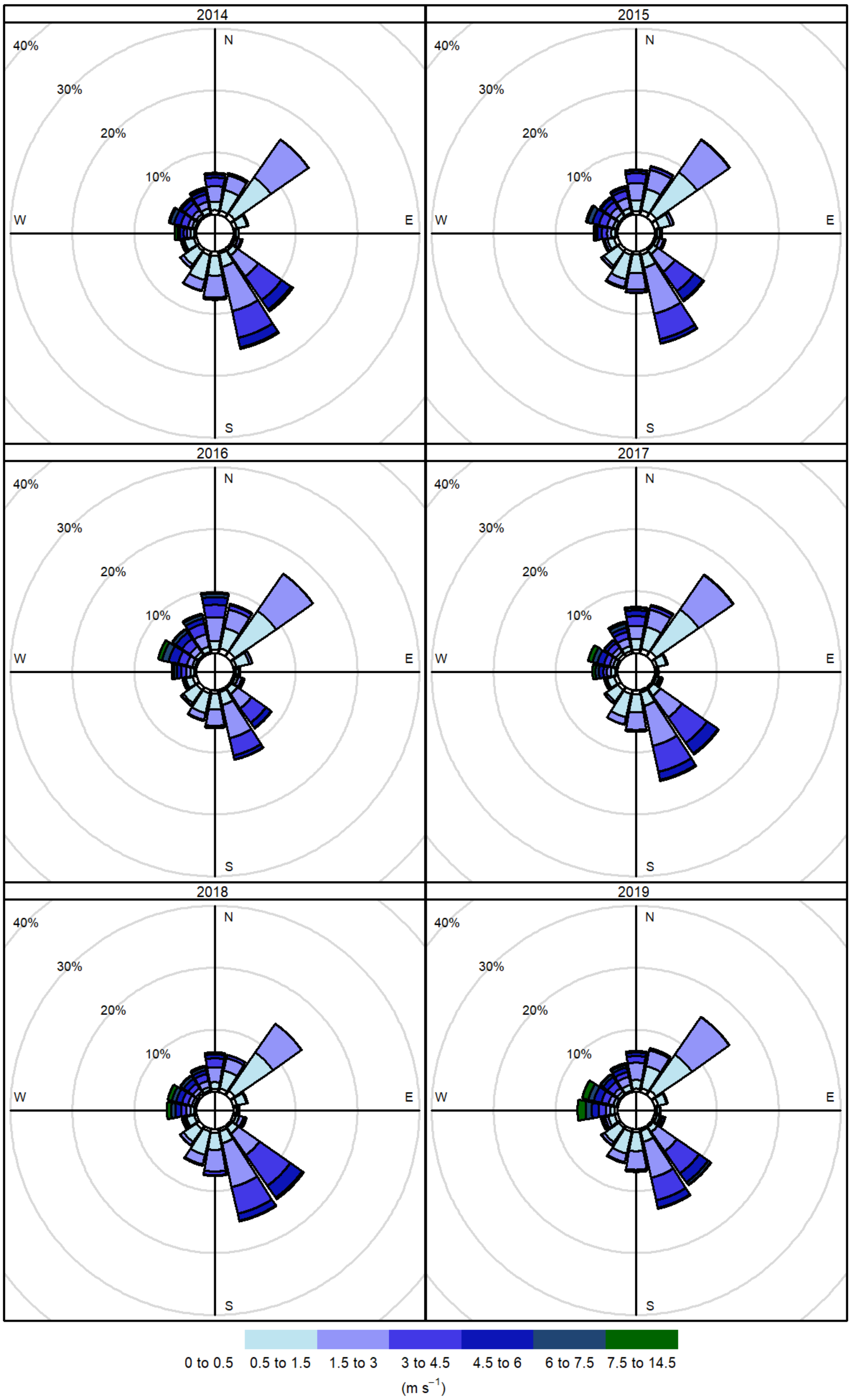



**Figure 5-4: Annual wind roses for Muswellbrook NW from 2014 to 2019**

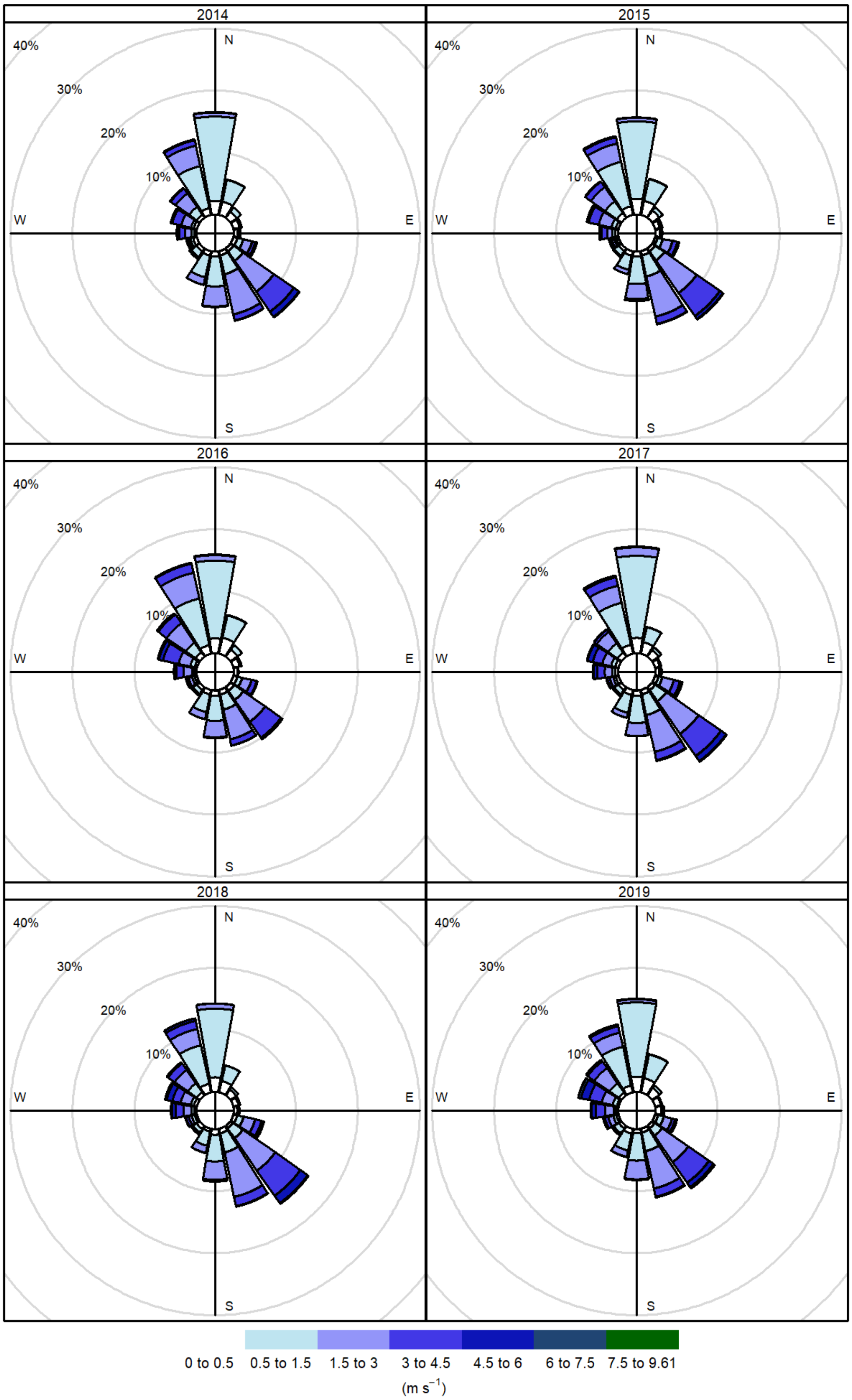



**Figure 5-5: Annual wind roses for Wybong from 2014 to 2019**

## 5.2 Existing air quality

### 5.2.1 Introduction

The four closest DPIE stations (Aberdeen, Muswellbrook, Muswellbrook NW and Wybong) record $PM_{10}$ concentrations. DPIE Muswellbrook also records $PM_{2.5}$ concentrations.

The Dartbrook Mine operates a network of 17 dust deposition gauges, and five High Volume Air Samplers (HVAS) that measure $PM_{10}$ concentrations every sixth day. Most recent data are not considered in this review as these data were not available. The locations of the DPIE stations are shown on Figure 5-6.

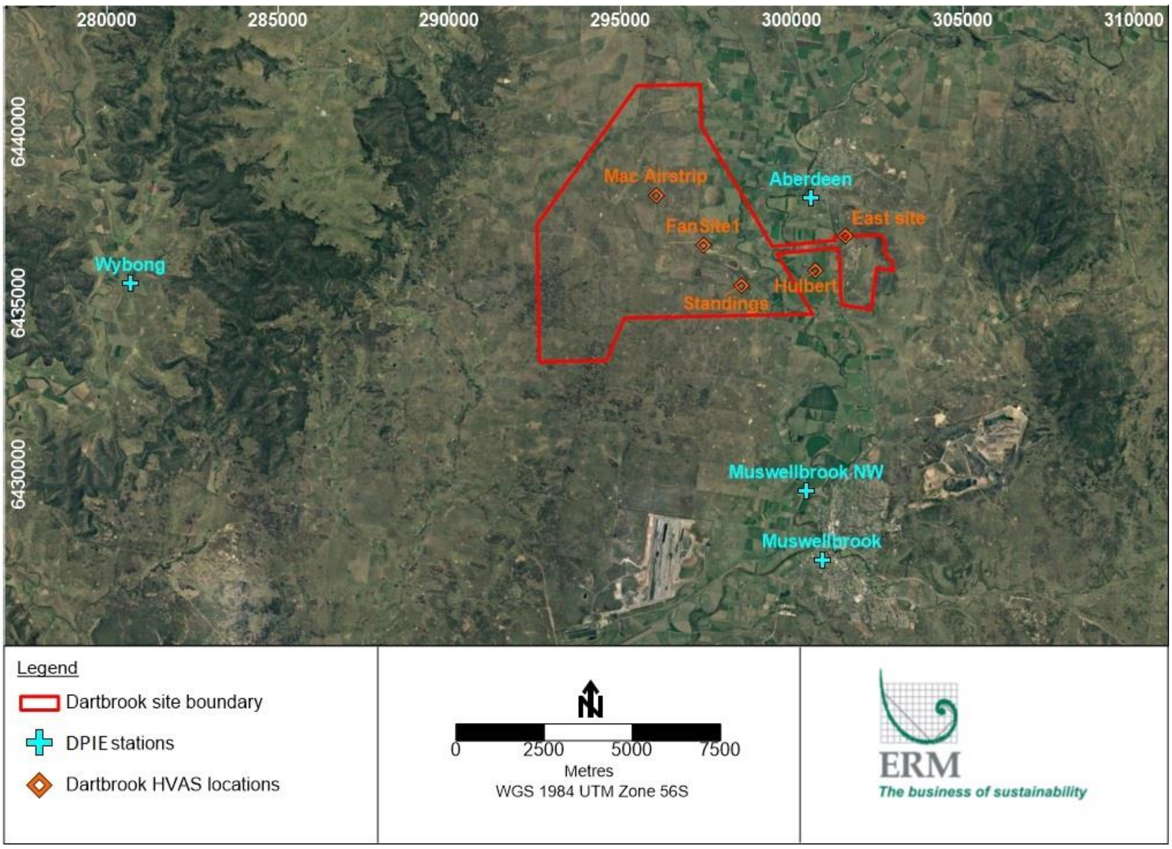



**Figure 5-6: Location of DPIE stations and HVAS monitoring sites**

### 5.2.2 TSP

No TSP concentration data are available in the vicinity of the Modification. Estimates of annual average TSP concentrations can be made from the $PM_{10}$ measurements by assuming that 40% of the TSP is $PM_{10}$. This relationship was obtained from data collected by co-located TSP and $PM_{10}$ monitors operated for long periods of time in the Hunter Valley (NSW Minerals Council, 2000).

In the absence of site specific data this provides an indicative estimate of the ambient TSP. Use of this relationship on the adopted $PM_{10}$ annual average of 17.8 µg/m$^3$ (see Section 5.2.6), gives an existing annual average TSP concentration of approximately 44.5 µg/m$^3$.

### 5.2.3 Particulate Matter ($PM_{10}$)

A summary of the annual average $PM_{10}$ concentrations from 2014 to 2019 at the four DPIE stations is provided in Table 5-2. The period average (2014-2019) at all sites is driven up by the high concentrations recorded in 2019 due to extreme drought conditions and bush fire activity. When considering a five-year average (2014-2018), the concentrations are reduced. The background $PM_{10}$ concentrations determined for the previous assessment was 17.8 µg/m³ for 2014 at Aberdeen. It can be seen that the five-year average (2014-2018) is very similar to the value at Aberdeen for 2014. On that basis the use of this value for the assessment is still considered appropriate.

**Table 5-2: Annual average $PM_{10}$ at DPIE stations from 2015 to 2019**

| Year | DPIE stations | | | | Criteria |
|---|---|---|---|---|---|
| | Aberdeen | Muswellbrook | Muswellbrook NW | Wybong | |
| 2014 | 17.8 | 21.3 | 19.1 | 16.8 | 25 |
| 2015 | 15.2 | 19.1 | 16.7 | 14.8 | |
| 2016 | 15.6 | 19.2 | 16.6 | 15.3 | |
| 2017 | 17.6 | 21.7 | 18.5 | 17.6 | |
| 2018 | 22.3 | 27.2 | 25.0 | 21.6 | |
| 2019 | 29.5 | 34.4 | 33.7 | 28.5 | |
| Period average | 19.7 | 23.8 | 21.6 | 19.1 | |
| Average (excl. 2019) | 17.7 | 21.7 | 19.2 | 17.2 | |

Figure 5-7 presents a graphical representation of the annual average concentrations at the DPIE stations from 2014 to 2019, along with the NSW EPA impact assessment criteria.

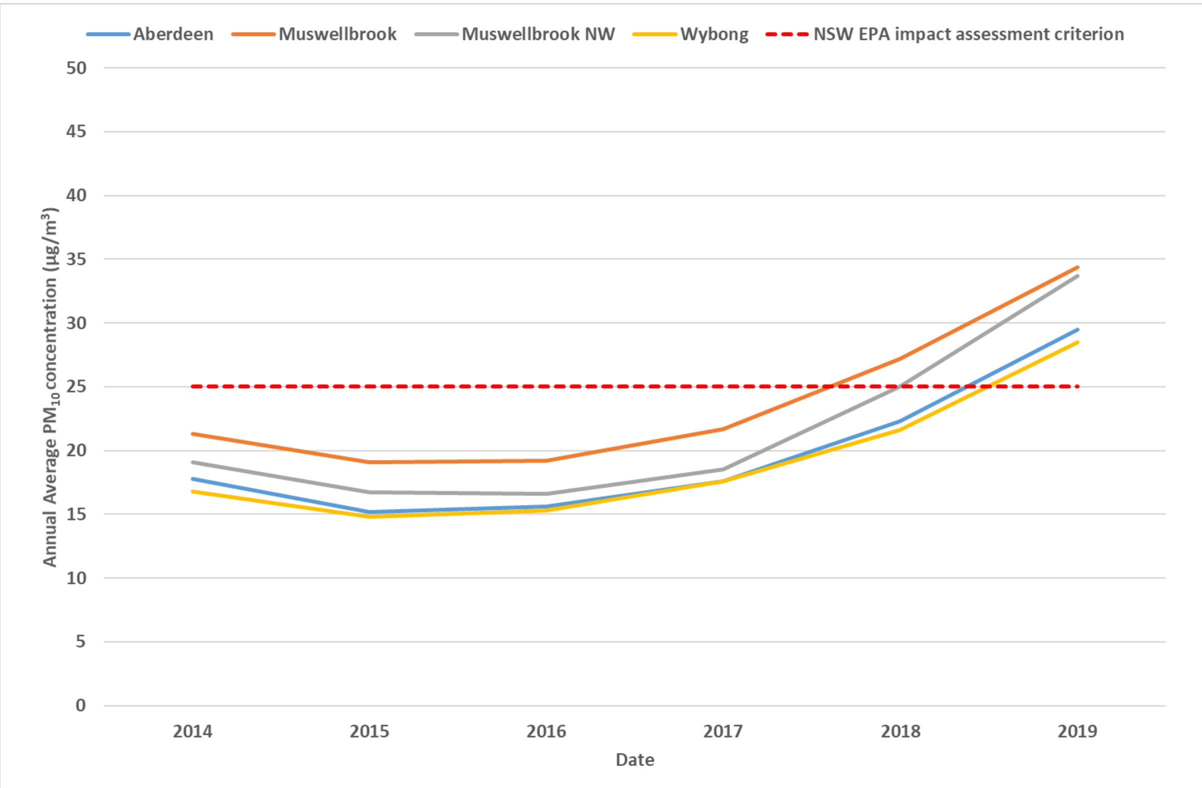



**Figure 5-7: Annual average $PM_{10}$ concentrations at the DPIE stations from 2014 to 2019**

Figure 5-8 presents the 24-hour average $PM_{10}$ concentrations from the DPIE station at Aberdeen for 2014.

The 24-hour average $PM_{10}$ concentrations at DPIE Aberdeen exceeded 50 µg/m³ on two occasions during 2014. The first occasion was on 15 November 2014 (recorded concentration of 50.1 µg/m³) which is explained by a small fire at Wybong (Wybong Rd, Sandy Hollow fire) (NSW OEH, 2015). The second occasion was on 17 December 2014 (recorded concentration of 50.4 µg/m³) explained by a state-wide dust event originating from Victorian Mallee region (NSW OEH, 2015).

In addition, there was a high 24-hour average $PM_{10}$ concentration of 48.7 µg/m³ recorded at OEH Aberdeen on 10 February 2014. This high concentration was noted at other nearby OEH stations with a $PM_{10}$ concentration of 52.2 µg/m³ recorded at Wybong on the same day. These high concentrations were explained by a very large fire to the west (at the Sheepskin Complex) (NSW OEH, 2015).

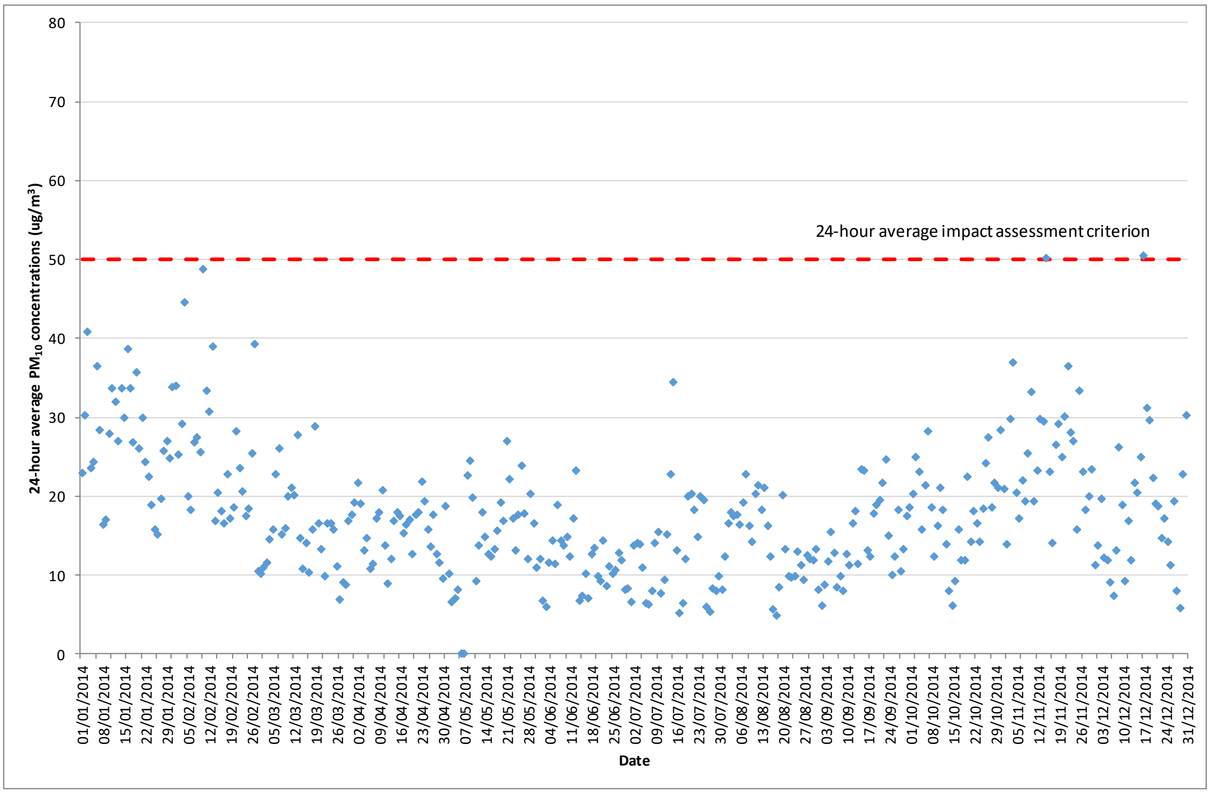



**Figure 5-8: Measured 24-hour average $PM_{10}$ concentrations at the DPIE Aberdeen station for 2014**

## *5.2.4 Fine Particulate Matter ($PM_{2.5}$)*

DPIE Muswellbrook station also monitors annual average $PM_{2.5}$ concentrations which are shown in Table 5-3. The concentration recorded in 2014 slightly exceeds the average for the six-year period from 2014 to 2019. The annual average for every year presented exceeds the impact assessment criterion of 8 µg/m³ for $PM_{2.5}$.

Given that the monitor locations are close to the towns of Muswellbrook and Singleton, it is likely that of the $PM_{2.5}$ concentrations monitored in winter months include a significant contribution from wood-burning fires. This is supported by the UHFPCS (NSW OEH, 2013), which found that wood smoke accounted for an average of approximately 30% of $PM_{2.5}$ in Muswellbrook, peaking at approximately 62% in winter. Similarly, in Singleton, wood smoke accounts for an average of approximately 14% of total $PM_{2.5}$, peaking at around 38% in winter.

There are currently no other $PM_{2.5}$ data in the vicinity of the Modification. Therefore, to estimate the $PM_{2.5}$ concentrations at the DPIE Aberdeen station (which is the closest station to the sensitive receptors being assessed), a $PM_{2.5}$:$PM_{10}$ ratio has been calculated for every day during 2014 at Muswellbrook. This ratio has then been applied to DPIE Aberdeen to generate background $PM_{2.5}$ concentrations for this monitoring station.

The calculated annual average $PM_{2.5}$ concentration of 7.6 µg/m$^3$ has been used as the background $PM_{2.5}$ value in this assessment. It should be noted that this is close to the NSW EPA impact assessment criterion of 8 µg/m$^3$, and a Modification contribution of greater than 0.4 µg/m$^3$ will cause an exceedance of the criterion.

The calculations showed seven days where $PM_{2.5}$ was greater than $PM_{10}$ due to the different monitoring methods used. For $PM_{10}$, a Tapered Element Oscillating Microbalance (TEOM) is used, and for $PM_{2.5}$, a Beta Attenuation Monitoring (BAM) is used. Figure 5-9 presents the monitored 24-hour average $PM_{10}$ concentrations and calculated 24-hour average $PM_{2.5}$ concentrations at DPIE Aberdeen.

**Table 5-3: Annual average $PM_{2.5}$ concentrations at DPIE Muswellbrook from 2015 to 2019**

| Year | Muswellbrook | Criteria |
|---|---|---|
| 2014 | 9.7 | 8 |
| 2015 | 8.7 | |
| 2016 | 8.4 | |
| 2017 | 9.4 | |
| 2018 | 9.4 | |
| 2019 | 12.2 | |
| Average | 9.6 | |
| Average (excl. 2019) | 9.1 | |

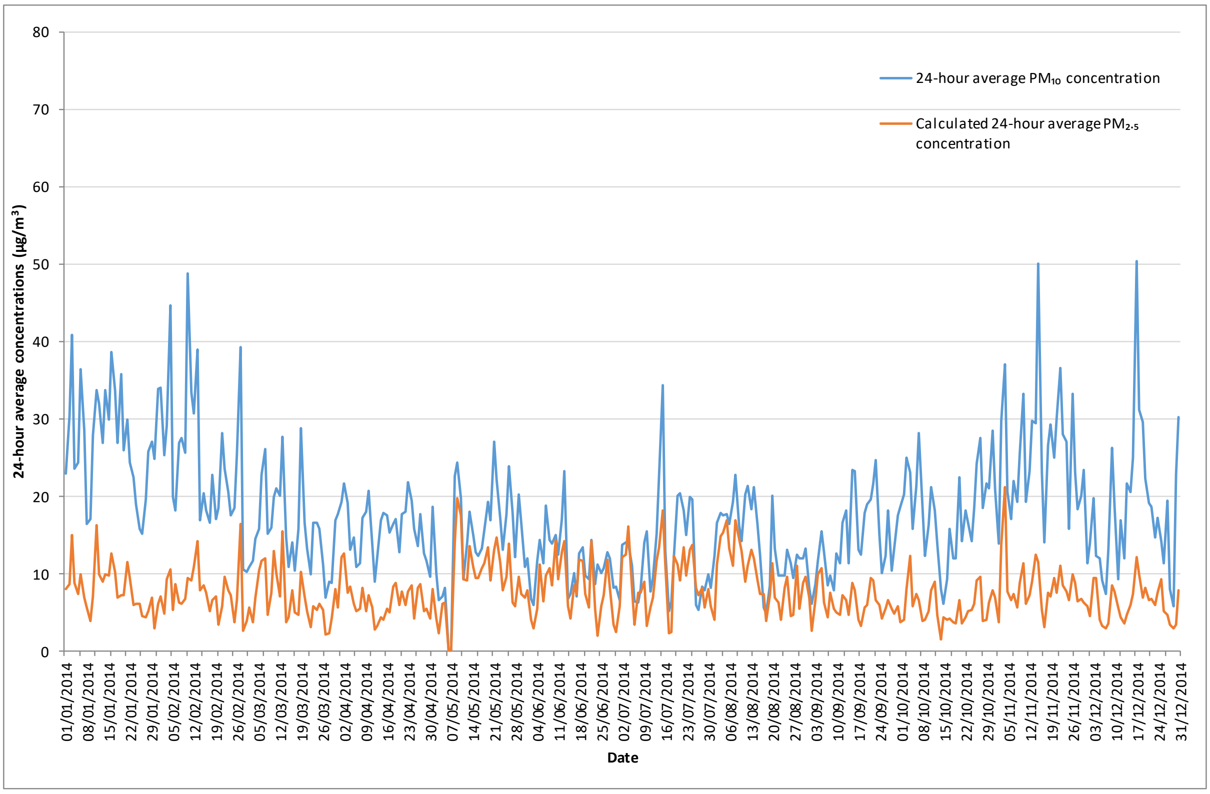



**Figure 5-9: Monitored 24-hour average $PM_{10}$ concentrations and calculated 24-hour average $PM_{2.5}$ concentrations at DPIE Aberdeen for 2014**

### 5.2.5 Dust Deposition

The average dust deposition measured at Dartbrook Mine in 2014 was 1.5 g/m$^2$/month. This value was adopted as the background dust deposition consistent with the previous assessment.

### 5.2.6 Summary and background values

Based on the above, it has been concluded that the data from DPIE Aberdeen station for the year 2014 is still considered appropriate for use in this assessment. The background year of 2014 is considered representative and conservative.

Table 5-4 presents a summary of the mines operating in the area and their respective production rates. For 2014, the Mangoola, Bengalla, Mount Arthur and Muswellbrook coal mines were all operating at close to maximum production rates. On that basis, background concentrations recorded in 2014 will include emissions from these nearby mines. The exception is Mount Pleasant Mine which was not operating in 2014 and has been modelled in addition to the Modification as part of the modelling exercise.

**Table 5-4: Operating mines in the area**

<table>
<tr><th rowspan="2">Coal Mine</th><th rowspan="2">Development Application (DA) current expiry date</th><th colspan="2">Production rate (Mtpa)</th><th rowspan="2">Assumptions for modelling</th></tr>
<tr><th>Max allowable per DA</th><th>2014 (per Annual Review)</th></tr>
<tr><td>Mount Pleasant</td><td>2026</td><td>10.5</td><td>Not operating</td><td>TAS (2017) AQ assessment for MTP Scenario 3 emissions = 3,750,801 kg TSP</td></tr>
<tr><td>Mangoola</td><td>2029</td><td>13.5</td><td>11.6</td><td rowspan="4">Measured concentrations at monitors to be used as the background is assumed to include contribution</td></tr>
<tr><td>Bengalla</td><td>2039</td><td>15</td><td>10.7</td></tr>
<tr><td>Mt Arthur</td><td>2026</td><td>32 (open-cut) 4 (underground)</td><td>FY14 – 25.7 (open-cut)</td></tr>
<tr><td>Muswellbrook Colliery</td><td>2022</td><td>2</td><td>~1.2</td></tr>
</table>

From 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/$m^3$ (average of calculated TSP assuming that 40% of TSP concentrations are $PM_{10}$ for 2014).
- Annual average $PM_{10}$ concentration of 17.9 µg/$m^3$ (annual average of 2014 data collected at DPIE Aberdeen station).
- 24-hour average $PM_{10}$ concentration – varies daily (DPIE Aberdeen station 2014 daily data)
- Annual average $PM_{2.5}$ concentration of 7.6 µg/$m^3$ (annual average of calculated $PM_{2.5}$ for Aberdeen based on the daily ratio between $PM_{2.5}$ and $PM_{10}$ at DPIE Muswellbrook station).
- 24-hour average $PM_{2.5}$ concentration – varies daily (calculated for DPIE Aberdeen station based on the daily ratio between $PM_{2.5}$ and $PM_{10}$ at DPIE Muswellbrook station).
- Annual average dust deposition of 1.5 g/$m^2$/month (2014 average of all annual data collected at Dartbrook).

# 6. APPROACH TO ASSESSMENT

The overall approach to the assessment follows the Approved Methods (NSW EPA, 2016) using the Level 2 assessment methodology. The Approved Methods specify how assessments based on the use of air dispersion models should be completed. They include guidelines for the preparation of meteorological data to be used in dispersion models and the relevant air quality criteria for assessing the significance of predicted concentration and deposition rates from the Modification.

The air dispersion modelling conducted for this assessment is based on an advanced modelling system using the models TAPM and CALMET/CALPUFF. The modelling system works as follows:

- TAPM is a prognostic meteorological model that generates gridded three-dimensional meteorological data for each hour of the model run period.
- CALMET, the meteorological pre-processor for the dispersion model CALPUFF, calculates fine resolution three-dimensional meteorological data based upon observed ground and upper level meteorological data, as well as observed or modelled upper air data generated for example by TAPM.
- CALPUFF then calculates the dispersion of plumes within this three-dimensional meteorological field.

Output from TAPM, plus local observational weather station data were entered into CALMET, a meteorological pre-processor endorsed by the US Environmental Protection Agency (US EPA) and recommended by the NSW EPA for use in complex terrain and non-steady state conditions (that is, conditions that change in time and space). From this, a 1-year representative meteorological dataset suitable for use in the 3-dimensional plume dispersion model, CALPUFF, was compiled. An overview of the modelling system is presented in Figure 6-1, and details on the model configuration and data inputs are provided in the following sections.

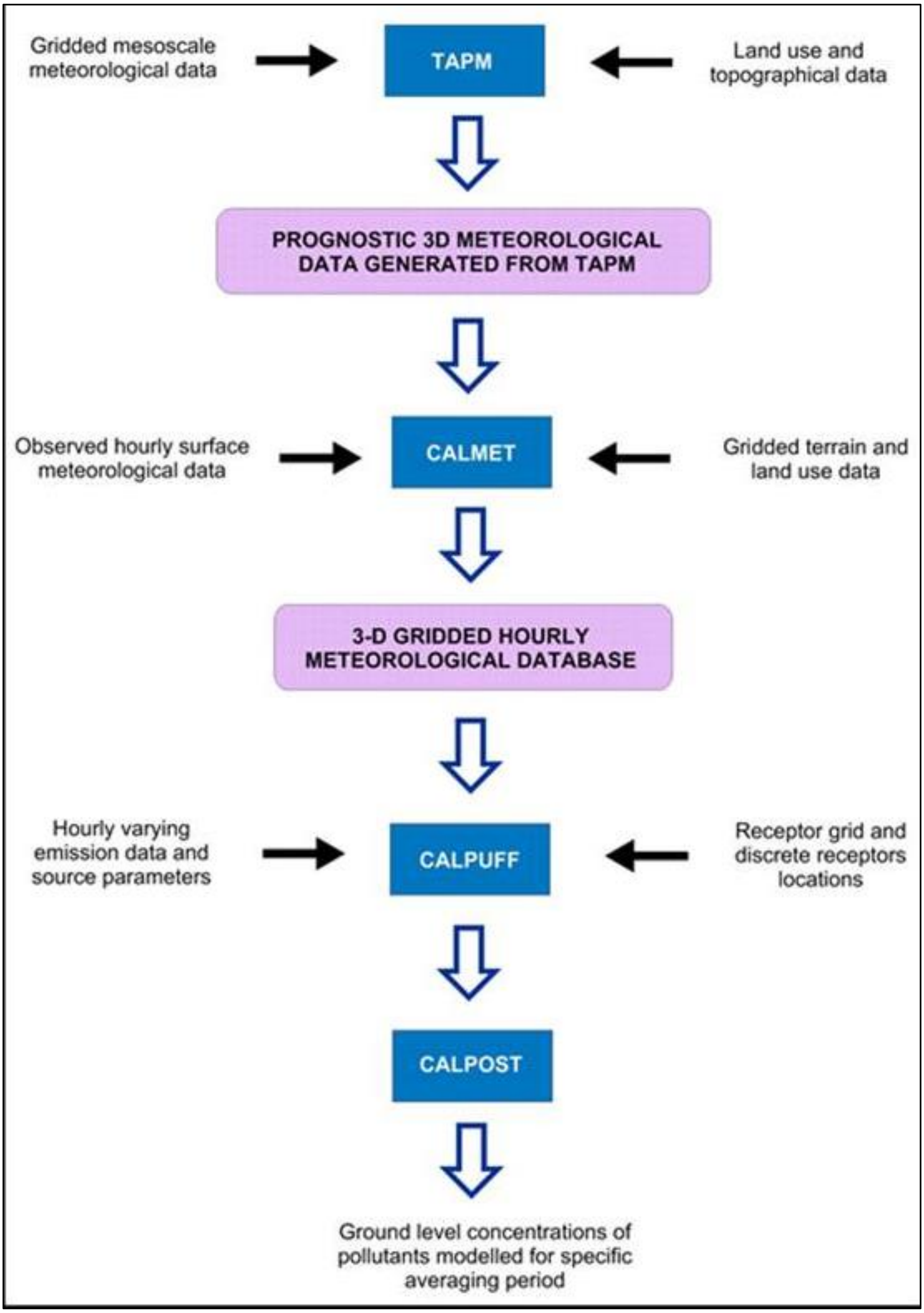



**Figure 6-1: Overview of modelling methodology**

## 6.1 TAPM

The Air Pollution Model, or TAPM, is a three-dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research. Detailed description of the TAPM model and its performance is provided in Hurley (2008) and Hurley et al. (2009).

TAPM solves the fundamental fluid dynamics and scalar transport equations to predict meteorology and pollutant concentrations. It consists of coupled prognostic meteorological and air pollution concentration components. The model predicts airflow important to local scale air pollution, such as sea breezes and terrain induced flows, against a background of larger scale meteorology provided by synoptic analyses.

For this Modification, TAPM was set up with 3 domains, composed of 25 grids along both the x and the y axes, centred on -32˚11' Latitude and 150˚50' Longitude. Each nested domain had a grid resolution of 30 km, 10 km and 3 km respectively.

## 6.2 CALMET

CALMET is a meteorological pre-processor that includes a wind field generator containing objective analysis and parameterised treatments of slope flows, terrain effects and terrain blocking effects. The pre-processor produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables to produce the three-dimensional meteorological fields that are utilised in the CALPUFF dispersion model (i.e. the CALPUFF dispersion model requires meteorological data in three dimensions). CALMET uses the meteorological inputs in combination with land use and geophysical information for the modelling domain to predict gridded meteorological fields for the region.

A summary of the CALMET modelling is presented in Table 6-1.

## 6.3 CALPUFF

CALPUFF is the dispersion module of the CALMET/CALPUFF suite of models. It is a multi-layer, multi species, non-steady-state puff dispersion model that can simulate the effects of time-varying and space-varying meteorological conditions on pollutant transport, transformation and removal. The model contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as longer range effects such as pollutant removal, chemical transformation, vertical wind shear and coastal interaction effects. The model employs dispersion equations based on a Gaussian distribution of pollutants across released puffs and takes into account the complex arrangement of emissions from point, area, volume and line sources (Scire et al., 2000). In March 2011, generic guidance and optional settings for the CALPUFF modelling system were published for inclusion in the Approved Methods (TRC, 2011). The model set up for this study has been conducted in consideration of these guidelines.

The CALMET and CALPUFF model options are presented in Appendix A.

**Table 6-1: CALMET meteorological model settings**

| | |
|---|---|
| **TAPM (v 4.0.4)** | |
| Number of grids (spacing) | 30 km, 10 km, 3 km |
| Number of grid points | 25 x 25 x 35 |
| Year of analysis | January 2014 – December 2014 |
| Centre of domain | -32°11' S, 150°50' E |
| **CALMET (v 6327)** | |
| Meteorological grid domain | 36 km x 36 km |
| Meteorological grid resolution | 250 m |
| Surface meteorological stations | Inner and outer grid:<br>Dartbrook meteorological station (MET01)<br>- Wind speed,<br>- Wind direction<br>- Temperature<br>Dartbrook meteorological station (MET02)<br>- Wind speed<br>- Wind direction<br>- Temperature<br>DPIE Aberdeen<br>- Wind speed<br>- Wind direction<br>- Temperature<br>- Relative humidity<br>DPIE Muswellbrook<br>- Wind speed<br>- Wind direction<br>- Temperature<br>- Relative humidity<br>DPIE Muswellbrook NW<br>- Wind speed<br>- Wind direction<br>- Temperature<br>- Relative humidity<br>DPIE Wybong<br>- Wind speed<br>- Wind direction<br>- Temperature<br>- Relative humidity<br>TAPM<br>- Cloud height<br>- Cloud content<br>- Station level pressure |
| 3D.dat | Data extracted from 3 km TAPM |

# 7. OVERVIEW OF BEST PRACTICE DUST CONTROL

A number of dust control measures have been applied across the Modification. These are taken from the NSW Coal Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining (Donnelly et al, 2011), a study that was commissioned by the EPA, hereafter referred to as “the Best Practice Report”.

The dust control measures are as follows:

- Enclosure and water sprays at ROM hopper (85% control)
- Enclosure and wet suppression for crushing and screening (70% control)
- Enclosure and water sprays at washery (85% control)
- Water sprays at product stockpile (85% control)
- Water application for loading product coal to train conveyor (50% control)
- Water sprays at the ROM coal stockpile (50% control)
- Water sprays at the reject stockpile (50% control)
- Water sprays at the product coal stockpile (50% control)
- Fencing at the Reject Emplacement Area (REA) (30% control)

# 8. PARTICLE MATTER EMISSIONS ESTIMATION

This section describes the calculation of the emissions for the assessment. Emissions have been calculated for the following:

- The surface operations associated with the Modification
- Existing ventilation shafts at Dartbrook Mine
- Operations at Mount Pleasant Mine.

The operation of the Modification has been analysed and estimates of dust emissions for the key dust generating activities have been made, including two existing upcast ventilation shafts. A detailed emissions inventory has been prepared for the underground operating scenario.

There are potential sources of dust emissions from the proposed mining activities which have been analysed and estimates of dust emissions for the key dust generating activities have been made.

As discussed in Section 5.2.6, all other local mines are considered to be included within the background concentrations and have therefore not been modelled separately.

## 8.1 Particle size categories

Emission rates of TSP, $PM_{10}$ and $PM_{2.5}$ have been calculated using emission factors developed both within NSW and by the US EPA. Modelling of TSP, $PM_{10}$ and $PM_{2.5}$ was undertaken using the particle size specific inventories and was assumed to emit and deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mass of the particle size range.

Modelling was completed for three particle size categories; Total Suspended Particulates (TSP), Coarse Matter (CM) and $PM_{2.5}$. $PM_{2.5}$ particles were modelled using $PM_{2.5}$ emission rates. The coarse fraction was modelled using $PM_{2.5-10}$ emission rates ($PM_{10}$ emissions minus $PM_{2.5}$ emissions). The particle mass mean diameters were determined from particle size distribution data for various coal mining activities (presented in SPCC, 1986).

The resultant predicted CM and $PM_{2.5}$ concentrations were then summed to determine the $PM_{10}$ concentrations.

## 8.2 Emissions estimates from the Modification

Estimates of emissions for each source were developed on an hourly time step taking into account the activities that would take place at that location. Thus, for each source and for each hour, an emission rate was determined which depended on the level of activity and the wind speed. Dust generating activities were represented by a series of volume sources situated according to the location of activities for the modelled scenarios. Terrain was incorporated into the modelling.

Figure 8-1 shows the locations of the volume sources used to represent the mining activities and Table 8-1 shows the allocation of sources for each activity.

Detailed emissions tables are provided in Appendix B.

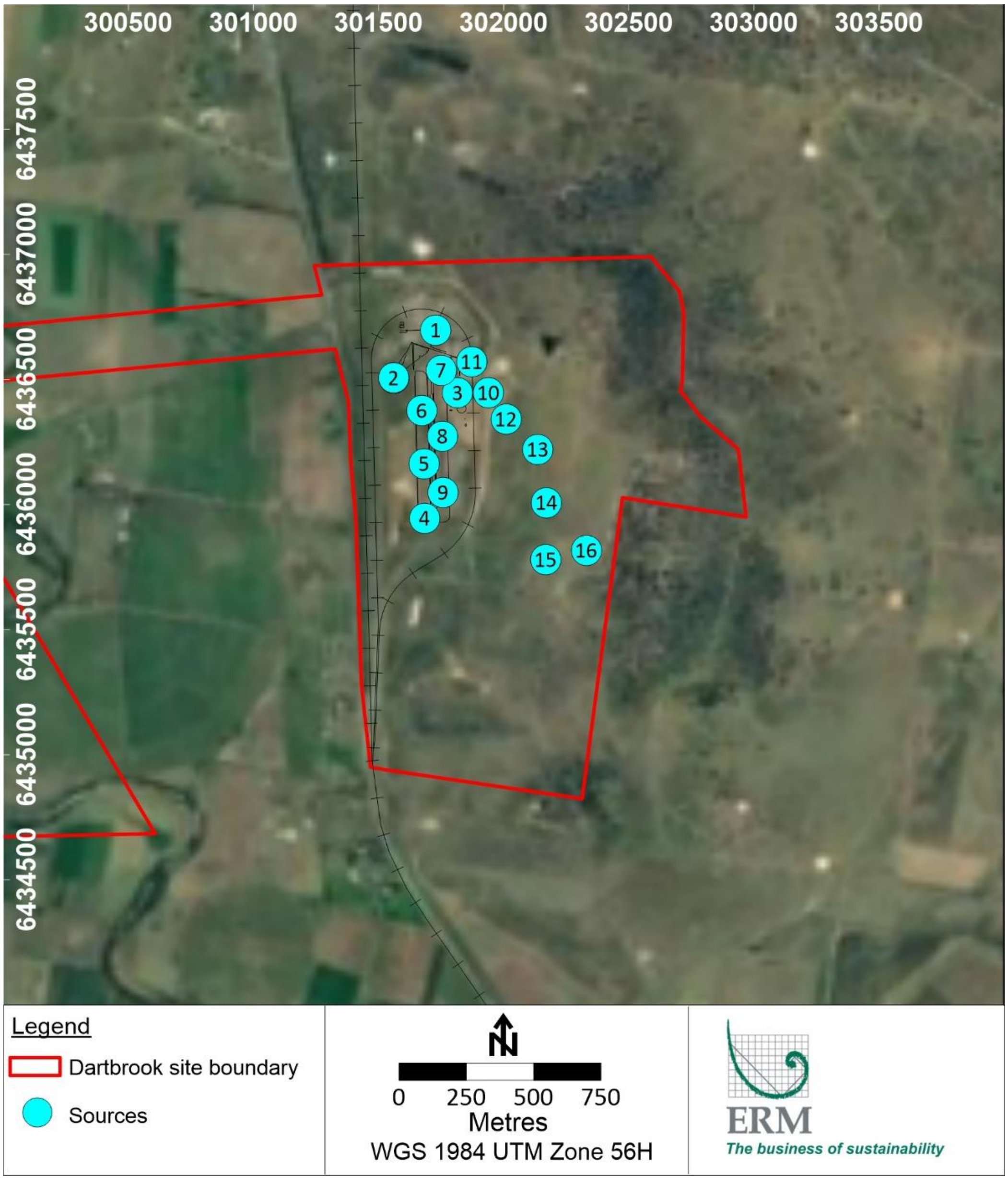



**Figure 8-1: Location of dust sources**

**Table 8-1: Inventory activity and allocated source number**

| Activity | Source number |
|---|---|
| Unloading of coal at ROM Hopper | 1 |
| Crushing of coal | 1 |
| Screening of coal | 1 |
| Loading crushed coal to conveyor at ROM Hopper | 1 |
| Unloading of coal at ROM Stockpile | 2 |
| Unloading of coal at Washery | 3 |
| Loading of product coal onto conveyor from Washery | 3 |
| Unloading of coal at Product Stockpile | 4,5,6,7,8,9 |
| Loading of rejects onto conveyor from Washery | 3 |
| Unloading of rejects at Reject Stockpile | 10 |
| Reclaiming product coal to train conveyor | 4,5,6,7,8,9 |
| Loading of product coal to trains | 11 |
| Loading of rejects to trucks at Rejects Stockpile | 10 |
| Hauling of rejects from Reject Stockpile to REA (sealed roads) | 10,12,13,14,15,16 |
| Unloading of rejects at REA | 15,16 |
| Dozers at REA | 15,16 |
| ROM Stockpile | 2 |
| Reject Stockpile | 10 |
| Product Stockpile | 4,5,6,7,8,9 |
| Reject Emplacement Area | 15,16 |

Notes: ROM – Run of Mine, REA – Reject Emplacement Area

The information used for developing the inventories is based on the operational descriptions and mine plan drawings and used to determine haul road distances and routes, stockpile areas, activity operating hours, truck sizes and other details that are necessary to estimate dust emissions.

Table 8-2 summarises the quantities of TSP, $PM_{10}$ and $PM_{2.5}$ estimated to be released by each activity of the Modification.

**Table 8-2: Estimated TSP, $PM_{10}$ and $PM_{2.5}$ emissions for the Modification**

| Activity | TSP emissions (kg/y) | $PM_{10}$ emissions (kg/y) | $PM_{2.5}$ emissions (kg/y) |
|---|---|---|---|
| Unloading of coal at ROM Hopper | 484 | 229 | 35 |
| Crushing of coal | 1,080 | 486 | 90 |
| Screening of coal | 1,980 | 666 | 45 |
| Loading crushed coal to conveyor at ROM Hopper | 484 | 229 | 35 |
| Unloading of coal at ROM Stockpile | 1,613 | 763 | 116 |
| Unloading of coal at washery | 484 | 229 | 35 |
| Loading of product coal onto conveyor from washery | 178 | 84 | 13 |
| Unloading of coal at Product Stockpile | 178 | 84 | 13 |
| Loading of rejects onto conveyor from washery | 41 | 19 | 3 |
| Unloading of rejects at Reject Stockpile | 137 | 65 | 10 |
| Reclaiming product coal to train conveyor | 592 | 280 | 42 |
| Loading of product coal to trains | 1,183 | 560 | 85 |
| Loading of rejects to trucks at Rejects Stockpile | 273 | 129 | 20 |
| Hauling of rejects from Reject Stockpile to REA (sealed roads) | 24,413 | 4,686 | 1,134 |
| Unloading of rejects at REA | 273 | 129 | 20 |
| Dozers at REA | 33,659 | 6,857 | 741 |
| ROM Stockpile | 468 | 234 | 35 |
| Reject Stockpile | 468 | 234 | 35 |
| Product Stockpile | 2,678 | 1,339 | 201 |
| Reject Emplacement Area | 1,785 | 893 | 134 |
| **Total emissions** | **72,448** | **18,193** | **2,838** |

### *8.2.1 Emissions estimates from ventilation shafts*

To provide an indication of potential emissions from the ventilation shafts, reference is made to particulate matter testing, conducted at other underground mines in NSW. A previous assessment undertaken by PAEHolmes (now ERM) reviewed particulate concentrations for a number of underground mines in the southern coal fields (PAEHolmes, 2010). Particulate concentrations were in the range of 0.4 $mg/m^3$ to 2 $mg/m^3$ and the highest value was chosen for the Modification and conservatively applied to each size fraction (TSP/$PM_{10}$/$PM_{2.5}$).

Two existing ventilation shafts will be utilised during the proposed underground mining. The stack characteristics for modelling are summarised in Table 8-3. The emission rates and stack parameters are provided in Table 8-4. The locations of the proposed vent shafts are shown in Figure 8-2.

**Table 8-3: Stack characteristics for modelling**

| Vent Shaft | x | y | Base elevation (m) | Stack height (m) | Stack diameter (m) | Volumetric flow rate (dry STP) ($m^3$/min) | Exit velocity (m/s) | Exit temperature (degrees Celsius) |
|---|---|---|---|---|---|---|---|---|
| No.1 | 297540 | 6436605 | 196 | 10 | 4 | 136 | 10.8 | 293 |
| No.2 | 296286 | 6436520 | 226 | 10 | 6 | 507 | 17.9 | 293 |

**Table 8-4: Emission rates and stack parameters**

| Vent Shaft | Pollutant | Measured concentration ($mg/m^3$) | Mass emission rate (g/s) |
|---|---|---|---|
| No.1 | Particulate matter (TSP/$PM_{10}$/$PM_{2.5}$) | 2 | 0.27 |
| No.2 | Particulate matter (TSP/$PM_{10}$/$PM_{2.5}$) | 2 | 1.01 |

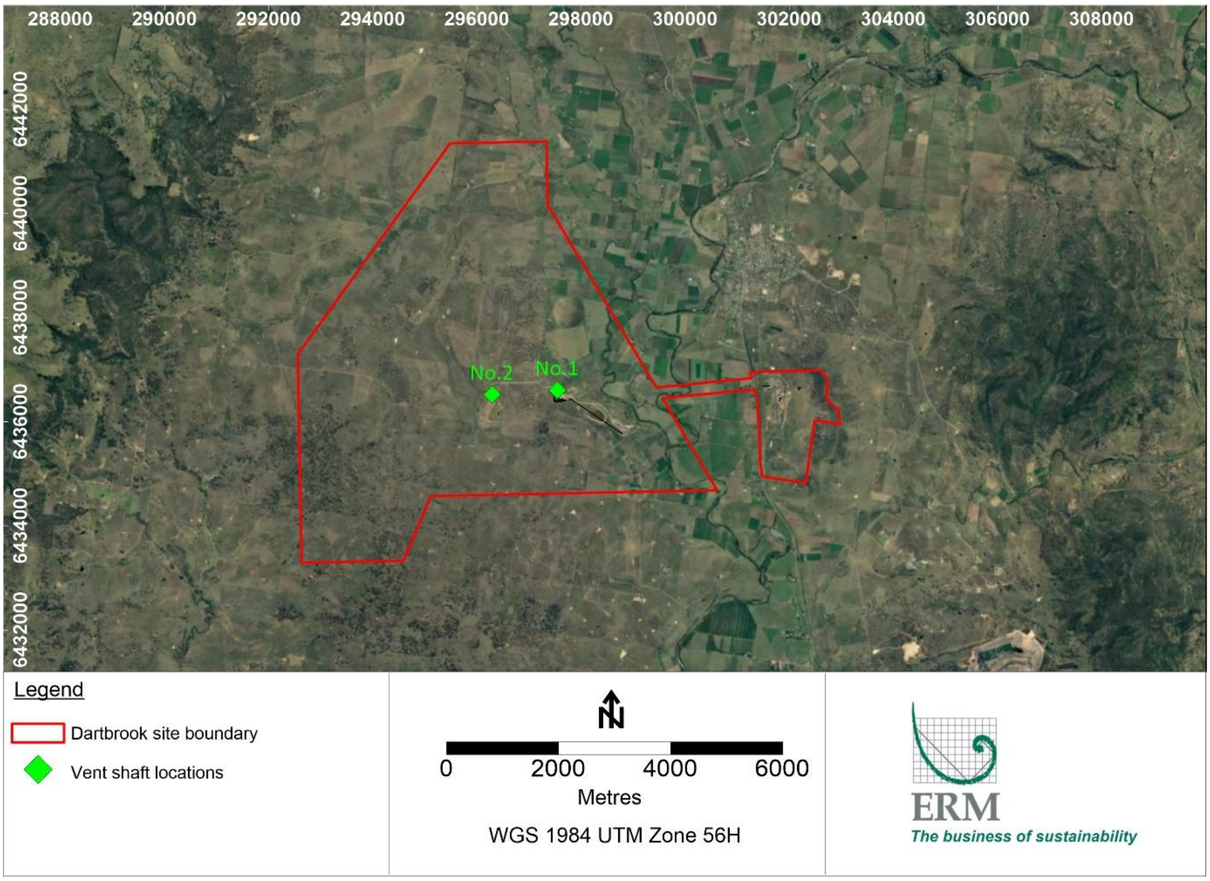



**Figure 8-2: Location of vent shafts**

## 8.3 Emissions estimates from Mount Pleasant

As discussed in Section 5.2.6, Mount Pleasant Mine was not operating in 2014 and emissions from this mine have therefore been explicitly included in the modelling.

Mount Pleasant Mine was treated as a number of volume sources located at the points of major emission, as estimated from the locations of pits, dumps and other major dust sources. Sources were considered in three classes covering all dust emission sources for which there are emission factor equations for open cut mines. These classes are:

1. Wind erosion sources where emissions vary with the hourly average wind speed according to the cube of the wind speed (Skidmore, 1998)
2. Loading/dumping operations where emissions vary with the wind speed raised to the power of 1.3 (USEPA, 1987)
3. All other sources where emissions are assumed to be independent of wind speed

The proportion of emissions in each of these categories was calculated for Mount Pleasant Mine based on the activities occurring at that site.

Table 8-5 presents the estimated TSP, $PM_{10}$ and $PM_{2.5}$ for Mount Pleasant Mine.

**Table 8-5: Estimated TSP, $PM_{10}$ and $PM_{2.5}$ emissions for Mount Pleasant Mine**

| Mine | TSP emissions (kg/y) | $PM_{10}$ emissions (kg/y) | $PM_{2.5}$ emissions (kg/y) |
|---|---|---|---|
| Mount Pleasant | 3,750,801 | 1,018,777 | 156,907 |

Source: TAS (2017)

# 9. ASSESSMENT OF IMPACTS

## 9.1 Introduction

The modelling predictions for the Modification are presented in the sections below. The contour plots are indicative of the concentrations that could potentially be reached under the conditions modelled. It is important to note that the isopleth figures are presented to provide a visual representation of the predicted impacts. To produce the isopleths, it is necessary to make interpolations between predicted concentrations, and as a result the isopleths will not always match exactly with predicted impacts at any specific location.

In the case of maximum 24-hour average concentrations, it is also important to note that individual contour plots do not represent one moment in time, but rather the maximum 24-hour average that could potentially occur at a sensitive receptor over the period of a year. A discussion of cumulative 24-hour average concentrations is presented in Section 9.3.

There are two days during 2014 when the 24-hour average $PM_{10}$ concentrations at DPIE Aberdeen exceeded 50 µg/m$^3$ (see Section 5.2.3 for further details). Additional analysis has been undertaken which excludes these two days of elevated background concentrations. This provides an indication of additional days of exceedance of the criterion due to the Modification.

## 9.2 Annual average concentrations

### *9.2.1 TSP*

Table 9-1 presents the predicted annual average TSP concentrations at each of the sensitive receptor locations for the Modification, Mount Pleasant alone and when including existing background concentrations.

Contour plots of the predicted annual average concentrations due to the Modification and cumulatively are presented in Figure 9-1 and Figure 9-2, respectively.

There are no sensitive receptors predicted to experience annual average TSP concentrations above the NSW EPA impact assessment criterion or DPE VLAMP criterion of 90 µg/m$^3$, either due to the Modification or cumulatively.

**Table 9-1: Predicted annual average TSP concentrations from the Modification alone, Mount Pleasant alone and cumulatively**

| Receptor ID | Modification only | Mount Pleasant only | Cumulative |
|---|---|---|---|
| | Assessment criteria = N/A | | Assessment criteria = 90 µg/m$^3$ |
| 3 | 0.1 | 0.3 | 45.2 |
| 8 | 0.1 | 0.3 | 45.2 |
| 10 | 0.1 | 0.3 | 45.2 |
| 14 | 0.1 | 0.5 | 45.4 |
| 18 | 0.1 | 0.3 | 45.3 |
| 19 | 0.1 | 0.3 | 45.2 |
| 20 | 0.1 | 0.4 | 45.4 |
| 21 | 0.1 | 0.3 | 45.3 |
| 22 | 0.1 | 0.3 | 45.3 |
| 25 | 0.1 | 0.3 | 45.2 |
| 26 | 0.1 | 0.3 | 45.3 |
| 28 | 0.2 | 0.3 | 45.2 |
| 29 | 0.1 | 0.9 | 45.9 |
| 34 | 0.2 | 0.8 | 45.8 |
| 52 | 0.1 | 0.4 | 45.3 |
| 53 | 0.1 | 0.4 | 45.3 |
| 54 | 0.1 | 0.4 | 45.4 |
| 55 | 0.1 | 0.5 | 45.4 |
| 59 | 0.3 | 0.4 | 45.4 |
| 60 | 0.3 | 0.4 | 45.4 |
| 61 | 0.3 | 0.4 | 45.5 |
| 62 | 0.2 | 0.5 | 45.5 |
| 63 | 0.2 | 0.5 | 45.5 |
| 64 | 0.3 | 0.5 | 45.5 |
| 65 | 0.4 | 0.4 | 45.6 |
| 66 | 0.1 | 1.5 | 46.3 |
| 67 | <0.1 | 2.2 | 47.1 |
| 70 | 0.2 | 0.5 | 45.5 |
| 72 | 0.2 | 0.5 | 45.5 |
| 75 | 0.2 | 0.6 | 45.6 |
| 77 | 0.3 | 0.5 | 45.5 |
| 87 | 1.1 | 0.4 | 46.3 |
| 88 | 1.3 | 0.4 | 46.5 |
| 89 | 1.4 | 0.4 | 46.5 |
| 90 | 1.4 | 0.4 | 46.6 |
| 91 | 1.4 | 0.4 | 46.6 |
| 92 | 1.2 | 0.4 | 46.3 |
| 116 | 0.1 | 0.2 | 45.1 |
| 118 | 0.1 | 0.2 | 45.2 |

| Receptor ID | Modification only | Mount Pleasant only | Cumulative |
|---|---|---|---|
| | Assessment criteria = N/A | | Assessment criteria = 90 µg/m$^3$ |
| 122 | <0.1 | 2.1 | 46.9 |
| 128 | <0.1 | 2.1 | 47.0 |
| 303 | 2.4 | 0.7 | 47.9 |
| 313 | 0.2 | 0.3 | 45.3 |
| 314 | 0.2 | 0.3 | 45.2 |
| 315 | 0.2 | 0.3 | 45.3 |
| 316 | 0.4 | 0.3 | 45.6 |
| 317 | 0.2 | 0.3 | 45.3 |
| 422 | 2.8 | 0.7 | 48.3 |
| 423 | 2.4 | 0.7 | 47.9 |
| 424 | 2.4 | 0.7 | 47.9 |
| 427 | 1.5 | 0.7 | 47.0 |
| 436 | 0.3 | 0.7 | 45.9 |
| 437 | 0.3 | 0.8 | 45.9 |
| 438 | 0.3 | 0.8 | 45.9 |
| 439 | 0.3 | 0.6 | 45.7 |
| 440 | 0.3 | 0.5 | 45.5 |
| 545 | 1.0 | 1.2 | 47.0 |
| 546 | 1.0 | 1.4 | 47.2 |
| 555 | 0.1 | 0.3 | 45.2 |
| 561 | 0.1 | 0.4 | 45.3 |
| 562 | <0.1 | 0.3 | 45.2 |
| 567 | <0.1 | 0.3 | 45.1 |
| 27A | 0.1 | 0.3 | 45.3 |
| 27B | 0.1 | 0.3 | 45.3 |
| 27C | 0.1 | 0.3 | 45.3 |
| 35A | 0.1 | 0.6 | 45.6 |
| 35B | 0.1 | 0.6 | 45.5 |
| 442A | 0.1 | 0.7 | 45.6 |
| 442B | 0.1 | 0.6 | 45.5 |
| 442C | 0.1 | 0.5 | 45.4 |
| 442D | 0.1 | 0.5 | 45.4 |
| 445A | <0.1 | 4.0 | 48.8 |
| 445B | <0.1 | 3.9 | 48.7 |
| 48A | 0.1 | 0.4 | 45.3 |
| 48B | 0.1 | 0.3 | 45.3 |
| 5A | 0.1 | 0.3 | 45.2 |
| 5B | 0.1 | 0.3 | 45.2 |
| 74A | 0.2 | 0.5 | 45.6 |
| 74B | 0.2 | 0.5 | 45.6 |
| 80A | 0.2 | 0.6 | 45.6 |

| Receptor ID | Modification only | Mount Pleasant only | Cumulative |
|---|---|---|---|
| | Assessment criteria = N/A | | Assessment criteria = 90 µg/m$^3$ |
| 80B | 0.2 | 0.6 | 45.6 |
| 81A | 0.2 | 0.6 | 45.7 |
| 81B | 0.2 | 0.7 | 45.7 |
| 86 | 0.5 | 0.4 | 45.7 |
| 181 | 0.3 | 1.1 | 46.2 |
| 212 | 0.3 | 1.1 | 46.3 |
| 228 | 0.3 | 1.2 | 46.3 |
| 238 | 0.3 | 1.1 | 46.3 |
| 242 | 0.4 | 1.1 | 46.2 |
| 244 | 0.4 | 1.0 | 46.2 |
| 374 | 0.4 | 1.2 | 46.3 |
| 391 | 0.8 | 1.0 | 46.6 |
| 153 | 0.1 | 2.7 | 47.6 |
| 86a | 0.7 | 0.4 | 46.0 |
| 86b | 0.5 | 0.5 | 45.7 |

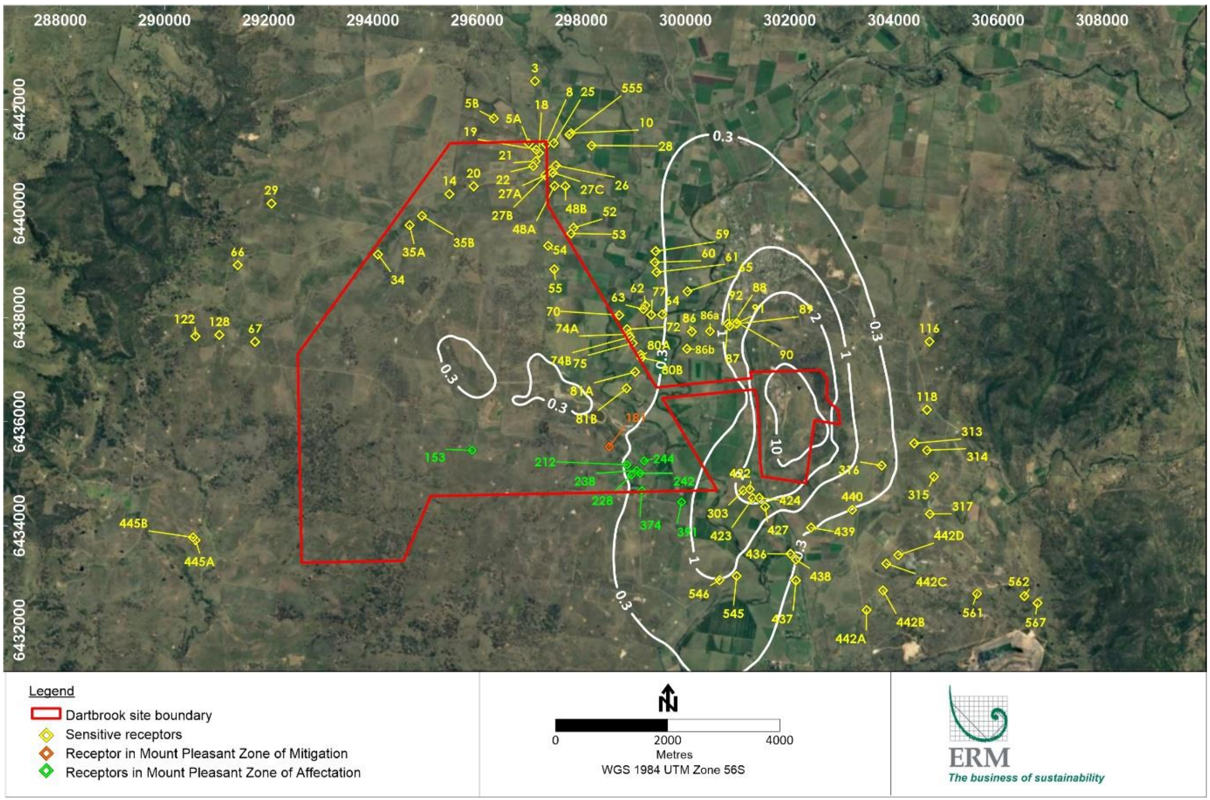



**Figure 9-1: Predicted annual average TSP concentrations (µg/m³) – Modification only**

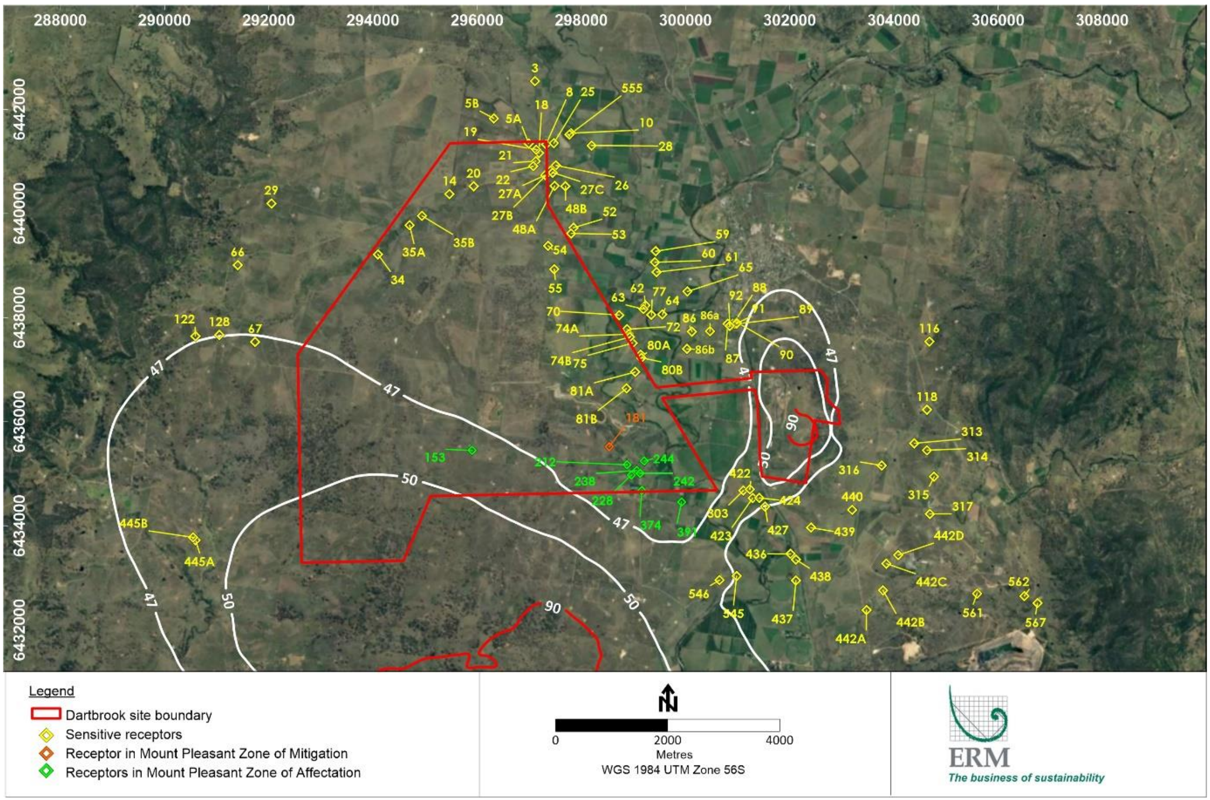



**Figure 9-2: Predicted annual average TSP concentrations (µg/m³) – Cumulative**

### 9.2.2 $PM_{10}$

Table 9-2 presents the predicted annual average $PM_{10}$ concentrations at each of the sensitive receptor locations for the Modification, Mount Pleasant alone and when including existing background concentrations.

Contour plots of the predicted annual average concentrations due to the Modification and cumulatively are presented in Figure 9-3 and Figure 9-4, respectively.

There are no sensitive receptors predicted to experience annual average $PM_{10}$ concentrations above the NSW EPA impact assessment criterion of 25 µg/m$^3$ or DPE VLAMP criterion of 30 µg/m$^3$, either due to the Modification or cumulatively.

**Table 9-2: Predicted annual average $PM_{10}$ concentrations from the Modification alone, Mount Pleasant alone and cumulatively**

| Receptor ID | Modification only | Mount Pleasant only | Cumulative |
|---|---|---|---|
| | Assessment criteria = N/A | | Assessment criteria = 25 µg/m$^3$ |
| 3 | 0.1 | 0.1 | 18.1 |
| 8 | 0.1 | 0.1 | 18.1 |
| 10 | 0.1 | 0.1 | 18.1 |
| 14 | 0.2 | 0.2 | 18.3 |
| 18 | 0.1 | 0.2 | 18.1 |
| 19 | 0.1 | 0.2 | 18.1 |
| 20 | 0.1 | 0.2 | 18.2 |
| 21 | 0.1 | 0.2 | 18.1 |
| 22 | 0.1 | 0.2 | 18.1 |
| 25 | 0.1 | 0.1 | 18.1 |
| 26 | 0.1 | 0.2 | 18.1 |
| 28 | 0.1 | 0.1 | 18.1 |
| 29 | 0.2 | 0.4 | 18.5 |
| 34 | 0.3 | 0.4 | 18.5 |
| 52 | 0.1 | 0.2 | 18.2 |
| 53 | 0.1 | 0.2 | 18.2 |
| 54 | 0.1 | 0.2 | 18.2 |
| 55 | 0.1 | 0.2 | 18.2 |
| 59 | 0.1 | 0.2 | 18.2 |
| 60 | 0.1 | 0.2 | 18.2 |
| 61 | 0.1 | 0.2 | 18.2 |
| 62 | 0.1 | 0.2 | 18.2 |
| 63 | 0.1 | 0.2 | 18.2 |
| 64 | 0.1 | 0.2 | 18.2 |
| 65 | 0.2 | 0.2 | 18.3 |
| 66 | 0.1 | 0.6 | 18.7 |
| 67 | 0.1 | 0.9 | 18.9 |
| 70 | 0.1 | 0.2 | 18.2 |
| 72 | 0.1 | 0.2 | 18.3 |

| Receptor ID | Modification only | Mount Pleasant only | Cumulative |
|---|---|---|---|
| | Assessment criteria = N/A | | Assessment criteria = 25 µg/m$^3$ |
| 75 | 0.1 | 0.2 | 18.3 |
| 77 | 0.1 | 0.2 | 18.2 |
| 87 | 0.5 | 0.2 | 18.5 |
| 88 | 0.5 | 0.2 | 18.6 |
| 89 | 0.5 | 0.2 | 18.6 |
| 90 | 0.6 | 0.2 | 18.6 |
| 91 | 0.6 | 0.2 | 18.6 |
| 92 | 0.5 | 0.2 | 18.5 |
| 116 | 0.1 | 0.1 | 18.0 |
| 118 | 0.1 | 0.1 | 18.1 |
| 122 | 0.1 | 0.9 | 18.8 |
| 128 | 0.1 | 0.9 | 18.9 |
| 303 | 0.8 | 0.3 | 19.0 |
| 313 | 0.1 | 0.1 | 18.1 |
| 314 | 0.1 | 0.1 | 18.1 |
| 315 | 0.1 | 0.1 | 18.1 |
| 316 | 0.2 | 0.1 | 18.2 |
| 317 | 0.1 | 0.1 | 18.1 |
| 422 | 0.9 | 0.3 | 19.1 |
| 423 | 0.7 | 0.3 | 18.9 |
| 424 | 0.7 | 0.3 | 18.9 |
| 427 | 0.5 | 0.3 | 18.7 |
| 436 | 0.2 | 0.3 | 18.4 |
| 437 | 0.1 | 0.3 | 18.4 |
| 438 | 0.1 | 0.3 | 18.3 |
| 439 | 0.2 | 0.3 | 18.3 |
| 440 | 0.1 | 0.2 | 18.2 |
| 545 | 0.3 | 0.5 | 18.7 |
| 546 | 0.3 | 0.6 | 18.8 |
| 555 | 0.1 | 0.1 | 18.1 |
| 561 | 0.0 | 0.2 | 18.1 |
| 562 | 0.0 | 0.1 | 18.1 |
| 567 | 0.0 | 0.1 | 18.1 |
| 27A | 0.1 | 0.2 | 18.1 |
| 27B | 0.1 | 0.2 | 18.1 |
| 27C | 0.1 | 0.2 | 18.1 |
| 35A | 0.2 | 0.3 | 18.4 |
| 35B | 0.2 | 0.3 | 18.4 |
| 442A | 0.1 | 0.3 | 18.3 |
| 442B | 0.1 | 0.2 | 18.2 |
| 442C | 0.1 | 0.2 | 18.2 |

| Receptor ID | Modification only | Mount Pleasant only | Cumulative |
|---|---|---|---|
| | Assessment criteria = N/A | | Assessment criteria = 25 µg/m$^3$ |
| 442D | 0.1 | 0.2 | 18.2 |
| 445A | 0.0 | 1.6 | 19.5 |
| 445B | 0.0 | 1.6 | 19.5 |
| 48A | 0.1 | 0.2 | 18.1 |
| 48B | 0.1 | 0.2 | 18.1 |
| 5A | 0.1 | 0.2 | 18.1 |
| 5B | 0.1 | 0.2 | 18.1 |
| 74A | 0.1 | 0.2 | 18.3 |
| 74B | 0.1 | 0.2 | 18.3 |
| 80A | 0.1 | 0.3 | 18.3 |
| 80B | 0.1 | 0.3 | 18.3 |
| 81A | 0.2 | 0.3 | 18.3 |
| 81B | 0.2 | 0.3 | 18.4 |
| 86 | 0.2 | 0.2 | 18.3 |
| 181 | 0.2 | 0.5 | 18.6 |
| 212 | 0.2 | 0.5 | 18.6 |
| 228 | 0.2 | 0.5 | 18.6 |
| 238 | 0.2 | 0.5 | 18.6 |
| 242 | 0.2 | 0.5 | 18.6 |
| 244 | 0.2 | 0.4 | 18.5 |
| 374 | 0.2 | 0.5 | 18.6 |
| 391 | 0.3 | 0.4 | 18.6 |
| 153 | 0.2 | 1.2 | 19.2 |
| 86a | 0.3 | 0.2 | 18.4 |
| 86b | 0.2 | 0.2 | 18.3 |

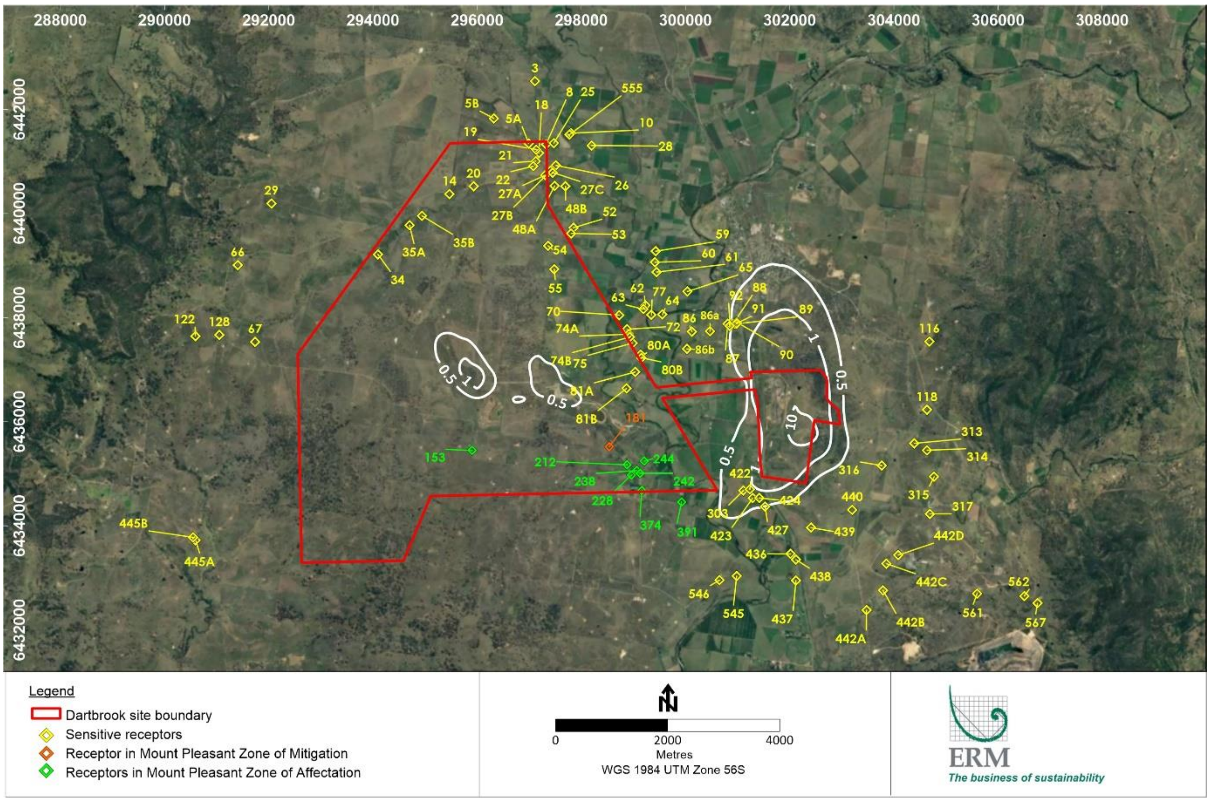



**Figure 9-3: Predicted annual average $PM_{10}$ concentrations ($\mu g/m^3$) – Modification only**

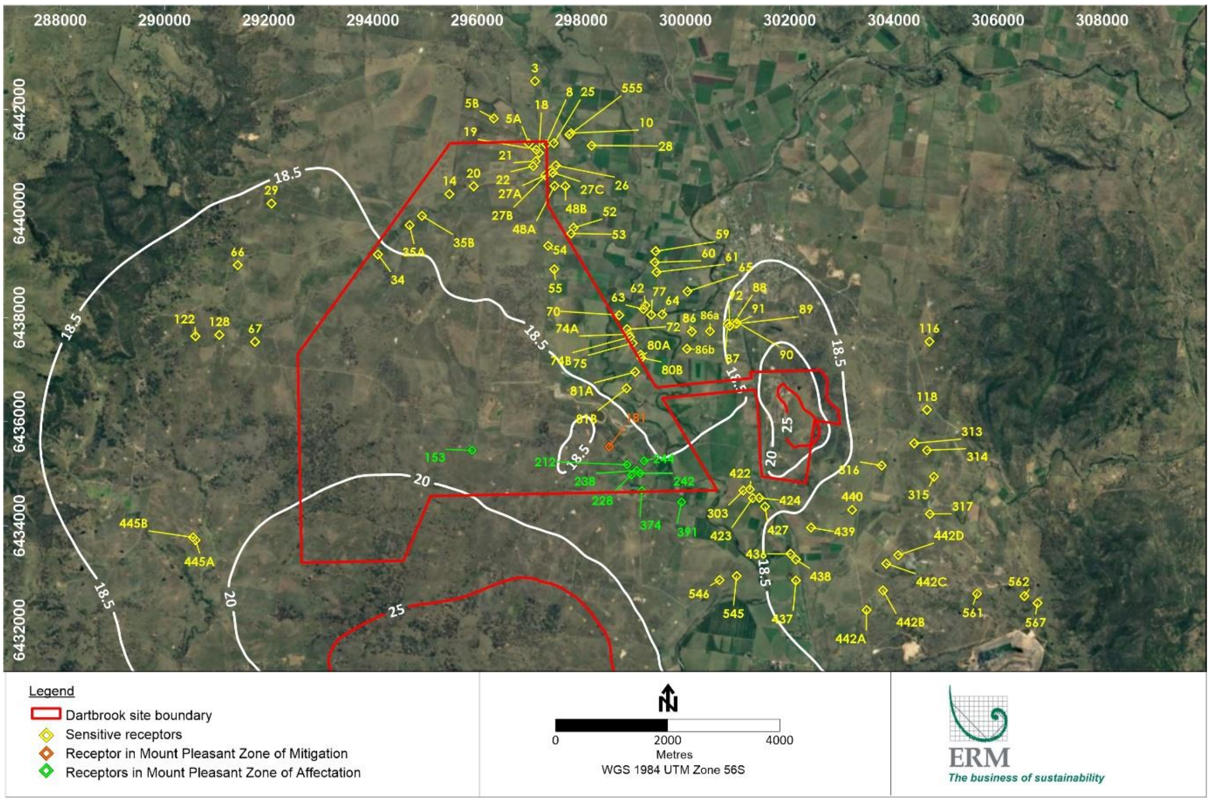



**Figure 9-4: Predicted annual average $PM_{10}$ concentrations ($\mu g/m^3$) – Cumulative**

### 9.2.3 $PM_{2.5}$

Table 9-3 presents the predicted annual average $PM_{2.5}$ concentrations at each of the sensitive receptor locations for the Modification, Mount Pleasant alone and when including existing background concentrations. The assumed background concentrations have been outlined previously in Section 5.2.6.

Contour plots of the predicted annual average concentrations due to the Modification and cumulatively are presented in Figure 9-5 and Figure 9-6, respectively.

There are no sensitive receptors predicted to experience annual average $PM_{2.5}$ concentrations above the NSW EPA impact assessment criterion of 8 µg/m³ due to the Modification or cumulatively.

**Table 9-3: Predicted annual average $PM_{2.5}$ concentrations from the Modification alone, Mount Pleasant alone and cumulatively**

| Receptor ID | Modification only | Mount Pleasant only | Cumulative |
|---|---|---|---|
| | Assessment criteria = N/A | | Assessment criteria = 8 µg/m³ |
| 3 | <0.1 | <0.1 | 7.7 |
| 8 | <0.1 | <0.1 | 7.7 |
| 10 | <0.1 | <0.1 | 7.7 |
| 14 | 0.1 | 0.1 | 7.7 |
| 18 | <0.1 | <0.1 | 7.7 |
| 19 | <0.1 | <0.1 | 7.7 |
| 20 | 0.1 | <0.1 | 7.7 |
| 21 | <0.1 | <0.1 | 7.7 |
| 22 | <0.1 | <0.1 | 7.7 |
| 25 | <0.1 | <0.1 | 7.7 |
| 26 | <0.1 | <0.1 | 7.7 |
| 28 | <0.1 | <0.1 | 7.7 |
| 29 | 0.1 | 0.1 | 7.8 |
| 34 | 0.1 | 0.1 | 7.8 |
| 52 | <0.1 | <0.1 | 7.7 |
| 53 | <0.1 | <0.1 | 7.7 |
| 54 | <0.1 | <0.1 | 7.7 |
| 55 | <0.1 | <0.1 | 7.7 |
| 59 | <0.1 | <0.1 | 7.7 |
| 60 | <0.1 | <0.1 | 7.7 |
| 61 | <0.1 | <0.1 | 7.7 |
| 62 | <0.1 | <0.1 | 7.7 |
| 63 | <0.1 | <0.1 | 7.7 |
| 64 | <0.1 | <0.1 | 7.7 |
| 65 | <0.1 | <0.1 | 7.7 |
| 66 | 0.1 | 0.1 | 7.8 |
| 67 | <0.1 | 0.2 | 7.8 |
| 70 | <0.1 | <0.1 | 7.7 |
| 72 | <0.1 | <0.1 | 7.7 |

| Receptor ID | Modification only | Mount Pleasant only | Cumulative |
|---|---|---|---|
| | Assessment criteria = N/A | | Assessment criteria = 8 µg/m$^3$ |
| 75 | <0.1 | 0.1 | 7.7 |
| 77 | <0.1 | <0.1 | 7.7 |
| 87 | 0.1 | <0.1 | 7.7 |
| 88 | 0.1 | <0.1 | 7.7 |
| 89 | 0.1 | <0.1 | 7.8 |
| 90 | 0.1 | <0.1 | 7.8 |
| 91 | 0.1 | <0.1 | 7.8 |
| 92 | 0.1 | <0.1 | 7.7 |
| 116 | <0.1 | <0.1 | 7.6 |
| 118 | <0.1 | <0.1 | 7.6 |
| 122 | <0.1 | 0.2 | 7.8 |
| 128 | <0.1 | 0.2 | 7.8 |
| 303 | 0.2 | 0.1 | 7.8 |
| 313 | <0.1 | <0.1 | 7.7 |
| 314 | <0.1 | <0.1 | 7.7 |
| 315 | <0.1 | <0.1 | 7.7 |
| 316 | <0.1 | <0.1 | 7.7 |
| 317 | <0.1 | <0.1 | 7.7 |
| 422 | 0.2 | 0.1 | 7.8 |
| 423 | 0.1 | 0.1 | 7.8 |
| 424 | 0.1 | 0.1 | 7.8 |
| 427 | 0.1 | 0.1 | 7.8 |
| 436 | <0.1 | 0.1 | 7.7 |
| 437 | <0.1 | 0.1 | 7.7 |
| 438 | <0.1 | 0.1 | 7.7 |
| 439 | <0.1 | 0.1 | 7.7 |
| 440 | <0.1 | <0.1 | 7.7 |
| 545 | 0.1 | 0.1 | 7.8 |
| 546 | 0.1 | 0.1 | 7.8 |
| 555 | <0.1 | <0.1 | 7.7 |
| 561 | <0.1 | <0.1 | 7.7 |
| 562 | <0.1 | <0.1 | 7.6 |
| 567 | <0.1 | <0.1 | 7.6 |
| 27A | <0.1 | <0.1 | 7.7 |
| 27B | <0.1 | <0.1 | 7.7 |
| 27C | <0.1 | <0.1 | 7.7 |
| 35A | 0.1 | 0.1 | 7.8 |
| 35B | 0.1 | 0.1 | 7.7 |
| 442A | <0.1 | 0.1 | 7.7 |
| 442B | <0.1 | 0.1 | 7.7 |
| 442C | <0.1 | 0.1 | 7.7 |

| Receptor ID | Modification only | Mount Pleasant only | Cumulative |
|---|---|---|---|
| | Assessment criteria = N/A | | Assessment criteria = 8 µg/m³ |
| 442D | <0.1 | <0.1 | 7.7 |
| 445A | <0.1 | 0.3 | 7.9 |
| 445B | <0.1 | 0.3 | 7.9 |
| 48A | <0.1 | <0.1 | 7.7 |
| 48B | <0.1 | <0.1 | 7.7 |
| 5A | <0.1 | <0.1 | 7.7 |
| 5B | <0.1 | <0.1 | 7.7 |
| 74A | <0.1 | 0.1 | 7.7 |
| 74B | <0.1 | 0.1 | 7.7 |
| 80A | <0.1 | 0.1 | 7.7 |
| 80B | <0.1 | 0.1 | 7.7 |
| 81A | 0.1 | 0.1 | 7.7 |
| 81B | 0.1 | 0.1 | 7.7 |
| 86 | 0.1 | <0.1 | 7.7 |
| 181 | 0.1 | 0.1 | 7.8 |
| 212 | 0.1 | 0.1 | 7.8 |
| 228 | 0.1 | 0.1 | 7.8 |
| 238 | 0.1 | 0.1 | 7.8 |
| 242 | 0.1 | 0.1 | 7.8 |
| 244 | 0.1 | 0.1 | 7.8 |
| 374 | 0.1 | 0.1 | 7.8 |
| 391 | 0.1 | 0.1 | 7.8 |
| 153 | 0.1 | 0.2 | 7.9 |
| 86a | 0.1 | <0.1 | 7.7 |
| 86b | 0.1 | <0.1 | 7.7 |

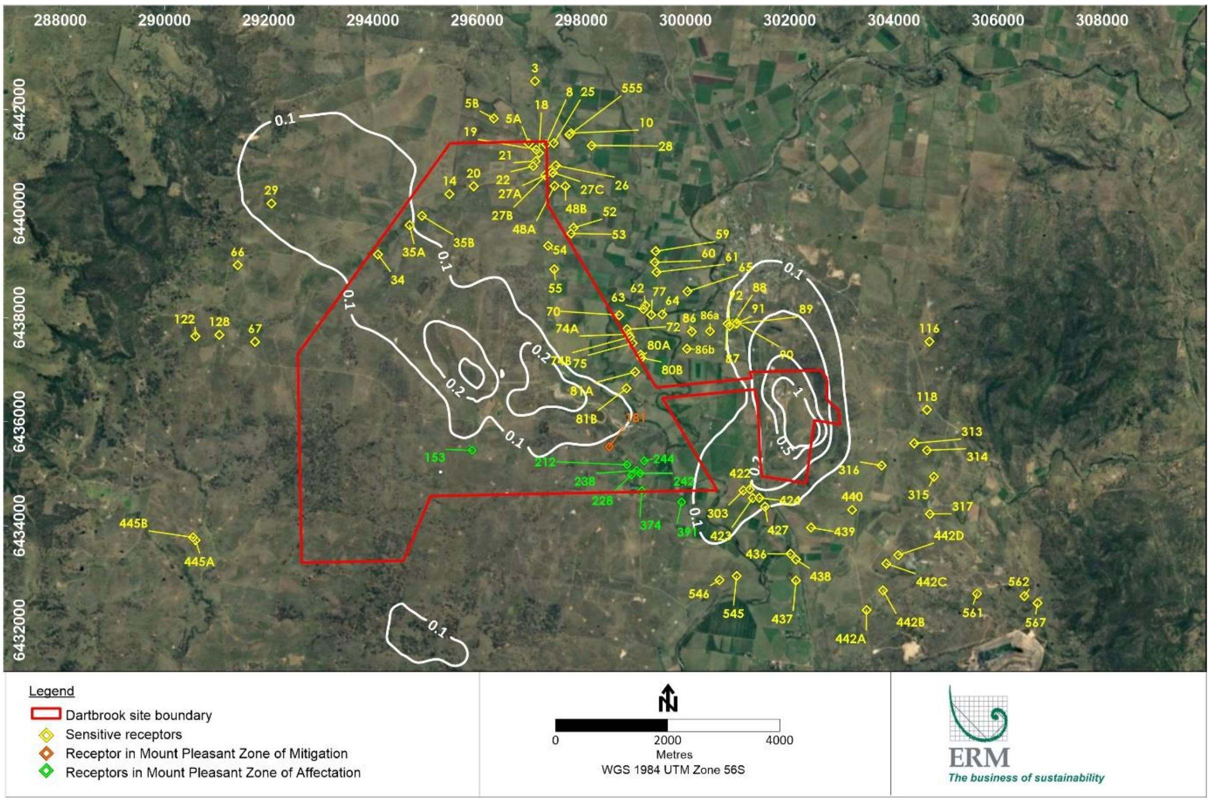



**Figure 9-5: Predicted annual average $PM_{2.5}$ concentrations (µg/m$^3$) – Modification only**

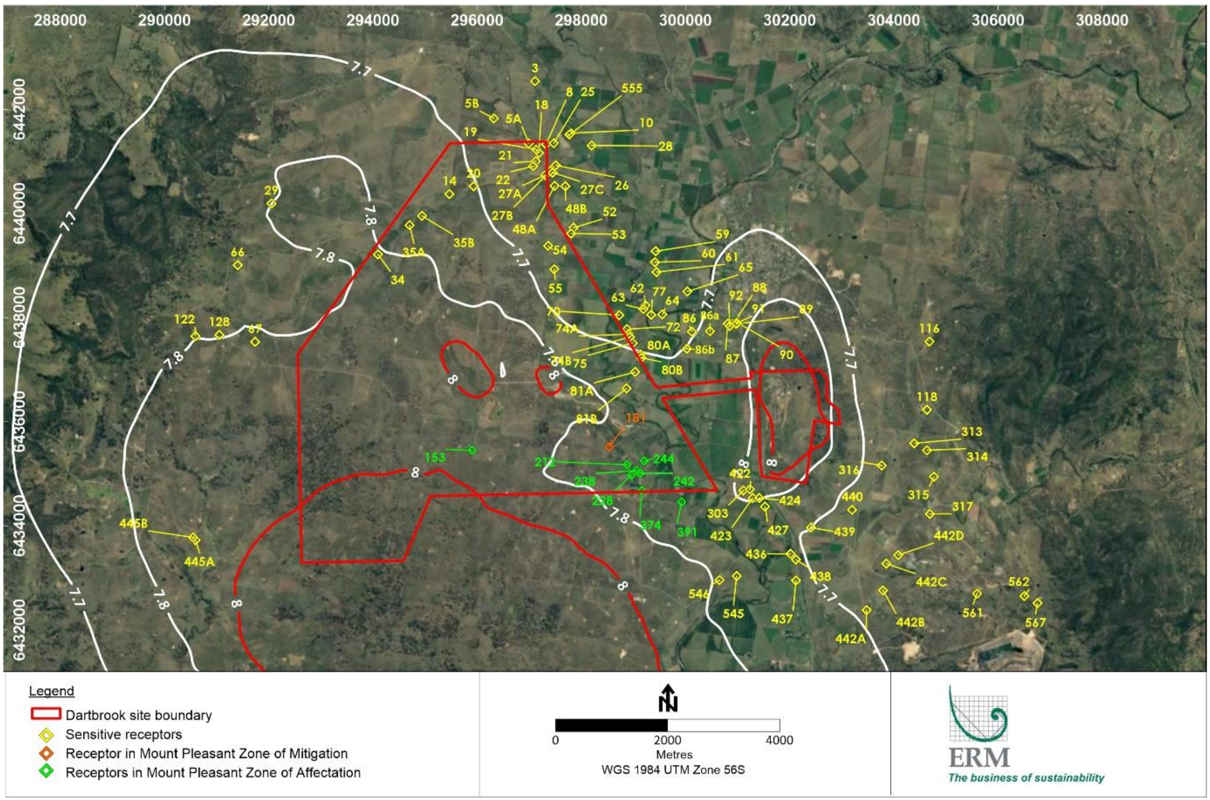



**Figure 9-6: Predicted annual average $PM_{2.5}$ concentrations (µg/m$^3$) – Cumulative**

### 9.2.4 Dust deposition

Table 9-4 presents the predicted annual average dust deposition levels at each of the sensitive receptor locations for the Modification, Mount Pleasant alone and when including existing background concentrations.

Contour plots of the predicted annual average concentrations due to the Modification and cumulatively are presented in Figure 9-7 and Figure 9-8, respectively.

There are no sensitive receptors predicted to experience annual average dust deposition levels above the NSW EPA impact assessment criterion or the DPE VLAMP criterion of 2 g/m$^2$/month (increment) or 4 g/m$^2$/month (cumulative).

**Table 9-4: Predicted annual average dust deposition from the Modification alone, Mount Pleasant alone and cumulatively**

| Receptor ID | Modification only | Mount Pleasant only | Cumulative |
|---|---|---|---|
| | Assessment criteria = 2 g/m$^2$/month | | Assessment criteria = 4 g/m$^2$/month |
| 3 | 0.00 | 0.01 | 2 |
| 8 | 0.00 | 0.01 | 2 |
| 10 | 0.00 | 0.01 | 2 |
| 14 | 0.00 | 0.01 | 2 |
| 18 | 0.00 | 0.01 | 2 |
| 19 | 0.00 | 0.01 | 2 |
| 20 | 0.00 | 0.01 | 2 |
| 21 | 0.00 | 0.01 | 2 |
| 22 | 0.00 | 0.01 | 2 |
| 25 | 0.00 | 0.01 | 2 |
| 26 | 0.00 | 0.01 | 2 |
| 28 | 0.00 | 0.01 | 2 |
| 29 | 0.00 | 0.04 | 2 |
| 34 | 0.00 | 0.02 | 2 |
| 52 | 0.00 | 0.01 | 2 |
| 53 | 0.00 | 0.01 | 2 |
| 54 | 0.00 | 0.01 | 2 |
| 55 | 0.00 | 0.01 | 2 |
| 59 | 0.01 | 0.01 | 2 |
| 60 | 0.00 | 0.01 | 2 |
| 61 | 0.00 | 0.01 | 2 |
| 62 | 0.00 | 0.01 | 2 |
| 63 | 0.00 | 0.01 | 2 |
| 64 | 0.00 | 0.01 | 2 |
| 65 | 0.01 | 0.01 | 2 |
| 66 | 0.00 | 0.06 | 2 |
| 67 | 0.00 | 0.09 | 2 |
| 70 | 0.00 | 0.01 | 2 |
| 72 | 0.00 | 0.01 | 2 |

| Receptor ID | Modification only | Mount Pleasant only | Cumulative |
|---|---|---|---|
| | Assessment criteria = 2 g/m$^2$/month | | Assessment criteria = 4 g/m$^2$/month |
| 75 | 0.00 | 0.01 | 2 |
| 77 | 0.00 | 0.01 | 2 |
| 87 | 0.02 | 0.01 | 2 |
| 88 | 0.03 | 0.01 | 2 |
| 89 | 0.03 | 0.01 | 2 |
| 90 | 0.03 | 0.01 | 2 |
| 91 | 0.03 | 0.01 | 2 |
| 92 | 0.03 | 0.01 | 2 |
| 116 | 0.00 | 0.00 | 2 |
| 118 | 0.00 | 0.01 | 2 |
| 122 | 0.00 | 0.08 | 2 |
| 128 | 0.00 | 0.08 | 2 |
| 303 | 0.03 | 0.01 | 2 |
| 313 | 0.01 | 0.01 | 2 |
| 314 | 0.01 | 0.01 | 2 |
| 315 | 0.01 | 0.01 | 2 |
| 316 | 0.02 | 0.01 | 2 |
| 317 | 0.00 | 0.01 | 2 |
| 422 | 0.04 | 0.01 | 2 |
| 423 | 0.03 | 0.01 | 2 |
| 424 | 0.03 | 0.01 | 2 |
| 427 | 0.02 | 0.01 | 2 |
| 436 | 0.00 | 0.02 | 2 |
| 437 | 0.00 | 0.02 | 2 |
| 438 | 0.00 | 0.02 | 2 |
| 439 | 0.00 | 0.01 | 2 |
| 440 | 0.01 | 0.01 | 2 |
| 545 | 0.01 | 0.03 | 2 |
| 546 | 0.01 | 0.03 | 2 |
| 555 | 0.00 | 0.01 | 2 |
| 561 | 0.00 | 0.01 | 2 |
| 562 | 0.00 | 0.01 | 2 |
| 567 | 0.00 | 0.01 | 2 |
| 27A | 0.00 | 0.01 | 2 |
| 27B | 0.00 | 0.01 | 2 |
| 27C | 0.00 | 0.01 | 2 |
| 35A | 0.00 | 0.02 | 2 |
| 35B | 0.00 | 0.01 | 2 |
| 442A | 0.00 | 0.02 | 2 |
| 442B | 0.00 | 0.02 | 2 |
| 442C | 0.00 | 0.01 | 2 |

| Receptor ID | Modification only | Mount Pleasant only | Cumulative |
|---|---|---|---|
| | Assessment criteria = 2 g/m$^2$/month | | Assessment criteria = 4 g/m$^2$/month |
| 442D | 0.00 | 0.01 | 2 |
| 445A | 0.00 | 0.12 | 2 |
| 445B | 0.00 | 0.11 | 2 |
| 48A | 0.00 | 0.01 | 2 |
| 48B | 0.00 | 0.01 | 2 |
| 5A | 0.00 | 0.01 | 2 |
| 5B | 0.00 | 0.01 | 2 |
| 74A | 0.00 | 0.01 | 2 |
| 74B | 0.00 | 0.01 | 2 |
| 80A | 0.00 | 0.01 | 2 |
| 80B | 0.00 | 0.01 | 2 |
| 81A | 0.00 | 0.01 | 2 |
| 81B | 0.00 | 0.01 | 2 |
| 86 | 0.01 | 0.01 | 2 |
| 181 | 0.00 | 0.02 | 2 |
| 212 | 0.00 | 0.02 | 2 |
| 228 | 0.00 | 0.02 | 2 |
| 238 | 0.00 | 0.02 | 2 |
| 242 | 0.00 | 0.02 | 2 |
| 244 | 0.00 | 0.02 | 2 |
| 374 | 0.00 | 0.02 | 2 |
| 391 | 0.01 | 0.02 | 2 |
| 153 | 0.00 | 0.08 | 2 |
| 86a | 0.01 | 0.01 | 2 |
| 86b | 0.01 | 0.01 | 2 |

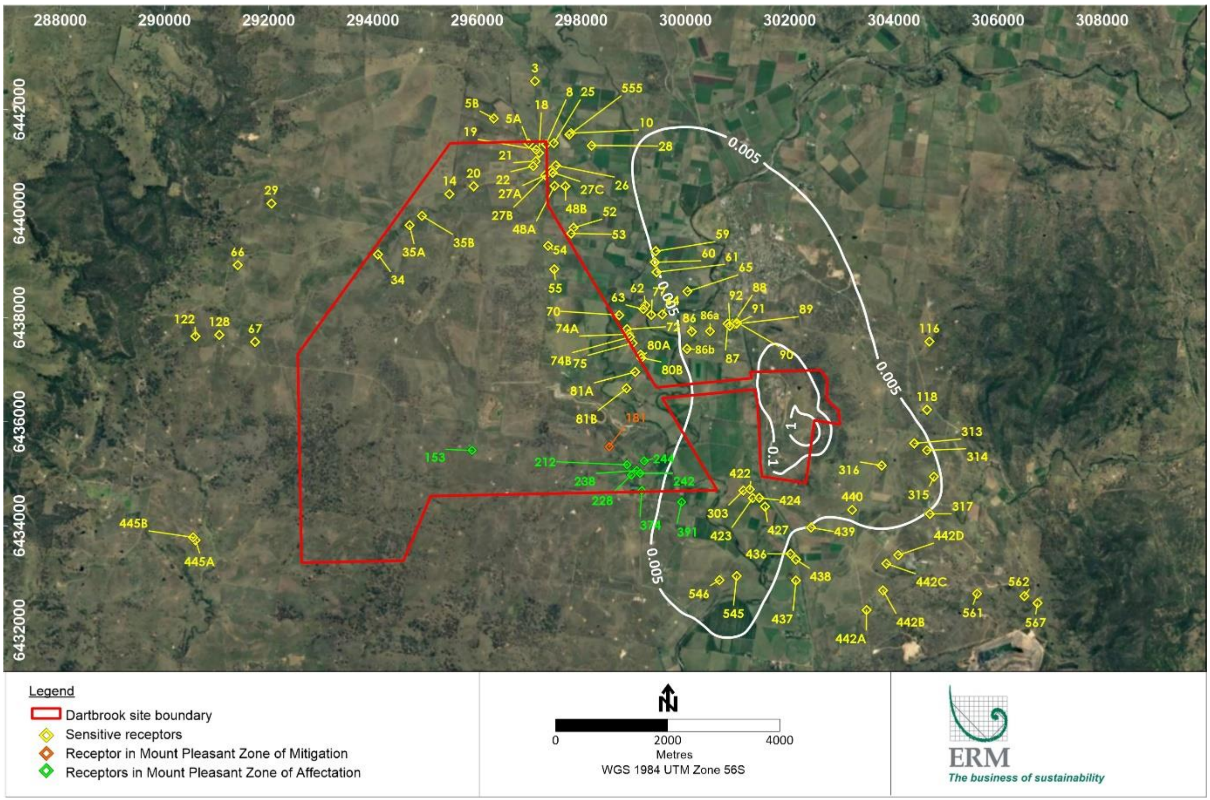



**Figure 9-7: Predicted annual average dust deposition concentrations (g/m$^2$/month) – Modification only**

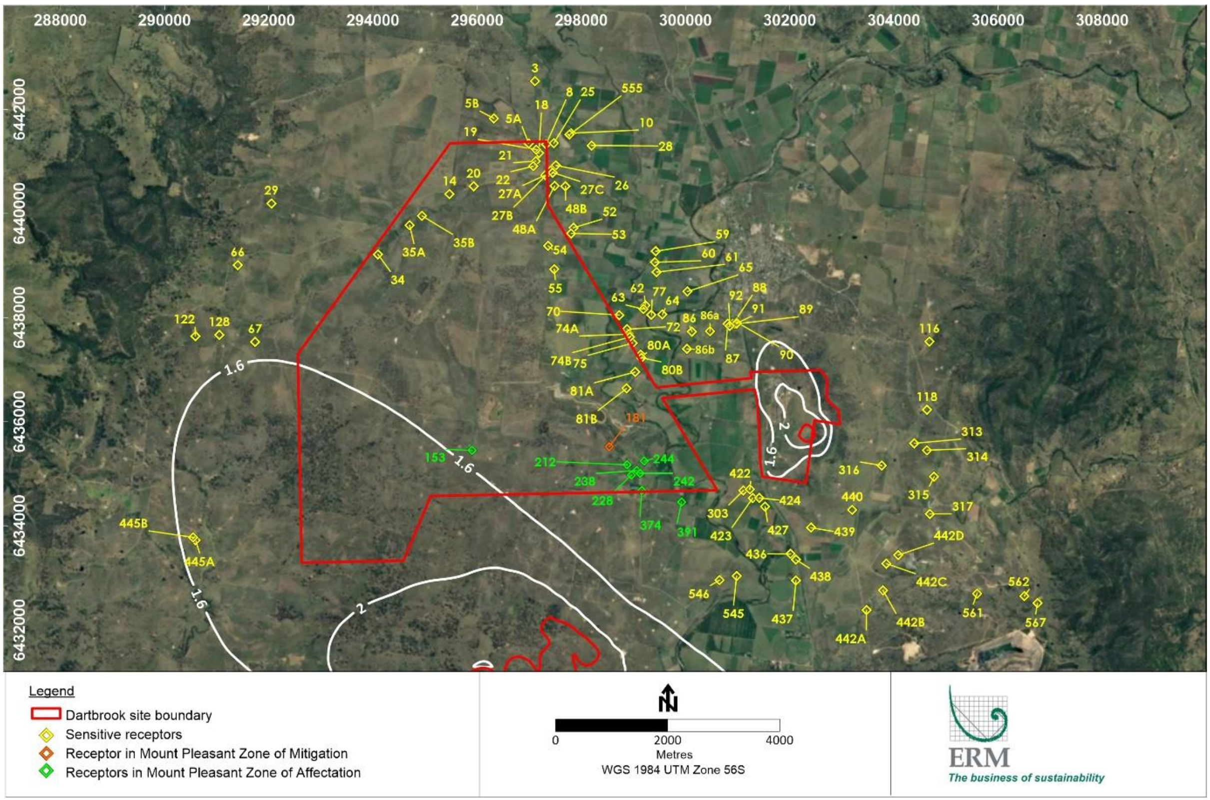



**Figure 9-8: Predicted annual average dust deposition concentrations (g/m$^2$/month) – Cumulative**

## 9.3 24-hour average concentrations

### *9.3.1 Introduction*

It is important to note that it is not possible to accurately predict cumulative 24-hour average concentrations many years into the future using dispersion modelling, principally due to the variability in ambient levels and spatial and temporal variation in any day-to-day anthropogenic activity. Experience shows that the worst-case 24-hour $PM_{10}$ concentrations are strongly influenced by other sources in the area, such as bushfires and inland dust storms, which are unpredictable.

It is also important to note that individual contour plots do not represent one moment in time, but rather the maximum 24-hour average that could potentially occur at a location over the period of a year.

The cumulative concentrations were calculated by adding the maximum predicted 24-hour average concentration due to the Modification and Mount Pleasant to the corresponding concentration measured at DPIE Aberdeen on the same day for the representative year (2014).

### *9.3.2 PM10*

Table 9-5 presents the maximum predicted 24-hour average concentrations of $PM_{10}$ at each of the sensitive receptor locations due to the Modification and cumulatively. Note that the maximum concentration at each receptor resulting from the different operations will not necessarily occur on the same day. That is, the maximum contribution from Dartbrook, may not necessarily occur on the same day as the maximum contribution from Mt Pleasant or the background, at that same location.

A discussion of the results for the Modification and with the inclusion of background concentrations are presented below.

There are no sensitive receptors predicted to experience 24-hour average $PM_{10}$ concentrations above the VLAMP criterion of 50 $\mu g/m^3$ due to the Modification alone.

A contour plot of the maximum predicted 24-hour average concentrations due to the Modification is presented in Figure 9-9.

As the background data already contains two days above the impact assessment criterion of 50 $\mu g/m^3$ (see Section 5.2.3), all sensitive receptors are predicted to experience 24-hour average $PM_{10}$ concentrations above the NSW EPA impact assessment criterion of 50 $\mu g/m^3$ when including background concentrations and the predicted contribution from Mt Pleasant Mine. The high $PM_{10}$ concentrations on these two days are attributed to natural events (fires or dust storms). Accordingly, these exceedances would occur regardless of the Modification and have been disregarded.

When considering additional exceedances (per the Approved Methods), there are seven receptors predicted to have one additional day where the cumulative concentration exceeds the criteria. However, it is noted that all these occur at the background concentration recorded on 10 February 2014. As discussed in Section 5.2.3, a 24-hour average $PM_{10}$ concentration of 48.7 $\mu g/m^3$ was recorded at DPIE Aberdeen on this day due to a large bush fire in the area. Elevated concentrations were also recorded at other DPIE stations in the region on the same day indicating that this was the result of a regional event rather than due to local sources.

The concentration recorded at DPIE Aberdeen on 10 February 2014 is the third highest recorded 24-hour average $PM_{10}$ concentration during 2014 but is still below the NSW EPA impact assessment criterion of 50 $\mu g/m^3$. If this day was removed from the analysis (due to the influence of natural events) there would be no additional exceedances of the EPA $PM_{10}$ 24-hour average impact assessment criterion of 50 $\mu g/m^3$.

Figure 9-10 to Figure 9-16 presents the cumulative 24-hour average $PM_{10}$ concentrations for each day of the year for each of the seven residences (29, 66, 67, 122, 128, 445A, 445B) showing an additional day of exceedance.

**Table 9-5: Predicted 24-hour average $PM_{10}$ from the Modification alone, Mount Pleasant alone and cumulatively**

| Receptor ID | Modification only | Mount Pleasant only | Cumulative | |
|---|---|---|---|---|
| | DPE VLAMP criteria = 50 µg/m$^3$ | | NSW EPA impact assessment criteria = 50 µg/m$^3$ | Additional days > 50 µg/m$^3$ |
| 3 | 0.4 | 2.4 | **51** | 0 |
| 8 | 0.6 | 3.1 | **51** | 0 |
| 10 | 0.7 | 3.1 | **51** | 0 |
| 14 | 1.0 | 3.5 | **51** | 0 |
| 18 | 0.7 | 3.1 | **51** | 0 |
| 19 | 0.7 | 3.0 | **51** | 0 |
| 20 | 1.1 | 3.3 | **51** | 0 |
| 21 | 0.7 | 3.1 | **51** | 0 |
| 22 | 0.7 | 3.1 | **51** | 0 |
| 25 | 0.6 | 3.1 | **51** | 0 |
| 26 | 0.6 | 3.4 | **51** | 0 |
| 28 | 0.6 | 3.1 | **51** | 0 |
| 29 | 1.5 | 4.2 | **51** | **1** |
| 34 | 1.2 | 5.3 | **51** | 0 |
| 52 | 0.6 | 4.1 | **51** | 0 |
| 53 | 0.6 | 4.1 | **51** | 0 |
| 54 | 0.5 | 3.9 | **51** | 0 |
| 55 | 0.5 | 4.0 | **51** | 0 |
| 59 | 0.7 | 3.0 | **51** | 0 |
| 60 | 0.7 | 3.2 | **51** | 0 |
| 61 | 0.7 | 3.3 | **51** | 0 |
| 62 | 0.7 | 3.9 | **51** | 0 |
| 63 | 0.6 | 3.9 | **51** | 0 |
| 64 | 0.6 | 3.9 | **51** | 0 |
| 65 | 0.9 | 3.3 | **51** | 0 |
| 66 | 1.1 | 4.7 | **52** | **1** |
| 67 | 0.7 | 5.4 | **52** | **1** |
| 70 | 0.6 | 4.8 | **51** | 0 |
| 72 | 0.6 | 4.8 | **51** | 0 |
| 75 | 0.7 | 4.9 | **51** | 0 |
| 77 | 0.6 | 4.0 | **51** | 0 |
| 87 | 2.3 | 3.2 | **51** | 0 |
| 88 | 2.5 | 3.2 | **51** | 0 |
| 89 | 2.6 | 3.1 | **51** | 0 |
| 90 | 2.6 | 3.1 | **51** | 0 |
| 91 | 2.6 | 3.1 | **51** | 0 |
| 92 | 2.3 | 3.2 | **51** | 0 |
| 116 | 0.7 | 1.7 | **51** | 0 |
| 118 | 1.0 | 2.1 | **51** | 0 |

| Receptor ID | Modification only | Mount Pleasant only | Cumulative | |
|---|---|---|---|---|
| | DPE VLAMP criteria = 50 µg/m$^3$ | | NSW EPA impact assessment criteria = 50 µg/m$^3$ | Additional days > 50 µg/m$^3$ |
| 122 | 0.8 | 4.3 | **52** | **1** |
| 128 | 0.6 | 4.5 | **52** | **1** |
| 303 | 2.6 | 5.5 | **52** | 0 |
| 313 | 1.4 | 2.3 | **51** | 0 |
| 314 | 1.3 | 2.4 | **51** | 0 |
| 315 | 1.3 | 2.5 | **51** | 0 |
| 316 | 2.0 | 2.4 | **51** | 0 |
| 317 | 0.9 | 2.5 | **51** | 0 |
| 422 | 3.1 | 5.3 | **52** | 0 |
| 423 | 2.8 | 5.2 | **52** | 0 |
| 424 | 2.7 | 5.0 | **52** | 0 |
| 427 | 1.7 | 4.8 | **52** | 0 |
| 436 | 0.8 | 5.3 | **51** | 0 |
| 437 | 0.8 | 6.1 | **51** | 0 |
| 438 | 0.8 | 5.4 | **51** | 0 |
| 439 | 0.9 | 4.5 | **51** | 0 |
| 440 | 1.2 | 3.4 | **51** | 0 |
| 545 | 1.9 | 8.2 | **51** | 0 |
| 546 | 2.0 | 9.8 | **52** | 0 |
| 555 | 0.7 | 3.1 | **51** | 0 |
| 561 | 0.6 | 4.2 | **51** | 0 |
| 562 | 0.5 | 4.2 | 50 | 0 |
| 567 | 0.5 | 3.9 | 50 | 0 |
| 27A | 0.6 | 3.4 | **51** | 0 |
| 27B | 0.6 | 3.4 | **51** | 0 |
| 27C | 0.6 | 3.4 | **51** | 0 |
| 35A | 1.1 | 4.3 | **51** | 0 |
| 35B | 0.9 | 3.9 | **51** | 0 |
| 442A | 0.5 | 5.7 | **51** | 0 |
| 442B | 0.6 | 4.4 | **51** | 0 |
| 442C | 0.9 | 3.8 | **51** | 0 |
| 442D | 1.0 | 3.5 | **51** | 0 |
| 445A | 0.2 | 6.6 | **55** | **1** |
| 445B | 0.2 | 6.5 | **55** | **1** |
| 48A | 0.5 | 3.5 | **51** | 0 |
| 48B | 0.5 | 3.6 | **51** | 0 |
| 5A | 0.7 | 2.9 | **51** | 0 |
| 5B | 0.7 | 2.5 | **51** | 0 |
| 74A | 0.6 | 4.9 | **51** | 0 |
| 74B | 0.6 | 4.9 | **51** | 0 |
| 80A | 0.7 | 4.8 | **51** | 0 |

| Receptor ID | Modification only | Mount Pleasant only | Cumulative | |
|---|---|---|---|---|
| | DPE VLAMP criteria = 50 µg/m³ | | NSW EPA impact assessment criteria = 50 µg/m³ | Additional days > 50 µg/m³ |
| 80B | 0.8 | 4.8 | **51** | 0 |
| 81A | 0.9 | 5.5 | **51** | 0 |
| 81B | 1.5 | 6.5 | **51** | 0 |
| 86 | 0.9 | 3.8 | **51** | 0 |
| 181 | 0.9 | 9.6 | **51** | 0 |
| 212 | 1.0 | 9.8 | **51** | 0 |
| 228 | 0.9 | 9.7 | **51** | 0 |
| 238 | 0.9 | 9.2 | **51** | 0 |
| 242 | 0.9 | 8.8 | **51** | 0 |
| 244 | 1.1 | 7.9 | **51** | 0 |
| 374 | 0.9 | 8.9 | **51** | 0 |
| 391 | 1.5 | 6.1 | **51** | 0 |
| 153 | 1.7 | 11.6 | **52** | 0 |
| 86a | 1.6 | 3.6 | **51** | 0 |
| 86b | 0.9 | 4.2 | **51** | 0 |

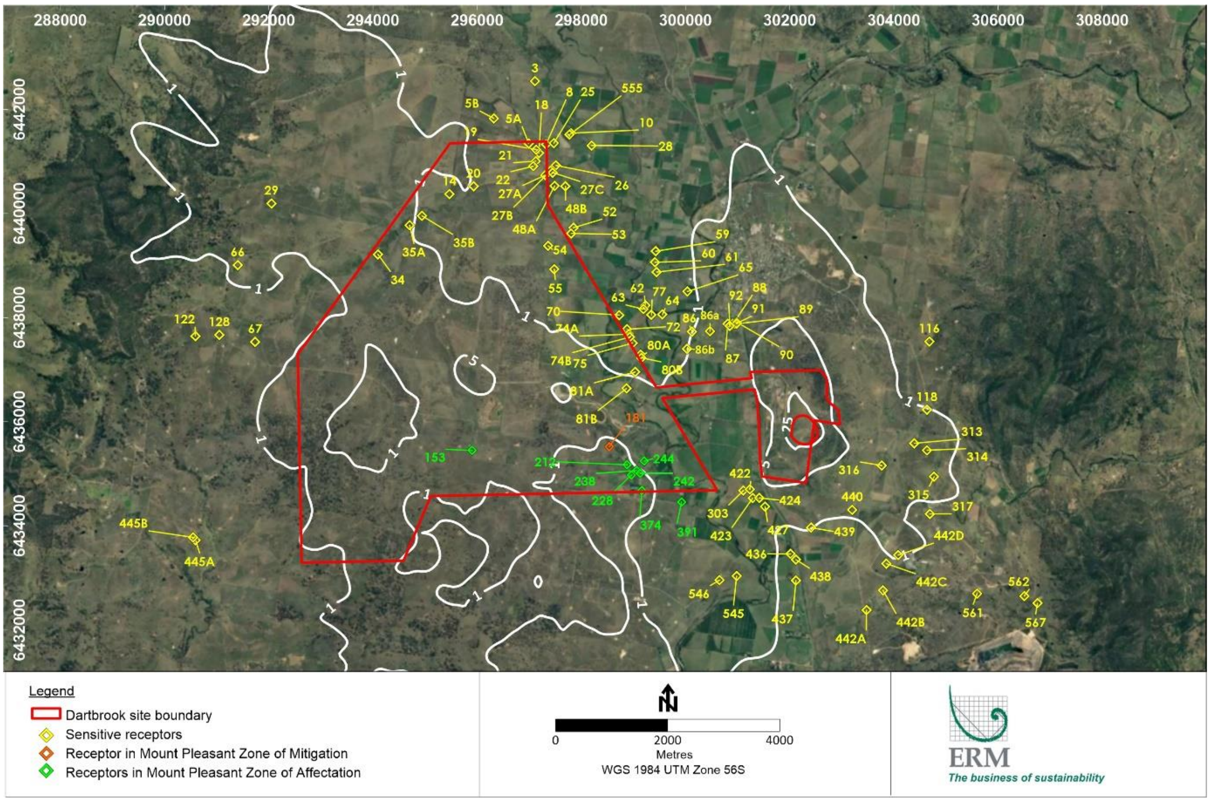



**Figure 9-9: Maximum predicted 24-hour average $PM_{10}$ concentrations (µg/m³) – Modification only**

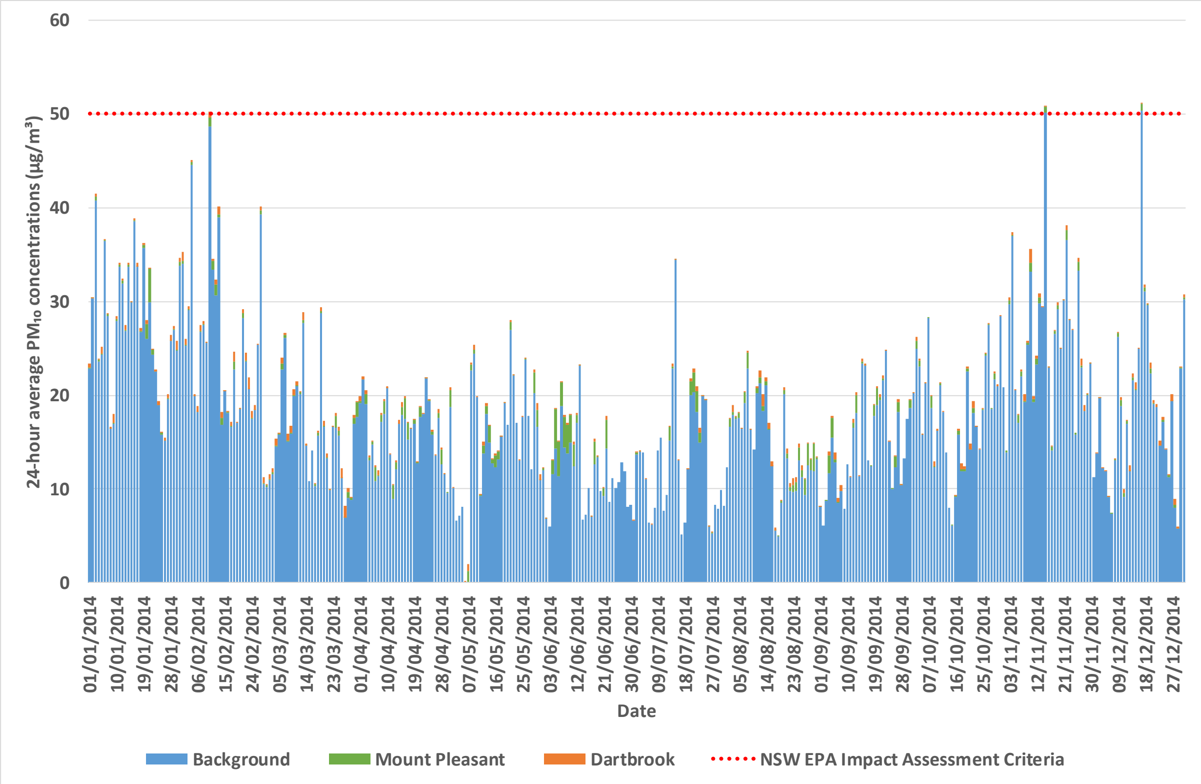



**Figure 9-10: Cumulative 24-hour average $PM_{10}$ concentrations (µg/m$^3$) for Residence 29 for each day of the year**

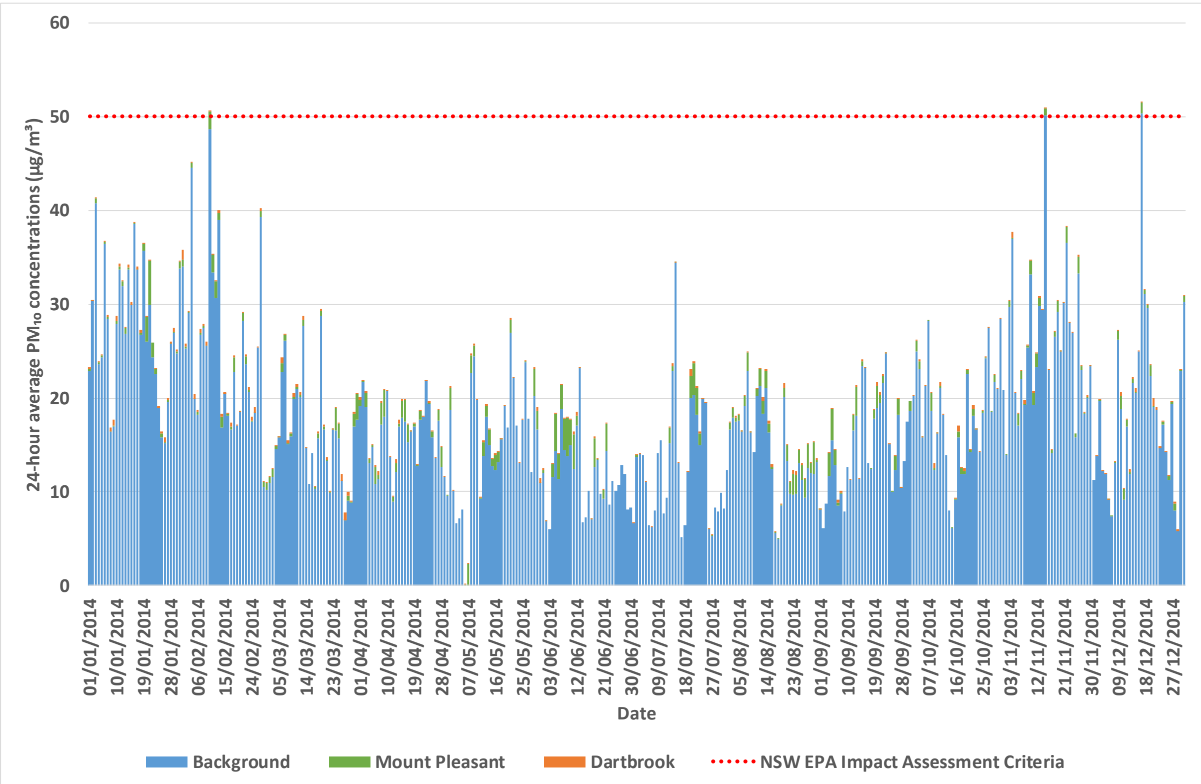



**Figure 9-11: Cumulative 24-hour average $PM_{10}$ concentrations (µg/m$^3$) for Residence 66 for each day of the year**

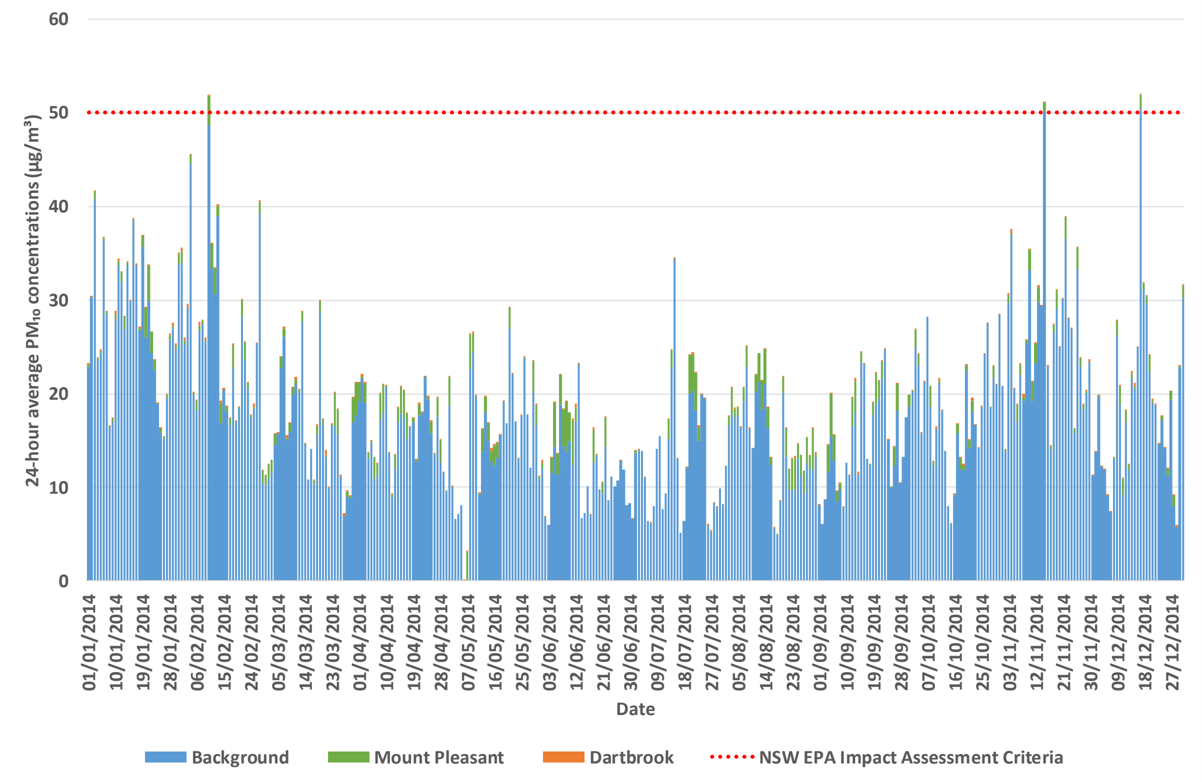



**Figure 9-12: Cumulative 24-hour average $PM_{10}$ concentrations ($\mu g/m^3$) for Residence 67 for each day of the year**

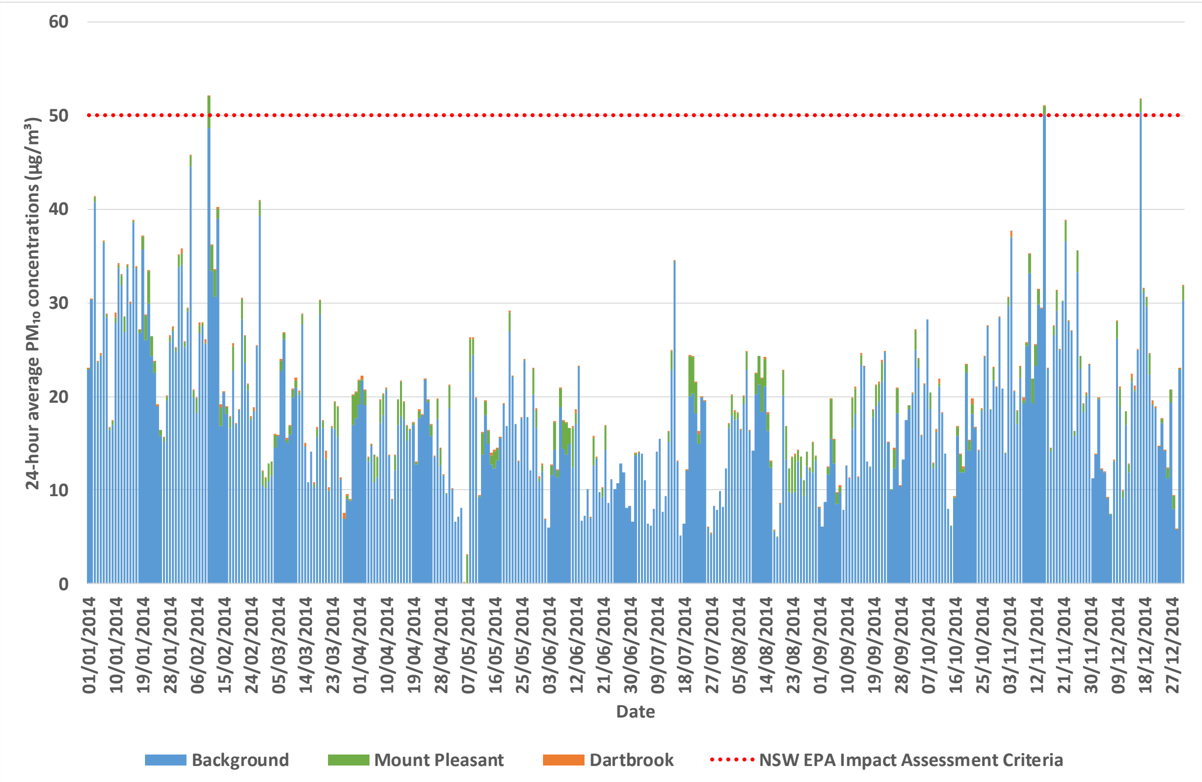



**Figure 9-13: Cumulative 24-hour average $PM_{10}$ concentrations ($\mu g/m^3$) for Residence 122 for each day of the year**

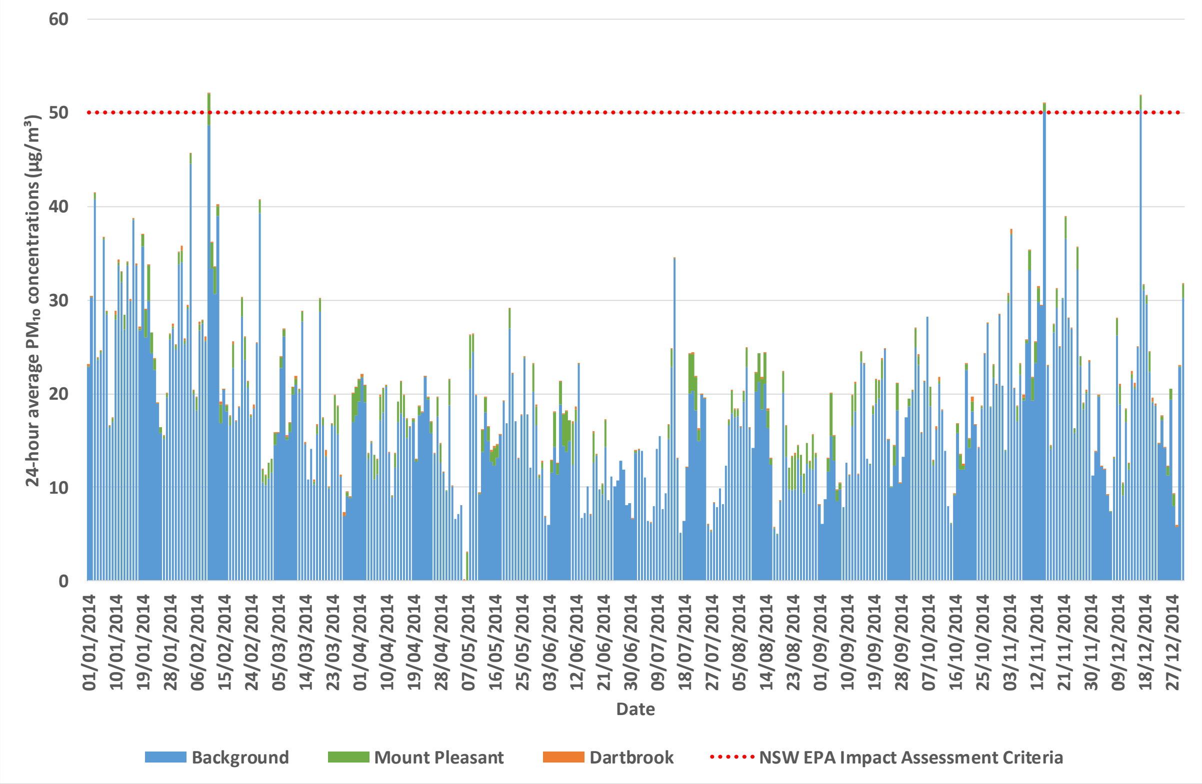



**Figure 9-14: Cumulative 24-hour average $PM_{10}$ concentrations (µg/m$^3$) for Residence 128 for each day of the year**

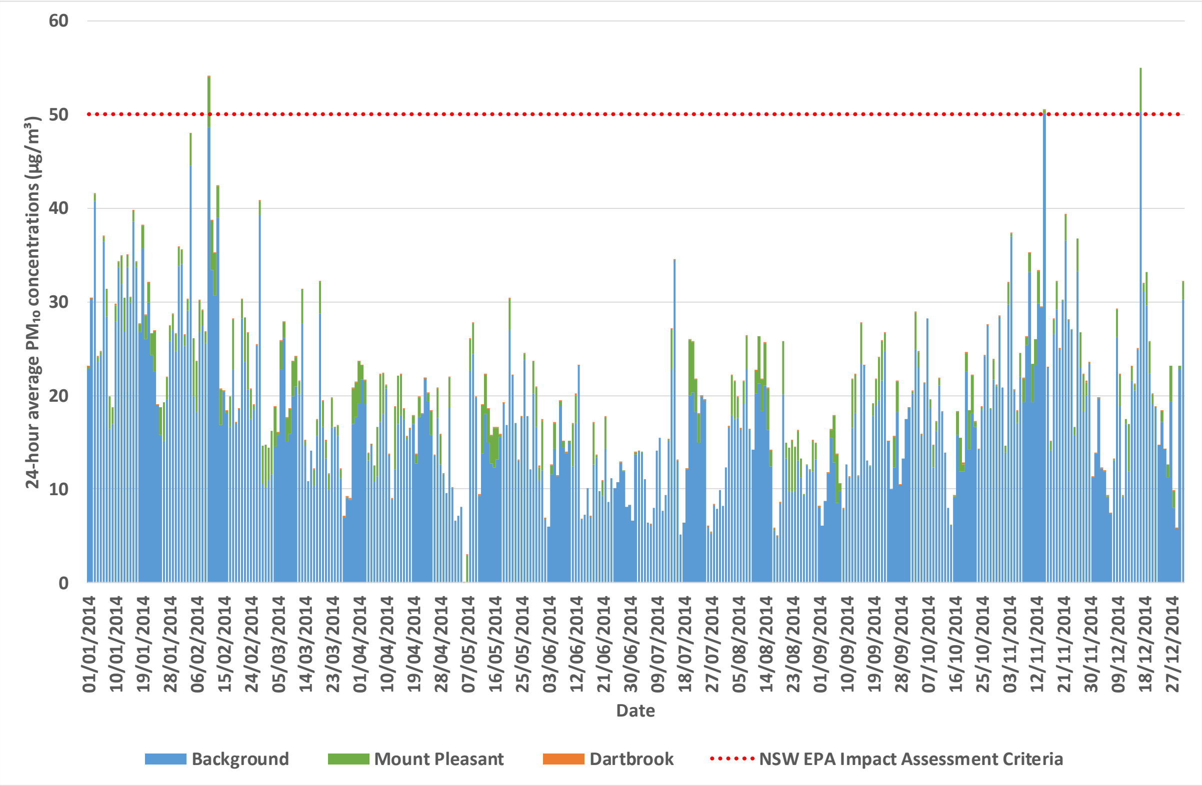



**Figure 9-15: Cumulative 24-hour average $PM_{10}$ concentrations (µg/m$^3$) for Residence 445A for each day of the year**

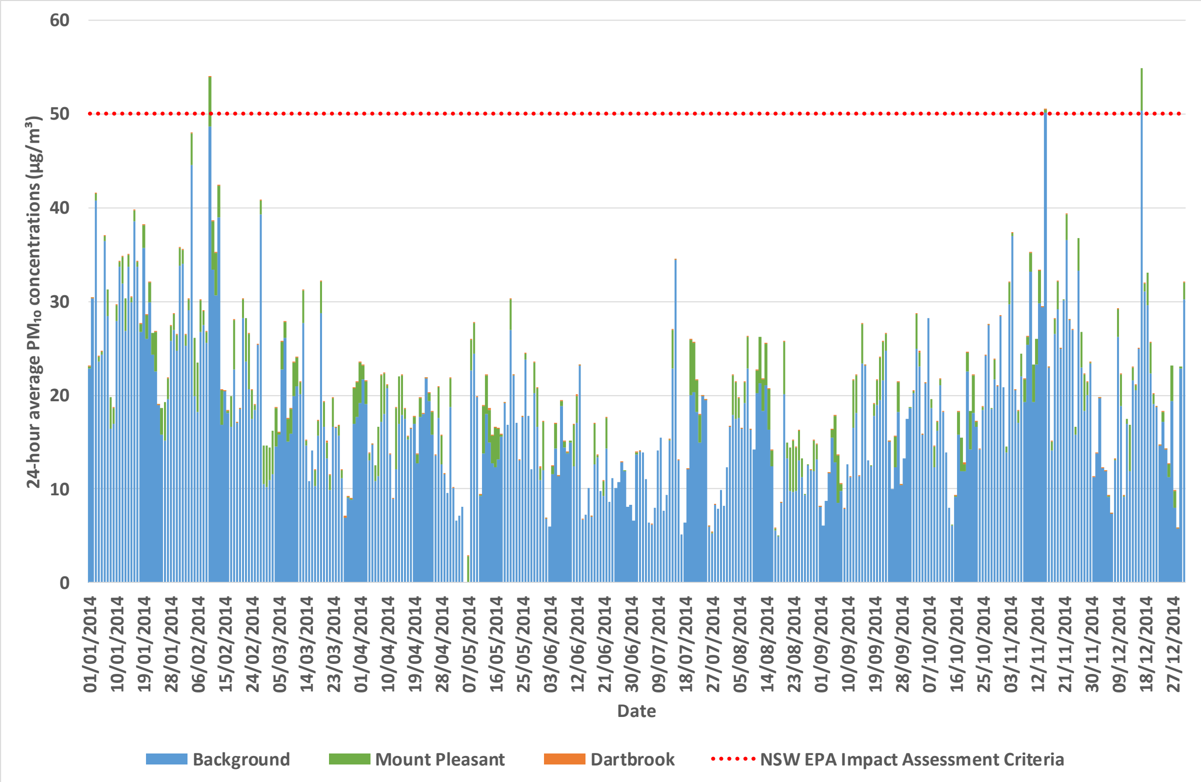



**Figure 9-16: Cumulative 24-hour average $PM_{10}$ concentrations (µg/m$^3$) for Residence 445B for each day of the year**

As discussed, the additional day of exceedances all occurred on the same day – 10 February 2014. Figure 9-18 and Table 9-7 present the source contribution to 24-hour average $PM_{10}$ concentrations on 10 February 2014 for each of the seven receptors showing an additional exceedance. It can be seen that the background concentrations are dominating the total concentrations and the contribution from the Modification is small. At all receptors, the contribution of the Modification alone to the total concentration is 1% or less. The maximum contribution is at Receptor 29 and is 0.54 µg/m$^3$. At receptors 66, 67, 122, 128, 445A and 445B, the sum of the background concentration and the Mount Pleasant contribution is greater than the criteria (50 µg/m$^3$). In these instances, the exceedance would occur regardless of whether Dartbrook Mine is operating.

**Table 9-6: Source contribution to 24-hour average $PM_{10}$ concentrations (µg/m³) on 10 February 2014 for receptors showing an additional day of exceedances**

| Receptor | Background | Mt Pleasant | Total before modification | Modification | Total | Percentage contribution from Modification | Criterion |
|---|---|---|---|---|---|---|---|
| R29 | 48.7 | 0.97 | 49.67 | 0.54 | 50.21 | 1 | 50 |
| R66 | 48.7 | 1.92 | 50.62 | 0.07 | 50.69 | <1 | |
| R67 | 48.7 | 3.16 | 51.86 | 0.03 | 51.88 | <1 | |
| R122 | 48.7 | 3.34 | 52.04 | 0.01 | 52.05 | <1 | |
| R128 | 48.7 | 3.35 | 52.05 | 0.02 | 52.07 | <1 | |
| R445A | 48.7 | 5.36 | 54.06 | 0.01 | 54.06 | <1 | |
| R445B | 48.7 | 5.20 | 53.90 | 0.01 | 53.90 | <1 | |

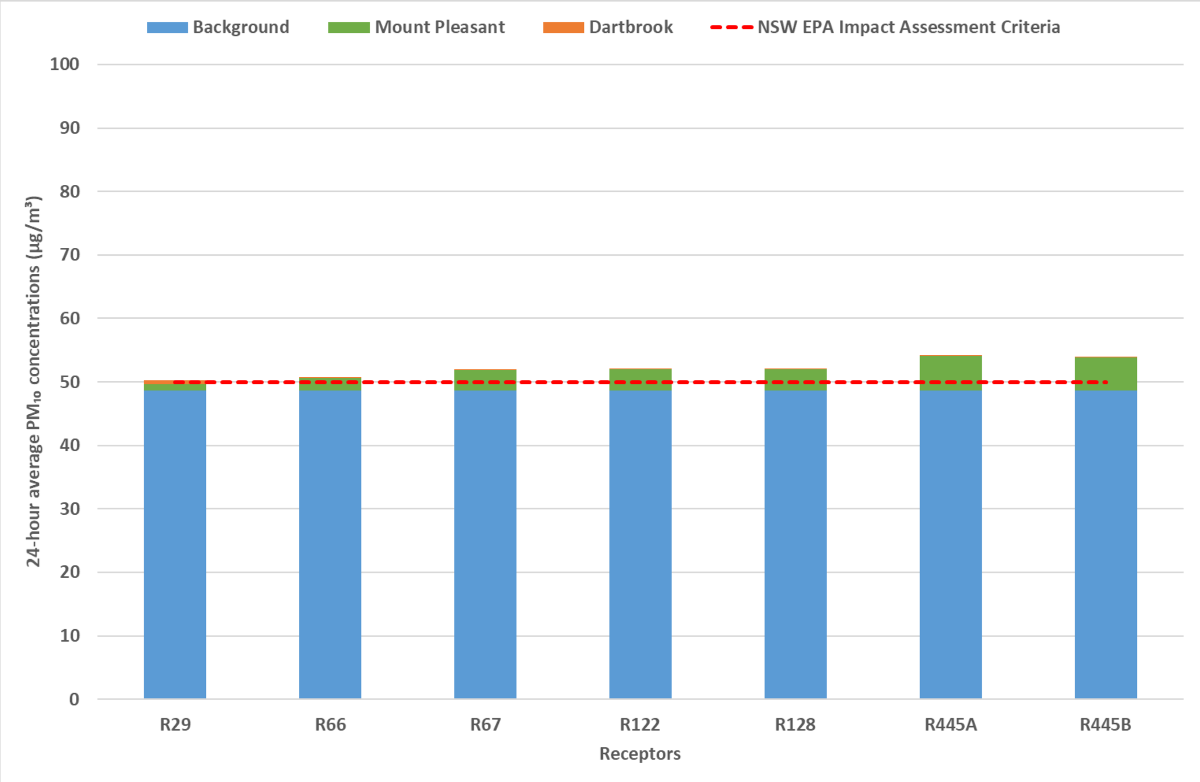



**Figure 9-17: Source contribution to 24-hour average $PM_{10}$ concentrations (µg/m³) on 10 February 2014 for receptors showing an additional day of exceedances**

### 9.3.3 $PM_{2.5}$

Table 9-7 presents the maximum predicted 24-hour average concentrations of $PM_{2.5}$ at each of the sensitive receptor locations due to the Modification and cumulatively.

Contour plots of the maximum predicted 24-hour average concentrations due to the Modification are presented in Figure 9-18.

A discussion of the results for the Modification and with the inclusion of background concentrations are presented below.

There are no sensitive receptors predicted to experience 24-hour average $PM_{2.5}$ concentrations above the impact assessment criterion of 25 µg/m$^3$ due to the Modification.

There are no sensitive receptors predicted to experience 24-hour average $PM_{2.5}$ concentrations above the impact assessment criterion of 25 µg/m$^3$ when including background concentrations.

**Table 9-7: Predicted 24-hour average $PM_{2.5}$ from the Modification alone, Mount Pleasant alone and cumulatively**

| Receptor ID | Modification only | Mount Pleasant only | Cumulative | |
|---|---|---|---|---|
| | Assessment criteria = N/A | | NSW EPA impact assessment criteria = 25 µg/m$^3$ | Additional days > 25 µg/m$^3$ |
| 3 | 0.2 | 0.6 | 21.2 | 0 |
| 8 | 0.3 | 0.8 | 21.2 | 0 |
| 10 | 0.4 | 0.7 | 21.2 | 0 |
| 14 | 0.5 | 0.8 | 21.3 | 0 |
| 18 | 0.3 | 0.8 | 21.2 | 0 |
| 19 | 0.3 | 0.8 | 21.2 | 0 |
| 20 | 0.6 | 0.9 | 21.3 | 0 |
| 21 | 0.4 | 0.8 | 21.2 | 0 |
| 22 | 0.4 | 0.8 | 21.2 | 0 |
| 25 | 0.3 | 0.8 | 21.2 | 0 |
| 26 | 0.3 | 0.8 | 21.2 | 0 |
| 28 | 0.3 | 0.7 | 21.2 | 0 |
| 29 | 0.8 | 0.9 | 21.3 | 0 |
| 34 | 0.6 | 1.1 | 21.4 | 0 |
| 52 | 0.2 | 0.9 | 21.2 | 0 |
| 53 | 0.2 | 0.9 | 21.2 | 0 |
| 54 | 0.3 | 1.0 | 21.2 | 0 |
| 55 | 0.3 | 1.0 | 21.2 | 0 |
| 59 | 0.3 | 0.8 | 21.2 | 0 |
| 60 | 0.3 | 0.8 | 21.2 | 0 |
| 61 | 0.3 | 0.9 | 21.2 | 0 |
| 62 | 0.3 | 1.0 | 21.2 | 0 |
| 63 | 0.2 | 1.0 | 21.2 | 0 |
| 64 | 0.3 | 1.0 | 21.2 | 0 |
| 65 | 0.4 | 0.8 | 21.2 | 0 |
| 66 | 0.6 | 0.9 | 21.5 | 0 |
| 67 | 0.3 | 1.1 | 21.4 | 0 |
| 70 | 0.3 | 1.0 | 21.2 | 0 |
| 72 | 0.3 | 1.1 | 21.2 | 0 |
| 75 | 0.4 | 1.1 | 21.2 | 0 |
| 77 | 0.2 | 1.0 | 21.2 | 0 |
| 87 | 0.8 | 0.8 | 21.2 | 0 |
| 88 | 1.0 | 0.8 | 21.2 | 0 |
| 89 | 1.1 | 0.8 | 21.3 | 0 |
| 90 | 1.1 | 0.8 | 21.3 | 0 |
| 91 | 1.1 | 0.8 | 21.3 | 0 |
| 92 | 0.9 | 0.8 | 21.2 | 0 |
| 116 | 0.3 | 0.5 | 21.2 | 0 |
| 118 | 0.5 | 0.6 | 21.2 | 0 |

| Receptor ID | Modification only | Mount Pleasant only | Cumulative | |
|---|---|---|---|---|
| | Assessment criteria = N/A | | NSW EPA impact assessment criteria = 25 µg/m³ | Additional days > 25 µg/m³ |
| 122 | 0.4 | 1.0 | 21.5 | 0 |
| 128 | 0.3 | 0.9 | 21.5 | 0 |
| 303 | 0.7 | 1.0 | 21.3 | 0 |
| 313 | 0.6 | 0.7 | 21.2 | 0 |
| 314 | 0.6 | 0.7 | 21.2 | 0 |
| 315 | 0.4 | 0.7 | 21.2 | 0 |
| 316 | 0.5 | 0.8 | 21.2 | 0 |
| 317 | 0.3 | 0.8 | 21.2 | 0 |
| 422 | 0.8 | 0.9 | 21.3 | 0 |
| 423 | 0.7 | 0.9 | 21.3 | 0 |
| 424 | 0.7 | 0.9 | 21.3 | 0 |
| 427 | 0.6 | 0.9 | 21.2 | 0 |
| 436 | 0.3 | 1.2 | 21.2 | 0 |
| 437 | 0.3 | 1.4 | 21.2 | 0 |
| 438 | 0.3 | 1.2 | 21.2 | 0 |
| 439 | 0.3 | 1.1 | 21.2 | 0 |
| 440 | 0.4 | 1.0 | 21.2 | 0 |
| 545 | 0.5 | 1.4 | 21.2 | 0 |
| 546 | 0.5 | 1.7 | 21.2 | 0 |
| 555 | 0.4 | 0.7 | 21.2 | 0 |
| 561 | 0.3 | 0.8 | 21.2 | 0 |
| 562 | 0.2 | 0.8 | 21.2 | 0 |
| 567 | 0.2 | 0.8 | 21.2 | 0 |
| 27A | 0.3 | 0.8 | 21.2 | 0 |
| 27B | 0.3 | 0.8 | 21.2 | 0 |
| 27C | 0.3 | 0.8 | 21.2 | 0 |
| 35A | 0.5 | 1.0 | 21.5 | 0 |
| 35B | 0.4 | 0.9 | 21.4 | 0 |
| 442A | 0.3 | 1.8 | 21.2 | 0 |
| 442B | 0.3 | 1.4 | 21.2 | 0 |
| 442C | 0.3 | 1.1 | 21.2 | 0 |
| 442D | 0.3 | 1.0 | 21.2 | 0 |
| 445A | 0.1 | 1.3 | 21.3 | 0 |
| 445B | 0.1 | 1.3 | 21.3 | 0 |
| 48A | 0.3 | 0.9 | 21.2 | 0 |
| 48B | 0.3 | 0.8 | 21.2 | 0 |
| 5A | 0.4 | 0.8 | 21.2 | 0 |
| 5B | 0.4 | 0.7 | 21.2 | 0 |
| 74A | 0.3 | 1.1 | 21.2 | 0 |
| 74B | 0.3 | 1.1 | 21.2 | 0 |
| 80A | 0.4 | 1.1 | 21.2 | 0 |

| Receptor ID | Modification only | Mount Pleasant only | Cumulative | |
|---|---|---|---|---|
| | Assessment criteria = N/A | | NSW EPA impact assessment criteria = 25 µg/m³ | Additional days > 25 µg/m³ |
| 80B | 0.4 | 1.2 | 21.2 | 0 |
| 81A | 0.4 | 1.2 | 21.2 | 0 |
| 81B | 0.8 | 1.3 | 21.2 | 0 |
| 86 | 0.4 | 0.9 | 21.2 | 0 |
| 181 | 0.5 | 1.8 | 21.2 | 0 |
| 212 | 0.5 | 1.7 | 21.2 | 0 |
| 228 | 0.5 | 1.7 | 21.2 | 0 |
| 238 | 0.5 | 1.7 | 21.2 | 0 |
| 242 | 0.5 | 1.6 | 21.2 | 0 |
| 244 | 0.6 | 1.5 | 21.2 | 0 |
| 374 | 0.4 | 1.6 | 21.2 | 0 |
| 391 | 0.5 | 1.1 | 21.2 | 0 |
| 153 | 0.8 | 2.2 | 21.4 | 0 |
| 86a | 0.4 | 0.9 | 21.2 | 0 |
| 86b | 0.4 | 1.0 | 21.2 | 0 |

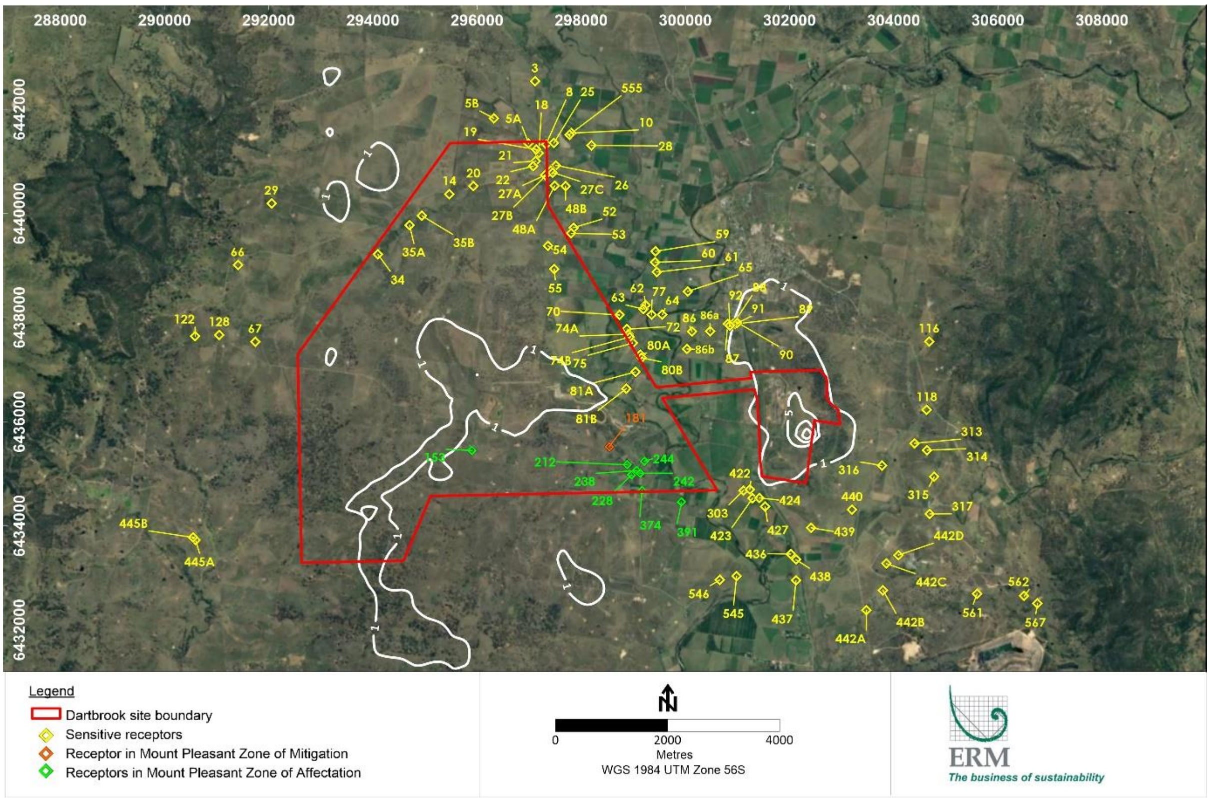



**Figure 9-18: Maximum predicted 24-hour average $PM_{2.5}$ concentrations (µg/m³) – Modification only**

# 10. MANAGEMENT AND MITIGATION

The Modification has the potential to generate dust. It is therefore necessary to take reasonable and practicable measures to prevent or minimise dust impacts at all sensitive residences and in particular those residences predicted to experience 24-hour $PM_{10}$ concentrations above the impact assessment criteria.

AQC is committed to best practice dust management and control. This includes the application of dust controls in accordance with best practice monitoring and a proactive dust management system as stated in this assessment (see Section 7).

The existing air quality management plan will be updated to include the additional commitments in this assessment for the approval for relevant regulators.

# 11. GREENHOUSE GAS ASSESSMENT

## 11.1 Relevant legislation

### *11.1.1 International framework*

#### *11.1.1.1 Intergovernmental Panel on Climate Change*

The Intergovernmental Panel on Climate Change (IPCC) is a panel established in 1988 by the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP) to provide independent scientific advice on climate change. The panel was originally asked to prepare a report, based on available scientific information, on all aspects relevant to climate change and its impacts and to then formulate realistic response strategies. This first assessment report of the IPCC served as the basis for negotiating the United Nations Framework Convention on Climate Change (UNFCCC).

The IPCC also produces a variety of guidance documents and recommended methodologies for GHG emissions inventories, including (for example):

- 2006 IPCC Guidelines for National GHG Inventories; and
- Good Practice Guidance and Uncertainty Management in National GHG Inventories (2000).

Since the UNFCCC entered into force in 1994, the IPCC remains the pivotal source for scientific and technical information relevant to GHG emissions and climate change science.

The IPCC operates under the following mandate: "to provide the decision-makers and others interested in climate change with an objective source of information about climate change". The IPCC does not conduct any research nor does it monitor climate-related data or parameters. Its role is to assess on a comprehensive, objective, open and transparent basis the latest scientific, technical and socio-economic literature produced worldwide, relevant to the understanding of the risk of human-induced climate change, its observed and projected impacts and options for adaptation and mitigation. IPCC reports should be neutral with respect to policy, although they need to deal objectively with policy relevant scientific, technical and socio economic factors. They should be of high scientific and technical standards, and aim to reflect a range of views, expertise and wide geographical coverage" (IPCC, 2011).

The stated aims of the IPCC are to assess scientific information relevant to:

- Human-induced climate change;
- The impacts of human-induced climate change; and
- Options for adaptation and mitigation.

IPCC reports are widely cited within international literature, and are generally regarded as authoritative.

#### *11.1.1.2 United National Framework Convention on Climate Change*

The UNFCCC sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognises that the climate system is a shared resource, the stability of which can be affected by industrial and other emissions of $CO_2$ and other GHGs. The convention has near-universal membership, with 172 countries (parties) having ratified the treaty, the Kyoto Protocol.

Under the UNFCCC, governments:

- Gather and share information on GHG emissions, national policies and best practices.
- Launch national strategies for addressing GHG emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries.
- Cooperate in preparing for adaptation to the impacts of climate change.

#### *11.1.1.3 Kyoto Protocol*

The Kyoto Protocol entered into force on 16 February 2005. The Kyoto Protocol built upon the UNFCCC by committing to individual, legally binding targets to limit or reduce GHG emissions. Annex I Parties (which includes Australia) are countries that were members of the Organisation for Economic Co-operation and Development (OECD) in 1992, plus countries with economies in transition such as Russia. The GHGs included in the Kyoto Protocol were:

- Carbon dioxide ($CO_2$);
- Methane ($CH_4$);
- Nitrous oxide ($N_2O$);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Sulfur hexafluoride ($SF_6$)

Each of the above gases has a different effect on the earth's warming and this is a function of radiative efficiency and lifetime in the atmosphere for each individual gas. To account for these variables, each gas is given a 'global warming potential' (GWP) that is normalised to $CO_2$. For example, $CH_4$ has a GWP of 28 over a 100 year lifetime (IPCC, 2014). This factor is multiplied by the total mass of gas to be released to provide a $CO_2$ equivalent mass, termed '$CO_2$-equivalent'.The emission reduction targets were calculated based on a party's domestic GHG emission inventories (which included land use change and forestry clearing, transportation and stationary energy sectors). Domestic inventories required approval by the Kyoto Enforcement Branch. The Kyoto Protocol required developed countries to meet national targets for GHG emissions over a five year period between 2008 and 2012.

To achieve their targets, Annex I Parties had to implement domestic policies and measures. The Kyoto Protocol provided an indicative list of policies and measures that might help mitigate climate change and promote sustainable development.

Under the Kyoto Protocol, developed countries could use a number of flexible mechanisms to assist in meeting their targets. These market-based mechanisms include:

- Joint Implementation – where developed countries invest in GHG emission reduction projects in other developed countries.
- Clean Development Mechanism – where developed countries invest in GHG emission reduction projects in developing countries.

Annex I countries that failed to meet their emissions reduction targets during the 2008-2012 period were liable for a 30 per cent penalty (additional to the level of exceedance). A second commitment period was agreed in 2012 that spans from 2013 to 2020, whereby 37 countries, including Australia, were bound to emissions targets (DFAT, 2015).

#### *11.1.1.4 Paris Agreement*

In 2015, a historic global climate agreement was reached under the UNFCCC at the 21st Conference of the Parties (COP21) in Paris (known as the Paris Agreement). The Paris Agreement sets in place a durable and dynamic framework for all countries to take action on climate change from 2020 (that is, after the Kyoto period), building on existing efforts in the period up to 2020. Key outcomes of the Paris Agreement include:

- A global goal to hold average temperature increase to well below 2°C and pursue efforts to keep warming below 1.5°C above pre-industrial levels.
- All countries to set mitigation targets from 2020 and review targets every five years to build ambition over time, informed by a global stocktake.

- Robust transparency and accountability rules to provide confidence in countries' actions and track progress towards targets.
- Promoting action to adapt and build resilience to climate change.
- Financial, technological and capacity building support to help developing countries implement the Paris Agreement.

Australia ratified the Paris Agreement in November 2016. Australia's target under the Paris Agreement is to reduce emissions by 26-28 per cent below 2005 levels by the year 2030, progressing the levels of reduction required to meet the Kyoto Protocol targets.

### 11.1.2 Australian context

According to the Department of Environment and Energy (DoEE), Australia's GHG emissions have increased by 27.9% since 1990 reaching 534.7 Million tonnes of $CO_2$-equivalent ($MtCO_2$-e) in 2016 (excluding Land Use, Land Use Change and Forestry - LULUCF) (DoEE, 2017). Stationary energy excluding electricity includes emissions from direct combustion of fuels, predominantly in the manufacturing, mining, residential and commercial sectors. In 2016, stationary energy excluding electricity accounted for 18% of Australia's national inventory (DoEE, 2016).

#### 11.1.2.1 State Environment Planning Policy (Mining, Petroleum and Extractive Industries) 2007

Clause 14(2) of State Environmental Planning Policy (Mining, Petroleum and Extractive Industries) 2007 – The Mining SEPP, provides:

*"(2) in determining a development application for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider an assessment of the greenhouse gas emissions (including downstream emissions) of the development, and must do so having regard to any applicable State or national policies, programs or guidelines concerning greenhouse gas emissions".*

In this context, although the GHG protocol does not require indirect or downstream emissions (Scope 3) to be reported, they are included in this assessment.

#### 11.1.2.2 National Greenhouse and Energy Reporting Framework

The National Greenhouse and Energy Reporting Act 2007 (Cth) (the NGER Act) establishes a mandatory obligation on corporations which exceed defined thresholds to report GHG emissions, energy consumption, energy production and other related information.

Corporate and facility reporting thresholds for GHG emissions and energy consumption or energy production are provided in Table 11-1.

**Table 11-1 NGER Act reporting thresholds per financial year**

| Parameter | Reporting Threshold | |
|---|---|---|
| | Corporate | Facility |
| GHG Emissions (Scope 1 & 2) (kt $CO_2$-e) | 50 | 25 |
| Energy production (TJ) | 200 | 100 |
| Energy consumption (TJ) | 200 | 100 |

*Source: Clean Energy Regulator (2019)*

If a corporation has operational control over facilities whose GHG emissions or energy use in a given reporting year:

- Individually exceed the relevant facilities threshold; or
- When combined with other facilities under the corporation's operational control, exceed the relevant corporate thresholds.

That corporation must report the relevant GHG emissions or energy use (as the case may be) for that year under the NGER Act. For example, this may include construction or other contractors.

It is anticipated that during construction, there will be multiple parties with operational control over different aspects of the site development. For this reason, while it is anticipated that there is likely to be some reporting requirement under the NGER scheme, this is likely to be apportioned across the NGER reporting corresponding to several corporations.

Once operational, the Project's total Scope 1 and 2 GHG emissions are anticipated to exceed 25,000 tonnes $CO_2$-e in a financial year. Because of this, the reporting of emissions is expected to be required under the NGER scheme.

Dartbrook reports under the NGER scheme. The total scope 1 and 2 emissions reported under this scheme are shown in Table 11.2 (Clean Energy Regulator, 2019). It is noted that Dartbrook was not actually operating at this time and so the majority of these scope 1 emissions are likely to be due to fugitive methane emissions. In the absence of any additional data, and to remain conservative, it is assumed that all these emissions are from fugitive methane. The calculations presented in Section 11.3.1.2 have assumed the same increase from 2017/18 to 2018/19 will apply going forward for the life of the project.

**Table 11.2 Scope 1 and 2 emissions reported under the NGER scheme**

| Reporting year | Scope 1 emissions (t $CO_2$-e) | Scope 2 emissions (t $CO_2$-e) | Net energy consumed (GJ) |
|---|---|---|---|
| 2017 / 18 | 89,453 | 4,891 | 21,685 |
| 2018 / 19 | 99,883 | 4,377 | 219,019 |

*Source: Clean Energy Regulator (2019)*

### *11.1.2.3 NSW Climate Change Policy Framework*

The NSW Office of Environment and Heritage (now part of DPIE) published the NSW Climate Change Policy Framework in 2016, which aims to "maximise the economic, social and environmental wellbeing of NSW in the context of changing climate and current and emerging international and national policy settings and actions to address climate change". The long-term objectives of the Framework are to achieve net-zero emissions by 2050 and ensure NSW is more resilient and responsive to climate change. The key policy directions under the Framework are:

- Create an investment environment which manages the transition to reduced emissions
- Boost energy productivity and put downward pressure on energy bills
- Capture co-benefits and manage unintended impacts of external policies
- Take advantage of opportunities to grow new industries
- Reduce risks and damage to public and private assets arising from climate change
- Reduce climate change impacts on health and wellbeing
- Manage impacts on natural resources, ecosystems and communities

The Framework is being delivered through:

- A climate change fund strategic plan
- Developing value for emissions savings
- Embedding climate change considerations in government decision making
- Developing action plans and strategies and undertake additional policy investigation for sectors with risks, such as mining

## 11.2 Assessment methodology

Quantification of GHG emissions has been completed in accordance with the GHG Protocol (WRI & WBCSD, 2004), IPCC and Australian Government GHG accounting/classification systems.

This GHGA is also guided by the emission estimation methodologies endorsed under the National Greenhouse and Energy Reporting Regulations 2008 (the NGER Regulations) (as amended in 2019). These describe the detailed requirements for reporting under the NGER framework and also provide a basis for estimating emissions from proposed activities.

The Technical Guidelines for the Estimation of Greenhouse Gas Emissions by Facilities in Australia (the NGER Guidelines) (DoEE, 2017) support reporting under the NGER Act. They have been designed to assist corporations in understanding and applying the NGER Measurement Determination.

The NGER Guidelines are reporting year specific, and outline calculation methods and criteria for determining GHG emissions, energy production, energy consumption and potential GHG emissions embodied in combusted fuels. The latest published NGER Guidelines (at the time of writing) have been referenced.

### *11.2.1 The GHG protocol*

The GHG Protocol establishes an international standard for accounting and reporting of GHG emissions. The GHG Protocol has been adopted by the International Organization for Standardisation, endorsed by GHG initiatives (such as the Carbon Disclosure Project) and is compatible with existing GHG trading schemes.

Under this protocol, three “scopes” of emissions (Scope 1, Scope 2 and Scope 3) are defined for GHG accounting and reporting purposes. This terminology has been adopted in Australian GHG reporting and measurement methods and has been employed in this assessment. The definitions for Scope 1, Scope 2 and Scope 3 emissions are provided in the following sections, with a visual representation provided in Figure 11-1.

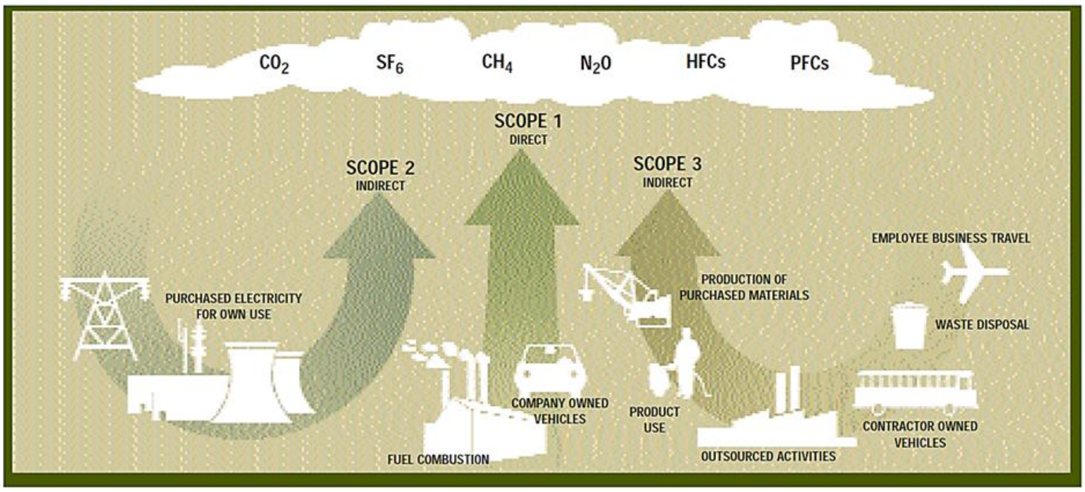



**Figure 11-1: Overview of scope and emissions across a reporting entity**

#### 11.2.1.1 Scope 1: Direct greenhouse gas emissions

Direct GHG emissions are defined as those emissions that occur from sources that are owned or controlled by the reporting entity. Direct GHG gas emissions are those emissions that are principally the result of the following types of activities undertaken by an entity:

- Generation of electricity, heat or steam. These emissions result from combustion of fuels in stationary sources;
- Physical or chemical processing. Most of these emissions result from manufacture or processing of chemicals and materials, e.g., the manufacture of cement, aluminium, etc;
- Transportation of materials, products, waste and employees. These emissions result from the combustion of fuels in entity owned/controlled mobile combustion sources, e.g., trucks, trains, ships, aeroplanes, buses and cars; and
- Fugitive emissions. These emissions result from intentional or unintentional releases, e.g., equipment leaks from joints, seals, packing, and gaskets; methane emissions from coal mines and venting; HFC emissions during the use of refrigeration and air conditioning equipment; and methane leakages from gas transport.

#### 11.2.1.2 Scope 2: Energy product use indirect greenhouse gas emissions

Scope 2 emissions are a category of indirect emissions that accounts for GHG emissions from the generation of purchased energy products (principally, electricity, steam/heat and reduction materials used for smelting) by the entity.

Scope 2 covers purchased electricity defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity. Scope 2 emissions physically occur at the facility where electricity is generated. Entities report the emissions from the generation of purchased electricity that is consumed in its owned or controlled equipment or operations as Scope 2.

#### 11.2.1.3 Scope 3: Other indirect greenhouse gas emissions

Scope 3 emissions are defined as those emissions that are a consequence of the activities of an entity, but which arise from sources not owned or controlled by that entity. Some examples of Scope 3 activities provided in the GHG Protocol are extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services.

The GHG Protocol provides that reporting Scope 3 emissions is optional. If an organisation believes that Scope 3 emissions are a significant component of the total emissions inventory, these can be reported along with Scope 1 and Scope 2. However, the GHG Protocol notes that reporting Scope 3 emissions can result in double counting of emissions and can also make comparisons between organisations and/or products difficult because reporting is voluntary. Double counting needs to be avoided when compiling national (country) inventories under the Kyoto Protocol. The GHG Protocol also recognises that compliance regimes are more likely to focus on the “point of release” of emissions (i.e. direct emissions) and/or indirect emissions from the purchase of electricity. Notwithstanding that Scope 3 reporting is optional, they have been estimated and are reported in Section 11.3.3. As noted in Section 11.1.2.1, Scope 3 emissions are also required to be taken into consideration by consent authorities so should be calculated as part of the assessment process for the development application.

### 11.2.2 Assessment approach

GHG emissions have been estimated for the Project based upon the methods outlined in the following documents:

- The National Greenhouse and Energy Reporting (Measurement) Amendment Determination 2008 (as amended 2019);
- Site specific information;

- The NGER Guidelines; and
- The NGA Factors.

## 11.3 Greenhouse gas calculations

The following sections present the GHG calculations and resultant estimated emissions from each of the GHG scopes as described in Section 11.2.1. All GHG calculations have been made using the relevant equations and emissions factors given within the NGER Measurement Determination. Data provided by Dartbrook has been used as input into these equations.

### *11.3.1 Calculation of scope 1 emissions*

#### *11.3.1.1 Diesel fuel consumption*

Estimated annual consumption of diesel oil has been provided by Dartbrook. The total diesel accounted for within the data is equal to diesel used for transport, stationary and non-combustion purposes. Diesel is consumed on-site for the following activities:

- Exploration and drilling;
- Extraction of coal (underground);
- Operation of heavy machinery and diesel generators; and
- Coal handling.

Emissions for Scope 1 diesel consumption are calculated using the following method:

*Method 1 – emissions of carbon dioxide, methane and nitrous oxide from liquid fuels other than petroleum based oils or greases (Subdivision 2.41 of the NGER Determination 2008 (as amended in 2019)).*

GHG emissions from diesel consumption were estimated using the following equation:

$$E_{ij} = \frac{Q_i \times EC_i \times EF_{ijoxec}}{1000}$$

Where:

| | | | |
|---|---|---|---|
| $E_{ij}$ | = | Emissions of GHG from diesel combustion | ($t\ CO_2$-e) |
| $Q_i$ | = | Quantity of fuel | (GJ)[1] |
| $EC_i$ | = | Energy content of fuel | (GJ/kL) |
| $EF_{ijoxec}$ | = | Emission factor (Scope 1) for diesel combustion | ($kg\ CO_2$-e/GJ)[2] |

[1] GJ = giga joules

[2] $kg\ CO_2$-e/GJ = kilograms of carbon dioxide equivalents per gigajoule

Scope 1 fuel consumption emissions have been calculated using the energy content and emission factors from Part 3 of the NGER Measurement Determination and are presented in Table 11-3 and Table 11-4.

**Table 11-3 Diesel (for stationary purposes) GHG emission factors – Scope 1**

| Fuel type | Energy Content (GJ/kL) | Emission factor (kg $CO_2$-e/GJ) | | |
|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_20$ |
| Diesel oil | 38.6 | 69.9 | 0.1 | 0.2 |

*Source: Schedule 1, Part 3 of the NGER Determination (2008) (as amended 2019).*

The estimated annual and total GHG emissions from diesel usage are presented in Table 11-4.

**Table 11-4 Annual diesel fuel consumption and GHG emissions**

| Year | Estimated Diesel Usage (kL/y) | Scope 1 Emissions (t $CO_2$-e) |
|---|---|---|
| 2021 | 1,321 | 3,579 |
| 2022 | 1,803 | 4,866 |
| 2023 | 1,803 | 4,866 |
| 2024 | 1,803 | 4,866 |
| 2025 | 1,803 | 4,866 |
| 2026 | 1,803 | 4,866 |
| 2027 | 1,803 | 4,866 |
| **Total** | **12,142** | **32,775** |

### *11.3.1.2 Fugitive methane*

As discussed in Section 11.1.2.2, Dartbrook reports scope 1 and 2 $CO_2$-e emissions under the NGER scheme and these have been reported for 2018 and 2019 when the mine was not operating. The assumption has been made that these are likely to therefore represent fugitive emissions of methane and increased slightly from 2018 to 2019. This is a conservative assumption but in the absence of other information this annual increase has been carried forward for the life of the project, as shown in Table 11-5.

The estimated GHG emissions by year are presented in Table 11-5.

**Table 11-5 Annual estimated GHG emissions from fugitive methane**

| Year | Scope 1 Emissions (t $CO_2$-e) |
|---|---|
| 2021 | 120,743 |
| 2022 | 131,173 |
| 2023 | 141,603 |
| 2024 | 152,033 |
| 2025 | 162,463 |
| 2026 | 172,893 |
| 2027 | 183,323 |
| **Total** | **1,064,231** |

### 11.3.2 Calculation of scope 2 emissions

#### 11.3.2.1 Electricity consumption

Consumption of electricity has been provided by Dartbrook. Emissions for Scope 2 electricity consumption are calculated using the following method:

*Method 1 – Indirect (scope 2) emission factors from consumption of purchased electricity from a grid (Subdivision 7.2 of the NGER Technical Guidelines 2008 (as amended in 2017).*

GHG emissions from electricity consumption were estimated using the following equation:

$$Y = Q \times \frac{EF}{1000}$$

Where:

| | | | |
|---|---|---|---|
| Y | = | Scope 2 Electricity emissions | ($CO_2$-e tonnes) |
| Q | = | Quantity of electricity purchased from the electricity grid during the year | (kWh/annum)[1] |
| EF | = | Scope 2 emission factor for the State of Territory in which the consumption occurs | (kg $CO_2$-e/kWh)[2] |

[1] kWh/annum = kilowatt hours per annum

[2] kg$CO_2$-e/kWh = kilograms of carbon dioxide equivalents per kilowatt hour

Scope 2 emissions have been calculated using an emission factor of 0.83 kg $CO_2$-e/kWh for New South Wales and Australian Capital Territory as sourced from Part 7.2 of the NGER Technical Guidelines 2008 (as amended 2017).

The estimated annual and total GHG emissions from electricity usage are presented in Table 11-6.

**Table 11-6 Projected electricity consumption and Scope 2 GHG emissions**

| Year | Estimated Electricity Consumption (kWh/y) | Scope 2 Emissions (t $CO_2$-e) |
|---|---|---|
| 2021 | 43,400,000 | 36,022 |
| 2022 | 93,900,000 | 77,937 |
| 2023 | 93,900,000 | 77,937 |
| 2024 | 93,900,000 | 77,937 |
| 2025 | 93,900,000 | 77,937 |
| 2026 | 93,900,000 | 77,937 |
| 2027 | 93,900,000 | 77,937 |
| **Total** | **606,800,000** | **503,644** |

### 11.3.3 Calculation of scope 3 emissions

#### 11.3.3.1 Energy production from product coal

Scope 3 greenhouse gas emissions from Dartbrook Mine have been estimated based upon the methods outlined in the following documents:

- The Corporate Value Chain (Scope 3) Accounting and Reporting Standard (Scope 3 Standard)
- The World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) Greenhouse Gas Protocol The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard Revised Edition (WRI/WBCSD, 2004) (hereafter referred to as the GHG Protocol);
- National Greenhouse and Energy Reporting (Measurement) Determination 2008; and
- The Australian Government Department of Climate Change and Energy (DCCE) National Greenhouse Accounts (NGA) Factors 2018 (DCCE, 2018).

The GHG Protocol establishes an international standard for accounting and reporting of GHG emissions. The GHG Protocol has been adopted by the International Standard Organisation, endorsed by GHG initiatives (such as the Carbon Disclosure Project) and is compatible with existing GHG trading schemes. The GHG Protocol Corporate Accounting and Reporting Standard classifies corporate GHG emissions into three 'scopes'. Scope 1 emissions are direct GHG emissions from operations that are owned or controlled by the reporting company. Scope 2 emissions are indirect emissions from the generation of purchased energy consumed by a company. Scope 3 emissions are all other indirect emissions (not included in scope 2) that occur in the value chain of the reporting company.

The Scope 3 Standard allows companies to assess their entire value chain emissions impact and identify where to focus reduction activities. It divides scope 3 emissions into upstream and downstream emissions, based on the financial transactions of the reporting company:

- Upstream emissions are indirect GHG emissions related to purchased or acquired goods and services;
- Downstream emissions are indirect GHG emissions related to sold goods and services.

Scope 3 emissions are defined as those emissions that are a consequence of the activities of an entity, but which arise from sources not owned or controlled by that entity. Some examples of scope 3 activities provided in the GHG Protocol are extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services.

In the case of Dartbrook Mine, scope 3 emissions are indirect emissions outside of AQC's operational control. As part of this assessment these include:

- Indirect emissions from the consumption of purchased electricity at Dartbrook Mine
- Indirect emissions from the extraction, processing and transport of diesel used at Dartbrook Mine
- Indirect emissions from the transportation and combustion of product coal.

The Scope 3 emission factors applied to the assessment are summarised in Table 11-7.

**Table 11-7 Summary of Scope 3 greenhouse gas emission factors**

| Emission Source | Emission factor | | Source |
|---|---|---|---|
| Diesel - on-site transport activities | 3.6 | kg $CO_2$-e/GJ | Table 40 (DCCE, 2018) |
| | 38.6 | GJ/kL | Table 3 (DCCE, 2018) |
| | 138.96 | kg $CO_2$-e/kL | Calculated |
| Electricity | 0.10 | kg $CO_2$-e/kWh | Table 41 (DCCE, 2018) |
| Rail transport | 12.3 | g $CO_2$-e/tonne.km | QR Network Access (2002) |
| Fuel oil (ship transport) | 0.00354 | kg $CO_2$-e/tonne.km | UK Government (2018)[(a)] |
| Burning coal | 2.97 | kg $CO_2$-e/tonne (Japan) | IEA,WEO, 2018 |
| | 4.90 | kg $CO_2$-e/tonne (Republic of Korea) | Enerdata (2018)[(b)] |

Notes:
(a) Average of bulk carrier conversion factors
(b) Calculated from Republic of Korea coal and lignite consumption/$CO_2$ emissions

Using the same assumptions around annual diesel usage and electricity consumption as presented in Sections 11.3.1 and 11.3.2, and the same assumptions around transportation methods and destinations of coal in the recent Scope 3 emissions report (ERM, 2019), the scope 3 emissions are summarised in Table 11-8.

**Table 11-8 Scope 3 GHG emissions summary**

| Year | ROM (Mt/y) | Upstream diesel usage (t $CO_2$-e) | Upstream electricity usage (t $CO_2$-e) | Transport by rail (t $CO_2$-e) | Transport by ship (t $CO_2$-e) | Burning of coal (t $CO_2$-e) | Total (t $CO_2$-e) |
|---|---|---|---|---|---|---|---|
| 2021 | 1.4 | 184 | 4,340 | 4,477 | 94,548 | 5,509,000 | 5,612,549 |
| 2022 | 6 | 251 | 9,390 | 14,391 | 303,904 | 17,707,500 | 18,035,436 |
| 2023 | 6 | 251 | 9,390 | 14,391 | 303,904 | 17,707,500 | 18,035,436 |
| 2024 | 6 | 251 | 9,390 | 14,391 | 303,904 | 17,707,500 | 18,035,436 |
| 2025 | 6 | 251 | 9,390 | 14,391 | 303,904 | 17,707,500 | 18,035,436 |
| 2026 | 6 | 251 | 9,390 | 14,391 | 303,904 | 17,707,500 | 18,035,436 |
| 2027 | 6 | 251 | 9,390 | 14,391 | 303,904 | 17,707,500 | 18,035,436 |
| **Total** | **37.4** | **1,687** | **60,680** | **90,823** | **1,917,971** | **111,754,000** | **113,825,161** |

## 11.4 Summary of GHG emissions

A summary of the annual GHG emissions is provided in Table 11-9.

**Table 11-9 Summary of estimated $CO_2$-e (tonnes) – all scopes**

| Scope 1 Emissions (t $CO_2$-e) | | | | Scope 2 Emissions (t $CO_2$-e) | Scope 3 Emissions (t $CO_2$-e) |
|---|---|---|---|---|---|
| Year | Diesel | Fugitive methane | Total | Electricity | Energy Production |
| 2021 | 3,579 | 120,743 | 124,322 | 36,022 | 5,612,549 |
| 2022 | 4,866 | 131,173 | 136,039 | 77,937 | 18,035,436 |
| 2023 | 4,866 | 141,603 | 146,469 | 77,937 | 18,035,436 |
| 2024 | 4,866 | 152,033 | 156,899 | 77,937 | 18,035,436 |
| 2025 | 4,866 | 162,463 | 167,329 | 77,937 | 18,035,436 |
| 2026 | 4,866 | 172,893 | 177,759 | 77,937 | 18,035,436 |
| 2027 | 4,866 | 183,323 | 188,189 | 77,937 | 18,035,436 |
| **Total** | **32,775** | **1,064,231** | **1,097,006** | **503,644** | **113,825,161** |
| | | **Annual average** | **156,715** | **71,949** | **16,260,738** |

Note: Total values may not always equate to the sum of the numbers shown due to rounding

# 12. CONCLUSIONS

ERM has prepared an air quality and greenhouse gas assessment for the proposed Dartbrook Mine Modification 7.

The air quality assessment uses the computer-based dispersion model, CALPUFF, to predict ground-level dust concentrations for the Modification scenario. An emissions inventory was developed and modelled, and predictions of particulate matter were compared against regulatory air quality criteria. Predictions were made across a model domain and at sensitive receptors identified by Hansen Bailey.

The assessment is based on a conventional approach following the procedures outlined in the NSW Environment Protection Authority's (EPA) document titled "*Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW*" (NSW EPA, 2016), hereafter referred to as the 'Approved Methods'.

For annual average TSP concentrations there are no predicted exceedances of the NSW EPA or VLAMP impact assessment criteria of 90 µg/m$^3$ either due to the Modification alone, or cumulatively. For annual average $PM_{10}$ concentrations there are no predicted exceedances of the NSW impact assessment criterion of 25 µg/m$^3$ or the VLAMP criteria of 30 µg/m$^3$, either due to the Modification, or cumulatively. For annual average $PM_{2.5}$ concentrations there are no exceedances of the NSW EPA impact assessment criterion of 8 µg/m$^3$, either due to the Modification, or cumulatively.

For annual average dust deposition there are no exceedances of the NSW EPA impact assessment criteria/VLAMP criteria of 2 g/m$^2$/month due to the Modification alone. When including background concentrations and the predicted contribution from Mount Pleasant, there are no exceedances of the NSW EPA impact assessment criterion/VLAMP criteria of 4 g/m$^2$/month.

No sensitive receptors are predicted to experience 24-hour average $PM_{10}$ concentrations above the VLAMP criteria of 50 µg/m$^3$ due to the Modification alone. When including background concentrations, all sensitive receptors are predicted to experience 24-hour average $PM_{10}$ concentrations above the EPA impact assessment criterion of 50 µg/m$^3$ as there are already two days when the background concentration alone exceeds the criterion. The exceedances on these two days would occur regardless of Dartbrook Mine. When considering additional exceedances, seven receptors are predicted to experience one additional day exceeding the cumulative criterion. It is noted that the additional exceedances at all seven receptors occur on the same day (10 February) when the background concentration was 48.7 µg/m$^3$ and there was a large bush fire in the area. The contribution from the Modification at these seven receptors on 10 February is a maximum of 1% of the total concentration. If this day is disregarded due to the presence of the fire, there would be no predicted exceedances.

There are no sensitive receptors predicted to experience 24-hour average $PM_{2.5}$ concentrations above the NSW EPA impact assessment criterion of 25 µg/m$^3$ due to the Modification alone or cumulatively.

GHG emissions have been estimated over the life of the Modification. All calculations have been made based on the relevant guidance documents using the relevant equations and emissions factors given within the NGER Measurement Determination. Data provided by Dartbrook has been used as input into these equations.

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# Appendix A MODEL SET-UP

**Table A-1: CALMET model options**

| Flag | Value Used |
|---|---|
| IEXTRP | -4 |
| BIAS (NZ) | -1, 0, 0, 0, 0, 0, 0, 0 |
| TERRAD | 7 |
| RMAX1 and RMAX2 | 5 |
| R1 and R2 | 3.5 |

**Table A-2: CALPUFF model options**

| Flag | Flag Descriptor | Value Used | Value Description |
|---|---|---|---|
| MCHEM | Chemical transformation | 0 | Chemical transformation not modelled |
| MDRY | Dry deposition | 1 | Yes |
| MTRANS | Transitional plume rise allowed? | 1 | Yes |
| MTIP | Stack tip downwash | 1 | Yes |
| MRISE | Method to compute plume rise | 1 | Briggs plume rise |
| MSHEAR | Vertical wind shear | 0 | Vertical wind shear not modelled |
| MPARTL | Partial plume penetration of elevated inversion | 1 | Yes |
| MSPLIT | Puff splitting | 0 | No puff splitting |
| MSLUG | Near field modelled as slugs | 0 | Not used |
| MDISP | Dispersion coefficients | 2 | Based on micrometeorology |
| MPDF | Probability density function used for dispersion under convective conditions | 1 | Yes |
| MROUGH | PG sigma y, z adjusted for z | 0 | No |
| MCTADJ | Terrain adjustment method | 3 | Partial Plume Adjustment |
| MBDW | Method for building downwash | 1 | ISC Method |

# Appendix B EMISSIONS ESTIMATION

## Table B-1: Dartbrook Underground emissions inventory for TSP

| ACTIVITY | TSP emissions (kg/y) | Intensity | Units | Emission Factor | Units | Variable 1 | Units | Variable 2 | Units | Variable 3 | Units | Variable 4 | Units | Variable 5 | Units | Variable 6 | Units | CONTROLS ASSUMED | Source Type | Emission Factor Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CHPP operations** | | | | | | | | | | | | | | | | | | | | |
| Unloading of coal at ROM Hopper | 484 | 6,000,000 | t/y | 0.00054 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 6 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Crushing of coal | 1,080 | 6,000,000 | t/y | 0.00060 | kg/t | | | | | | | | | | | 70 | % control | Enclosed & emission factor assumes wet suppression | 1 | AP-42 Table 11.19.2-1 |
| Screening of coal | 1,980 | 6,000,000 | t/y | 0.00110 | kg/t | | | | | | | | | | | 70 | % control | Enclosed & emission factor assumes wet suppression | 1 | AP-42 Table 11.9-2 |
| Loading crushed coal to conveyor at ROM Hopper | 484 | 6,000,000 | t/y | 0.00054 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 6 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Unloading of coal at ROM Stockpile | 1,613 | 6,000,000 | t/y | 0.00054 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 6 | moisture content in % | | | | | | | 50 | % control | Water sprays | 2 | AP-42 c13s2.4.3 |
| Unloading of coal at Washery | 484 | 6,000,000 | t/y | 0.00054 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 6 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Loading of product coal onto conveyor from Washery | 178 | 4,500,000 | t/y | 0.00026 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 10 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Unloading of coal at Product Stockpile | 178 | 4,500,000 | t/y | 0.00026 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 10 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Loading of rejects onto conveyor from Washery | 41 | 1,500,000 | t/y | 0.00018 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 13 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Unloading of rejects at Reject Stockpile | 137 | 1,500,000 | t/y | 0.00018 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 13 | moisture content in % | | | | | | | 50 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Reclaiming product coal to train conveyor | 592 | 4,500,000 | t/y | 0.00026 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 10 | moisture content in % | | | | | | | 50 | % control | Water application | 1 | AP-42 Table 11.9-2 |
| Loading of product coal to trains | 1,183 | 4,500,000 | t/y | 0.00026 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 10 | moisture content in % | | | | | | | 0 | % control | No control | 2 | AP-42 Table 11.9-2 |
| Loading of rejects to trucks at Rejects Stockpile | 273 | 1,500,000 | t/y | 0.00018 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 13 | moisture content in % | | | | | | | 0 | % control | No control | 2 | AP-42 c13s2.4.3 |
| Hauling of rejects from Reject Stockpile to REA (sealed roads) | 24,413 | 1,500,000 | t/y | 0.0163 | kg/t | 40 | t/load | 45 | Vehicle mean mass (t) | 2.0 | km/return trip | 0.33 | kg/VKT | 2.0 | g/m2 silt loading | 0 | %control | No control | 1 | AP-42 c13s2.2.2 |
| Unloading of rejects at REA | 273 | 1,500,000 | t/y | 0.00018 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 13 | moisture content in % | | | | | | | 0 | % control | No control | 2 | AP-42 c13s2.4.3 |
| Dozers at REA | 33,659 | 5,520 | h/y | 6.1 | kg/h | 3.7 | silt content in % | 13 | moisture content in % | | | | | | | 0 | % control | No control | 1 | AP-42 Table 11.9-2 |
| **Wind erosion** | | | | | | | | | | | | | | | | | | | | |
| ROM Stockpile | 468 | 1.1 | ha | 850 | kg/ha/y | | | | | | | | | | | 50 | % control | Water sprays | 3 | AP-42 Table 11.9-2 |
| Reject Stockpile | 468 | 1.1 | ha | 850 | kg/ha/y | | | | | | | | | | | 50 | % control | Water sprays | 3 | AP-42 Table 11.9-2 |
| Product Stockpile | 2,678 | 6.3 | ha | 850 | kg/ha/y | | | | | | | | | | | 50 | % control | Water sprays | 3 | AP-42 Table 11.9-2 |
| Reject Emplacement Area | 1,785 | 3.0 | ha | 850 | kg/ha/y | | | | | | | | | | | 30 | % control | Fencing | 3 | AP-42 Table 11.9-2 |
| **Total TSP emissions (kg/yr)** | **72,448** | | | | | | | | | | | | | | | | | | | |

## Table B-2: Dartbrook Underground emissions inventory for $PM_{10}$

| ACTIVITY | PM10 emissions (kg/y) | Intensity | Units | Emission Factor | Units | Variable 1 | Units | Variable 2 | Units | Variable 3 | Units | Variable 4 | Units | Variable 5 | Units | Variable 6 | Units | CONTROLS ASSUMED | Source Type | Emission Factor Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CHPP operations** | | | | | | | | | | | | | | | | | | | | |
| Unloading of coal at ROM Hopper | 229 | 6,000,000 | t/y | 0.00025 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 6 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Crushing of coal | 486 | 6,000,000 | t/y | 0.00027 | kg/t | | | | | | | | | | | 70 | % control | Enclosed & emission factor assumes wet suppression | 1 | AP-42 Table 11.19.2-1 |
| Screening of coal | 666 | 6,000,000 | t/y | 0.00037 | kg/t | | | | | | | | | | | 70 | % control | Enclosed & emission factor assumes wet suppression | 1 | AP-42 Table 11.9-2 |
| Loading crushed coal to conveyor at ROM Hopper | 229 | 6,000,000 | t/y | 0.00025 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 6 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Unloading of coal at ROM Stockpile | 763 | 6,000,000 | t/y | 0.00025 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 6 | moisture content in % | | | | | | | 50 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Unloading of coal at Washery | 229 | 6,000,000 | t/y | 0.00025 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 6 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Loading of product coal onto conveyor from Washery | 84 | 4,500,000 | t/y | 0.00012 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 10 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Unloading of coal at Product Stockpile | 84 | 4,500,000 | t/y | 0.00012 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 10 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Loading of rejects onto conveyor from Washery | 19 | 1,500,000 | t/y | 0.00009 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 13 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Unloading of rejects at Reject Stockpile | 65 | 1,500,000 | t/y | 0.00009 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 13 | moisture content in % | | | | | | | 50 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Reclaiming product coal to train conveyor | 280 | 4,500,000 | t/y | 0.00012 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 10 | moisture content in % | | | | | | | 50 | % control | Water application | 1 | AP-42 Table 11.9-2 |
| Loading of product coal to trains | 560 | 4,500,000 | t/y | 0.00012 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 10 | moisture content in % | | | | | | | 0 | % control | No control | 2 | AP-42 Table 11.9-2 |
| Loading of rejects to trucks at Rejects Stockpile | 129 | 1,500,000 | t/y | 0.00009 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 13 | moisture content in % | | | | | | | 0 | % control | No control | 2 | AP-42 c13s2.4.3 |
| Hauling of rejects from Reject Stockpile to REA (sealed roads) | 4,686 | 1,500,000 | t/y | 0.0031 | kg/t | 40 | t/load | 45 | Vehicle mean mass (t) | 2.0 | km/return trip | 0.1 | kg/VKT | 2.0 | g/m2 silt loading | 0 | %control | No control | 1 | AP-42 c13s2.2.2 |
| Unloading of rejects at REA | 129 | 1,500,000 | t/y | 0.00009 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 13 | moisture content in % | | | | | | | 0 | % control | No control | 2 | AP-42 c13s2.4.3 |
| Dozers at REA | 6,857 | 5,520 | h/y | 1.2 | kg/h | 3.7 | silt content in % | 13 | moisture content in % | | | | | | | 0 | % control | No control | 1 | AP-42 Table 11.9-2 |
| **Wind erosion** | | | | | | | | | | | | | | | | | | | | |
| ROM Stockpile | 234 | 1.1 | ha | 425 | kg/ha/y | | | | | | | | | | | 50 | % control | Water sprays | 3 | AP-42 Table 11.9-2 |
| Reject Stockpile | 234 | 1.1 | ha | 425 | kg/ha/y | | | | | | | | | | | 50 | % control | Water sprays | 3 | AP-42 Table 11.9-2 |
| Product Stockpile | 1,339 | 6.3 | ha | 425 | kg/ha/y | | | | | | | | | | | 50 | % control | Water sprays | 3 | AP-42 Table 11.9-2 |
| Reject Emplacement Area | 893 | 3.0 | ha | 425 | kg/ha/y | | | | | | | | | | | 30 | % control | Fencing | 3 | AP-42 Table 11.9-2 |
| **Total PM10 emissions (kg/yr)** | **18,193** | | | | | | | | | | | | | | | | | | | |

## Table B-3: Dartbrook Underground emissions inventory for $PM_{2.5}$

| ACTIVITY | PM2.5 emissions (kg/y) | Intensity | Units | Emission Factor | Units | Variable 1 | Units | Variable 2 | Units | Variable 3 | Units | Variable 4 | Units | Variable 5 | Units | Variable 6 | Units | CONTROLS ASSUMED | Source Type | Emission Factor Sour |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CHPP operations** | | | | | | | | | | | | | | | | | | | | |
| Unloading of coal at ROM Hopper | 35 | 6,000,000 | t/y | 0.00004 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 6 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Crushing of coal | 90 | 6,000,000 | t/y | 0.00005 | kg/t | | | | | | | | | | | 70 | % control | Enclosed & emission factor assumes wet suppression | 1 | AP-42 Table 11.19.2-1 |
| Screening of coal | 45 | 6,000,000 | t/y | 0.00003 | kg/t | | | | | | | | | | | 70 | % control | Enclosed & emission factor assumes wet suppression | 1 | AP-42 Table 11.9-2 |
| Loading crushed coal to conveyor at ROM Hopper | 35 | 6,000,000 | t/y | 0.00004 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 6 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Unloading of coal at ROM Stockpile | 116 | 6,000,000 | t/y | 0.00004 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 6 | moisture content in % | | | | | | | 50 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Unloading of coal at Washery | 35 | 6,000,000 | t/y | 0.00004 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 6 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Loading of product coal onto conveyor from Washery | 13 | 4,500,000 | t/y | 0.00002 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 10 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Unloading of coal at Product Stockpile | 13 | 4,500,000 | t/y | 0.00002 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 10 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Loading of rejects onto conveyor from Washery | 3 | 1,500,000 | t/y | 0.00001 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 13 | moisture content in % | | | | | | | 85 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Unloading of rejects at Reject Stockpile | 10 | 1,500,000 | t/y | 0.00001 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 13 | moisture content in % | | | | | | | 50 | % control | Enclosed & water sprays | 2 | AP-42 c13s2.4.3 |
| Reclaiming product coal to train conveyor | 42 | 4,500,000 | t/y | 0.00002 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 10 | moisture content in % | | | | | | | 50 | % control | Water application | 1 | AP-42 Table 11.9-2 |
| Loading of product coal to trains | 85 | 4,500,000 | t/y | 0.00002 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 10 | moisture content in % | | | | | | | 0 | % control | No control | 2 | AP-42 Table 11.9-2 |
| Loading of rejects to trucks at Rejects Stockpile | 20 | 1,500,000 | t/y | 0.00001 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 13 | moisture content in % | | | | | | | 0 | % control | No control | 2 | AP-42 c13s2.4.3 |
| Hauling of rejects from Reject Stockpile to REA | 1,134 | 1,500,000 | t/y | 0.00076 | kg/t | 40 | t/load | 45 | Vehicle mean mass (t) | 2.0 | km/return trip | 0.015 | kg/VKT | 2.0 | g/m2 silt loading | 0 | %control | No control | 1 | AP-42 c13s2.2.2 |
| Unloading of rejects at REA | 20 | 1,500,000 | t/y | 0.00001 | kg/t | 2.114 | average of (wind speed/2.2)^1.3 in m/s | 13 | moisture content in % | | | | | | | 0 | % control | No control | 2 | AP-42 c13s2.4.3 |
| Dozers at REA | 741 | 5,520 | h/y | 0.1 | kg/h | 3.7 | silt content in % | 13 | moisture content in % | | | | | | | 0 | % control | No control | 1 | AP-42 Table 11.9-2 |
| **Wind erosion** | | | | | | | | | | | | | | | | | | | | |
| ROM Stockpile | 35 | 1.1 | ha | 63.75 | kg/ha/y | | | | | | | | | | | 50 | % control | Water sprays | 3 | AP-42 Table 11.9-2 |
| Reject Stockpile | 35 | 1.1 | ha | 63.75 | kg/ha/y | | | | | | | | | | | 50 | % control | Water sprays | 3 | AP-42 Table 11.9-2 |
| Product Stockpile | 201 | 6.3 | ha | 63.75 | kg/ha/y | | | | | | | | | | | 50 | % control | Water sprays | 3 | AP-42 Table 11.9-2 |
| Reject Emplacement Area | 134 | 3.0 | ha | 63.75 | kg/ha/y | | | | | | | | | | | 30 | % control | Fencing | 3 | AP-42 Table 11.9-2 |
| **Total PM2.5 emissions (kg/yr)** | **2,838** | | | | | | | | | | | | | | | | | | | |

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# *APPENDIX B*
# *Acoustic Assessment*

BRIDGES ACOUSTICS
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20 July 2020
Ref: J0073-05-L1

Sparke Helmore Lawyers
Level 7, 28 Honeysuckle Drive
NEWCASTLE NSW 2300

**Attn: Mr Alan McKelvey**

Dear Alan,

**RE: DARTBROOK MODIFICATION 7 – ACOUSTIC ASSESSMENT**

**PRIVILEGED AND CONFIDENTIAL**

1. This report presents predicted noise levels from the proposed recommencement of mining at Dartbrook Mine, including production of up to 6 million tonnes per annum (Mtpa) of Run Of Mine (ROM) coal if longwall mining recommences as currently approved. The assessment has been commissioned by Sparke Helmore Lawyers for consideration by the Land & Environment Court as part of a Class 1 merits appeal to a previous IPC determination of a Modification Application in which a proposed 5 year extension of mining operations was not approved.

2. I have read Schedule 7 to the Uniform Civil Procedure Rules 2005, the expert witness code of conduct, and agree to be bound by the Code. My CV is appended to this report.

## 1. PURPOSE OF THIS REPORT

3. A previous Modification Application (for Modification 7) considered by the IPC sought approval for bord and pillar mining as an alternative to the currently approval longwall method, trucking of ROM coal as an alternative to the approved coal clearance system and a 5 year extension of the current approval period. The alternative mining method and coal clearance system was approved by the IPC in August 2019. The proposed 5 year extension was not approved as the IPC determined that noise (and other potential environmental impacts) associated with recommencement of longwall mining and production of up to 6 Mtpa of ROM coal were not assessed in the Modification Application.

4. Noise levels from proposed bord and pillar mining producing up to 1.5 Mtpa of ROM coal were assessed and were considered acceptable by the IPC. The previous noise assessment omitted noise from some CHPP equipment including the preparation plant (washery) and reject handling infrastructure as the project at that time did not include washing the coal. The project as currently proposed includes washing coal for both the bord and pillar and longwall options.

5. This report therefore considers noise levels from full operation of the Dartbrook CHPP as it operated up to the year 2006, before the extended period of care and maintenance.

# 2. RECEIVERS AND NOISE CRITERIA

## 2.1 Development Consent Noise Criteria

6. Current noise criteria from Development Consent DA 231-07-2000 are assumed to apply to this assessment. The criteria are taken from Condition 6.4.1a Table 3 in the current Development Consent. Receiver locations are shown on the figures attached to this report and are separated into privately owned and mine owned residences.

| | |
|---|---|
| East site receivers | 50/50/41 LAeq,15min day/evening/night, 52 LA1,1min night; |
| West site receivers | 40/40/35 LAeq,15min day/evening/night, 52 LA1,1min night; and |
| Aberdeen receivers | 49/42/40 LAeq,15min day/evening/night, 52 LA1,1min night. |

## 2.2 Cumulative Noise Criteria

7. Cumulative noise levels, from Dartbrook Mine combined with other sources of industrial noise in the area such as other nearby mining developments, are compared to the recommended amenity noise levels in the Noise Policy for Industry (NPI) (EPA, 2017). Table 2.2 in the NPI recommends, for rural residences, amenity noise levels of:

| | |
|---|---|
| Day | 50 LAeq,11hr from 7 am to 6 pm, or from 8 am Sundays and public holidays; |
| Evening | 45 LAeq,4hr from 6 pm to 10 pm; and |
| Night | 40 LAeq,9hr from 10 pm to 7 am, or to 8 am Sundays and public holidays. |

8. Alternative amenity criteria apply to suburban and urban residences considering the typically higher levels of traffic and other noise in these environments. Table 2.3 of the NPI indicates receivers located on land zoned R1 and B4 are typically urban receivers. Urban receivers are also characterised by exposure to noise from heavy and continuous through-traffic during peak periods. The residences in southern Aberdeen are generally located on land zoned R1 and B4 and are exposed to continuous noise from the New England Highway during peak periods. Accordingly, the urban amenity criteria are appropriate for the receivers in southern Aberdeen. Table 2.2 prescribes the following amenity criteria for urban residences:

| | |
|---|---|
| Day | 60 LAeq,11hr from 7 am to 6 pm, or from 8 am Sundays and public holidays; |
| Evening | 50 LAeq,4hr from 6 pm to 10 pm; and |
| Night | 45 LAeq,9hr from 10 pm to 7 am, or to 8 am Sundays and public holidays. |

9. The development consent noise criteria are similar to the cumulative noise criteria for the day and night periods and above the cumulative noise criteria for the evening period for East Site receivers. In these cases, alternative cumulative noise criteria set 3 dBA above the development consent criteria are adopted, provided the resulting criteria do not exceed the urban amenity limits recommended in the NPI. Adopted cumulative noise criteria are therefore:

| | |
|---|---|
| East Site receivers | 53 LAeq,11hr day, 50 LAeq,4hr evening and 44 LAeq,9 hr night; |
| West Site receivers | 50 LAeq,11hr day, 45 LAeq,4hr evening and 40 LAeq,9 hr night; and |
| Aberdeen receivers | 52 LAeq,11hr day, 45 LAeq,4hr evening and 43 LAeq,9 hr night. |

## 3. NOISE MODEL DATA AND ASSUMPTIONS

10. Noise level calculations were completed using RTA Technology's Environmental Noise Model (ENM) software, originally developed in conjunction with the NSW Environment Protection Authority (EPA) and used for projects of this nature for over 20 years. ENM is particularly suitable where a number of noise sources require assessment and the effects of various weather conditions on noise propagation are important. Input data to ENM include:

- Terrain data, which were reused from previous Dartbrook Mine assessments completed for the proponent as contours in 2 m vertical intervals;
- Noise source locations including source elevation, which are consistent with previous assessments and intended to include all potentially significant noise sources associated with the CHPP including mobile plant required to transport and place reject material;
- Source noise levels, which were based on on-site noise measurement data taken by Bridges Acoustics in December 2004 and March 2005 when the CHPP was operating. The data include 1/3 octave percentile noise levels at each of 61 separate locations around significant components of the CHPP. Notes for each noise measurement indicating distances from each significantly audible source allowed 1/3 octave source sound power levels to be determined with reasonable accuracy;
- Noise mitigation measures as described below; and
- Weather conditions for the day and the combined evening/night periods which were determined according to current EPA recommendations and are identical to the weather conditions considered in previous acoustic assessments.

11. Terrain over the CHPP site and noise source locations for the noise model are shown on the figures appended to this report. The actual source location is the small cross at the lower left corner of each source code.

12. Mobile equipment required to transport and place reject material within the REA have been modelled operating to the junction of the central and southern REA, relatively remote from receivers, and to the south western corner of the southern REA representing the closest point to receivers. Noise contours and reported noise levels represent the worst case from these two options, with the exception of the noise contours in Figure B4 which exclude mobile plant operating in the south western corner of the REA to manage noise levels to closest receivers during the most sensitive night period.

13. Noise mitigation measures include:

- Fibre cement or equivalent sheet walls adjacent to the western side of unenclosed stockyard conveyors, to a height just above the top idlers;
- A large noise barrier/wall on the northern side of the train loadout conveyor (CV17/CV05) from its western end to the CHPP access road, to a height of 2 m above the conveyor which requires a variable height of 5 m at the western end to 18 m at the eastern end. This wall would be clad with a sheet of sandwich panel, fibre cement or similar material;
- Upgraded cladding for the preparation plant building including minimal openings on the northern and western faces, using sandwich panel or fibre cement for additional noise reduction;
- Upgraded cladding for the elevated section of the train loadout conveyor (CV05) east of the noise barrier, using sandwich panels for the roof, fibre cement sheeting for the northern walls and steel sheets for the floor;
- Upgraded cladding for elevated conveyors CV07, CV08, CV10 and CV14 generally as described for CV05;
- Cladding for CV12 including 0.6 mm corrugated steel sheeting or similar for the roof and northern side and steel sheet floor;

- Low noise conveyor idlers for all conveyors except those within the preparation plant building;
- An enclosure on the rear of the raw coal reclaimer consisting of reused conveyor belt or similar material;
- Replacement bucket chains and sprockets for the two product coal reclaimers to minimise noise from these components.

14. Noise mitigation measures have been developed to the concept stage and may require refinement to avoid unnecessary work and materials. The refined design would be intended to meet relevant noise criteria at all noise sensitive receptors.

### 3.1 Source Sound Power Levels

15. Modelled source sound power levels, converted to octave bands for ease of presentation, are presented in Table 1. Sound power spectra are presented as dBL levels, which are unweighted sound power levels used directly by the noise model without the usual A-weighting frequency correction applied. Total sound power levels are presented as both dBL and dBA.

16. Some sources, particularly long conveyors, were modelled as a series of points along the conveyor rather than as one source in the centre of the conveyor's length. Both CV03 and CV04 were divided into four sections, with each section assigned the reduced sound power level shown in Table 1. Other divided conveyors were modelled in two sections, with each section assigned the lower sound power level indicated in Table 1. In most cases, shorter conveyors were divided into two sections to account for the widely varying height of the conveyor above the ground along its length. In these cases the two modelled source heights, representing the height of the midpoint of each half of the conveyor, are both shown in Table 1.

17. Conveyor CV05 is divided into two separate sections as the eastern section would be enclosed and the western section would not. The two sections are therefore assigned different sound power levels.

18. Noise from proposed reject truck movements is evenly distributed along the haul routes to the REA, while the loader is modelled at the reject stockpile and the dozer is modelled at representative locations within the REA. The loader is assumed to operate for approximately 25% of the time to load up to 7 trucks per hour, representing a production rate of up to 6 Mtpa.

**Table 1: Modelled Sound Power Levels and Source Heights Above Ground.**

| Code, Description | Height, m | Sound Power dBL in Octave Band, Hz | | | | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 31.5 | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | dBL | dBA |
| H1, HT01 | 4 | 107 | 99 | 101 | 98 | 96 | 93 | 90 | 84 | 78 | 110 | 98 |
| H1d, HT01 drive | 1 | 112 | 101 | 92 | 80 | 72 | 64 | 58 | 46 | 34 | 113 | 81 |
| CR, Primary crusher | 6 | 122 | 106 | 100 | 84 | 75 | 69 | 62 | 51 | 40 | 122 | 88 |
| C2, CV02 | 6 | 104 | 96 | 98 | 95 | 93 | 90 | 87 | 81 | 75 | 107 | 95 |
| C7, CV07 | 10 | 104 | 96 | 98 | 95 | 93 | 90 | 87 | 81 | 75 | 107 | 95 |
| RS, Raw stacker | 12 | 107 | 100 | 102 | 98 | 98 | 94 | 92 | 85 | 78 | 110 | 100 |
| RR, Raw reclaimer | 3 | 96 | 91 | 93 | 85 | 79 | 72 | 66 | 52 | 42 | 99 | 82 |
| C8, CV08 | 3 | 104 | 96 | 98 | 95 | 93 | 90 | 87 | 81 | 75 | 107 | 95 |
| C9, CV09 | 3 - 6 | 95 | 97 | 99 | 94 | 90 | 84 | 81 | 75 | 65 | 103 | 92 |
| C10, CV10 | 6 - 15 | 96 | 96 | 99 | 94 | 90 | 86 | 83 | 77 | 71 | 103 | 93 |
| CP, Prep plant | 20 | 130 | 115 | 106 | 96 | 87 | 80 | 73 | 64 | 54 | 130 | 94 |
| C12, CV12 | 8 | 93 | 93 | 96 | 91 | 87 | 83 | 80 | 74 | 68 | 100 | 90 |
| C14, CV14 | 3 - 8 | 93 | 89 | 86 | 76 | 66 | 58 | 53 | 44 | 34 | 95 | 73 |
| C15, CV15 | 6 | 96 | 96 | 99 | 94 | 90 | 86 | 83 | 77 | 71 | 103 | 93 |

| Code, Description | Height, m | Sound Power dBL in Octave Band, Hz | | | | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 31.5 | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | dBL | dBA |
| C3, CV03 | 1 | 103 | 97 | 98 | 93 | 95 | 89 | 87 | 79 | 67 | 106 | 96 |
| PS, Product stacker | 10 | 94 | 91 | 94 | 90 | 91 | 94 | 92 | 83 | 73 | 101 | 97 |
| PR, Prod reclaimer | 3 | 108 | 102 | 92 | 87 | 78 | 70 | 63 | 53 | 41 | 109 | 82 |
| C4, CV04 | 1 | 103 | 97 | 98 | 93 | 95 | 89 | 87 | 79 | 67 | 106 | 96 |
| C5W, CV05 west | 6 | 108 | 107 | 108 | 104 | 98 | 93 | 90 | 84 | 75 | 113 | 101 |
| C5E, CV05 east | 16 | 102 | 97 | 90 | 80 | 65 | 56 | 50 | 40 | 28 | 103 | 77 |
| LD, Train loadout | 3 | 104 | 99 | 96 | 95 | 95 | 95 | 97 | 96 | 87 | 107 | 102 |
| Lo, Locomotive | 3 | 108 | 104 | 106 | 100 | 100 | 98 | 92 | 90 | 75 | 112 | 102 |
| L, Loader (25%) | 2.5 | 114 | 122 | 107 | 99 | 98 | 94 | 92 | 84 | 75 | 123 | 101 |
| T, Truck 40t | 2.5 | 111 | 115 | 111 | 110 | 107 | 102 | 96 | 91 | 82 | 119 | 108 |
| Z, Dozer D8 | 2 | 101 | 110 | 114 | 107 | 110 | 103 | 98 | 92 | 82 | 117 | 109 |

### 3.2 Modelled Weather Conditions

19. Weather conditions included in the noise model are summarised in Table 2 and are consistent with the previous Modification Application considered by the IPC. The weather parameters were determined according to current EPA policy, based on weather data from the proponent's weather station located approximately 180 m north of the East Site access road. The evening and night time periods have been combined as the weather analysis showed very similar parameters would apply to both periods.

**Table 2: Summary of Modelled Weather Parameters, Dartbrook CHPP.**

| Atmospheric Parameter | Day Calm | Day Prevailing | | | Evening/Night Prevailing | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Temperature °C | 20 | | | | 10 | | | | |
| Relative Humidity % | 70 | | | | 90 | | | | |
| Wind Speed m/s | 0 | 3 | | | 0 | 3 | | | 2 |
| Wind Direction | - | SSW | W | SE | - | SSW | ENE | SE | N |
| Temp Gradient °C/100m | -2 | | | | 3 | 0 | | | 3 |
| Equivalent Inversion[1] | -2 | 5.5 | 5.5 | 5.5 | 3 | 7.5 | 7.5 | 7.5 | 8 |

1 The equivalent inversion is based on a 1 m/s wind towards a receiver providing the same noise enhancement as a 2.5 °C/100m inversion, as calculated by the noise model for the 'rural' terrain category and 'rough pasture' surface category which apply to this region.

# 4. CALCULATED NOISE LEVELS

## 4.1 Longwall Mining Up to 6 Mtpa of ROM Coal

20. Calculated noise levels for full CHPP operation are presented in the noise contour figures attached to this report and in Table 3 to representative privately owned and mine owned residences. Residences outside the 30 dBA contour in all time periods have been omitted from the table. Calculated noise levels above the noise criteria at privately owned receivers are shaded green, while blue shading highlights receivers that are entitled to acquisition by Mt Pleasant Mine and any exceedances of relevant noise criteria at these receivers.

**Table 3: Calculated Noise Levels, Longwall Mining Up to 6 Mtpa of ROM Coal**

| Receiver ID | Calculated Noise Level, LAeq,15min | | | | |
|---|---|---|---|---|---|
| | Day Neutral | Day Wind | Evening/Night Wind/Inversion | Evening/Night (excluding SW REA) | Noise Criteria Day/Evening/Night |
| Privately Owned East Site Receivers | | | | | |
| 303 | 30 | 31 | 42 | 42 | 50/50/41 |
| 422 | 31 | 31 | 44 | 42 | 50/50/41 |
| 423 | 26 | 26 | 40 | 40 | 50/50/41 |
| 424 | 25 | 25 | 40 | 40 | 50/50/41 |
| 427 | 23 | 23 | 40 | 40 | 50/50/41 |
| 436 | 16 | 17 | 36 | 32 | 50/50/41 |
| 437 | 15 | 15 | 36 | 32 | 50/50/41 |
| 438 | 16 | 17 | 35 | 32 | 50/50/41 |
| 545 | 21 | 21 | 34 | 33 | 50/50/41 |
| 546 | 20 | 20 | 32 | 32 | 50/50/41 |
| Privately Owned West Site Receivers | | | | | |
| 62 | 19 | 28 | 31 | 30 | 40/40/35 |
| 63 | 19 | 28 | 31 | 30 | 40/40/35 |
| 64 | 19 | 29 | 31 | 31 | 40/40/35 |
| 65 | 18 | 29 | 32 | 32 | 40/40/35 |
| 72 | 20 | 28 | 30 | 30 | 40/40/35 |
| 74A | 21 | 28 | 31 | 31 | 40/40/35 |
| 74B | 21 | 28 | 31 | 31 | 40/40/35 |
| 75 | 22 | 29 | 32 | 32 | 40/40/35 |
| 77 | 19 | 29 | 31 | 31 | 40/40/35 |
| 80A | 23 | 30 | 33 | 33 | 40/40/35 |
| 80B | 24 | 31 | 34 | 33 | 40/40/35 |
| 81A | 23 | 30 | 33 | 32 | 40/40/35 |
| 81B | 22 | 30 | 33 | 32 | 40/40/35 |
| 181 | 23 | 28 | 32 | 31 | 40/40/35 |
| 212 | 24 | 28 | 33 | 32 | 40/40/35 |
| 228 | 24 | 28 | 34 | 32 | 40/40/35 |
| 238 | 24 | 29 | 34 | 33 | 40/40/35 |
| 242 | 24 | 29 | 35 | 33 | 40/40/35 |
| 244 | 25 | 30 | 35 | 34 | 40/40/35 |
| 391 | 27 | 28 | 37 | 36 | 40/40/35 |
| Privately Owned Aberdeen Receivers | | | | | |
| 87 | 25 | 35 | 37 | 37 | 49/42/40 |
| 88 | 24 | 34 | 37 | 37 | 49/42/40 |

| Receiver ID | Calculated Noise Level, LAeq,15min | | | | |
|---|---|---|---|---|---|
| | Day Neutral | Day Wind | Evening/Night Wind/Inversion | Evening/Night (excluding SW REA) | Noise Criteria Day/Evening/Night |
| 89 | 24 | 34 | 37 | 37 | 49/42/40 |
| 90 | 24 | 34 | 36 | 36 | 49/42/40 |
| 91 | 24 | 34 | 37 | 37 | 49/42/40 |
| 92 | 25 | 35 | 37 | 37 | 49/42/40 |
| 105 | 17 | 31 | 34 | 34 | 49/42/40 |
| Mine-Owned East Site Receivers | | | | | |
| 86N | 26 | 34 | 36 | 36 | N/A |
| 86S | 25 | 32 | 35 | 34 | N/A |
| 299A | 34 | 39 | 42 | 41 | N/A |
| 299B | 41 | 45 | 49 | 49 | N/A |
| 300 | 41 | 45 | 48 | 46 | N/A |
| 301 | 42 | 43 | 50 | 47 | N/A |
| 302 | 36 | 36 | 46 | 45 | N/A |
| 304 | 36 | 36 | 46 | 44 | N/A |
| Mine-Owned West Site Receivers | | | | | |
| 82 | 26 | 34 | 36 | 35 | N/A |
| 85 | 23 | 30 | 34 | 32 | N/A |
| 167 | 23 | 28 | 32 | 31 | N/A |
| 207 | 24 | 28 | 33 | 32 | N/A |
| 268 | 25 | 30 | 36 | 34 | N/A |
| 295A | 23 | 30 | 34 | 33 | N/A |
| 295B | 24 | 31 | 35 | 33 | N/A |
| 381 | 24 | 26 | 34 | 32 | N/A |
| 543A | 20 | 20 | 31 | 30 | N/A |
| 543B | 19 | 19 | 31 | 29 | N/A |
| Reference | Figure B1 | Figure B2 | Figure B3 | Figure B4 | - |

21. Calculated noise levels meet relevant criteria at all privately owned receivers that are not entitled to acquisition by Mt Pleasant Mine, except East Site receivers 303 and 422. Receivers 303 and 422 are predicted to receive a night noise level of 42 and 44 LAeq,15min, respectively, including noise from mobile reject handling plant operation at the south-western corner of the southern REA which is the closest point to these receivers. Calculated noise levels reduce to 42 LAeq,15min at both receivers if operation of reject handling plant is avoided in the south-western half of the southern REA during the most sensitive night period. Reject material could be placed in closer REA areas during the day, and in more remote areas of the REA during the evening and night to minimise noise to these receivers.

22. A calculated noise level of 42 LAeq,15min remaining at Receivers 303 and 422 is only 1 dBA above the criterion which, according to the Voluntary Land Acquisition and Mitigation Policy (VLAMP), is a negligible noise impact that is unlikely to be perceptible to residents and therefore does not warrant mitigation measures.

23. Noise levels from the West Site under the longwall mining option have not been reassessed in this report, however would remain substantially unchanged from previous mining operations. If anything, more modern equipment operating on the surface may produce less noise than the previous operation.

### 4.2 Bord and Pillar Mining Up to 1.4 Mtpa of ROM Coal

24. Noise levels from the proposed bord and pillar mining option would be identical to the levels calculated for the longwall mining option with the CHPP operating, however would occur for a smaller percentage of the time in an average week due to the lower production rate for this option. Noise from full CHPP operation would not occur continuously as the CHPP has a higher hourly capacity than the proposed bord and pillar mining system.

25. The reported noise levels for the longwall option, as shown in Table 3 and Appendix B, therefore also apply to the bord and pillar option for periods of time in which the CHPP is operating.

### 4.3 Sleep Disturbance

26. The LA1,1min noise criteria in consent condition 6.4.1a are intended to minimise the potential for sleep disturbance to residential receptors during the night period. A detailed assessment of sleep disturbance is not included in this report as normal operation of the CHPP, whether at 1.4 Mtpa for the bord and pillar option or at 6 Mtpa for the longwall mining option, does not include any sources of noise with the potential to cause sleep disturbance at any privately owned residence.

## 5. CUMULATIVE NOISE LEVELS

27. Residences near Dartbrook Mine may receive additional industrial noise from Mt Pleasant Mine. Other known industrial developments in the area that are considered unlikely to affect cumulative noise levels to assessed receptors include:

- Muswellbrook Colliery located approximately 5.6 km to the south east;
- Bengalla Mine located approximately 8.6 km to the south west; and
- Rossgole Quarry located approximately 10.8 km to the north west.

28. The cumulative noise level contribution from Dartbrook Mine has been calculated based on the noise contours in Figure B4 for the night period, assuming the longwall mining option up to 6 Mtpa and excluding south western REA activity at night.

29. Noise levels from Mt Pleasant Mine have been determined from the most recent acoustic assessment, described in *Mount Pleasant Operation, Mine Optimisation Modification, Noise and Blasting Assessment* (Wilkinson Murray, May 2017). Appendix C of the Mt Pleasant noise assessment contains tables of predicted noise levels at each receiver for years 2018, 2021 and 2025. The highest of the 2021 or 2025 noise levels, for the night period under noise enhancing weather conditions, has been adopted for each receiver.

30. Exceedances of the adopted cumulative noise criteria are predicted at four privately owned residences in Kayuga Village as highlighted in Table 4, with all of these residences primarily affected by noise from Mt Pleasant Mine rather than Dartbrook Mine. All of these residences are entitled to acquisition by Mt Pleasant Mine. As such, no further mitigation or acquisition rights are required to be imposed on Dartbrook Mine.

**Table 4: Cumulative Noise Levels, Longwall Mining Up to 6 Mtpa of ROM Coal, Night**

| Dartbrook Mine | | Mt Pleasant Mine | | Cumulative Level, LAeq | Cumulative Noise Criteria, Night |
|---|---|---|---|---|---|
| Receiver ID | Night LAeq,15min | Receiver ID | Night LAeq,15min | | |
| Privately Owned East Site Receivers | | | | | |
| 303 | 42 | 190 | 36 | 43 | 44 |
| 422 | 42 | 189 | 35 | 43 | 44 |
| 423 | 40 | 192 | 35 | 41 | 44 |

| Dartbrook Mine | | Mt Pleasant Mine | | Cumulative Level, LAeq | Cumulative Noise Criteria, Night |
|---|---|---|---|---|---|
| Receiver ID | Night LAeq,15min | Receiver ID | Night LAeq,15min | | |
| 424 | 40 | 191 | 35 | 41 | 44 |
| 427 | 40 | 193 | 35 | 41 | 44 |
| 436 | 32 | 194 | 34 | 36 | 44 |
| 437 | 32 | 195 | 36 | 37 | 44 |
| 438 | 32 | 547 | 35 | 37 | 44 |
| 545 | 33 | 140 | 36 | 38 | 44 |
| 546 | 32 | 139 | 36 | 37 | 44 |
| Privately Owned West Site Receivers | | | | | |
| 62 | 30 | 180 | 30 | 33 | 40 |
| 63 | 30 | 179 | 30 | 33 | 40 |
| 64 | 31 | 180b | 30 | 34 | 40 |
| 72 | 30 | 173 | 31 | 34 | 40 |
| 74A | 31 | 174 | 32 | 35 | 40 |
| 74B | 31 | 175 | 32 | 35 | 40 |
| 75 | 32 | 176 | 32 | 35 | 40 |
| 77 | 31 | 178 | 31 | 34 | 40 |
| 80A | 33 | 310 | 33 | 36 | 40 |
| 80B | 33 | 172 | 33 | 36 | 40 |
| 81A | 32 | 171 | 33 | 36 | 40 |
| 81B | 32 | 169 | 33 | 36 | 40 |
| 181 | 31 | 154 | 38 | 39 | 40 |
| 212 | 32 | 156 | 39 | 40 | 40 |
| 228 | 32 | 157 | 41 | 42 | 40 |
| 238 | 33 | 158 | 40 | 41 | 40 |
| 242 | 33 | 159 | 40 | 41 | 40 |
| 244 | 34 | 161 | 39 | 40 | 40 |
| 391 | 36 | 143 | 40 | 41 | 40 |

## 6. CONCLUSION

31. This assessment has determined predicted noise levels from approved longwall mining at the maximum annual production rate of 6 Mtpa of ROM coal from Dartbrook Mine. The calculated noise levels reflect full operation of the Dartbrook Mine CHPP including mobile plant to transport and place reject material within the Browns Mountain REA. Noise mitigation measures applied to CHPP equipment as described in Section 3 have been included in the assessment.

32. Calculated noise levels at closest receivers are predicted to meet the existing Development Consent Condition 6.4.1a noise criteria at all except for two privately owned receivers. Receivers 303 and 422, located west of the New England Highway south of Dartbrook Mine's East Site, are predicted to receive a noise level 1 dBA over the noise criteria during the night period under noise enhancing weather conditions. As the VLAMP regards a 1 dBA exceedance of a noise criterion to represent a negligible and not perceptible impact, and as these residences are subject to significant traffic noise from the adjacent New England Highway during all time periods, the predicted noise levels at these residences are considered acceptable.

33. Cumulative noise levels, including noise from Dartbrook Mine and from other major sources of industrial noise in the area such as Mt Pleasant Mine, are predicted to exceed relevant cumulative

noise criteria at four residences within Kayuga Village. Cumulative noise levels at these receivers are primarily affected by Mt Pleasant Mine noise, and all are entitled to acquisition by Mt Pleasant Mine. No further mitigation or acquisition rights are required to be imposed on Dartbrook Mine.

34. Calculated noise levels for the proposed bord and pillar option are identical to the predicted noise levels for the longwall option, as both options include the same CHPP equipment. The lower production rate for the bord and pillar option would require CHPP operation for only part of an average week, however would not change the noise levels from the CHPP while it is operating.

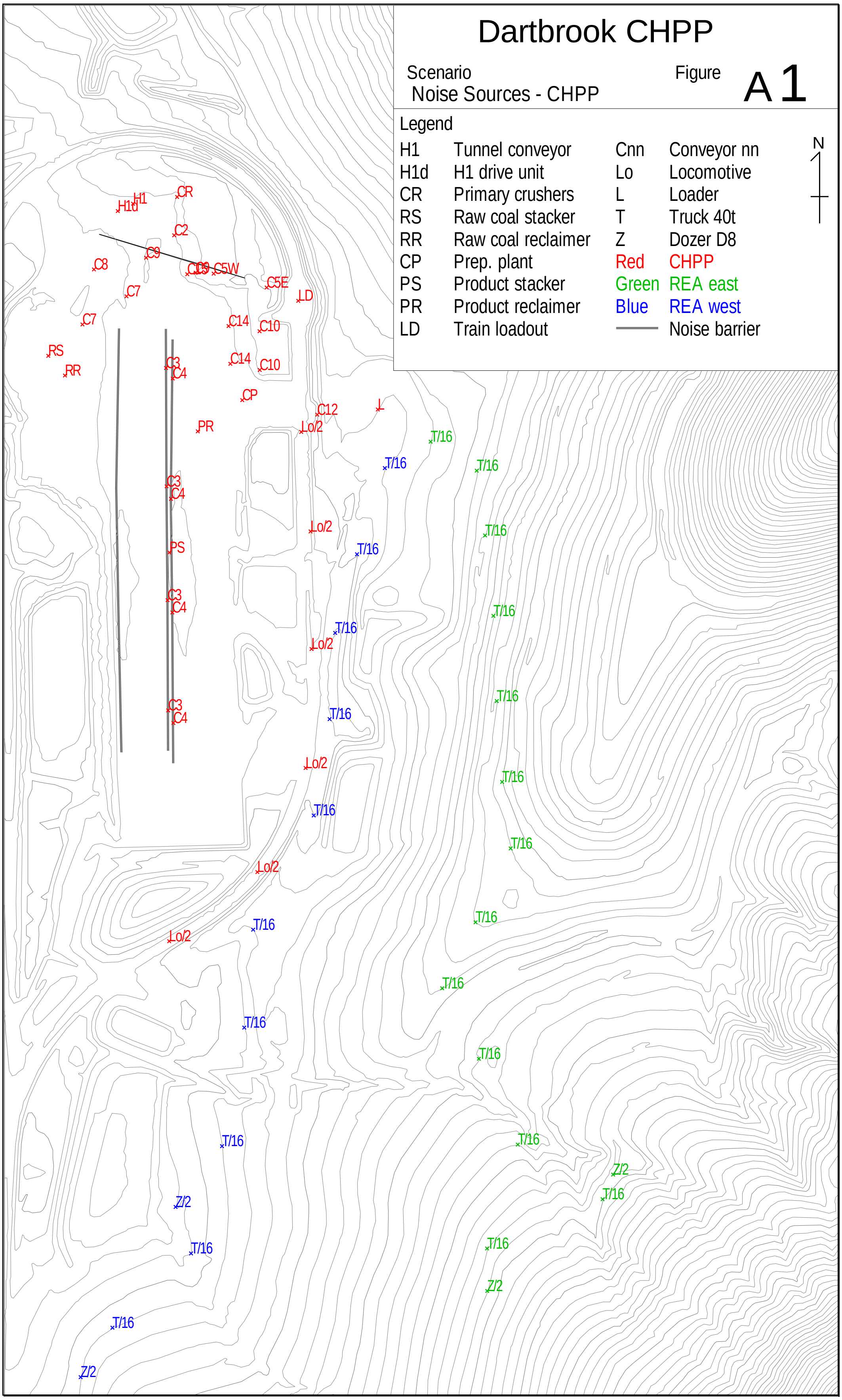
35. Based on the results presented in this assessment, noise levels from a restart of longwall mining at Dartbrook Mine are consistent with current Development Consent noise criteria and should therefore not prevent approval of the proposed Modification including the proposed extension of the approval period.

Yours faithfully,

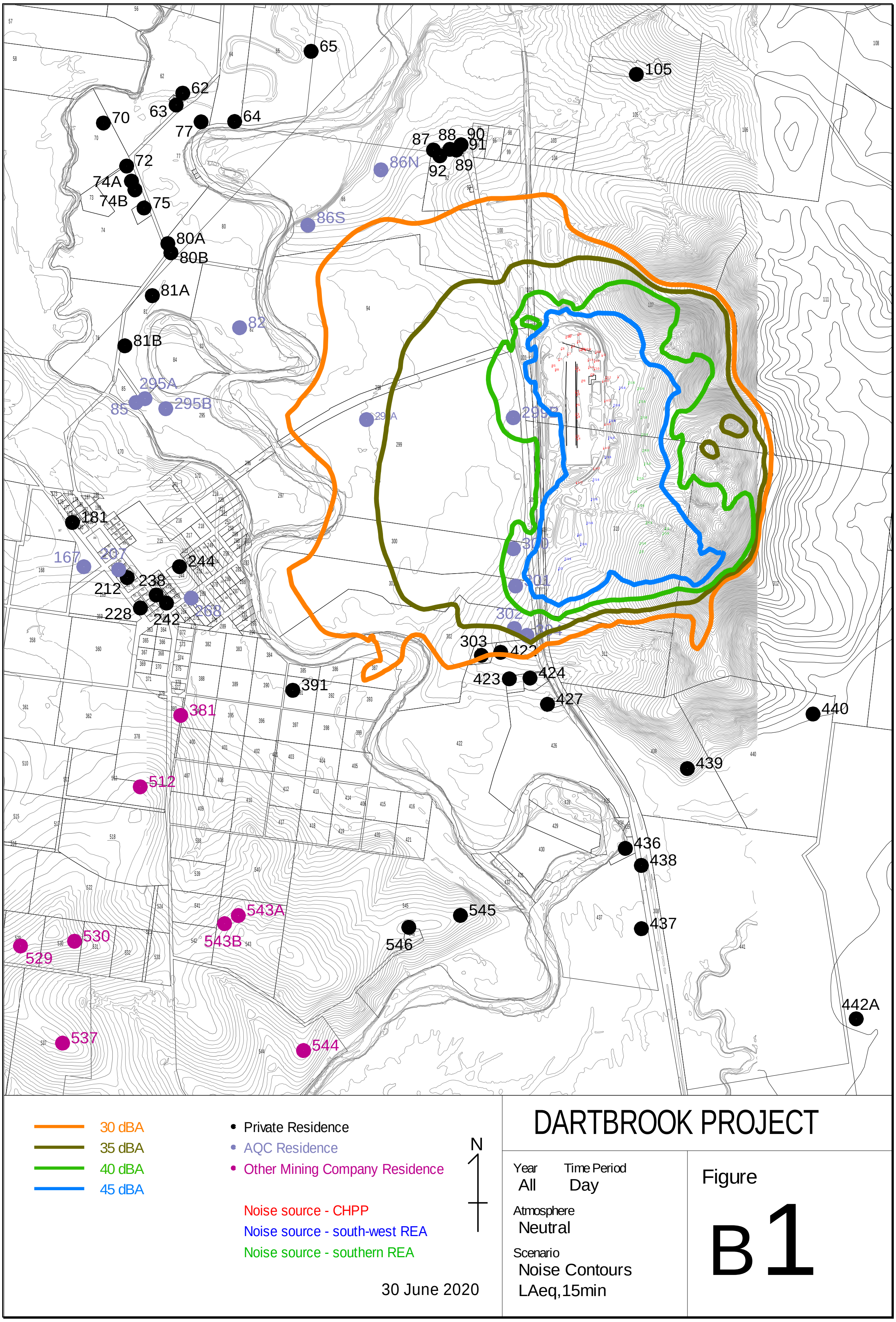
**BRIDGES ACOUSTICS**

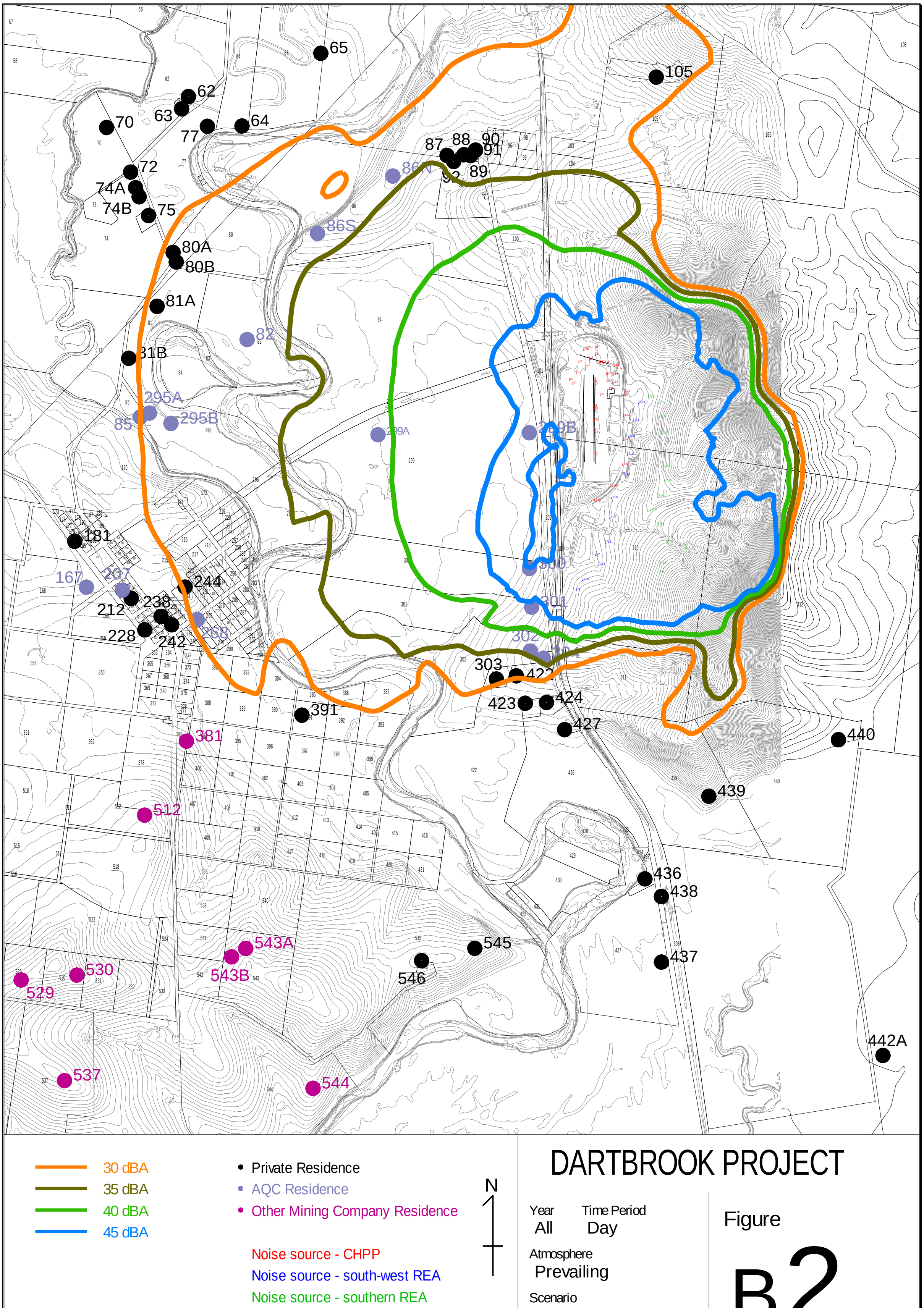
**MARK BRIDGES BE (Mech) (Hons) MAAS**
**Principal Consultant**

## APPENDIX A: MODELLED NOISE SOURCE LOCATION FIGURE



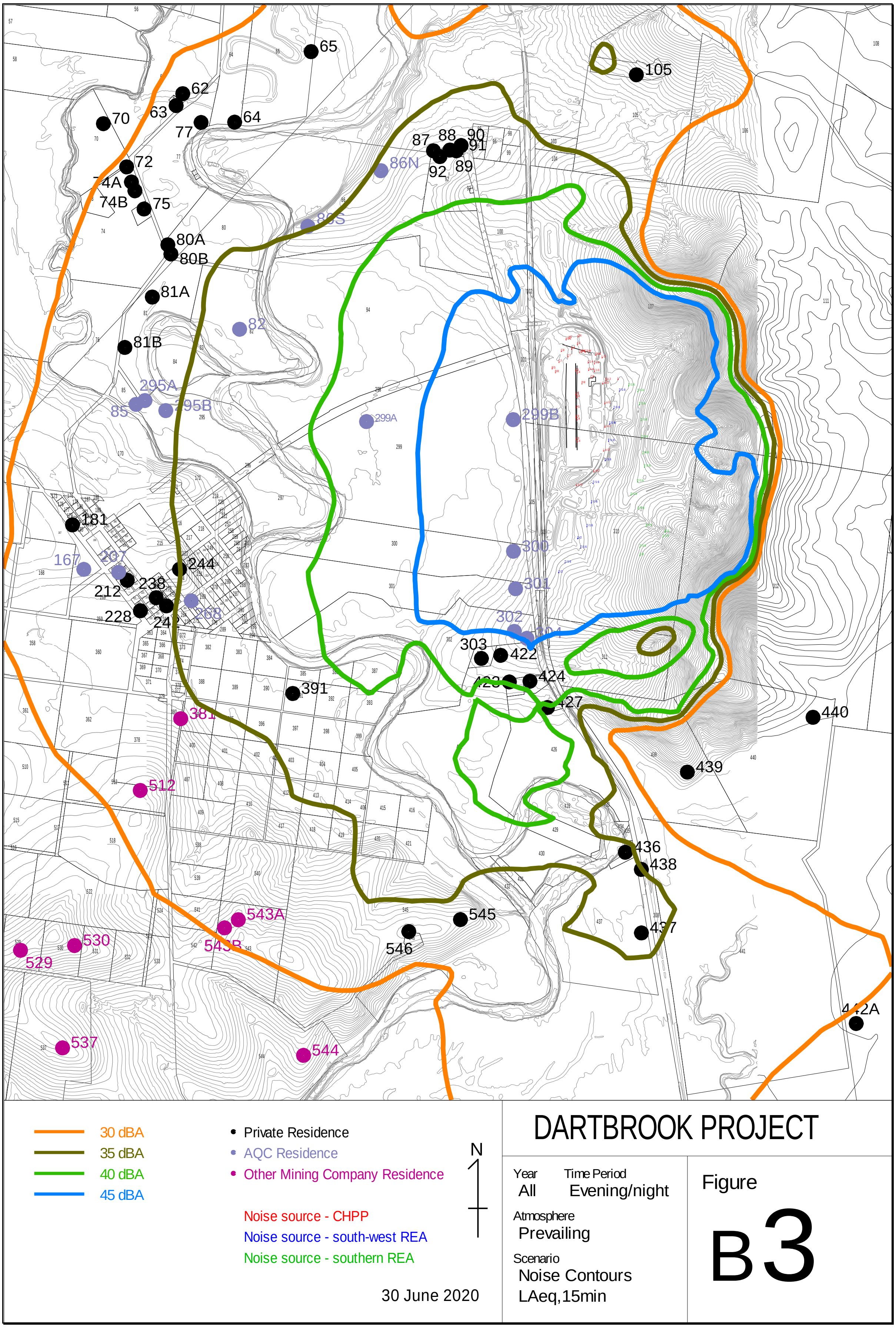
**APPENDIX B: NOISE CONTOUR FIGURES**

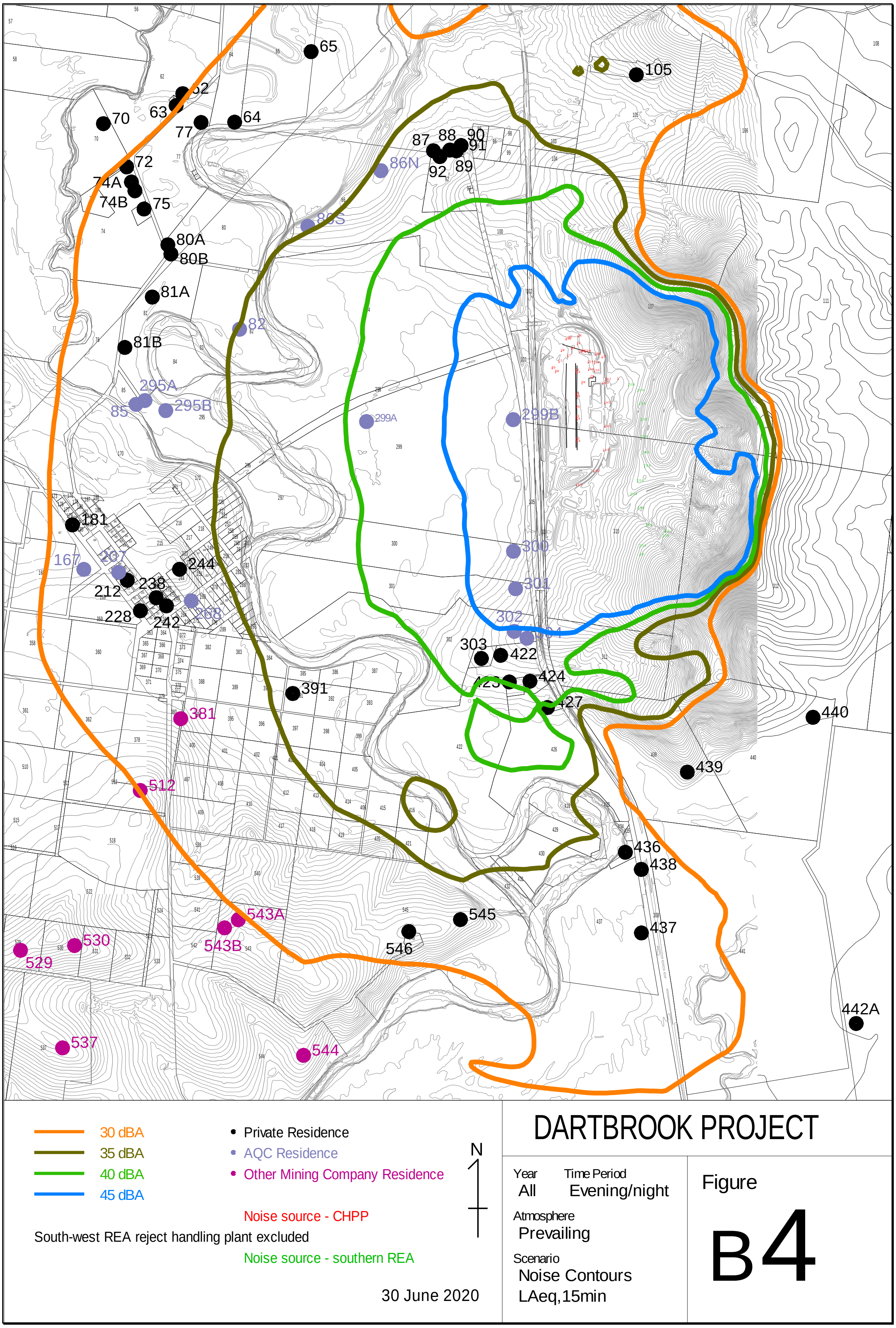





DARTBROOK PROJECT

| | | |
|---|---|---|
| Year<br>All | Time Period<br>Day | Figure |
| Atmosphere<br>Prevailing | | B2 |
| Scenario<br>Noise Contours<br>LAeq,15min | | |


DARTBROOK PROJECT
30 dBA
35 dBA
40 dBA
45 dBA
Private Residence
AQC Residence
Other Mining Company Residence
Noise source - CHPP
Noise source - south-west REA
Noise source - southern REA
N
30 June 2020
Year
All
Time Period
Evening/night
Atmosphere
Prevailing
Scenario
Noise Contours
LAeq,15min
Figure
B3


65
105
62
63
70
64
77
87
88
90
91
86N
92
89
72
74A
74B
75
80S
80A
80B
81A
82
81B
295A
85
295B
299A
299B
181
167
207
244
212
238
228
242
268
300
301
302
303
422
423
424
427
391
381
440
439
512
436
438
543A
530
543B
545
546
437
529
442A
537
544
30 dBA
35 dBA
40 dBA
45 dBA
Private Residence
AQC Residence
Other Mining Company Residence
Noise source - CHPP
South-west REA reject handling plant excluded
Noise source - southern REA
N
30 June 2020
DARTBROOK PROJECT
Year
All
Time Period
Evening/night
Atmosphere
Prevailing
Scenario
Noise Contours
LAeq,15min
Figure
B4

## APPENDIX C: CURRICULUM VITAE

| | | |
|---|---|---|
| Name: | Mark Leslie BRIDGES. | |
| Address: | 78 Woodglen Close,<br>PATERSON NSW 2421 | |
| Qualifications: | Bachelor of Mechanical Engineering (Hons), awarded May 1991. | |
| Affiliations: | Member of the Australian Acoustical Society, admitted February 1999. | |
| Employment: | Since Feb 2000: | Principal, Bridges Acoustics. |
| | Oct 1998 to Feb 2000: | A/Manager, Caleb Smith Consulting. |
| | Nov 1995 to Oct 1998: | Senior Acoustic Engineer, Caleb Smith Consulting. |
| | Feb 1995 to Nov 1995: | Acoustic Engineer, Caleb Smith Consulting. |
| | Feb 1984 to Feb 1995: | Various trainee and graduate engineering positions in the Water, Hydraulics and Manufacturing industries. |

Experience:

Over 25 years as a professional acoustical consultant specialising in environmental noise measurement, prediction and control. Published two professional papers on best practise environmental noise reduction in the open cut coal mining industry.

Completed over 100 major noise impact statements and more than 160 other environmental noise assessments in the mining, industrial commercial, domestic, utilities and services sectors.

Prepared expert evidence and appeared in the Land & Environment Court or the Liquor Licensing Court on over 15 occasions, primarily for Lake Macquarie City Council and Great Lakes Shire Council and other private clients.

Current and previous clients include:

- Hansen Bailey Pty Ltd (environmental engineers);
- CH2M Hill Australia Pty Ltd (environmental and process engineers);
- Energy Australia (power industry);
- Essential Energy (power industry);
- AGL Energy (gas supply);
- MRM Thompson Norrie (legal);
- Perception Planning (planning and development);
- BlueScope Steel (steel making);
- OneSteel Market Mills (heavy manufacturing);
- Shell Refining (Australia) Pty Ltd (oil and fuel industry);
- Anglocoal (Dartbrook Management) Pty Ltd (coal mining);
- Liddell Operations Pty Ltd (coal mining);
- Centennial Coal (coal mining);
- NSW Roads & Maritime Services (transport industry); and
- Department of Planning & Infrastructure (independent noise surveys).

Completed mining related projects include:

- Isaac Plains East EIS, Central Queensland, for Stanmore Coal;
- Peer Review of Bylong Coal Project Acoustic Report, Upper Hunter, for Bylong Coal;

- Gemco Eastern Leases EIS, Groote Eylandt NT, for BHP Billiton;
- Eagle Downs Gas Project, Central Queensland, for Eagle Downs Coal Management;
- Acoustic audit of Environmental Management System, for Ulan Coal;
- Cook Colliery EIS, Central Queensland, for Blackwater Coal;
- Continuation of Bengalla Mine EA, Hunter NSW, for Bengalla Mining Company;
- Watermark Project EA, Gunnedah Basin NSW, for Watermark Coal;
- Minyango Project EIS, Central Queensland, for Blackwater Coal;
- Drayton South EA, Hunter NSW, for Anglo American;
- Maules Creek Coal Mine EA, Gunnedah Basin NSW, for Aston Resources;
- Foxleigh Plains Coal Mine EIS, Bowen Basin Qld, for Anglo Coal;
- Coalpac Consolidation Project EA, Lithgow Region NSW, for Coalpac;
- Grosvenor Mine EIS, Bowen Basin Qld, for Anglo Coal;
- Boggabri Coal Mine Extension EA, Gunnedah Basin NSW, for Boggabri Coal;
- Eagle Downs Coal Mine EIS, Bowen Basin Qld, for Bowen Central Coal Management.

# *APPENDIX C*

## *Subsidence Review*

REF:sh-01

Friday, 3 July 2020

Alan McKelvey
Partner – Corporate and Commercial
Sparke Helmore Lawyers
Level 7, 28 Honeysuckle Drive
Newcastle

*Confidential and subject to Legal Professional Privilege*
*Prepared for the dominant purpose of actual or anticipated litigation*.

Dear Alan

At your request, I have examined the supplied documents on the Dartbrook project:

- G.E.Holt and Associates Pty Ltd. 2000. Subsidence impact study for proposed extension of longwall operations at Dartbrook Colliery. Appendix N of EIS
- SCT Operations Pty Ltd. 2018. Pillar layout to limit surface subsidence from mining in the Kayuga Seam. Letter to Hanson Bailey Environmental Consultants

In your email of 19 June 2020 (*Item 03 - 200501 Dartbrook Legal Challenge_Subsidence scope (73755332.1)*) you listed a number of items for me to address. They are reproduced below along with my comments.

Attached to this letter is a brief CV that outlines my experience in coal mine subsidence.

## Review the subsidence assessment in the Dartbrook EIS (conducted by G.E. Holt and Associates) and SCT's assessment in the MOD7 EA

### G.E.Holt and Associates (Holt)

Holt adopted standard empirical guidelines to predict vertical subsidence for each coal seam and used the Newcastle relationship for isolated panels and the Southern coalfield relationship to assess the subsidence of a series of panels separated by chain pillars. In these guidelines one of the key parameters is the ratio of the maximum vertical subsidence to the extracted seam thickness (Smax/T). Holt adopted a Smax/T ratio = 0.55 which was validated by information then available from the Dartbrook operations in the Wynn Seam.

Holt then added the maximum vertical subsidence from each seam to obtain a maximum value for when multiple seams are extracted. This was standard practice at the time. To estimate the ground strains and tilts Holt applied the standard Newcastle factors of 400, 600, 1800 to the maximum multiple-seam vertical subsidence. This was also standard practice at the time.

There is no new data since that time that makes these empirical relationships for a single seam invalid but there is published work[1] that post-dates the EIS that indicates a change in thinking for multiple seams. This 2010 paper differentiates between overmining (where the first extracted seam

[1] Li, G., Steuart, P., Paquet, R., and Ramage, R. 2010. A case study on mine subsidence due to multi-seam longwall extraction. Second Australasian Ground control in Mining Conference, Sydney NSW, 23-24 November 2010.

is the deepest – as is the case of the Dartbrook project where the Wynn Seam has been extracted) and the more common undermining where the extracted seams are progressively deeper.

The paper includes two examples of overmining with inconclusive conclusions. There is very little monitoring data so extrapolation to Dartbrook is somewhat difficult. My interpretation for the Kayuga Seam above the Wynn longwalls is that there is a need to increase the subsidence level for the Kayuga extraction by increasing the Smax/T ratio by an additional 0.2 – i.e. the 0.55 used by Holt should be 0.75. For Dartbrook the situation is even more complicated in that the proposed Piercefield Seam extraction is overmining with respect to the Wynn Seam but undermining with respect to the Kayuga Seam.

The implication is that there is a possibility that the simple summing of individual Smax values may be an underestimate (see Table 1). Mining the Piercefield after Kayuga could make the underprediction even larger. It is emphasised that the absolute subsidence values in Table 1 may not actually be achieved as this depends on how the mine layout interacts with the seam depths. The point of the table is simply to compare how the prediction could differ in the light of more recent knowledge.

*Table 1 Estimation of maximum vertical subsidence in the case of multiple seams being extracted using empirical guidelines of 2000 and 2010*

| | Extracted thickness (m) | Holt 2000 (m) | Application of Li et al (2010) guidelines (m) | |
|---|---|---|---|---|
| Kayuga | 4 | 2.2 | 3.0 | 3.4 |
| Piercefield | 4.5 | 2.48 | | 3.38 |
| Wynn | 4 | 2.2 | 2.2 | 2.2 |
| Total | | 6.88 | 5.5 | 8.98 |

## SCT MOD 7 – Kayuga Seam

SCT modified an empirical pillar design process such that pillar dimensions are reduced to incorporate rib spall. This is a modification to the published method that utilises the as planned/mined dimensions and is considered to be inappropriate. Consequently, the SCT proposed pillars would be very stable (in fact more stable than necessary) and should not collapse if undermined by either longwall or pillar extraction. The depths of the Kayuga Seam will mean that any collapse of the 5.5 m roadways that form the pillars in the Kayuga Seam will not result in subsidence at the surface if the pillar workings are undermined.

The calculations that underpin the SCT estimation of subsidence (30 mm - 80 mm) are not given. My estimation of pillar subsidence is 50 mm - 90 mm so I accept the SCT values to be appropriate.

## Determine whether the subsidence that may be induced by longwall mining in the years 2022-2027 (inclusive) will be less than the predictions in the 2000 EIS. It is envisaged that only one seam (likely the Kayuga/Mt Arthur Seam) can be mined during the remaining mine life. Assume that all management measures required by the conditions of DA 231-7-2000 following the determination of MOD7 are implemented;

Maximum vertical subsidence induced by longwall mining in the three seams could exceed the 2000 EIS predictions. If keeping the subsidence to less than the EIS 2000 predictions is critical, then only one of the Piercefield or Kayuga can be mined by longwall. Extraction by bord and pillar in any of the seams will result in subsidence less than the 2000 EIS predictions.

Regarding the conditions in DA 231-7-2000, with two seams extracted by longwall there will be fracture connection to the surface.

## Advise whether the active mining at the neighbouring Mt Pleasant Mine will affect subsidence behaviour;

The Mount Pleasant Mine approval lies immediately to the south of Dartbrook (Figure 1).

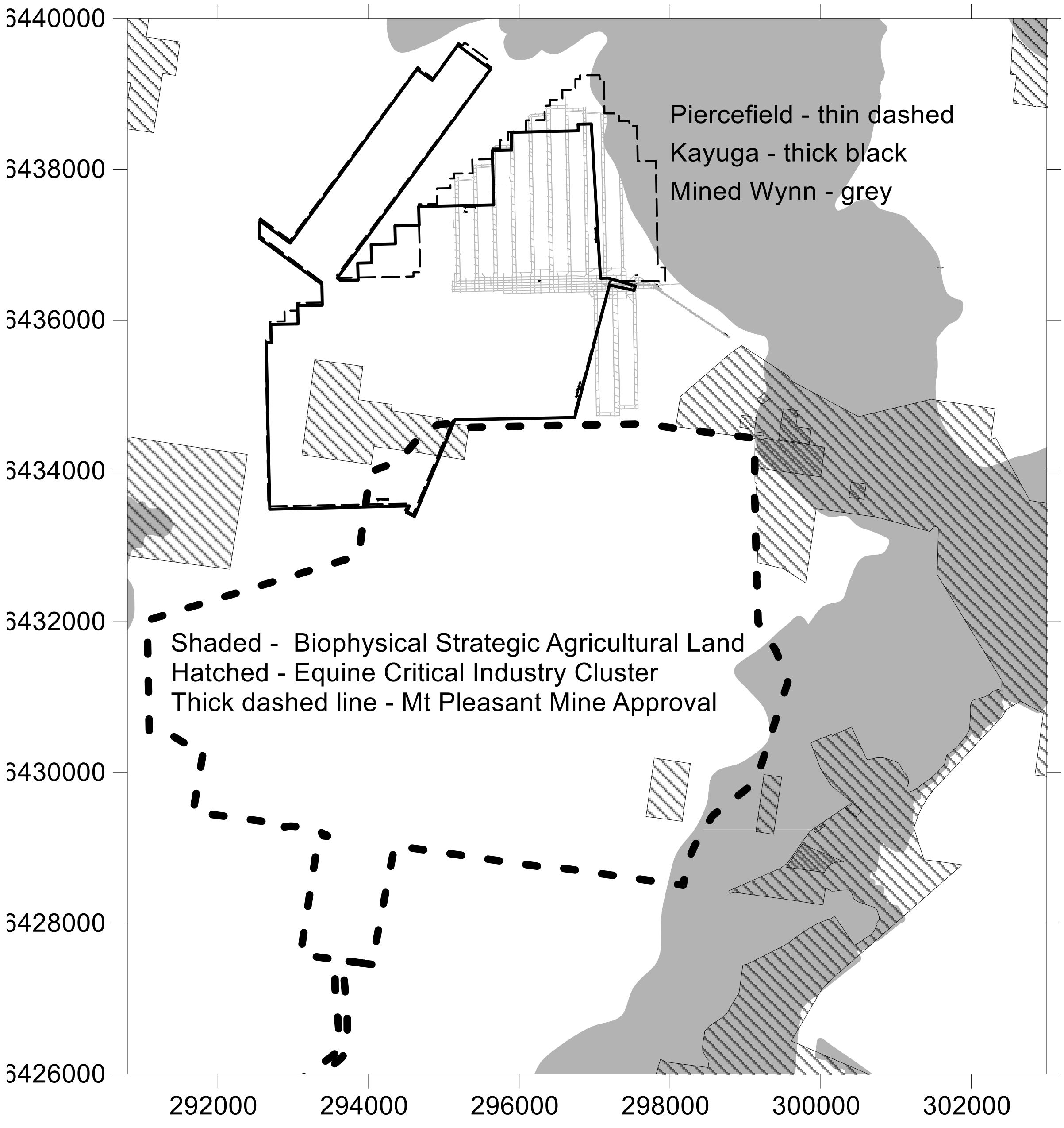



*Figure 1 Map showing mined Wynn, approved Kayuga and Piercefield limits, Mount Pleasant approval area, and BSAL and ECIC areas*

I am not aware of any reports of additional surface subsidence in the Hunter Valley associated with adjacent surface mining (for example Bulga/Beltana or Ashton) nor do I expect such impacts from my understanding of the geotechnical regime. On this basis I assess that surface mining operations at Mount Pleasant will not impact on subsidence at Dartbrook.

Where the approvals overlap, any mining in the Mount Pleasant area will be in shallower seams and if the operation is surface mining there will be a need to consider pit wall stability – the surface mine disturbance will over-ride any Dartbrook subsidence. If the Mount Pleasant mining is to be longwall mining, then the subsidence deformations associated with the Mount Pleasant mining will need to consider the impact of multiple seam extraction.

Assess the potential subsidence impacts on the land identified as BSAL or ECIC. There is a small area of ECIC overlying the other approved longwall panels. Other areas of BSAL or ECIC are laterally offset from the mine plan;

Longwalling within the approved Kayuga Seam layout is offset from (Figure 1) and will not result in subsidence deformations in the adjacent BSAL and hence no subsidence impacts.

Longwalling of the four easternmost panels in the Piercefield Seam (referred to as P210-P213 in the Holt report) will result in subsidence deformations within the BSAL. In this area the Piercefield would be the only seam to be extracted. The mining depths are less than about 130 m. Holt did not provide predictions for these panels but using his method and assuming a 4.5 m extraction thickness the following predictions can be made:

| Depth (m) | Vertical subsidence (m) | Tensile strain (mm/m) | Compressive strain (mm/m) | Tilt (mm/m) |
|---|---|---|---|---|
| 60 | 2.47 | 16 | 25 | 74 |
| 90 | 2.47 | 11 | 16 | 50 |
| 120 | 2.47 | 8 | 12 | 37 |
| 150 | 2.47 | 7 | 10 | 30 |

In terms of subsidence impacts of Piercefield extraction on the BSAL in this area the tensile strains will result in the formation of substantial open cracking at the surface – possibly in the order of several hundred millimetres. The compressive strains will result in the formation of humps that may be in the order of 100-200 millimetres high. The tilts could result in localised ponding in any ephemeral water courses. There will be connective cracking from the seam to the surface. The surface deformations should be readily remediated and the impacts and environmental consequences should be capable of management through an Extraction Plan approval process.

For the ECIC located to the south west of the area of interest (see Figure 1), the minimum depth to the Kayuga Seam is about 170 m and to the Piercefield Seam is about 250 m. The Holt predictions for KA108 apply for the extraction of the Kayuga Seam at 170 m depth:

- Maximum vertical subsidence - 2.08 m
- Maximum tensile strains – 5.2 mm/m
- Maximum compressive strain – 7.8 mm/m
- Maximum tilt – 23 mm/m

At the same location the depth to the Piercefield Seam is 250 m and assuming both seams are extracted the subsidence parameters for multiple seam extraction and making reference to the Li et al (2010) paper are:

- Maximum vertical subsidence – 6.6 m
- Maximum tensile strains – 11 mm/m
- Maximum compressive strain – 21 mm/m
- Maximum tilt – 48 mm/m

Similar to the previous the tensile strains induced under ECIC will result in the formation of substantial open cracking at the surface – possibly in the order of several hundred millimetres. The cracking would be less if only the Kayuga Seam was extracted – in general the crack aperture will be in proportion to the maximum tensile strain. The compressive strains will result in the formation of humps that may be in the order of 100-200 millimetres high and once again such humps will be smaller if only the Kayuga Seam is extracted. The tilts could result in localised ponding in any ephemeral water courses and once again the magnitude of the tilts will be less if only the Kayuga is extracted. There will be connective cracking from the seam to the surface for both single and two seam extraction. The surface deformations should be readily remediated and the impacts and environmental consequences should be capable of management through an Extraction Plan approval process.

I am instructed that there are no built structures identified in the ECIC, but if there were, any damage would be beyond safe serviceable and repairable.

If bord and pillar mining in the Kayuga Seam is conducted under the ECIC the vertical subsidence will be less than 90 mm and the associated tensile and compressive strains and tilts will not be detectable by standard survey techniques. There would be no observable or measurable impacts.

## Assess the potential implications of longwall mining on the previously assessed bord and pillar workings (e.g. pillar instability);

The dimensions of the proposed pillars in the Kayuga Seam are such that they can be undermined without inducing collapse or additional surface subsidence. There is the opportunity to reduce the pillar sizes by 3 m - 4 m and still have adequate stability if the underlying seams are longwalled.

## Advise if there are any other developments since G.E. Holt and Associates' assessment that would materially affect the validity of those predictions;

There are two published papers on multiple seam longwalling that post-date the EIS[2]. The focus in those papers is undermining (which is not what will happen at Dartbrook) and the main finding in both

[2] Li et al 2010 – see footnote #1,

Mills, K. and Wilson, S. 2017. Insights into the mechanics of multi-seam subsidence from Ashton underground mine. *in* Aziz, N. and Kininmonth, R. (eds.), Proceedings of the 17th Coal Operators' Conference, Mining Engineering, University of Wollongong, 8-10 February 2017, 51-66.

papers is that adding subsidence predictions for each seams in not valid and will underestimate the vertical subsidence.

The 2010 paper includes inconclusive comments regarding the impact of ascending order of extraction with only one case example given. My interpretation is that there is a need to assume that the Holt estimates will be too low and I have adopted a subsidence factor of 0.75 instead of the 0.55 used by Holt.

Advise whether further mining (by longwall and/or bord and pillar) are able to be designed to and managed to be compliant with the performance measures in DA 231-7-2000;

In the context of connective cracking, extraction voids will need to be less than 40 % the depth of cover if there are Category 5 streams above.

Yours truly

Ross Seedsman
PhD, FAusIMM(CP)

## Ross Seedsman

rossseedsman@gmail.com

M| 0417 279 556

**Qualifications & professional affiliations**

Bachelor of Science (Hons), University of Melbourne

Master of Science, University of Melbourne

Doctor of Philosophy, University of Queensland

Fellow, Australasian Institute of Mining and Metallurgy

Chartered Professional (Mine Geotechnical) – AusIMM

Member, Australian Geomechanics Society

Ross has more than 35 years' experience working in mining consulting and research. He has expertise in mine planning for surface operations and underground coal mines, the design and specification of ground support for underground coal mines, pit-wall stability, and mine subsidence.

In the underground coal sector, Ross has published a strength criterion that can be used for laminated low strength rock and has made significant contributions to the understanding of boundary crushing in the roof and sides of excavations. He is a strong advocate of the importance of debonding cables to survive such crushing. Ross has also combined his understanding of boundary crushing in coal with his experiences in pitwall stability to make better correlations between coal and rock bursts.

Ross has also worked extensively on the prediction of mine subsidence in both NSW and Queensland coal fields. He introduced the influence function prediction method (SDPS) to Australia and adapted its use to better suit Australian mining geometries. He has had success in redesigning pillar and longwall-panel widths so as to better balance surface impacts with mine economics – this has involved both narrowing and widening of extraction panels and specific design of the chain pillars. His experiences with the prediction of mine water inflows in the NSW and Bowen Basin coalfields have led to the formulation of a fracturing model that substantially differs from currently accepted views.

Ross has published both locally and internationally. As well as presenting case studies in local and international conferences, he was invited by the SME (USA) to write the rock mechanics chapter of the 2010 edition of the Mining Engineering Handbook.  He recently contributed a chapter in an AusIMM Monograph on geotechnical modifying factors for longwall reserves. More recently he has focussed on publishing new insights into ground control and mine water inflow in international journals. Such publications include:

- Prediction of the height of caving and fracturing above an isolated longwall extraction panel. Mining Technology, 129:2, 95-103.
- Interpretations of mine water pumpout data and revisions to caving and fracturing models for longwalls. Mine Water And The Environment, 38,3,67-685.
- On the deception in requiring and providing singular accurate predictions for surface subsidence, tilt, and strain. Proceedings of the 9th Triennial Conference on Mine Subsidence. Pp 449 - 459.
- Calibrated parameters for the prediction of subsidence at Mandalong Mine. Coal 2010 - 10th Australasian Coal Operators' Conference, Wollongong

# *APPENDIX D*

## *Groundwater Assessment*

Australasian Groundwater and
Environmental Consultants Pty Ltd

Report on

# Dartbrook Mine Revised MOD7 Groundwater Assessment

Prepared for
AQC Dartbrook Management Pty Limited

Project No. G1730N July 2020
www.ageconsultants.com.au ABN 64 080 238 642

# Document details and history

## *Document details*

| | |
|---|---|
| **Project number** | G1730N |
| **Document title** | Dartbrook Mine - Revised MOD7 – Groundwater Assessment |
| **Site address** | Dartbrook, NSW, Australia |
| **File name** | G1730N.Dartbrook Revised MOD7 v02.01.docx |

## *Document status and review*

| Edition | Comments | Author | Authorised by | Date |
|---|---|---|---|---|
| v01.03 | First draft for client comment | JT | JT | 2/07/2020 |
| v01.04 | Final | JT | JT | 3/07/2020 |
| v02.01 | Addressed client comments | JT | JT | 20/7/2020 |

# Table of contents

*Page No.*

# Table of contents (continued)

*Page No.*

## *List of figures*



## *List of tables*

*Report on*

# Dartbrook Mine
# Revised MOD7 – Groundwater Assessment

## 1 Introduction

AQC Dartbrook Management Pty Limited (AQC) is the proprietor of the Dartbrook Mine, located in the Upper Hunter Valley of NSW. AQC is a wholly owned subsidiary of Australian Pacific Coal Limited. In August 2019 the Independent Planning Commission (IPC) determined an application from AQC to modify the Dartbrook Mine's development consent (DA 231-7-2000) to facilitate limited bord and pillar mining. The Modification allowed for bord and pillar mining in part of the Kayuga Seam within the footprint of already approved longwall mining activities which have been on care and maintenance since December 2006.

Whilst the IPC approved the bord and pillar mining component of the Modification, it refused AQCs application to extend the project approval by five years to 5 December 2027. The IPC concluded it *"..was not provided with a contemporary assessment of the potential impacts of the existing approved longwall mining and coal handling operations to support a 5 year extension of this approval (DA 231-7-2000), in the context of the significant increase in mining activity and other changes in the area since the original approval was granted in 1991. This gives rise to uncertainty about the Applications future impacts, and the veracity of mitigation available, should some aspects of the currently approved Project, such as longwall or coal washery operations continue or restart after 2022."*

In response AQC commissioned an assessment of the potential impacts of extending the approved mining operations until 2027 The proposed activities would extract up to 6 million tonnes of ROM coal per annum utilising longwall and/or bord and pillar methods. Mining would occur within the existing approved footprint of the mine. Sparke Helmore Pty Ltd engaged Australasian Groundwater and Environmental Consultants Pty Ltd (AGE), on behalf of AQC to assess the impact of extending longwall mining at Dartbrook for five years on the groundwater regime.

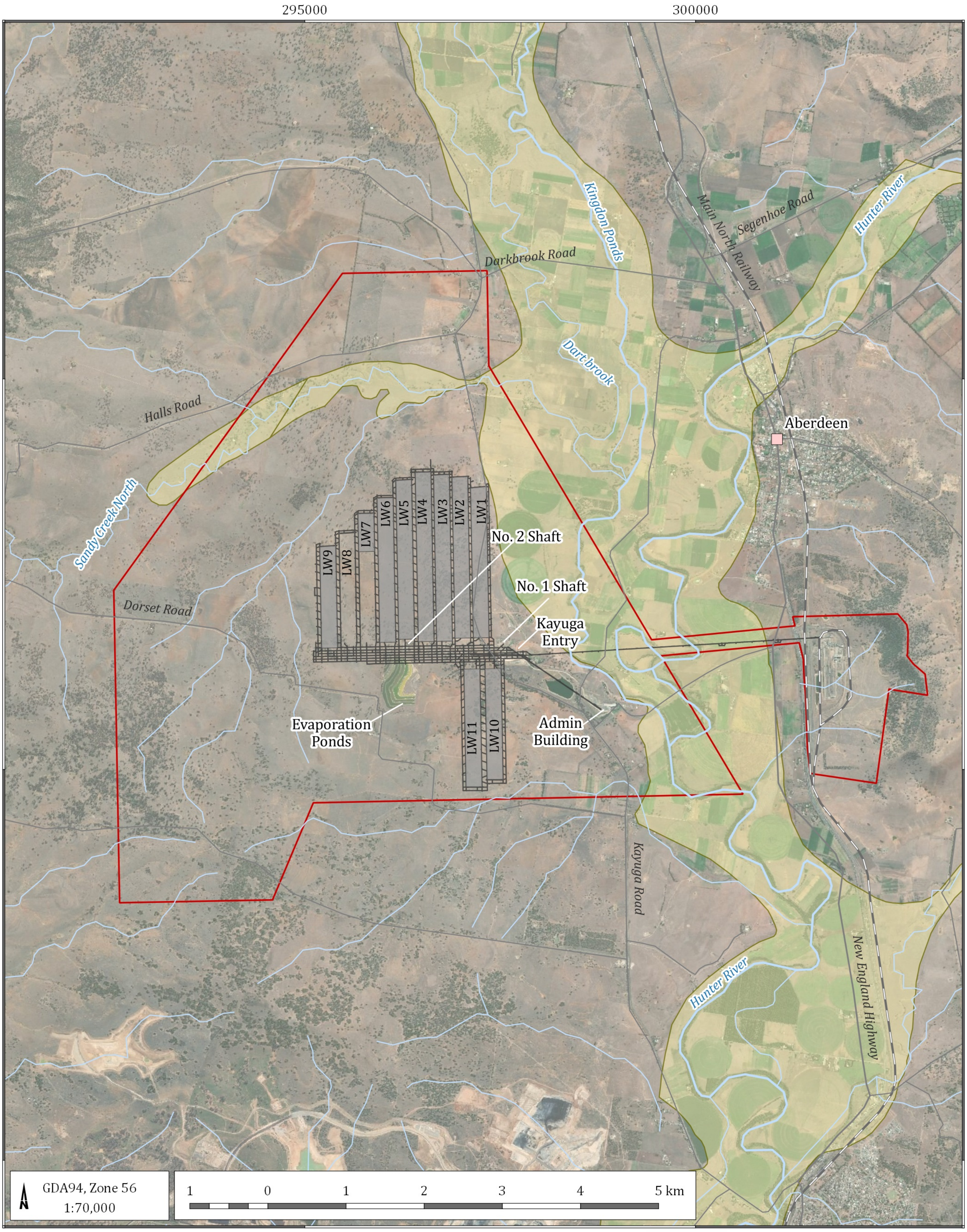
## 2 Objectives and scope of work

The objective of the consultancy engagement was to provide an opinion on the likely magnitude of groundwater impacts generated by a revised MOD 7, compared with the currently approved impacts associated with longwall mining. The objective was not to determine the absolute impacts on groundwater associated with MOD7, but rather to determine if there could be significant changes to impacts from extending the mine life for five years beyond what is already approved.

To achieve this objective the scope of work included review of the impact assessment upon which the longwall mining was previously approved. This assessment was conducted by Mackie Environmental Research (MER 2000) and included numerical groundwater modelling. The groundwater modelling conducted by MER (2000) was reviewed against contemporary expectations for modelling, and by review of groundwater monitoring data collected since 2000. This information was then used to provide an opinion on the expected effects of the revised MOD7, and whether the potential impacts on the groundwater regime may be significantly different from those already approved. As noted the assessment was based on the review of existing available information, and previous experience conducting groundwater assessments for major projects. Numerical modelling was not part of the scope of work.

# 3 Approved activities

Figure 3.1 shows the longwall mining within the Wynn Seam approved under the previous development consent for Dartbrook Mine (DA 30/91. Mining within the Kayuga/Mt Arthur and Piercefield Seams was approved under the current consent DA 231-7-2000. The approved longwall panels within these seams are shown in Figure 3.2 and Figure 3.3. The Kayuga and Mt Arthur seams are separated by about 30 m of interburden and become single seam to the west where three panels are approved in the Mt Arthur Seam. This seam is referred to as the Kayuga Seam for the purposes of this report.




LEGEND

- Populated place
- Road
- Drainage
- Rail
- Mining Authorisation
- Extracted Longwall Panels
- Indicative Longwall Panel Layout
- Alluvium boundary (Source: 1:250k Singleton Geology Sheet, modified after AGE (2007))

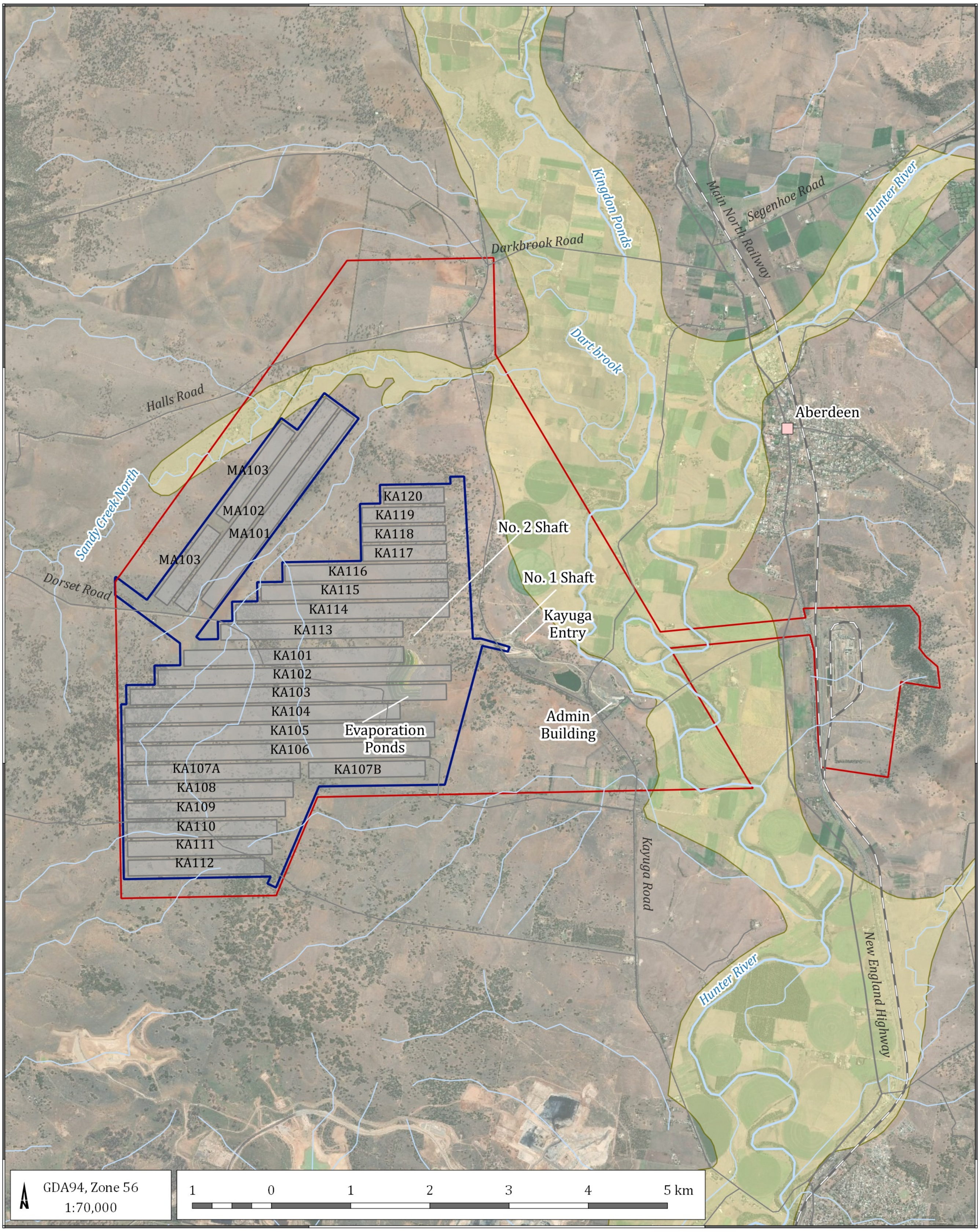
Dartbrook MOD7 (G1730N)

**Approved mining activities (Wynn seam)**

DATE 02/07/2020

FIGURE No: **3.1**


Source: 1 second SRTM Derived DEM-S - © Commonwealth of Australia (Geoscience Australia) 2011.; GEODATA TOPO 250K Series 3 - © Commonwealth of Australia (Geoscience Australia) 2006.;
G:\Projects\G1730N.Dartbrook MOD7\3_GIS\Workspaces\001_Deliverable1\03.01_G1730N_Approved mining activities (Wynn seam).qgs




LEGEND

- Populated place
- Road
- Drainage
- Rail
- Mining Authorisation
- Approved Kayuga and Mt Arthur Seam Mining Area
- Indicattive Longwall Panel
- Alluvium boundary (Source: 1:250k Singleton Geology Sheet, modified after AGE (2007))

Dartbrook MOD7 (G1730N)

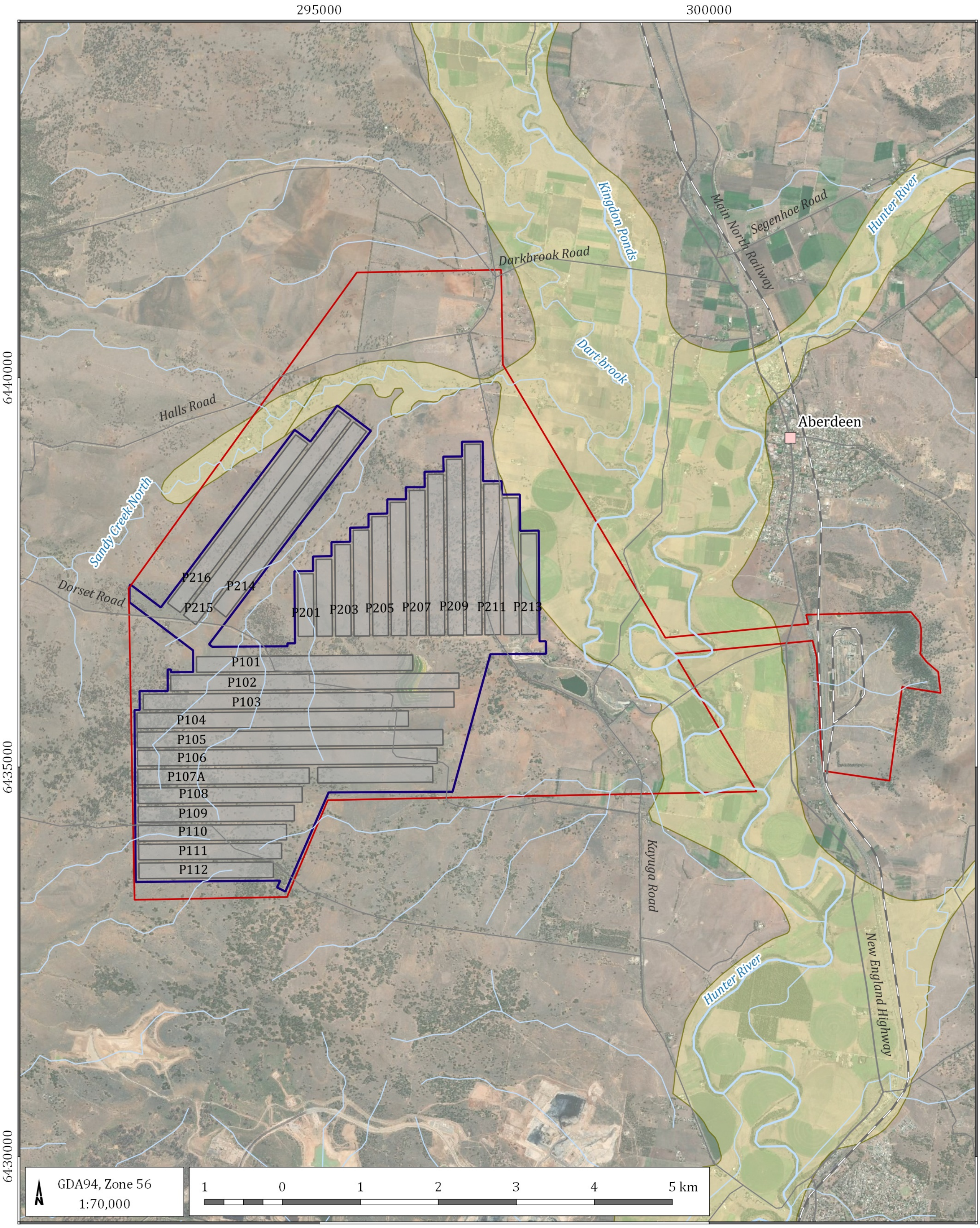
**Approved mining activities (Kyuga and Mt Arthur seam)**

AGE

DATE 02/07/2020

FIGURE No: **3.2**


Source: 1 second SRTM Derived DEM-S - © Commonwealth of Australia (Geoscience Australia) 2011.; GEODATA TOPO 250K Series 3 - © Commonwealth of Australia (Geoscience Australia) 2006.;
G:\Projects\G1730N.Dartbrook MOD7\3_GIS\Workspaces\001_Deliverable1\03.02_G1730N_Approved mining activities (Kyuga and Mt Arthur seam).qgs




LEGEND

- Populated place
- Road
- Drainage
- Rail
- Mining Authorisation
- Approved Piercefield Mining Area
- Indicatetive Longwall Panel Layout
- Alluvium boundary (Source: 1:250k Singleton Geology Sheet, modified after AGE (2007))

Dartbrook MOD7 (G1730N)

**Approved mining activities (Piercefield seam)**

DATE 02/07/2020

FIGURE No: **3.3**


Source: 1 second SRTM Derived DEM-S - © Commonwealth of Australia (Geoscience Australia) 2011.; GEODATA TOPO 250K Series 3 - © Commonwealth of Australia (Geoscience Australia) 2006.;
G:\Projects\G1730N.Dartbrook MOD7\3_GIS\Workspaces\001_Deliverable1\03.03_G1730N_Approved mining activities (Piercefield seam).qgs

# 4 Review of groundwater model

## 4.1 Model setup

MER (2000) developed a computer based numerical groundwater flow model of the Dartbrook mine and surrounding region using the MODFLOW 88 code. The model results were documented in Appendix L of the Dartbrook Extended EIS, dated June 2000.

The groundwater model was used to simulate the historical impact of approved mining which commenced in the Wynn Seam in 1996, as well as the impact of proposed longwall mining of the Kayuga and Piercefield seams over a period of 20 years.

The model represented the groundwater regime with 11 layers covering the main hydrostratigraphic units including Hunter River/Dartbrook alluvium, and alternating layers representing Permian non coal interburden and the Wynn, Kayuga and Piercefield seams. Layer 1 represented the Hunter River/Dartbrook alluvial aquifer and the Permian interburden outside the alluvial plain. Layers 3 and 6 and 9 were set at 50 m thick above each of the Kayuga, Piercefied and Wynn seams to allow higher vertical permeabilities associated with subsidence induced fracturing to be assigned.

Contemporary models for coal mining projects typically have more model layers due to improved computer processor speeds, however eleven model layers was significant at the time the Dartbrook model was developed, and as the major aquifers and aquitards are represented it is not expected to have compromised it's usefulness for estimating impacts.

The model domain was discretised into cells varying from 100 m x 100 m to 250 m x 250 m, with a total of 6396 model cells per layer. Again, improved computer processor speeds now allow smaller cells and more cells to be built into contemporary numerical models, however the dimensions of the cells were appropriate for the time, and many contemporary models continue to use similar model cells dimensions.

## 4.2 Boundary conditions, parameters and calibration

The hydraulic conductivity of the model layers was guided by field measurements and adjusted during the calibration process. The values of hydraulic conductivity were uniform in each model layer as follows:

- alluvium 30 m/day
- shallow interburden 0.001 m/day
- deep interburden 0.0002 m/day
- coal seams 0.01 m/day

Whilst it is now common in contemporary models to allow hydraulic conductivity to vary spatially within each layer, the values adopted are considered representative based on experience in the region. An anisotropy ratio for horizontal to vertical conductivity of 1:1 was adopted in the alluvium and coal seams, and 5:1 in the Permian interburden. Higher contrasts between horizontal and vertical hydraulic conductivity are considered possible within the Permian strata due to the inter layering of fine grained lower permeability layers within the strata. Slow declines observed in monitoring bores installed above the completed longwall panels supports this conclusion (refer Section 5.2.2). The anisotropy adopted for the Permian interburden in the model is therefore a likely conservative assumption that enhances transmission of groundwater between the alluvium and Permian layers in the model.

The report notes that the vertical hydraulic conductivity was adjusted in the layers overlying the mined coal seams, but the changes made to the hydraulic conductivity does not appear to be provided in the report. The height of the zone above the mining where fracturing occurs appears to be set 100 m, although this is not clearly stated in regards to the model. Whilst the report does not clearly provide this information (which would be required in a contemporary assessment), figures provided within Appendix E of MER (2000) indicates that the mining depressurises the Permian strata overlying the mining areas, but does not completely drain the overlying strata (Figures E6 and E7). Groundwater monitoring sites overlying the mined panels have recorded declining levels above the Kayuga Seam since mining commenced, but not induced complete drainage at the monitoring sites (refer Section 5.2.2). Therefore, whilst all the details of the fracturing represented in the model are not known, at a high level the available monitoring data, aligns with the predictions from the groundwater model.

A value of unconfined storage of 25% was adopted for the alluvium in the model, with a uniform specific storage of $1 \times 10^{-4} m^{-1}$ in all confined layers. Specific storage is a parameter used in the groundwater model that represents how much water is released from confined geological strata in response to declining water levels. Recent research into poroelastic theory has determined there are upper and lower bounds on the specific storage parameter. Rau et al. (2018) showed using poroelastic theory that specific storage can only occur in the range of $\simeq 2.3 \times 10^{-7} m^{-1}$ and $1.3 \times 10^{-5} m^{-1}$.

The Dartbrook numerical model therefore adopts a value about one order of magnitude higher than the theoretical maximum. It is not uncommon for numerical models prepared prior to this research being available in 2018 to have adopted values of specific storage higher than the theoretical maximum. The effect of this is that a larger volume of water can be represented in storage available for drainage to the mining activities during depressurisation than would be present in reality. If the specific storage was reduced in the Dartbrook model to within the theoretical bounds, and no further calibration conducted the model would predict a wider zone of depressurisation, particularly within the confined Permian strata. During calibration other adjustable parameters including recharge and hydraulic conductivity may have compensated for the adopted value of specific storage. The impact of this is difficult to determine, but the adopted value of this parameter cannot be considered conservative. As discussed, this issue is present in many pre-2018 numerical models and is a reflection of changes in modelling methodology rather than any shortcomings specific to the Dartbrook numerical model.

The model represented the Hunter River with a constant source boundary condition that could provide leakage into the alluvium where hydraulic heads allow. This is an appropriate representation as the Hunter River flow is maintained by releases from the upstream Glenbawn Dam. All other creeks were set as drains and could not enhance recharge to groundwater systems, which is considered an appropriate conservative assumption. Average rainfall recharge was set over the Permian strata at 2mm/year, and in the alluvium at 90mm/year. These values were estimates of long term averages based on available data. Of course, the future climate conditions could not be known when the modelling was conducted, and therefore the model does not represent periods of drought or above average rainfall. This is normally addressed by analysing the sensitivity of the model calibration and predictions to the adopted values of recharge. A sensitivity analysis is not included with the Dartbrook report, a task that is standard practice in contemporary models. It is worth nothing that the numerical modelling was conducted prior to guidance on groundwater modelling being released within Australia (Barnett et al, 2012, Murray Darling Basin Commission 2000).

The model was calibrated to match groundwater inflow rates to the Wynn Seam mine which were noted to be about 0.3 ML/day. There is no discussion of history matching of measured and predicted groundwater levels which is the most appropriate method to calibrate groundwater models. There is also no groundwater level monitoring included within the report and therefore the response of groundwater levels to the Wynn Seam mining is not known. This is a significant omission from the report that, again would not be acceptable in contemporary models.

MER (2000) openly noted the model limitations discussed above as including *'consolidation of many lithologies into single layers, simplified assignment of permeability based on consolidation of numerous field tests, generalisation of storatvity based on barometric efficiency of piezometers and limited tests, and uniform assignment of rainfall recharge. Groundwater abstraction from the alluvium by local land holders for stock and irrigation purposes, has not been included.'*

## 4.3 Model predictions

The model represented approved mining in the Wynn Seam and proposed mining in the Kayuga and Piercefield seams. Longwall mining was represented via nine longwall panels in the Wynn Seam from 1996 to 2003. Actual mining that occurred in this seam differs from the numerical model because two additional Wynn Seam panels were approved through a later modification. These are LWs 10 and 11 shown on the attached Figure 3.1.

A total of 20 panels of longwall mining in the Kayuga Seam were included in the model from 2003 to 2016, and three where is coalesces within the Mt Arthur Seam from 2016 to 2019. The first three Kayuga longwall panels in this layout were mined but not to the full approved length before the mine was placed on care and maintenance (Figure 3.2). The model represented four panels within the Piercefield Seam active from 2019 to 2023, none of which were extracted before the mine was placed into care and maintenance. The Dartbrook Extended EIS presented a mine plan for the Piercefield Seam that included 20 longwall panels (Figure 3.3). However, not all of these panels were to be mined within the duration of DA 231-7-2000.

The groundwater model predicted 0.3 ML/day groundwater inflow to the Wynn Seam, increasing to 0.6 ML/day at completion of Wynn Seam panels in 2003. Groundwater inflow is then predicted to gradually rise to 1.4 ML/day during extraction of Kayuga Seam. A notable increase occurs during mining of the Kayuga Seam which is expected to occur when the southern panels which move away from the alluvium are completed and mining changes to a northernly direction in closer proximity to the alluvium. The final three years occur in the Piercefield Seam and are predicted to generate about 0.3 ML/day inflow. All of the mining areas remain drained during the mine life, which is considered an appropriate conservative assumption that will maximise the inflow and drawdown. In practice panels are sometimes sealed and allowed to fill with water when completed.

The model indicated the mining will result in an indirect impact on the alluvial aquifer with a net loss of about 0.1 ML/day due to all mining represented in the model. The report notes the mining will reduce the upward leakage from the Permian to the alluvium and potentially create areas of reversed gradients where leakage is downwards from the alluvium into the Permian. The maximum change in downward leakage was assessed to be less than 0.01 L/m$^2$/day at the completion of underground mining of the Kayuga Seam. The leakage rate from the alluvium was calculated to be less than that of rainfall recharge which was calculated to be approximately 0.25 L/m$^2$/day. That is, more than two orders of magnitude higher than the predicted loss. This is a common conclusion of numerical modelling conducted in the Hunter Valley that indicates alluvial systems can buffer loses of groundwater due to mining, as losses are relatively small compared to the inputs of water within the alluvial systems. There are examples of mines operating adjacent to the Hunter River alluvium that have not recorded detectable drawdown within adjacent alluvium that supports this common modelling prediction

The groundwater inflow into the mining areas was predicted to depressurise the Permian strata and result in a zone of drawdown around the mining area. Figures included within the groundwater assessment show the drawdown grows outwardly from the mining areas over time and becomes most extensive towards the north, south and west. The growth in the zone of drawdown is retarded to the east by the available water within the alluvium that readily replenishes losses due to mining and prevents the zone of drawdown propagating significantly into the alluvial aquifer system. MER (2000) concluded that due to the high storage and recharge within the alluvium *"existing bores and wells in the alluvial lands will remain unaffected by depressurisation in the coal measures".*

Groundwater monitoring has shown this conclusion to be valid with monitoring bores within the alluvium not being detectably impacted by mining activities (refer Section 5.2.1).

MER (2000) did indicate the drawdown predicted within the Permian strata could result in a *"loss of aquifer pressure water levels within the coal measures may have impact on existing bores and wells in the hardrock coal measures depending upon location and local recharge mechanisms".* This is discussed further in Section 6.3.

## 4.4 Cumulative impacts

The MER (2000) modelling included a scenario where mining that was approved at the Mount Pleasant mine was included in the model. The Mount Pleasant mine was represented in the model as active when Dartbrook commenced mining the Kayuga Seam in 2003. The modelling indicated the potential for drawdown to be enhanced by cumulative impacts to the south of Dartbrook mine in proximity to Mt Pleasant mine. MER (2000) concluded that whilst there was potential for a cumulative impact, the influence on the predicted groundwater inflow to the Dartbrook mine was small with seepage reducing by less than 2%.

The only other foreseeable project in the region is the West Muswellbrook Project which is a proposed open cut mine located immediately adjacent to the western margin of Dartbrook mine. The West Muswellbrook Project proposes to extract coal from seams stratigraphically higher than those targeted by Dartbrook, with the Blakefield Seam being proposed as the basal target seam. Mining at West Muswellbrook is planned to commence in the north and will progress southwards over a planned 30 year period. A Conditional Gateway Certificate for the West Muswellbrook Project was issued in May 2015, however no further progress has occurred to date. This project is unlikely to commence during the period which Dartbrook mine is seeking a five year extension as an EIS has not been submitted.

Other operating mines in the region are Bengalla mine, located 7 km south of Dartbrook, and Mangoola mine, 15 km south-west. Both mines are located at a distance where the zones of drawdown will not overlap and therefore significant cumulative impacts will not occur.

It is therefore concluded that whilst the approved impacts are based on a relatively old numerical model, the main cumulative impacts, which could occur due to Mt Pleasant mine have be represented. Whilst it is logical there are now changes to the Mt Pleasant mine plan, the MER (2000) work does identify the potential for a cumulative impact between the mines, a logical conclusion considered they are appro mine common coal seams.

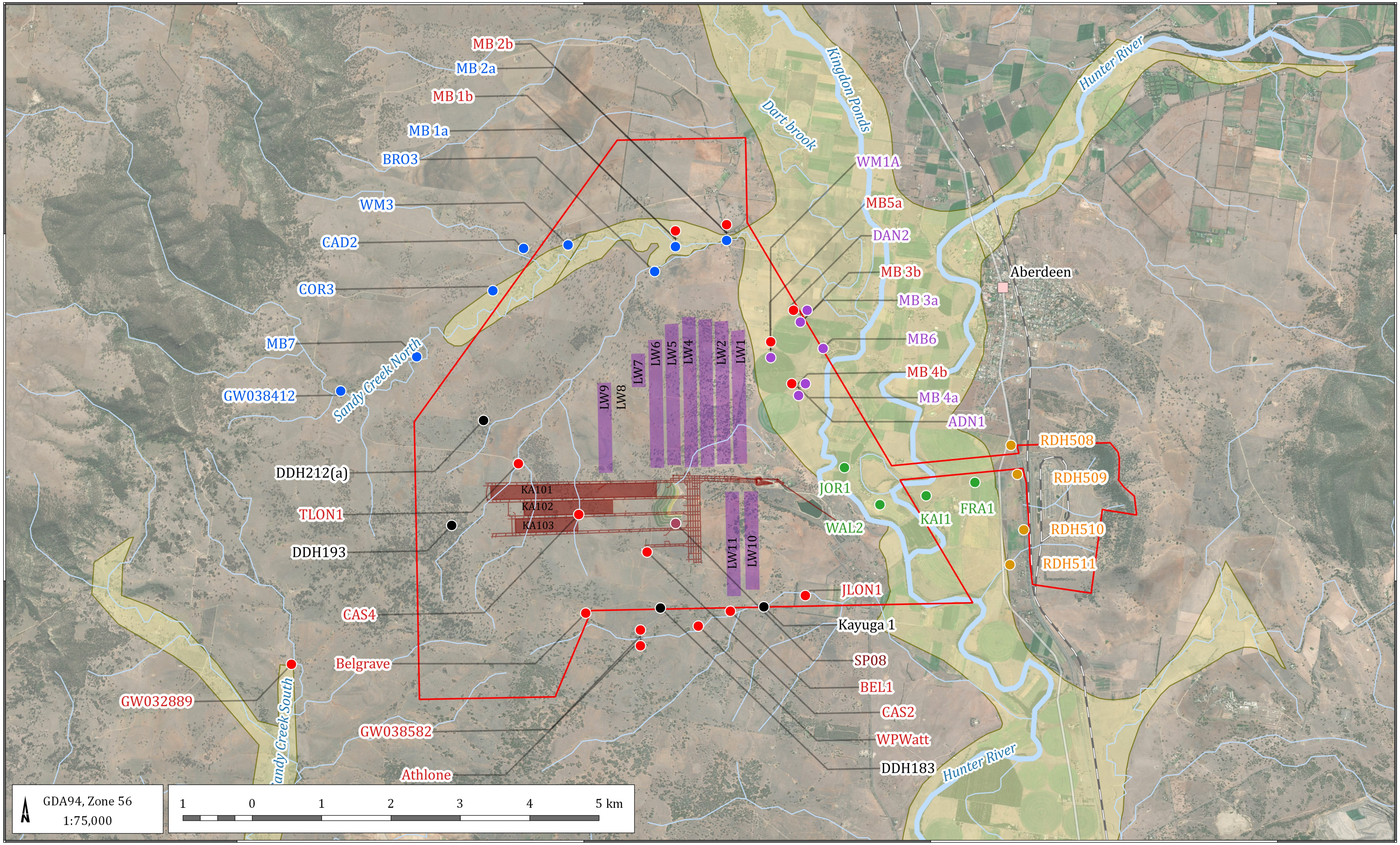
## 4.5 Post mining impacts

The MER (2000) model was also used to simulate the post mining recovery in water levels within the groundwater system. The report notes the rebound in groundwater levels occurs very slowly and a new equilibrium water level was not reached within the 100 year period that was modelled. This is a common prediction in coal mining settings where groundwater inflow rates are relatively low, and long time periods are required to refill the voids left by the collapsed mine workings. Whilst contemporary groundwater assessments typically provide more information on the period of time for the groundwater regime to reach a new equilibrium, the prediction of incomplete recovery at 100 years is considered plausible based on experience at other mines.

# 5 Review of groundwater monitoring data

## 5.1 Groundwater monitoring network

A network of monitoring bores is used to monitor groundwater levels and quality at Dartbrook Mine. The locations of the monitoring sites and the geological unit monitored in shown in Figure 5.1. The groundwater monitoring bore network is designed to measure depressurisation of the coal measures strata created by mine dewatering and drawdown within the alluvium. Groundwater monitoring data was last reviewed by AGE (2018) as part of the annual review and is compared to model predictions in the sections below.




LEGEND

- Populated place
- Mining Authorisation
- Alluvium (Source: 1:250k Singleton Geology Sheet modified after AGE (2007))
- Completed Kayuga Seam Workings
- Extracted Wynn Seam Longwall Panels
- Drainage/creek
- Roman road dyke and SP08
- Hunter River Alluvial Bores
- Regolith Shallow Bedrock Bores
- Sandy Creek Alluvial Bores
- CHPP/REA Monitoring Bores
- Coal Seam Bores
- Dartbrook Alluvial Bores

Dartbrook MOD7 (G1730N)

AGE

**Groundwater monitoring network**

DATE
02/07/2020

FIGURE No:
**5.1**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## 5.2 Groundwater levels

The Dartbrook mine has groundwater monitoring datasets that cover some 20 years and provide an excellent dataset to evaluate the nature of impacts from mining. The general trends evident in the monitoring can be grouped into:

- *Areas to the east where no impact are evident.* Groundwater levels have not declined significantly to the east of the mining areas within the alluvium or overburden. This outcome aligns with the general predictions from the numerical model developed by MER (2000).
- *Strata overlying the mining areas that have declined and not recovered*. Groundwater level trends in bores screened in the overburden directly above the Kayuga longwall panels show groundwater levels decreased in response to mining between 2004 and 2006. Unlike the overburden south-east of the mine area, groundwater levels in the overburden over the Kayuga longwall panels have not recovered post mining as pumping maintains water levels within the Wynn Seam mining area at a level below the pre-mining potentiometric surface.
- *Coal seams outside the mining footprint that show limited drawdown and some recovery.* Decreasing groundwater levels in the coal seams, due to mine-related depressurisation, have been less than that predicted. This is due in part to predictions having been modelled for a 20-year mining period, which did not occur due to the mine being placed in care and maintenance in 2007. Groundwater levels within the coal seam bores have recovered to varying degrees since the cessation of mining and have stabilised at a new equilibrium in response to continued pumping from the Wynn Seam during care and maintenance.

The sections below present water level monitoring data and discuss these trends further.

### *5.2.1 Quaternary alluvium*

Figure 5.2 below shows groundwater levels measured in three monitoring bores installed within the Dartbrook alluvium. The bores are located adjacent to completed Wynn Seam panels and have water level data available over most of the mine life. The cumulative rainfall departure (CRD) for the area is also included on the figure. The CRD is a summation of the monthly departure of rainfall from the long-term average monthly rainfall. A rising trend in the CRD indicates periods of above long-term average rainfall, whilst a falling slope indicates periods when rainfall is below long-term average. Groundwater level trends in aquifers with rainfall as the primary recharge source are commonly correlated with the CRD. This relationship can be used to assess if a decline in groundwater levels is related to climatic conditions, or due to other factors such as over-exploitation or mining.

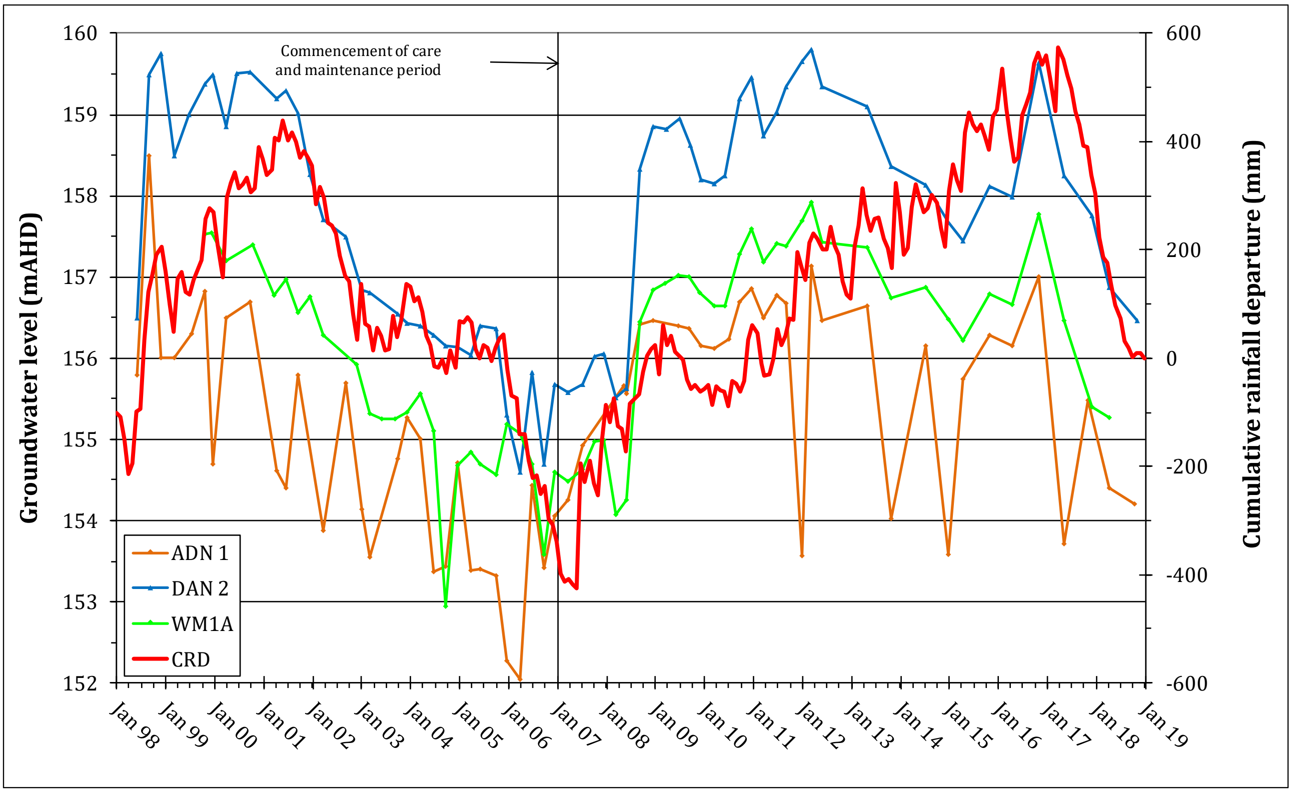



**Figure 5.2 Groundwater levels in Darbrook alluvium**

Figure 5.2 shows groundwater levels trends within the Dartbook allvium adjacent to the completed mining area are correlated with climatic conditions as indicated by the CRD. Where a decline in groundwater level occurs in an alluvial bore, it can be attributed to below average rainfall during the Millennium drought from mid-2001 to mid-2007 and not mining. This is confirmed by a rise in groundwater levels as a result of above average rainfall from mid-2007 to mid-2009 and again during 2010 to 2012 and a subsequent decline in groundwater levels from late 2016 aligned with a decline in rainfall.

The end of the Millennium drought coincidentally corresponded with the mine entering the care and maintenance period, but within continued dewatering from the Wynn Seam. This continued dewatering has had no detectable impact on the groundwater levels within the alluvium.

The groundwater monitoring data within the Dartbrook alluvium, that covers some 20 years confirms the conclusion reached by MER (2000) using numerical modelling that "*existing bores and wells in the alluvial lands will remain unaffected by depressurisation within the coal measures*" was a valid conclusion based on the modelling conducted.

### *5.2.2 Permian strata*

Three monitoring bores are located in Permian strata overlying the Kayuga Seam in proximity to the completed longwall panels. These bores provide information on the residual impact from completed mining activities. CAS4 is screened in the shallow overburden immediately above completed panels in the Kayuga Seam. Bores TLON1 and CAS2 also intersect the overburden and are located approximately 300 m north and south of the panels, respectively (Figure 5.1). The Kayuga Seam panels in this area were mined between 2004 and 2006. Groundwater level trends are compared to the CRD in Figure 5.3.

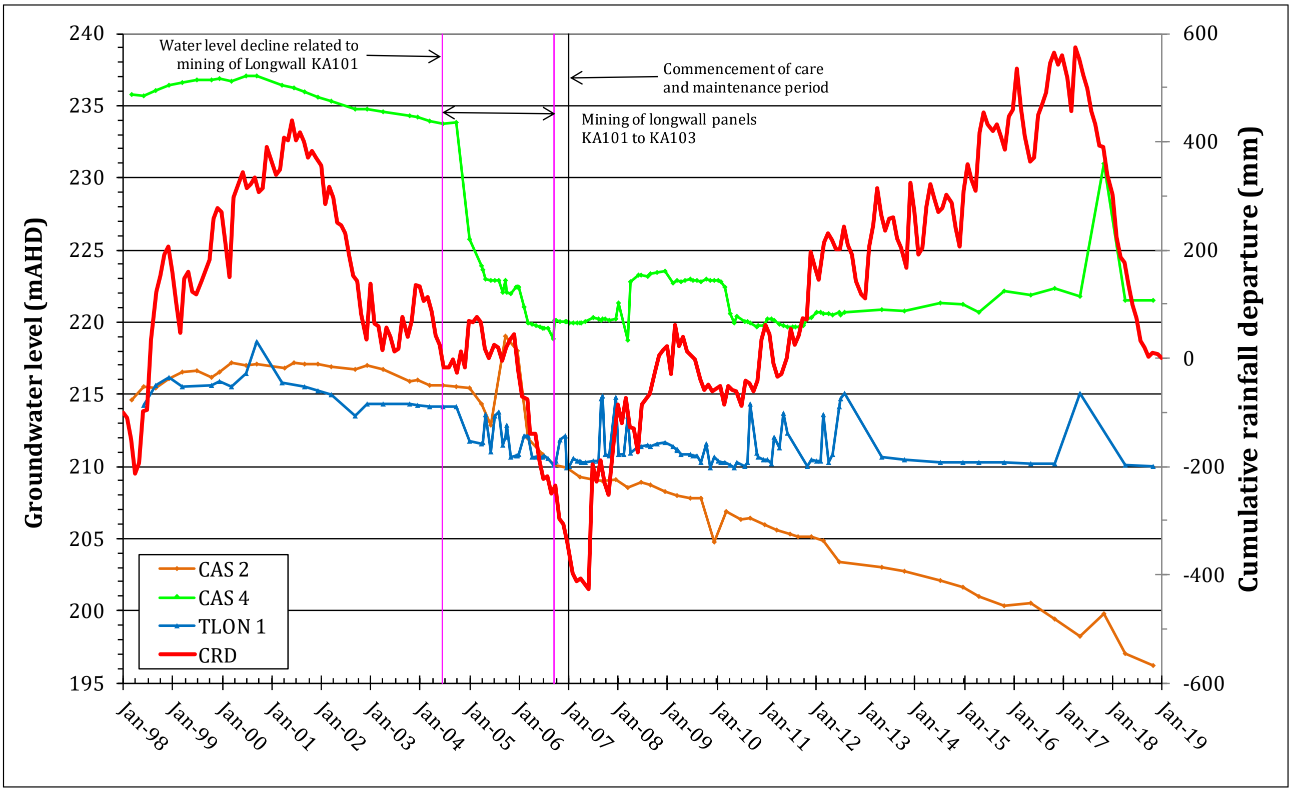



**Figure 5.3 Monitoring bores overlying completed Kayuga Seam longwall panels**

Figure 5.3 shows within the overburden water levels are less correlated with climatic conditions as indicated by the CRD. There is limited response to the above average rainfall conditions that occurred after the end of the Millennium drought, and a decline in water levels due to the underlying longwall mining is clear. Groundwater levels in the overburden over the Kayuga longwall panels have not recovered after mining of the Kayuga Seam was completed.

Since the mine entered care and maintenance the groundwater levels have stabilised in CAS4 and TLON1, while they have continued to decline in CAS2. The groundwater level trends for CAS4 and TLON1 are clearly due to subsidence and associated strata cracking. The level of water level decline is generally aligned with predictions by MER (2000). The continued decline in groundwater levels at CAS2 is likely to be related to the position of the bores between the Kayuga Seam and Wynn Seam longwall panels and the predicted connective cracking. MER (2000) considered a hydraulic connection between the Kayuga Seam goaf and the overburden up to 100 m above the coal seams was likely. This distance approximately corresponds with the depth of CAS2.

### *5.2.3 Permian coal seams*

Figure 5.4 shows groundwater levels of bores screened within coal seams at the mine. It can be seen that during mining of the Kayuga Seam the groundwater levels in all coal seam bores slightly declined. Following the commencement of care and maintenance the groundwater levels in all coal seam bores have remained stable or gradually recovered.

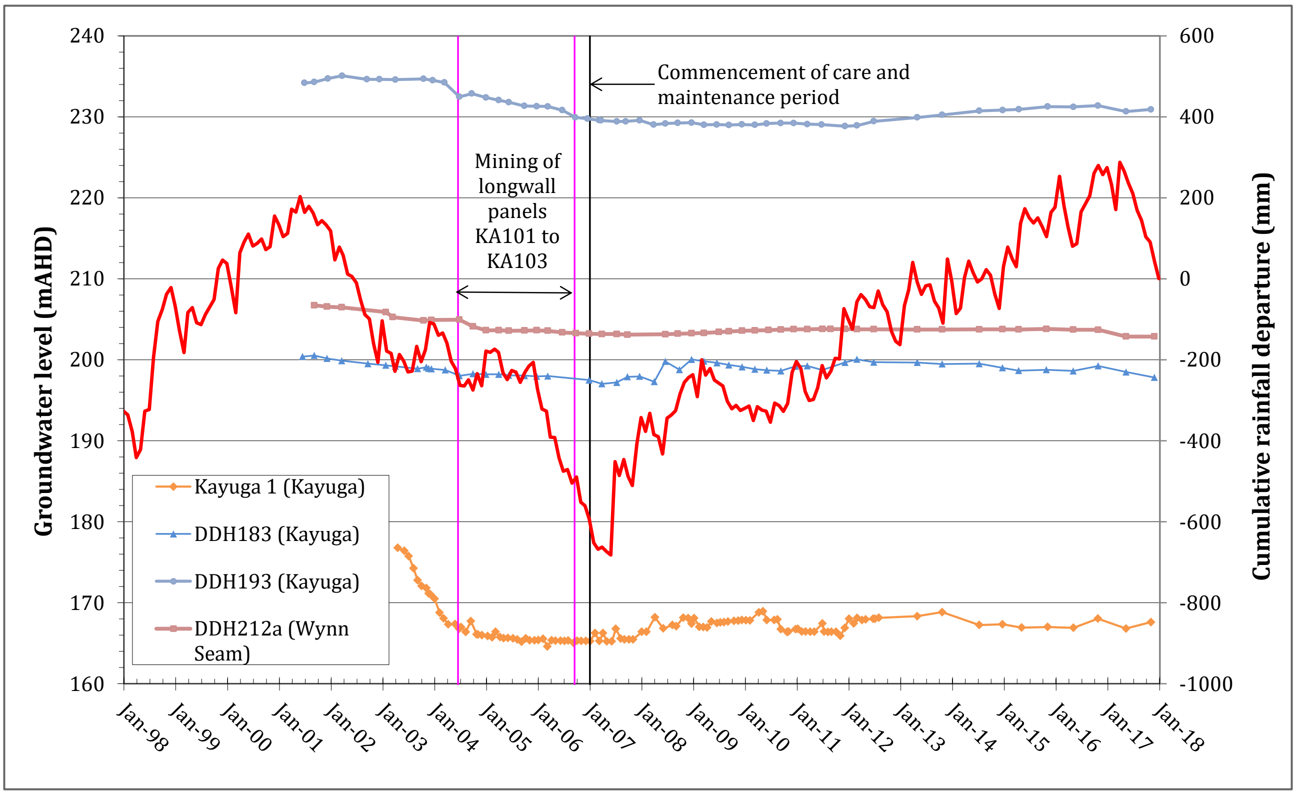



**Figure 5.4 Groundwater levels – coal seam bores**

# 6 Impact of revised MOD7

This section considers the impact of longwall mining restarting and continuing for an additional five years as proposed for the revised MOD7. Groundwater modelling was not conducted for the revised MOD7, rather an opinion is provided on the potential for significant changes to impacts beyond what is already approved based on review of the previously accepted numerical modelling and available groundwater monitoring data.

When considering the potential impacts of the revised MOD7 it has been assumed that the mine plan modelled by MER (2000) cannot practically be mined in five years if MOD7 were to be approved. For the purposes of this assessment it is assumed that mining will recommence in the Kayuga Seam and progress through the remaining approved longwall panels in the order represented in the numerical model by MER (2000) including the Mt Arthur Seam panels. That is, mining will progress to the south (panels KA104 to KA112), before relocating to the northern Kayuga panels (KA113 to KA120), and finishing with the three panels in the Mt Arthur Seam. The MER (2000) numerical model represents this mining being undertaken over a period of about 16 years, and therefore it is highly likely only a portion of the approved Kayuga Seam could be mined within the five year extension being sought as part of the revised MOD7 if the rate of mining is the same. It has therefore been assumed that mining will not be possible within the Piercefield Seam and will not be undertaken.

The impact of the revised MOD7 could differ from the impact of approved mining because of changes to the footprint of mining and the time period of active mining. The influence of these two mechanisms on potential impacts is discussed in the sections below. For the purposes of this discussion it is assumed based on the discussion in previous sections that the general nature of impacts has been previously identified by the MER (2000) numerical model.

## 6.1 Impact of change in footprint

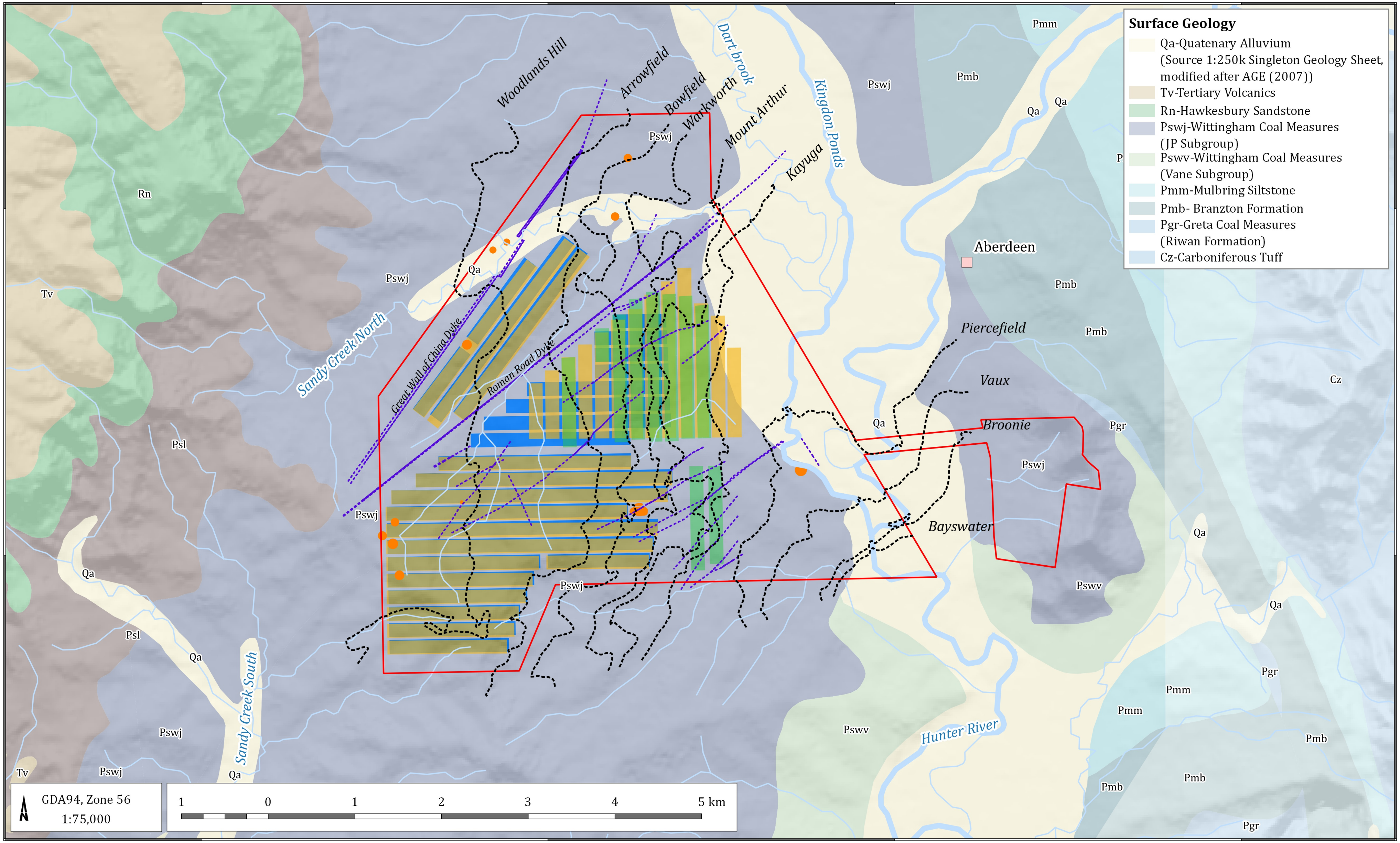
As discussed above for the purposes of this assessment it has been assumed that mining will occur in the Kayuga Seam only. Not mining the Piercefield Seam as part of MOD7 will reduce the magnitude of impacts compared with the approved mining for two reasons. Firstly, the total approved footprint of mining will be reduced, and secondly a direct connection with the alluvial aquifer through the subcrop under the base of the alluvium will not be made.

Figure 6.1 shows where the coal seams subcrop under the alluvial aquifer. It shows that the subcrop for the Piercefield Seam crosses the alluvial aquifer and passes under Dart Brook and the Hunter River east of the mining area. Approved mining of the Piercefield Seam is in relatively close proximity to the alluvium and would depressurise groundwater within the Piercefield Seam.

The drawdown generated by mining the Piercefield Seam would propagate through the coal seam gradually reducing with distance towards the subcrop, which is the connection with the alluvial aquifer. This mining would therefore influence the transfer of water and potentially promote some connectivity with the alluvial aquifer. If the Piercefield Seam is not mined as part of the revised MOD7 this connectivity and associated impact will not occur. In addition, removing the Piercefield Seam longwall panels also reduces the footprint of mining compared to that currently approved, which would result in a reduced zone of drawdown and reduced water take. Because the volume of coal removed by mining would also be reduced the time required for groundwater inflow to flood the mine workings and for the system to rebound to a new equilibrium post mining would be reduced for the revised MOD7.

As noted previously the MER (2000) numerical model represents remaining mining within the Kayuga seam being undertaken over a period of about 16 years. Given the revised MOD7 is only five years, it is highly likely only a portion of the approved Kayuga Seam could be mined within the extension period being sought. If the Kayuga Seam mining were to progress southwards in the order assumed by MER (2000) then it is possible the mining to the north of the completed Kayuga Seam panels would not occur in the available time. If this were to occur it would also further serve to reduce the impacts of MOD7 compared with the approved impacts because the area to the north of the completed panels within the Kayuga Seam is closer to the alluvium and the subcrop connection with alluvial aquifer (Figure 6.1). Mining the Kayuga lonwall panels in closer proximity to the alluvium would generate steeper hydraulic gradients which would result in an increase inflow and drawdown. This is evident in the model predictions presented by MER (2000) which show an increase in groundwater inflow to the Kayuga Seam longwall panels when mining moves to the north in the area closer to the alluvial aquifer.

The removal of the Piercefield Seam, and also the likely reduced footprint within the Kayuga Seam is expected to result in impacts which are less than already approved due to net reductions in footprint and connectivity with the alluvial aquifer.




LEGEND
- Populated place
- Mining Authorisation
- Approved Wynn Seam Longwall Panels
- Approved Piercefield Longwall Panels
- Approved Kayuga and Mt Arthur Seam Longwall Panels
- Seam subcrop
- Dykes
- Drainage/Creek
- Plug

Dartbrook Bord & Pillar MOD (G1730H)

**Seam subcrop**

DATE
02/07/2020

FIGURE No:
**6.1**

## 6.2 Impact of change in mining time period

When groundwater flows into excavations at rates that exceed the rate an aquifer can replenish, a zone of drawdown occurs around the excavation. The zone of drawdown expands outwards with time until it is sufficiently large and draws in the same volume of water that is draining into the excavation. Therefore, in theory, increasing the time of active mining at Dartbrook mine would result in the zone of drawdown expanding and the volume of groundwater intercepted increasing due to the revised MOD7.

However, there are a number of factors that mean the additional time period may not result in impacts that exceed those already approved. MER (2000) simulated the approved mining within the Kayuga and Piercefield seams occurring over a period of 20 years. The revised MOD7 proposes an extension of five years, which in theory would allow up to 25 years of active mining. However, removing the Piercefield Seam longwall panels from the revised MOD7 effectively removes 3.5 years of mining from the project represented by MER (2000), meaning the net extension associated with MOD7 is only about 1.5 years duration.

In addition to this the mine has been in care and maintenance since 2007, with monitoring indicating the groundwater levels within the alluvium are not detectably affected, and the water levels within the coal seams around the mining footprint have reached a new equilibrium level in response to ongoing dewatering and are not continuing to decline. The net effect of this is that there has been limited detectable impact from mining outside the mine footprint since about 2014 when a new equilibrium water level became evident at the coal seam monitoring sites. This is over the mine footprint where monitoring bores are recording slow continuing decline. When considering the area surrounding the mine it could be argued after 2014 there has been limited additional impact from approved mining, and therefore there has only been about 10 years during which a notable impact has occurred from 2003 to 2014. This conclusion does not considerer the influence of the Hunter Tunnel that is not proposed to be changed and therefore not considered in this assessment.

Therefore, whilst increasing periods of mining would theoretically be expected to result in an increased impact , when the care and maintenance period is considered, along with reducing the mining footprint the net effect is the potential less impact than is already approved.

## 6.3 Impact of private water bores

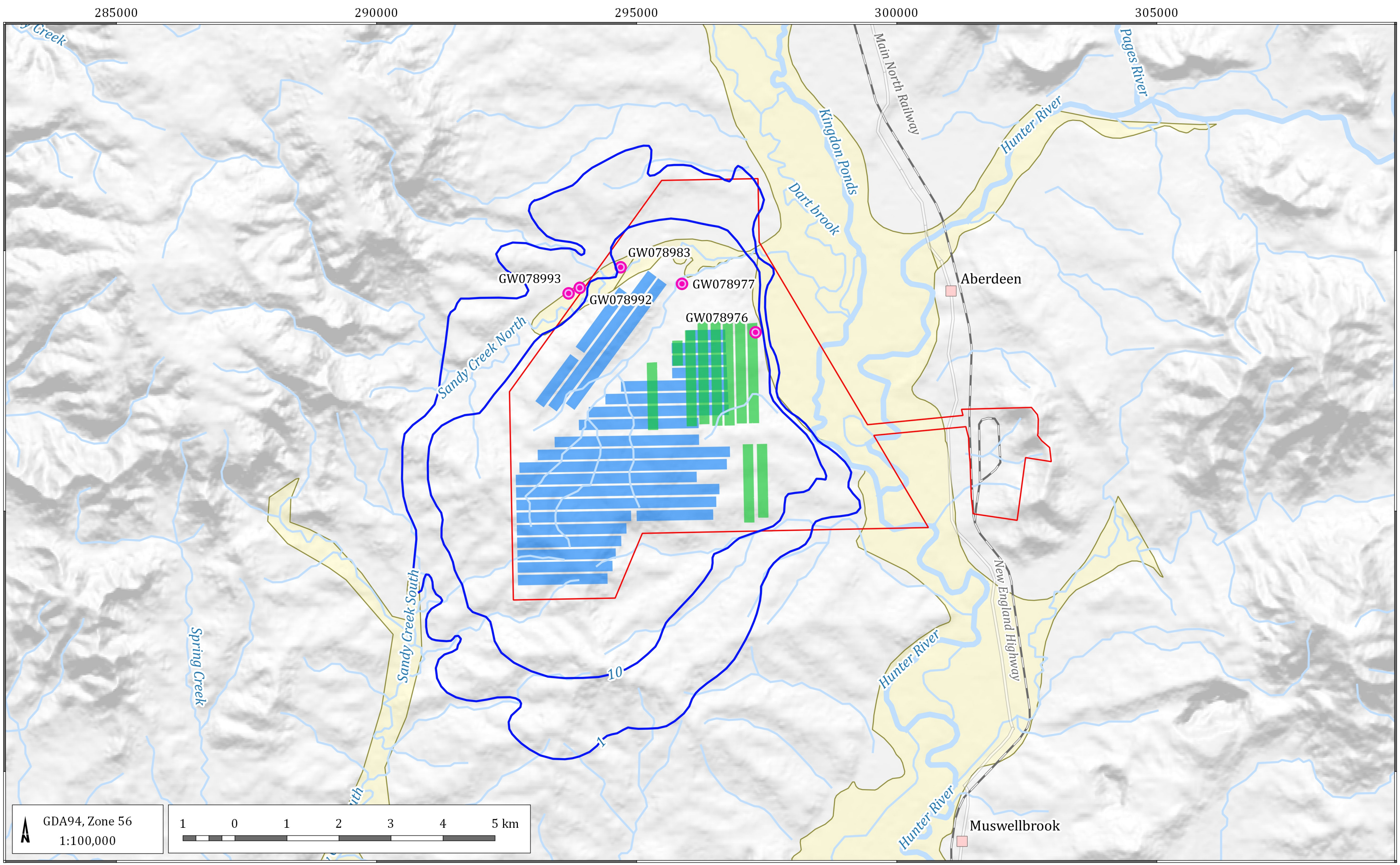
The 1 m and 10 m drawdown contours presented in MER (2000) are shown on Figure 6.2, along with private water supply bores surveyed during a bore census conducted in 2018. Details on the private bores are provided in Table 6.1. Figure 6.2 shows that there are five bores within the 1 m predicted drawdown limit, three of which use windmills to extract groundwater. The 1 m contour was georeferenced and digitised from the MER (2000) report.

As discussed in previous sections, not mining the Piercefield Seam would be expected to reduce the overall net impact on the groundwater regime generated by MOD7, compared to approved mining. The net reduction in drawdown at the private water bores from not mining the Piercefield could be negligible, as this seam is deeper and underlies the Kayuga which it is assumed will be mined as part of MOD7. Therefore, it is considered the potential for impact at the identified private bores remains if the revised MOD7 is approved and longwall mining of the remaining Kayuga Seam panels is undertaken.

The MER (2000) numerical modelling indicated the potential for predicted drawdown impacts on some privately owned registered bores within the Permian strata, to trigger the Aquifer Interference Policy (AIP) Level 2 threshold of the minimal impact considerations as the predicted drawdown is greater than 2 m from baseline conditions (Figure 6.2). Make good provisions will be required with private landholders if the revised MOD7 is approved.

## Table 6.1 Privately owned bores with approved 1 m drawdown limit

| Station name | Bore type | Lot no. | Depth bore (mbgl) | Water level (mbgl) |
|---|---|---|---|---|
| GW078977 | Windmill | 183//DP750951 | 19.03 | 6.65 |
| GW078976 | Windmill | 189//DP750951 | No access available | No access available |
| GW078993 | Windmill | 181//DP750951 | 13.46 | 5.97 |
| GW078992 | Agricultural well | 181//DP750951 | 7.39 | 6.16 |
| GW078983 | Wooden Well | 178//DP750951 | 4.71 | 1.98 |




LEGEND

- Populated place
- Mining Authorisation
- Alluvium (Source: 1:250k Singleton Geology Sheet,modified after AGE (2007))
- Approved Wynn Seam Longwall Panels
- Approved Kayuga and Mt Arthur Seam Longwall Panels
- Rail
- Drainage/creek
- Approved drawdown (m)
- Private water supply bores

Dartbrook Bord & Pillar MOD (G1730H)

DATE 02/07/2020

AGE

**Approved drawdown from MER (2000)**

FIGURE No: **6.2**


G:\Projects\G1730N.Dartbrook MOD7\3_GIS\Workspaces\001_Deliverable1\06.02_G1730N_Approved drawdown from MER (2000).qgs

## 6.4 Aquifer interference policy

### *6.4.1 Water take and licensing*

The AIP (NOW, 2012) states that "*all water taken by aquifer interference activities, regardless of quality, needs to be accounted for within the extraction limits defined by the water sharing plans. A water licence is required under the Water Management Act 2000 …….*" The AIP states that a WAL is required for the aquifer interference activity regardless of whether water is taken directly for consumptive use or incidentally. In all cases, separate access licences are required to account for the take from all individual water sources.

Three Water Sharing Plans are used to manage aquifers and surface waters in the area of the Dartbrook mine, namely the:

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

The Water Access Licences (WALs) AQC currently hold, and can be used to account for water take are summarised in Table 6.2.

**Table 6.2 Summary of WALs currently held by AQC**

| Water sharing plan | Water source | Licence category | Total share component |
|---|---|---|---|
| North Coast Fractured and Porous Rock WSP | Sydney Basin – North Coast Groundwater Source | aquifer | 180 |
| Hunter Regulated WSP | Hunter Regulated River Water Source (Zone 1a) | regulated river | 3,071.8 |
| Hunter Unregulated WSP | Muswellbrook | aquifer | Basic rights |
| | Dart Brook | unregulated river | 85 |
| | | aquifer | 950 |
| | Hunter Regulated River Alluvial | aquifer | 1,249 |

AQC currently hold 180 units from the *Sydney Basin – North Coast Groundwater Source*, which covers groundwater stored within the Permian coal measures strata. The numerical modelling by MER (2000) indicated groundwater inflow would gradually rise over the mine life reaching 180 ML/year when mining of the Kayuga Seam commenced, and peaking at about 584 ML/year at year 20.

The numerical model was calibrated by adjusting properties to produce groundwater inflows aligned with the rates observed during mining of the Wynn Seam. Given the numerical model was calibrated to groundwater inflow it is considered to provide a plausible guide on the volume of groundwater that could be intercepted by the revised MOD7. If all the remaining longwall panels within the Kayuga Seam are mined as part of MOD7 then AQC will need to obtain additional units from within the *Sydney Basin – North Coast Groundwater Source* to account for water taken. Alternatively, if MOD7 is approved and during active mining groundwater inflows are observed to be less than predicted by MER (2000) it will be necessary to update the groundwater model to validate the lower inflows and reconsider licensing requirements.

The numerical model indicated that the drawdown around the mine will reduce groundwater flow to the alluvium by about 36.5 ML/year. AQC hold 950 units from the Dart Brook Water Source and 1,249 units from the Hunter Regulated River Alluvial Water Source. The small indirect water take due to the revised MOD7 can be readily accounted for by water licences already held by AQC.

The MER (2000) numerical model does not indicate if there is an indirect water take from the Hunter River, however given the limited take from the alluvial aquifer (36.5 ML/year), it is considered any indirect take is very limited and easily accounted for as AQC hold 3,071.8 units from the regulated river.

### *6.4.2 Drawdown, water quality and receptor impacts*

In addition to the volumetric water licensing considerations, the AIP requires details of potential:

- water level, quality, or pressure drawdown impacts on nearby water users who are exercising their right to take water under a basic landholder right;
- water level, quality, or pressure drawdown impacts on nearby licensed water users in connected groundwater and surface water sources;
- water level, quality, or pressure drawdown impacts on groundwater dependent ecosystems;
- increased saline or contaminated water inflows to aquifers and highly connected river systems;
- to cause or enhance hydraulic connection between aquifers; and
- for river bank instability, or high wall instability or failure to occur.

In particular, the AIP describes minimal impact considerations for aquifer interference activities based upon whether the water source is highly productive or less productive and whether the water source is alluvial or porous/fractured rock in nature. A "highly productive" groundwater source is defined by the AIP as a groundwater source which has been declared in regulations and datasets, based on the following criteria:

- has a Total Dissolved Solids (TDS) concentration less than 1,500 mg/L; and
- contains water supply works that can yield water at a rate greater than 5 L/s.

Highly productive groundwater sources are further grouped by geology into alluvial, coastal sands, porous rock, and fractured rock. "Less productive" groundwater sources are all other aquifers that do not satisfy the "highly productive" criteria for yield and water quality.

The alluvial groundwater systems occurring in the Project Boundary associated with Sandy Creek, Dart Brook, and the Hunter River have been identified by DoI Water as "highly productive". The Permian coal measures (porous and fractured rock) are categorised as "less productive".

The AIP defines the Minimal Impact Considerations for "highly productive" and "less productive" groundwater sources. There are two levels of minimal impact considerations specified in the AIP. If the predicted impacts are less than the threshold level specified by the Level 1 minimal impact considerations, then these impacts are acceptable under the AIP. Where the predicted impacts are greater than the Level 1 minimal impact considerations, then additional studies are required to fully assess and manage these predicted impacts. If this assessment shows that the predicted impacts do not prevent the long-term viability of the relevant water-dependent asset, then the impacts will be considered to be acceptable.

Table 6.3 and Table 6.4 discuss the potential impacts associated with the revised MOD7 compared with the Level 1 minimal impact considerations from the AIP.

### Table 6.3 Summary of preliminary assessment and AIP considerations - alluvium

| Water sharing plan: Hunter Unregulated and Alluvial Water Sources | |
|---|---|
| **Aquifer** | Alluvial aquifer (Hunter Unregulated and Alluvial Water Sources) |
| **Category** | Highly Productive |
| ***Level 1: Minimal Impact Consideration*** | ***Assessment*** |
| **Water table**<br>Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any:<br>(a) high priority groundwater dependent ecosystem; or<br>(b) high priority culturally significant site;<br>listed in the schedule of the relevant water sharing plan<br>**or**<br>A maximum of a 2 m decline cumulatively at any water supply work. | At the time of writing, there was no Culturally Significant Sites or high priority GDEs located within the study area according to Hunter Unregulated and Alluvial Water Sources WSP. Hence there are no known risks to such sites at this time.<br>Groundwater level drawdown resulting from the approved operations and MOD7 is not predicted to exceed 2 m at any water supply work within the highly productive alluvial aquifers.<br>**Level 1 minimal impact consideration classification** |
| **Water quality**<br>Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity<br>No increase of more than 1% per activity in long-term average salinity in a highly connected surface water source at the nearest point to the activity. | Mining is predicted to induce leakage within the alluvium due to depressurisation of the Permian coal measures. The reduction of saline groundwater flow from the Permian to the alluvium will likely improve the salinity within the alluvium. Therefore, the beneficial use category is not predicted to be affected, nor is salinity expected to increase.<br>After cessation of mining the mine workings will fill with groundwater. There is no evaporative concentration of salts in underground mines and therefore no significant mechanism to promote degradation of surface water or groundwater quality outside the mined area is present.<br>**Level 1 minimal impact consideration classification** |

### Table 6.4 Summary of preliminary assessment and AIP considerations Permian coal measures

| Water sharing plan: North Coast Fractured and Porous Rock Groundwater Sources | |
|---|---|
| **Aquifer** | Permian (Sydney Basin) Porous rock - North Coast Groundwater Source |
| **Category** | Less Productive |
| ***Level 1: Minimal Impact Consideration*** | ***Preliminary assessment*** |
| **Water table** | |
| Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any:<br>(a) high priority groundwater dependent ecosystem; or<br>(b) high priority culturally significant site;<br>listed in the schedule of the relevant water sharing plan<br>**or** | At the time of writing, there were no Culturally Significant Sites or high priority GDEs located in the study area according to the North Coast Fractured and Porous Rock Groundwater Sources WSP. Hence there are no known risks to such sites at this time. |
| A maximum of a 2 m decline cumulatively at any water supply work. | Groundwater level drawdown resulting from the approved operations and MOD7 is predicted to exceed 2 m at water supply works within the less productive Permian strata.<br>**Level 2 minimal impact consideration classification – make good provisions apply.**<br>AQC has previously completed a bore census to understand the use of the bores which have been predicted to be affected as a result of the approved operations and MOD7. IF MOD7 is approved further work will be conducted in consultation with the private landholder to confirm the make good provisions. |
| **Water pressure** | |
| A cumulative pressure head decline of not more than a 2 m decline, at any water supply work | Groundwater level drawdown resulting from the approved operations and MOD7 is predicted to exceed 2 m at water supply works within the less productive Permian strata.<br>**Level 2 minimal impact consideration classification – make good provisions apply.**<br>AQC has previously completed a bore census to understand the use of the bores which have been predicted to be affected as a result of the approved operations and MOD7. IF MOD7 is approved further work will be conducted in consultation with the private landholder to confirm the make good provisions. |

| Water sharing plan: North Coast Fractured and Porous Rock Groundwater Sources | |
|---|---|
| **Water quality** | |
| Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity | Mining is predicted to induce leakage within the alluvium due to depressurisation of the Permian coal measures. The reduction of saline groundwater flow from the Permian to the alluvium will likely improve the salinity within the alluvium. Therefore, the beneficial use category is not predicted to be affected, nor is salinity expected to increase.<br>Post mining the mines will fill with groundwater. There is no evaporative concentration of salts in underground mines and therefore no significant mechanism to promote degradation of surface water or groundwater quality outside the mined area is present.<br>**Level 1 minimal impact consideration classification** |

# 7 Summary and conclusions

The objective of the consultancy engagement was to provide an opinion on the likely magnitude of groundwater impacts generated by a revised MOD 7, compared with the currently approved impacts associated with longwall mining. The objective was not to determine the absolute impacts on groundwater associated with MOD7, but rather to determine if there could be significant changes to the nature of impacts beyond what is already approved.

When considering the potential impacts of the revised MOD7 it has been assumed that the mine plan modelled by MER (2000) cannot practically be mined in the remaining duration of DA 231-7-2000. For the purposes of this assessment it is assumed that mining will recommence in the Kayuga Seam and progress through the remaining approved longwall panels in the order represented in the numerical model by MER (2000). It has also been assumed that mining will not be undertaken within the Piercefield Seam.

The review of the numerical model concluded there were aspects of the model setup, calibration and reporting that are not at a standard expected of contemporary groundwater models prepared for the NSW mining industry. However, this is not unexpected, and as the work was undertaken at a time when there was limited guidance on expectations for numerical models in the public domain. Whilst the model is not consistent with contemporary standards, groundwater monitoring which has been conducted at Dartbrook for up to 20 years has indicated the general predictions of the model are appropriate, and the general nature of impacts for the entire mine life remain plausible.

It is considered unlikely that the impact associated with a revised MOD7 will be greater than approved impacts as the mining footprint and timing is reduced by removal of the Piercefield Seam It is also considered highly unlikely the proposed five year extension will allow sufficient time to mine the remaining Kayuga Seam longwall panels which would further serve to reduce the impact of MOD7 compared with the already approved impacts.

To comply with the AIP that was released after the mine was approved will require make good agreements for five private water bores and obtaining further water entitlements from the *Sydney Basin – North Coast Groundwater Source*. The existing groundwater monitoring network has been well maintained and should serve to assess the impact of further mining at Dartbrook Mine.

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# *APPENDIX E*
# *Social Response*

# DARTBROOK MINE
# MODIFICATION 7

# SOCIAL RESPONSE

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# ABBREVIATIONS

| Term | Description |
|---|---|
| ABS | Australian Bureau of Statistics |
| ACHMP | Aboriginal Cultural Heritage Management Plan |
| AGE | Australasian Groundwater and Environmental Consultants |
| AIP | NSW Aquifer Interference Policy |
| AQC | AQC Dartbrook Management Pty Ltd |
| BSAL | Biophysical Strategic Agricultural Land |
| CHPP | Coal Handling and Preparation Plant |
| CIC | Critical Industry Cluster |
| DPI | NSW Department of Primary Industries |
| DPIE | NSW Department of Planning, Industry and Environment |
| EA | Environmental Assessment |
| Equine CIC | Equine Critical Industry Cluster |
| EP&A Act | *Environmental Planning and Assessment Act 1979* |
| ERP | Estimated Resident Population |
| ha | Hectares |
| HTBA | Hunter Thoroughbred Breeders Association Inc |
| IPC | Independent Planning Commission |
| $km^2$ | Square kilometres |
| LEC | Land and Environment Court |
| LEP | Local Environmental Plan |
| LGA | Local Government Area |
| MB | Mesh Block |
| MER | Mackie Environmental Research |
| MSC | Muswellbrook Shire Council |
| Mt | Million tonnes |
| Mtpa | Million tonnes per annum |
| NSW | New South Wales |
| REA | Rejects Emplacement Area |
| ROM | Run of Mine |
| SA2 | Statistical Area Level 2 |
| SAI | Social Area of Influence |
| SIA | Social Impact Assessment |
| TRA | Tourism Research Australia |
| The Proponent | AQC Dartbrook Management Pty Ltd |

| Term | Description |
|---|---|
| PSMP | Property Subsidence Management Plan |
| UCL | Urban Centre and Locality |
| UHS | Upper Hunter Shire |
| UHSC | Upper Hunter Shire Council |
| VLAMP | NSW Voluntary Land Acquisition and Mitigation Policy |
| VPA | Voluntary Planning Agreement |
| WAL | Water Access Licence |

# DARTBROOK MINE MODIFICATION 7
# SOCIAL RESPONSE

***for***
***Sparke Helmore Lawyers***

## 1 INTRODUCTION

Hansen Bailey was commissioned by Sparke Helmore Lawyers to respond to contentions raised by the Independent Planning Commission (IPC) in their determination of the Dartbrook Mine Modification 7 application (the Modification).

### 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. Dartbrook Mine is the subject of Development Consent DA 231-7-2000 granted under the *Environmental Planning and Assessment Act 1979* (EP&A Act). DA 231-7-2000 (and its subsequent modifications) authorise the operation of an underground longwall mine and ancillary surface infrastructure.

In February 2018, AQC sought a further modification to DA 231-7-2000 (the Modification) to enable an alternative method of underground mining (bord and pillar mining), an alternative coal clearance system (truck haulage of run of mine [ROM] coal) and a five year extension to the approval duration. The impacts of these activities were assessed in the *Dartbrook Mine Modification 7 Environmental Assessment* (Hansen Bailey, 2018) (MOD7 EA) and additional supporting information.

The IPC determined the Modification application in August 2018 by approving the alternative mining method and coal clearance system, but refusing the five year extension to the approval duration. The IPC's determination is currently the subject of Class 1 proceedings in the Land and Environment Court (LEC).

The IPC refused the time extension component of the Modification largely on the ground that the potential impacts of the approved longwall mining during the additional five years had not been adequately assessed. Specifically, the IPC has contended that the Social Impact Assessment (SIA) prepared for the Modification did not adequately assesses the extension of the existing approval (DA 231-7-2000) for an additional five years. The SIA undertaken for the Modification assumed a construction workforce of 26 personnel and an operational workforce of 99 personnel. This operational workforce was related to the proposed bord and pillar mining activities.

### 1.1.1 ~~Revised~~ Modification Description

The Modification ~~originally consisted~~consists of the following components:

- 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 (i.e. an alternative coal clearance system); and
- Extending the approval period under DA 231-7-2000 by five years (until 5 December 2027) (the Extension Period).

In light of the IPC's decision and AQC's ensuing consideration of its position, the ~~scope of the Modification has been altered in the following respects:~~modified development consent would authorise:

- Extraction of up to 37.4 million tonnes (Mt) of ROM coal using bord & pillar and/or longwall mining methods between 2021 and 2027 (inclusive). All mining will occur within the currently approved mining footprint and maximum production rate of 6 million tonnes per annum (Mtpa~~);~~). Longwall mining will be subject to approval of an Extraction Plan demonstrating that the subsidence impacts will be limited to those predicted by Holt (2000) in the original Environmental Impact Statement;
- During the five year extension period it is to be assumed that 30 Mt of ROM Coal resulting in 22.5 Mt of product coal will be produced;
- Delivery of ROM coal from the mine workings to the East Site using the Hunter Tunnel (i.e. ~~truck haulage of coal is no longer proposed);~~proponent is willing to accept refusal of the alternative coal clearance system);
- Use of the existing Coal Handling and Preparation Plant (CHPP) at the East Site to wash all ROM coal extracted (including washing of coal extracted through bord & pillar mining);
- Disposal of rejects and tailings using the already approved methods;
- No new surface infrastructure (i.e. ~~the shaft facility adjacent to the Western Access Road is no longer proposed~~proponent is willing to accept refusal of the alternative coal clearance system); and
- Operational workforce of up to 292 personnel, consistent with the employment during previously approved longwall mining operations.

## 1.2 PURPOSE AND SCOPE

This report responds specifically to the contentions of the IPC with respect to social issues. The assessment has been commissioned by Sparke Helmore Lawyers for consideration by the LEC as part of a Class 1 merits appeal to a previous IPC determination of a Modification Application in which a proposed five year extension of mining operations was not approved.

The scope of the report is to:

- Present a desktop analysis of the population, industry and employment, and land use changes (trends) in the local area since DA 231-7-2000 was approved.
- Assess the potential impacts of the additional five years of mine life (the Extension Period) on the Equine Critical Industry Cluster (Equine CIC).
- Consider the agricultural production from AQC's land holdings and the flow-on socio-economic benefits. AQC owns a substantial area of highly productive agricultural land and water licences that enable agricultural enterprises to be conducted concurrently with underground mining operations.
- Assess the potential social impacts of the Extension Period based on ~~revised~~the modification description presented in Section 1.1.1 and the changes in the local area described in Section 2.

## 1.3 DOCUMENT STRUCTURE

The report is structured as follows:

- **Section 1** – Introduction - provides the background to the Modification and describes the purpose and scope of the report.
- **Section 2** – Land Use Considerations – responds to the issues raised by the IPC with respect to changing land use, culture and values in the area proximate to the Dartbrook Mine.
- **Section 3** – Equine CIC Considerations - describes the equine industry proximate to the Dartbrook Mine, considers the potential impacts of the Modification on land identified as Equine CIC and the surrounding equine industry.
- **Section 4** – Presents the outcomes of an assessment of potential social impacts associated with the Extension Period.
- **Section 5** – Presents the references list.

## 1.4 REPORT LIMITATIONS

The report has been prepared based on a desktop assessment only. No detailed analysis of historical development assessment information (e.g. development approvals) has been undertaken to inform the assessment. Land zoning plans associated with superseded Regional Plans (i.e. Hunter Regional Environmental Plan 1989) or Local Environment Plans (LEPs) (i.e. e.g. Muswellbrook LEP 1985) were not available for review. Where possible, zoning and land use Information has been drawn from a review of approval documents for surrounding land developments.

There are also data limitations. Within this report, Australian Bureau of Statistics (ABS) Census data is used to describe trends in population, demography, industry growth and industry sector employment between 2001 and 2016. However, changes in ABS geographical boundaries during this period (primarily between the 2006 ABS Census and the 2011 ABS Census) makes it difficult to compare data across the approximate 20-year period. Further, where ABS census data is relied on, trends are based only on data up to and including the 2016 census period. Statistical data for the horse breeding industry located in the Upper Hunter Shire (UHS) and Muswellbrook Shire Local Government Areas (LGAs) is also limited.

# 2 DEMOGRAPHIC, INDUSTRY SECTOR AND LAND USE CHANGE

## 2.1 INTRODUCTION

This section presents an analysis of the changes that have occurred in the area surrounding Dartbrook Mine since the granting of DA 231-7-2000 with reference to the following indicators:

- Population change and forecast population growth (Section 2.2);
- Building approvals (Section 2.2);
- Housing market conditions (Section 2.32.2);
- Industry sector employment (Section 2.4); and
- Changes in surrounding land use and land use designation (Section 2.5).

This section includes a summary of the potential implications of changes in the local area for the period from 2023-2027 (Extension Period). It also provides further information regarding the local issues and perceptions prevalent in the LGAs of UHS and Muswellbrook to support the later assessment of social impacts of the Extension Period.

The information presented in this section informs the assessment of social impacts of the Extension Period presented in **Section 4**.

The IPC contends that the social impact for Modification 7:

> *(i) did not take into account the changes in the areas surrounding the Project site (particularly, growth in residential use, tourism and agriculture, especially the equine industry) since mining activities were approved at Dartbrook under the Approval*

The discussion presented in the following section demonstrates that the local area i.e. the area proximate to the Dartbrook Mine has not experienced substantial change via growth in residential use, tourism and agriculture since the granting of DA 231-7-2000. It does demonstrate the growth in the surrounding mining industry and associated land use in the local area. The potential social impacts of the Extension Period are unlikely to be substantially different to that assessed as part of the approval of DA 231-7-2000.

## 2.2 POPULATION, HOUSEHOLD AND DWELLING CHANGES

### 2.2.1 Overview

Population, household and dwelling trend data and forecasts for the LGAs of UHS and Muswellbrook has been reviewed to inform an understanding of the scale of population growth and residential land use change in the LGAs of UHS and Muswellbrook.

Data has primarily been drawn from the Australia Bureau of Statistics (ABS), specifically the 2006, 2011 and 2016 Census. Availability of data pre 2006 is limited due to changes in ABS geographical area boundaries, notably LGA boundaries.

### 2.2.2 Summary Findings

In summary, the data analysis presented in the following sections for the period 2001-2019 shows:

- Steady, but small population growth in the Muswellbrook LGA, with the majority of growth concentrated in the Muswellbrook Statistical Area Level 2 (SA2) and principally the regional centre of Muswellbrook. Between 2001 and 2019 the population of the Muswellbrook LGA increased by 8.5% (1,278 persons) or an annual average population increase of 0.5%.
- Steady, but small population growth in the UHS LGA, with the majority of this growth located outside the regional centre of Scone. Between 2001 and 2019 the population of the UHS LGA increased by 5.5% (750 persons) equal to an annual average population increase of 0.3%.
- Population decline (2.3% or 334 persons) in the UHS LGA between 2013 and 2019.

Analysis of population data for Aberdeen Urban Centre and Locality (UCL) shows an increase in population of 186 people (10.9% or an annual average increase of 0.7%) and an increase in dwelling counts of 164 (23.7% on average ~ 50 additional dwellings each inter census period) in the 15 years to 2016.

Based on ABS Mesh Block (MB) data, between 2011 and 2016 the population of the area within and surrounding the Dartbrook Mine Mining Authorities Boundary (Mining Authorities Boundary) increased by 27.5% (82 persons) and dwelling counts increased by 23.6% (33 dwelling units). The majority of this growth has occurred in the south eastern area of Aberdeen township and areas to the north and east of the Mining Authorities Boundary (i.e. north of Halls Road).

With respect to forecast population and dwelling growth:

- The population of UHS LGA is projected to decrease by approximately 7% to an estimated 13,200 people by 2036. Household and implied dwelling projections are generally in line with the projected changes in population (DPIE, 2020b) i.e. minimal.
- The population of Muswellbrook LGA is projected to increase by approximately 11% to 18,186 by 2036 (DPIE, 2020b) with a corresponding increase in dwelling numbers. However, the percentage change in population and dwelling numbers in Muswellbrook LGA to 2036 is projected to be smaller than for NSW.

### 2.2.3 Population Growth

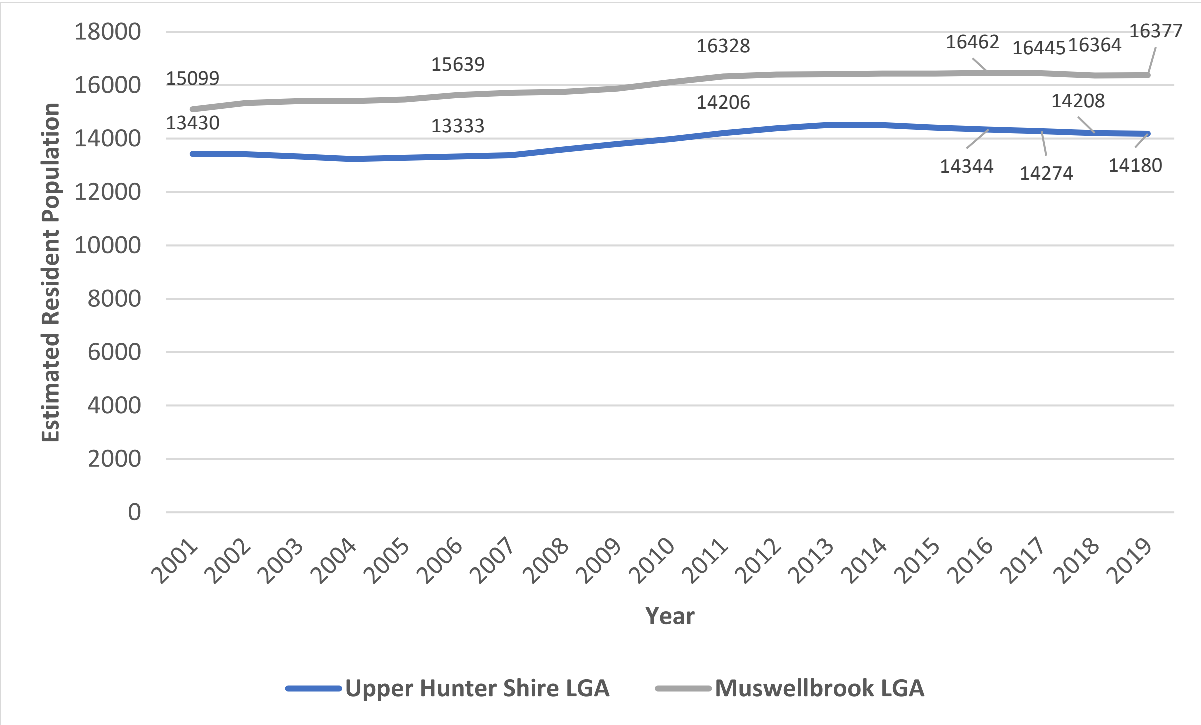
***Local Government***

The regional area for the Dartbrook Mine is defined as the Muswellbrook and UHS LGAs. Muswellbrook LGA has an area of 3,402 square kilometres ($km^2$) and had an Estimated Resident Population (ERP) in 2019 of 16,377 (ABS, 2020a). The UHS LGA has an area of 8,096 $km^2$ and had an ERP of 14,180 persons in 2019 (ABS, 2020a).

Graph 1 shows the population growth experienced in Muswellbrook and UHS LGAs between 2001 and 2019. Graph 1 shows a steady, but small increase in population across both LGAs. Between 2001 and 2019 the population of UHS LGA increased by 5.5% (750) compared to 8.5% (1,278) in Muswellbrook LGA and 23.9% across NSW. Population growth in Muswellbrook LGA has fluctuated from a low of 0% in 2004 to a high of 2.1% in 2012.

Within Muswellbrook LGA, the Muswellbrook and Denman urban areas have been the primary clusters of the population growth with an estimated 70% of the total population residing in Muswellbrook (MSC, 2017b).

**Graph 1**
**Population Growth 2001-2019 – Muswellbrook, UHS LGAs**




*Source:* (ABS, 2020a)

***Nearby Communities***

Muswellbrook and Scone

Analysis of population growth from 2001 to 2019 (ABS, 2020b) in the smaller areas of Muswellbrook SA2 (which includes the urban area of Muswellbrook) and Scone SA2 (which includes the urban area of Scone but excludes Aberdeen) shows:

- Steady population growth in Muswellbrook SA2. The population of Muswellbrook SA2 increased by 10.2% (1,150) between 2001 and 2019.
- Steady population growth in Scone SA2 between 2001 and 2013 (peaking at 6,215) followed by population decline to a low of 5,783 in 2019. Between 2001 and 2019 the population of Scone SA2 increased by 7.3% (395).

The majority of population growth in Muswellbrook SA2 occurred in the ten years from 2001 to 2011. Between 2011 and 2019 the population of Muswellbrook SA2 increased by just 150 people (1.3%).

The analysis of population growth in Scone SA2 suggests the majority of population growth in the UHS LGA has occurred outside of the key regional centre of Scone. Conversely the majority of growth in Muswellbrook LGA has occurred within the Muswellbrook SA2, likely within the regional centre of Muswellbrook.

Aberdeen Township

The township of Aberdeen is the closest township to the Dartbrook Mine, located 4.5 km north-west of Dartbrook Mine. The existing Dartbrook CHPP is located 1.3 km from the southernmost extent of Aberdeen and 2.3 km from the town centre. In 2016 Aberdeen UCL had an ERP of 1,894 persons, representing approximately 13.2% of the population of the UHS LGA (ABS, 2020b) (Table 1).

Table 1 presents population data for the Aberdeen UCL for the ABS census periods of 2001 (ABS, 2002), 2006 (ABS, 2007), 2011 (ABS, 2012b) and 2016 (ABS, 2017a). This data has been analysed to understand population change in the Aberdeen township during the period to which DA 231-7-2000 has applied.

Table 1 shows:

- The population of Aberdeen UCL increased by approximately 10.9% between 2001 and 2016 with a corresponding 23.7% increase in the number of private dwellings.
- The highest rate of inter census population growth occurred between 2001 and 2006 (4.9% or 83 persons) i.e. immediately following the granting of DA 231-7-2000.
- Fluctuations in the number of families residing in Aberdeen.

- The rate of population growth in Aberdeen UCL between 2006 and 2016 was approximately 5.8% (103), slightly less than the rate of population growth experienced across the broader UHS LGA (ABS, 2007; ABS, 2017a).

The population and dwelling increases experienced in Aberdeen UCL between 2011 and 2016 are likely associated with the subdivision of land by the UHS Council in 2011 and the release of this land for residential development. This is evidenced in the analysis of MB Data (see later discussion) which shows a significant increase in population and dwelling counts in the locality of the subdivision (Perth Street, Aberdeen). A desktop review of residential dwelling approvals on the UHS website also shows a prevalence of residential dwelling approvals in Aberdeen during this period.

**Table 1**
**Selected Statistics for Aberdeen UCL 2001-2016**

| Aberdeen UCL | 2001 | 2006 | 2011 | 2016 | Change 2001-2006 |
|---|---|---|---|---|---|
| Population | 1708 | 1,791 | 1837 | 1,894 | 186 (10.9%) |
| Private Dwellings | 692 | 746 | 799 | 856 | 164 (23.6%) |
| Families | 474 | 497 | 515 | 499 | 25 (8.3%) |
| Median Age | na | 37 | 36 | 37 | na |

*Source:* (ABS, 2002; ABS, 2007; ABS, 2012b; ABS, 2017a)

### *Population Within and Adjoining Dartbrook Mine*

- ABS MB data has been used to understand changes in population and dwelling numbers proximate to the Dartbrook Mine Mining Authorities Boundary. MBs are small areas for which the ABS produces only a population count and dwelling count.

Table 2 presents MB data for the area within and adjoining the Mining Authorities Boundary. The selected MBs cover an area of approximately 135 km$^2$. In 2016 all land within the selected MBs (with the exception of two small MB areas [equal to 1 km$^2$]) were categorised as primary production land (ABS, 2017b) consistent with the corresponding LEP land use zonings. Land classifications were not included in the 2011 MB data.

Table 2 shows an increase in both population and dwelling numbers in the subject MB areas between 2011 and 2016. During this period the population of the combined MB areas increased by 27.5% (82 persons). Significant increases in population and dwelling counts have occurred in areas to the north and west and outside of the Mining Authorities Boundary and in the urban footprint of Aberdeen.

Between 2011 and 2016 the most significant population changes occurred in the following MBs:

- MB 10789070000 (2011/2016) – population increase of 86% (31) and dwelling increase of 106% (16). This MB includes land to the north and west of the Mining Authorities Boundary but excludes land within the Mining Authorities Boundary.
- MB 10788201000 (2011) and MB 11205392000 (2016) – significant increase in both population and dwellings. This MB is designated residential and generally align with the south eastern portion of Aberdeen township adjoining AQC owned land, and includes Perth Street. The population and dwelling increases are related to the subdivision of land along Perth Street for residential development.
- MB 10789060000 (2011/2016) – population increase of 29 and dwelling increase of 5. This MB is located to the immediate west of Aberdeen and the Hunter River and includes the majority of the Mining Authorities Boundary that is located within the UHS LGA.
- MB 11204480100 (2016) – population decline of 19 and an increase of 4 dwellings. This MB is located west of the New England Highway and Hunter River and includes the majority of the Mining Authorities Boundary that is located within the Muswellbrook LGA It includes the township of Kayuga. Land associated with the Mt Pleasant Mine is also located within this MB. The population decline in this area is likely associated with the acquisitions and or population movements for the Mt Pleasant Mine.

**Table 2**
**Mesh Block Data 2011 and 2016**

| **2011 ABS Census** | | | **2016 ABS Census** | | | |
|---|---|---|---|---|---|---|
| **Mesh Block** | **Dwelling** | **Person** | **Mesh Block** | **Area ($km^2$)** | **Dwelling** | **Person** |
| 10789060000 | 9 | 14 | 10789060000 | 21.07 | 14 | 43 |
| 10531460000 | 5 | 10 | 10531460000 | 25.34 | 10 | 8 |
| 10531450000 | 23 | 60 | 11204480100 | 21.51 | 30 | 48 |
| 10531440000 | 3 | 7 | | | | |
| 10531430000 | 0 | 0 | | | | |
| 10529860000 | 10 | 16 | 11204486900 | 16.24 | 10 | 21 |
| 11014880000 | 0 | 0 | 11014880000 | 0.09 | 0 | 0 |
| 10788350000 | 72 | 151 | 11205103800 | 8.66 | 51 | 114 |
| | | | 11205393600 | 5.49 | 9 | 25 |
| 10788201000 | 3 | 4 | 11205392000 | 0.90 | 18 | 54 |
| 10789070000 | 15 | 36 | 10789070000 | 36.07 | 31 | 67 |
| **Total** | **140** | **298** | | **135.37** | **173** | **380** |

*Source:* (ABS, 2012; ABS, 2017b)
*Notes: 2011 and 2016 Mesh Block references are listed in order of alignment e.g. 10789060000 in 2011 is the same area as 10789060000 in 2016.*

### 2.2.4 Population, Dwelling and Household Forecasts

The NSW Government released population, household, and implied dwelling projections for LGAs in NSW in 2019. Table 3 presents projections to 2036 for the LGAs of interest and NSW. The population of Muswellbrook LGA is projected to increase by approximately 11% to 18,186 by 2036 (DPIE, 2020b). The population of UHS LGA is projected to decrease by approximately 7% to an estimated 13,200 people by 2036 (DPIE, 2020b). Household and implied dwelling projections are generally in line with the projected changes in population.

***Population Projections***

The NSW Department of Planning, Industry and Environment (DPIE) 2019 population projections for Muswellbrook LGA indicate that the:

- Population of Muswellbrook LGA is estimated to increase by 1,900 people between 2016 and 2041, from 16,450 to 18,350. Muswellbrook's population growth will be driven largely by natural increase.
- Working age population (aged 15-64) is estimated to remain stable, moving from 10,650 in 2016 to 10,600 in 2041 – a change of 50.
- Number of children aged 14 and under is estimated to change by 300 children, from 3,800 in 2016 to 3,500 in 2041.
- Number of people aged 65 and over is estimated to increase from 2,000 in 2016 to 4,300 by 2041 - a change of 2,300 (DPIE, 2020a).

The DPIE 2019 population projections for UHS LGA indicate that the:

- Population of UHS LGA is estimated to decrease by 1,650 people between 2016 and 2041, from 14,350 to 12,700. There is predicted to be a continued movement of young families out of the area.
- Working age population (aged 15-64) is estimated to decrease by 8,800 in 2016 to 7,000 in 2041 – a change of 1,800.
- Number of children aged 14 and under is estimated to change by 1,000 children, from 3,050 in 2016 to 2,050 in 2041.
- Number of people aged 65 and over is estimated to increase from 2,550 in 2016 to 3,700 by 2041 - a change of 1,150 (DPIE, 2020c).

**Table 3**
**Population Projections for the Regional Area**

| Geographic Area | 2016 | 2026 | 2036 | Change (%) 2016-2036 |
|---|---|---|---|---|
| **Population Projections** | | | | |
| Muswellbrook LGA | 16,462 | 17,578 | 18,186 | 10.5 |
| UHS LGA | 14,344 | 13,948 | 13,200 | -8.0 |
| NSW | 7,732,858 | 9,011,010 | 10,077,964 | 30.3 |
| **Household Projections** | | | | |
| Muswellbrook LGA | 6,452 | 7,256 | 7,796 | 20.8 |
| UHS LGA | 5,820 | 5,958 | 5,864 | 1.0 |
| NSW | 2,903,516 | 3,443,630 | 3,910,857 | 34.7 |
| **Implied Dwelling Projections** | | | | |
| Muswellbrook LGA | 7,563 | 8,085 | 8,505 | 12.5 |
| UHS LGA | 6,710 | 6,813 | 6,869 | 2.4 |
| NSW | 3,200,831 | 3,510,142 | 3,783,939 | 18.2 |

*Source*: (DPIE, 2020b)

***Household Projections***

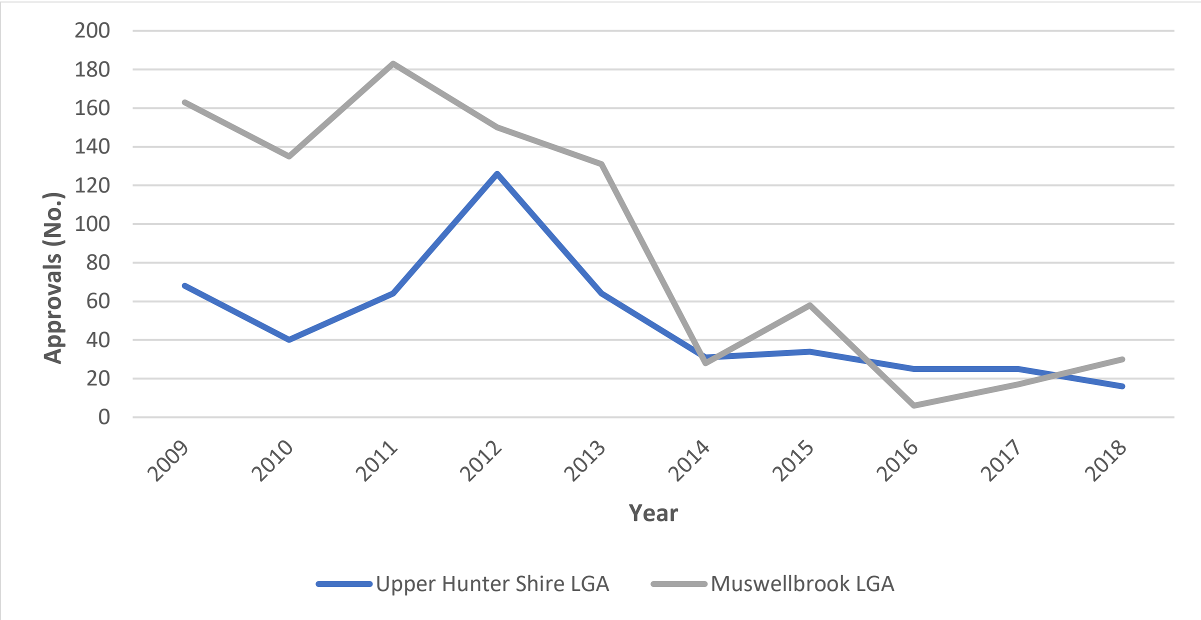
The DPIE 2019 household projections indicate that the:

- Number of households in the UHS LGA is projected to experience negligible increase between 2016 and 2036. This aligns with the forecast population decline.
- Population and household growth forecast in UHS LGA points to relatively minimal change (2.4%) in the number of dwellings in the LGA, suggesting limited future growth in the key centre of Scone or the small community of Aberdeen.
- Number of households in the Muswellbrook LGA is forecast to increase by 20.8%, less than the forecast growth across NSW between 2016 and 2036.
- Dwelling projections for Muswellbrook LGA show an increase of 12.5% between 2016 and 2036, less than the 18.2% growth anticipated across NSW for the same period (DPIE, 2020b).

### 2.2.5 Building Approvals

Building approvals data can provide an indication of population growth and the expansion of urban areas. Residential building approvals data from REMPLAN (2020a; 2020b) was reviewed. Graph 2 presents the number of residential building approvals (e.g. detached houses, townhouses and flats) between 2009 and 2018 for the LGAs of UHS and Muswellbrook. Graph 2 shows similar residential approval trends across both LGAs of interest suggesting common influencing factors. The sharp increase in approvals from 2010 and peak in 2011/2012 aligns with small but sustained population growth in both LGAs and corresponding expansion in the surrounding mining industry which would have generated demand both directly and indirectly for additional residential accommodation (rental and purchase).

**Graph 2**
**Residential Building Approvals – 2009-2018**




*Source:* (REMPLAN, 2020a; REMPLAN, 2020b)

Between 2009 and 2018 in Muswellbrook LGA, residential building approvals peaked in 2011 (183 approvals), with an associated value of approximately $43 M (REMPLAN, 2020a). From 2013, the number of annual residential building approvals dropped substantially, to a low of six approvals in 2016.

In the UHS LGA, residential building approvals (126 approvals) peaked in 2012, with an associated value of approximately $33.9 M (REMPLAN, 2020b). Graph 2 shows that the number of residential building approvals in the UHS LGA were consistently lower than Muswellbrook LGA between 2009 and 2013, after which residential approvals in both LGAs declined to a similar number. In 2018, Muswellbrook LGA and UHS LGA had similar residential building approval values, at $8.6 M, and $8 M respectively (REMPLAN, 2020a; REMPLAN, 2020b).

## 2.3 HOUSING MARKET CHARACTERISTICS

This section provides an analysis of changes in the housing market (rental and purchase) in the three primary residential areas nearby the Dartbrook Mine. These residential areas are defined by their postcodes and are:

- Aberdeen 2336;
- Muswelbrook 2333; and
- Scone 2337.

### 2.3.1 Existing Housing Availability

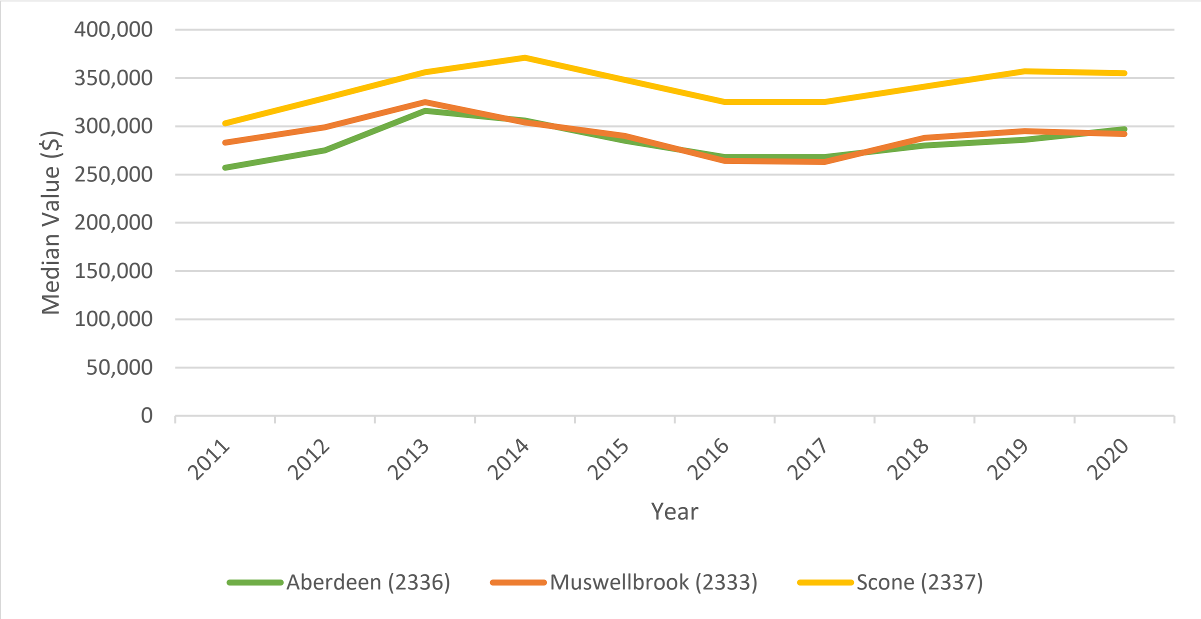
Housing market data available through Residex Pty Ltd and accessed 9 July 2020 shows that there were:

- 12 properties for sale in Aberdeen and seven recorded property sales in the last three months (Residex Pty Ltd, 2020a);
- 124 properties for sale in Muswellbrook, and an estimated 71 sales in the last three months (Residex Pty Ltd, 2020b); and
- 47 properties for sale in Scone, and an estimated 37 sales in the last three months (Residex Pty Ltd, 2020c).

### 2.3.2 Median House Prices

Graph 3 shows the median house prices for the Aberdeen, Muswellbrook, and Scone postcode areas (based on non-ABS suburb areas), between 2011 and 2020. The information is drawn from Residex Pty Ltd (2020a; 2020b; 2020c). Graph 3 indicates that the median house price in Scone between 2011 and 2020 has been consistently higher than Muswellbrook and Aberdeen. Graph 3 shows a similar trend in median house prices across all three areas of interest. The low point in house prices in Muswellbrook and Aberdeen in 2016 is likely attributable to the closure of Drayton Mine which employed a significant number of people who resided in both the Muswellbrook and UHS LGAs.

**Graph 3**
**Median House Prices – 2011-2020**

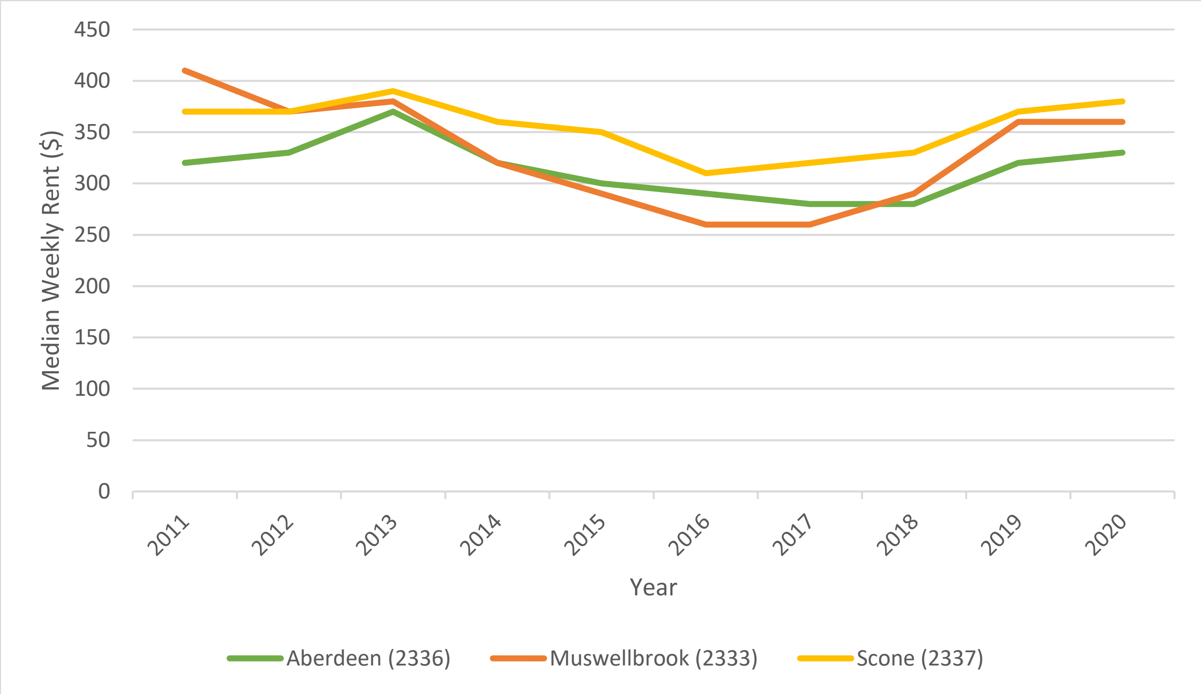



*Source:* (Residex Pty Ltd, 2020a; Residex Pty Ltd, 2020b; Residex Pty Ltd, 2020c)

### 2.3.3 Median Rent

Graph 4 shows median weekly rental prices for houses in the Aberdeen, Muswellbrook, and Scone areas (based on non-ABS suburb areas), between 2011 and 2020. The information is drawn from Residex Pty Ltd (2020a; 2020b; 2020c). All three suburbs experienced a similar drop in median rent between 2013 and 2018 suggesting the market in all three centres is influenced by similar factors, likely the corresponding decline in the mining industry sector from 2013. Of the areas of interest Muswellbrook has experienced the highest variability in median rental prices, with median rent peaking at $410 in 2011, dropping to a low of $260 in 2016 and 2017. Similar to the trends in housing market price, of the areas of interest Scone experienced the highest median rent for the majority of the period between 2011 and 2020. The steady increase in weekly rent from 2017 in Muswellbrook may be attributed to the construction of the Mt Pleasant Mine and the commencement of operations.

**Graph 4**
**Median Weekly Rent – 2011-2020**




*Source:* (Residex Pty Ltd, 2020a; Residex Pty Ltd, 2020b; Residex Pty Ltd, 2020c)

## 2.4 INDUSTRY SECTOR CHANGES

This section presents a summary of trends in the industry sectors of Mining, Agriculture and Tourism with reference to industry sector employment and output.

### 2.4.1 Summary Findings

Major industries in the Muswellbrook LGA are coal mining, power generation, equine, viticulture, grazing and livestock. Muswellbrook is the main centre for power generation capacity in NSW and is also the largest concentration of open cut mining in NSW (MSC, 2017a).

The UHS LGA is a predominantly rural area and encompasses a total land area of about 8,000 km$^2$, of which a large proportion is National Park and nature reserves. Most of the rural area is used for grazing, dairy farming, horse studs and general farming (UHS, 2020). The predominant industry in UHS is agriculture.

The Muswellbrook LGA, along with its neighbouring Councils in the Upper Hunter, has entered a transition period with structural changes impacting on the traditional power generation and mining industries while at the same time there are new emerging technologies and growth opportunities in agribusiness.

Analysis of industry sector employment and output shows:

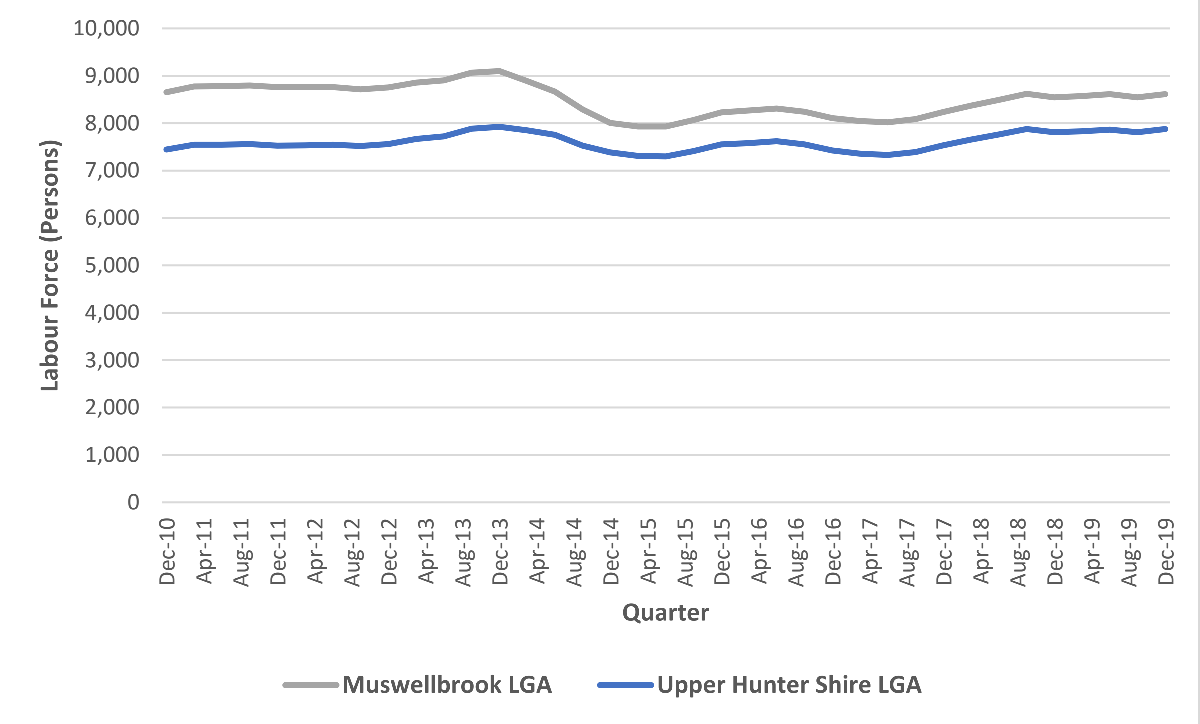
- With respect to LGA labour markets:
  - Fluctuating labour force size (particularly since 2013) and moderate unemployment in the LGAs of Muswellbrook and UHS;
- With respect to the Mining industry sector:
  - Of the LGAs of interest, Mining industry sector jobs are concentrated in the Muswellbrook LGA.
  - In both Muswellbrook and UHS LGAs, the number of residents employed in the Coal Mining industry has increased significantly (in the case of UHS LGA by almost 50%) in the 10 years from 2006 to 2016.
  - Between 2011 and 2016 Both LGAs of interest experienced negligible change in the number of jobs in the Mining industry sector.
- With respect to the Agricultural industry sector:
  - The agricultural industry is the dominant employment and output sector in the UHS LGA compared to Muswellbrook LGA where mining is the dominant employment and output sector.
  - An overall decline in the proportion of the working age population employed in the Agricultural industry in UHS and Muswellbrook LGAs between 2006 and 2016.
- With respect to Horse Breeding industry (a subsector of the Agricultural Industry):
  - Increased employment (5.9%) in the horse breeding industry sector in UHS LGA between 2011 and 2016 with a corresponding contraction in industry sector employment in Muswelbrook LGA, Hunter Region and NSW;
  - Contraction in employment and output in the Hunter Region thoroughbred breeding industry between 2014 and 2017;
- With respect to the Tourism industry:
  - Contractions in tourism related industry sectors between 2011 and 2016 in both the Muswellbrook and UHS LGAs;
  - Negligible change in the number of accommodation establishments and room occupancy rates across both LGAs;

### 2.4.2 Key Labour Force Characteristics

***Labour Force Size***

At December 2019 the labour force size in the LGAs of UHS and Muswellbrook was 4,453 persons and 7,876 persons respectively (DESE, 2020). An analysis of labour force data from 2010 to 2019 (Graph 5) shows that the labour force in both LGAs fluctuated significantly. This is likely associated with changes in the surrounding mining industry. Between 2010 and 2019, the labour force of UHS LGA increased by 5.8% (DESE, 2020) peaking at 7,924 in December 2013. Muswellbrook LGA shows a similar pattern in labour force size, however, the LGA has experienced a net (0.5%) decrease to a labour force of 8,610 between 2010 and 2019. Labour force decline in the Muswellbrook LGA in more recent years can be attributed to the closure of the Drayton South Mine in 2016. Similar to UHS LGA, the size of the labour force peaked in 2013 at 9,100. This aligns with a period of sustained output and expansion in the surrounding mining industry.

**Graph 5**
**Labour Force – 2010-2019**




*Source:* (DESE, 2020)

In Aberdeen, the labour force grew by approximately 0.5% between 2006 and 2016, to a total of 869 (ABS, 2007; ABS, 2017a). Between 2011 and 2016, the labour force size decreased by approximately 5.1% (ABS, 2012b).

***Predicted Labour Force Growth***

According to the Hunter Regional Plan 2036¸ employment in Muswellbrook LGA is anticipated to increase from 11,364 in 2016 to 13,551 in 2036 (an increase of 19%) (DP&E, 2016). Employment in UHS LGA is also anticipated to increase from 5,948 in 2016 to 7,143 in 2036 (an increase of 20%) (DP&E, 2016).

***Unemployment***

Both Muswellbrook LGA and UHS LGA experienced a steady increase in unemployment from 2013, consistent with the downturn in the regional mining industry. Unemployment peaked in December 2015 for both LGAs with a high of 6.8% in the UHS LGA, and 13.5% in Muswellbrook LGA (DESE, 2020). The significantly higher unemployment rate in Muswellbrook LGA reflects the shire's historically strong reliance on the resource sector for employment and the resulting sensitivity to recent changes in the sector.

Since late 2016, unemployment rates in the UHS LGA have fluctuated between 2.8% and 3.8% (DESE, 2020). Since December 2016 the unemployment rate in Muswellbrook LGA has remained relatively stable, albeit still high and varying between 6.3% and 7.8%. Unemployment rates in both LGAs of interest remain higher than the period prior to 2013.

### 2.4.3 Industry Sector Employment and Output

This section presents employment and economic output data for the Mining Industry (coal mining), Agricultural and Tourism for the period 2006-2016 (subject to data availability).

***Mining Industry***

Muswellbrook LGA is the major focus of coal mining in the Upper Hunter Region, with the largest concentration of open cut mining operations and the second highest rate of coal extraction in NSW (REMPLAN, 2020a). Employment in the Coal Mining industry is significant in Muswellbrook LGA. In comparison, the UHS LGA has no operating coal mines and a significantly smaller proportion of the LGA labour force is employed in Coal Mining.

Resident Employment

Table 4 presents data on employment in the Coal Mining industry in the LGAs of interest for the period 2006 to 2016 based on usual resident population. In both Muswellbrook and UHS LGAs, the number of residents employed in the Coal Mining industry has increased significantly (in the case of UHS LGA by almost 50%) in the 10 years from 2006 to 2016 (ABS, 2007; ABS, 2017a). This shows that the mining sector continues to be a strong employment sector across both LGAs.

**Table 4**
**ABS Industry of Employment – Coal Mining***

| Indicator | Muswellbrook LGA | | | UHS LGA | | |
|---|---|---|---|---|---|---|
| | 2006 | 2011 | 2016 | 2006 | 2011 | 2016 |
| People employed in Coal Mining | 928 | 1,367 | 1,351 | 367 | 602 | 689 |
| Percentage of labour force employed in Coal Mining (%) | 13.8 | 18.5 | 20.3 | 8.9 | 9.2 | 11.0 |

*Source:* (ABS, 2012b; ABS, 2017a; ABS, 2007)
**Some values may have been adjusted to avoid release of confidential data. This may have a significant impact on the calculated percentages* (ABS, 2017a).

Total Industry Sector Jobs

The Mining industry is the largest employment sector in Muswellbrook LGA. With respect to total mining jobs in the LGAs of interest, in 2016, the Mining industry sector accounted for 31.2% (3,120) of all jobs in the Muswellbrook LGA, and 0.5% (26) of all jobs in the UHS LGA (REMPLAN, 2020a; REMPLAN, 2020b). Between 2011 and 2016 Mining industry sector employment in the Muswellbrook LGA experienced a negligible increase, however this masks the significant labour market fluctuations that occurred between 2011 and 2016 which were directly associated with the growth and contraction of the Coal Mining industry sector. Between 2011 and 2016 Mining industry sector employment in UHS LGA declined. The biggest job growth during this period in both LGAs occurred in the Education and Training industry sector and the Health Care and Social Assistance industry sector (REMPLAN, 2020b; REMPLAN, 2020a).

Analysis of Mining industry sector employment data for the Hunter Region shows considerable fluctuation in industry sector employment and output consistent with the contraction and growth in the regional Coal Mining industry sector. During the period 2016 to 2018, the Coal Mining industry sector in the Hunter Region contracted with a corresponding reduction in workforce numbers. Based on media coverage (Australian Mining, 2016; Anglo American, 2016; Sydney Morning Herald, 2016) there have been an estimated 716 reported job cuts in the Hunter Region since 2016. Some of these job cuts have been offset by the commencement of construction at the Mt Pleasant Mine in late November 2016, and the subsequent commencement of mining operations in 2018.

Industry Sector Output

The Mining industry is Muswellbrook LGA's largest output generating industry sector, supporting an estimated annual output of $3.9 billion, representing 56.4% of total output in 2016. In comparison, the Mining industry sector of the UHS LGA generated $23.6 M (1.6%) in annual output compared with the highest performing sector, the Agricultural industry sector which generated $499.5 M in output.

***Agriculture***

The Agriculture, Forestry and Fishing industry (Agriculture industry) is the fourth largest employer in the Muswellbrook LGA (representing 6.9% of resident jobs) and the largest in the UHS LGA (representing 18.7% resident jobs) (ABS, 2017a).

Resident Employment

Employment in the Agricultural industry– which includes the Horse Farming and Viticulture industries, decreased by approximately 6% in UHS LGA between 2006 and 2016, but remains the largest industry in the LGA. Employment in the Agricultural industry increased by over 18% in Muswellbrook LGA over this period.

Between 2006 and 2016 the proportion of the resident working age population employed in the Agricultural industry in both LGAs declined from 10% to 6.9% in Muswellbrook LGA and 20.3% to 18.7% in UHS LGA (MSC, 2016) in parallel with a corresponding increase in mining industry sector employment.
Table 5 presents the changes in employment in the Agricultural industry compared to the Mining industry in the LGAs of interest between 2006 and 2016 based on place of usual residence.

**Table 5**
**Industry of Employment – Mining and Agriculture***

| Geographic Area | Industry | Year | | Change | |
|---|---|---|---|---|---|
| | | 2006 | 2016 | No. | % |
| Muswellbrook LGA | Agricultural | 395 | 467 | 72 | 18.2 |
| | Mining | 976 | 1,474 | 498 | 51.0 |
| UHS LGA | Agriculture | 1,257 | 1,179 | -78 | -6.2 |
| | Mining | 446 | 733 | 287 | 64.3 |
| NSW | Agriculture | 78,659 | 72,625 | -6,034 | -7.7 |
| | Mining | 20,314 | 31,736 | 11,422 | 56.2 |

*Source:* (ABS, 2007; ABS, 2017a)
**Some values may have been adjusted to avoid release of confidential data. This may have a significant impact on the calculated percentages* (ABS, 2017a).

## Total Industry Sector Jobs

Table 6 presents the changes in employment in the Agricultural industry and sub sectors of Horse Farming and Viticulture in the LGAs of interest between 2011 and 2016 based on place of work and reflects the number of jobs in the industry sector in the respective LGA.

Between 2011 and 2016 the number of jobs in the Agricultural industry sector in:

- UHS LGA increased from 1,178 to 1,215; and
- Muswellbrook LGA declined from 507 to 494.

**Table 6**
**Industry of Employment (Place of Work) – 2011-2016***

| Geographic Area | Industry of Employment | | |
|---|---|---|---|
| | Agriculture, Forestry and Fishing | Horse Farming | Viticulture |
| **2011** | | | |
| Muswellbrook LGA | 507 | 175 | 18 |
| UHS LGA | 1,178 | 389 | 0 |
| Hunter Valley exc Newcastle SA4 | 3,378 | 649 | 190 |
| NSW | 68,885 | 1,658 | 1,246 |

| Geographic Area | Industry of Employment | | |
|---|---|---|---|
| | Agriculture, Forestry and Fishing | Horse Farming | Viticulture |
| **2016** | | | |
| Muswellbrook LGA | 494 | 218 | 14 |
| UHS LGA | 1,215 | 402 | 3 |
| Hunter Valley exc Newcastle SA4 | 3,508 | 712 | 172 |
| NSW | 73,132 | 1,523 | 1,013 |

*Source:* (ABS, 2012b; ABS, 2017a)
**Some values may have been adjusted to avoid release of confidential data. This may have a significant impact on the calculated percentages* (ABS, 2017a)*. Data is based on ABS Census data and may show slight data variations compared to employment sector data derived from REMPLAN.*

Horse Farming

Muswellbrook and UHS LGAs are important locations for the equine industries, particularly thoroughbred breeding. The UHS LGA in particular is nationally recognised as the "Horse capital of Australia". The Hunter Valley's thoroughbred industry is further globally recognised as an International Centre of Thoroughbred Breeding Excellence.

Although equine related land use and enterprises in the UHS and Muswellbeook LGAs contribute to the economy and identify of these areas, comprehensive information on economic value is not readily available.

In 2014, IER (2014) estimated total value added generated by the thoroughbred breeding industry in the Hunter Region at $564.4 M with 1,013 breeding staff. In 2019 AgriFutures Australia released a report detailing the economic impact of the thoroughbred breeding industry in Australia and at a regional level (Hardy G and Limoli P, 2019). The total value added from thoroughbred breeding in the Hunter Valley in 2016-17 was estimated at $503.9 M, representing the majority of total value added generated by thoroughbred breeding in NSW. AgriFutures Australia estimates 1,808 direct jobs are generated by the thoroughbred breeding industry in the Hunter Valley. This data suggests some contraction in industry output and employment between 2014 and 2017. Earlier output and employment data was unavailable for this report.

Limited equine industry economic data is available for the LGAs of UHS and Muswellbrook. An indication of employment trends across the Horse Breeding sector can be gleamed from analyses of ABS Census data at the LGA level. Horse Farming is a subcategory of the broader Agricultural industry previously discussed. This industry category encompasses the thoroughbred breeding industry and other horse farming activities. Table 7 presents the changes in employment in the horse farming industry in the LGAs of interest between 2006 and 2016 based on place of usual residence.

**Table 7**
**Industry of Employment – Horse Farming***

| Geographic Area | Year | | Change | |
|---|---|---|---|---|
| | **2006** | **2016** | **No.** | **%** |
| Muswellbrook LGA | 204 | 199 | -5 | -2.5 |
| UHS LGA | 357 | 378 | 21 | 5.9 |
| Hunter Region[1] | 690 | 689 | -1 | -0.1 |
| NSW | 1,567 | 1,516 | -51 | -3.3 |

*Source:* (ABS, 2007; ABS, 2017a)
**Some values may have been adjusted to avoid release of confidential data. This may have a significant impact on the calculated percentages* (ABS, 2017a).
*[1]Hunter Statistical Division (SD) assessed for 2006 data, Hunter Valley exc Newcastle Statistical Area Level 4 (SA4) assessed for 2016 data. Hunter SD encompasses a larger area including Newcastle and a portion of Mid North Coast SA4.*

Table 7 indicates a small decline between 2006 and 2016 in employment in the Horse Farming industry in the Muswelbrook LGA, Hunter Region or NSW. UHS LGA experienced a 5.9% increase in employment in the Horse Farming industry between 2006 and 2016. Employment in Horse Farming in Muswellbrook LGA and UHS LGA represented approximately 38% of employment across the Horse Farming industry in NSW in 2016.

It is understood that the equine industry extends to employment in specialist equine training, racing, medical and research occupations (DPI, 2013a) which are not necessarily captured in the ABS Horse Farming industry category.

With respect to total jobs, ABS data (Table 6) shows a small increase in employment in the equine industry in both LGAs of interest between 2011 and 2016.

Viticulture

With over 150 years of grape growing history, the Hunter Region is known as the oldest wine making region in Australia (DPI, 2013b). While only producing around 2% of Australian wine, there is an emphasis on the production of premier, award winning wines that are renowned both nationally and internationally (DPI, 2013b). According to the NSW Department of Primary Industries (DPI), in 2010 the Hunter Region produced over 25 million litres of wine, with a value of over $210 M (DPI, 2013b).

Grape Growing (Viticulture) is a subcategory of the broader Agricultural industry previously discussed. Table 8 presents the changes in employment in the Viticulture industry in the Muswellbrook and Upper Hunter LGAs, as well as the broader Hunter Region, between 2006 and 2016 based on place of usual residence.

Table 8 shows that employment in the Viticulture industry substantially decreased across all areas of interest between 2006 and 2016. Of the areas of interest, Muswellbrook LGA experienced the most significant decline in Viticulture industry employment (86%). Employment in the Viticulture industry is low in the LGAs of interest, particularly in UHS LGA where there were fewer than 10 persons employed between 2006 and 2016.

**Table 8**
**Industry of Employment – Viticulture***

| Geographic Area | Number of People | | Change | |
|---|---|---|---|---|
| | 2006 | 2016 | No. | % |
| Muswellbrook LGA | 57 | 8 | -49 | -86.0 |
| UHS LGA | 7 | 4 | -3 | -42.9 |
| Hunter Region[1] | 282 | 172 | -110 | -39.0 |
| NSW | 1,843 | 919 | -924 | -50.1 |

*Source:* (ABS, 2007) (ABS, 2017a)
**Some values may have been adjusted to avoid release of confidential data. This may have a significant impact on the calculated percentages* (ABS, 2017a).
[1]*Hunter Statistical Division (SD) assessed for 2006 data, Hunter Valley exc Newcastle Statistical Area Level 4 (SA4) assessed for 2016 data. Hunter SD encompasses a larger area including Newcastle and a portion of Mid North Coast SA4.*

With respect to jobs in the Viticulture industry sector, ABS data (Table 6) shows a:

- Small decline in employment between 2011 and 2016 in Muswellbrook LGA; and
- Small growth in employment between 2011 and 2016 in the UHS LGA.

***Tourism***

<u>Sector Employment</u>

Tourism Research Australia (TRA) (2019) released LGA tourism profiles for 2018. In 2018, there were 124 tourism businesses recorded in Muswellbrook LGA, and 167 in UHS LGA (TRA, 2019).

Tourism supports approximately 364 jobs (3.6% of total employment) in Muswellbrook LGA, and 310 jobs (5.9% of total employment) in UHS LGA (REMPLAN, 2020a; REMPLAN, 2020b). In comparison, tourism across NSW supports approximately 6.1% of total employment in the State.

The largest tourism sub-sector in Muswellbrook is Accommodation & Food Services, with approximately 209 jobs supported by tourist expenditure. The largest sub-sector in Upper Hunter is also Accommodation & Food Services with 174 jobs supported by tourist expenditure.

The tourism sector described above is an amalgamation of activities across various industry sectors such as retail, accommodation, cafes & restaurants, cultural & recreational services. Analysis of trends in these activities for the period 2011-2016 shows contraction in a number of tourism related industry sectors across both the UHS and Muswellbrook LGAs. In the Muswellbrook LGA this is likely associated with the corresponding significant contraction in the mining industry sector.

Between 2011 and 2016 the UHS LGA experienced:

- A decline of 8.1% in the number of jobs in the retail trade sector (505 in 2011 to 464 in 2016;
- A decline of 8.1% in the number of jobs in the accommodation and food services industry (420 in 2011 to 386 in 2016); and
- A 4.2% increase in the number of jobs in the arts and recreation services (96 in 2011 to 100 in 2016) ( (REMPLAN, 2020b).

Between 2011 and 2016 the Muswellbrook LGA experienced a decline of:

- 12.5% in the number of jobs in the retail trade sector (780 in 2011 to 679 in 2016);
- 10.6% in the number of jobs in the accommodation and food services industry (565 in 2011 to 505 in 2016); and
- 4.3% in the number of jobs in the Arts and recreation services industry (70 in 2011 to 67 in 2016) (REMPLAN, 2020a).

Hunter Region Key Tourism Metrics

According to Regional NSW (Department of Premier and Cabinet, 2018) tourism injected nearly $3.0 billion into the Hunter Region in the year ending June 2019, with a 4.2% annual increase on average in visitor numbers since the year ending June 2010. No information is available regarding the specific destinations within the Hunter Region.

In 2019, the majority of visitors to the Hunter Region came for the purpose of visiting friends and relatives (41%). An additional 38% of visitors came for a holiday while 16% came for business purposes. The number of visitors to Regional NSW grew by 41.2% from June 2014 to June 2019, or 7.1% per year in compound annual growth terms.

Table 9 shows key tourism metrics for selected NSW Tourism regions, including the Hunter Region for the period 2017-2019 based on data available through STR (STR, 2018; STR, 2019a; STR, 2019b). There are 13 Tourism Regions in NSW. Table 9 shows marginal fluctuations in occupancy rates across all areas of interest between 2017 and 2019. It also shows an increase in the number of accommodation establishments and room numbers across the Hunter Region between 2017 and 2019. Analysis of all 13 Tourism Regions in NSW shows that room occupancy rates in the Hunter Region are relatively high.

**Table 9**
**Accommodation Data for Selected Tourism Regions – Year End June**

| NSW Tourism Regions | Establishments (No.) | | | Rooms (No.) | | | Room Occupancy Rate (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2017 | 2018 | 2019 | 2017 | 2018 | 2019 | 2017 | 2018 | 2019 |
| Hunter | 152 | 164 | 167 | 6,507 | 6,741 | 7,063 | 65.7 | 67.9 | 67.2 |
| Sydney | 388 | 406 | 411 | 40,490 | 42,967 | 43,835 | 85.3 | 84.9 | 83.4 |
| Central Coast | 49 | 49 | 49 | 2,094 | 2,084 | 2,074 | 66.5 | 67.6 | 66.1 |
| North Coast | 303 | 323 | 323 | 9,797 | 10,220 | 10,255 | 62.1 | 62.5 | 65.7 |
| Riverina | 68 | 68 | 68 | 2,203 | 2,226 | 2,229 | 64.0 | 67.4 | 68.1 |
| NSW | 1721 | 1,784 | 1,793 | 84,386 | 87,957 | 89,289 | 79.0 | 79.0 | 78.0 |

*Source:* (STR, 2018; STR, 2019a; STR, 2019b)

LGA Level Tourism Metrics

Key tourism metrics collected by TRA were not available for the Muswellbrook LGA. However TRA data for the UHS LGA shows a total of 259,000 visitors to the LGA in 2018 with a total spend of $46 M (TRA, 2019).

There are multiple short-term accommodation listings in the LGAs of UHS and Muswellbrook. Analysis of establishment numbers and room occupancy rates from 2013 shows little increase in either Muswellbrook LGA or UHS LGA. Table 10 shows the number of accommodation establishments with 15 or more rooms in the LGAs of interest and NSW in September Quarter 2013 and June Quarter 2016. Table 10 shows little change in the supply of tourist accommodation (or 15 or more rooms) between 2013 and 2016. There are also numerous short-term accommodation options available through AirBnB and Stayz.

**Table 10**
**Short Term Accommodation Provision – Year End June**

| Geographic Area | Establishments (No.) | | Rooms (No.) | | Room Occupancy Rate (%) | |
|---|---|---|---|---|---|---|
| | 2013[1] | 2016 | 2013 | 2016 | 2013 | 2016 |
| Muswellbrook LGA | 9 | 8 | 256 | 227 | 51.8 | 40.6 |
| UHS LGA | 8 | 8 | 164 | 164 | 52.8 | 51.9 |
| Regional NSW | 1,102 | 1,110 | na | 38,453 | na | 79.5 |
| NSW | 1,385 | 1,424 | na | 75,235 | 62.9 | 68.3 |

*Source:* (Destination NSW, 2020)
[1]*September Quarter.*

## 2.5 LAND USE ANALYSIS

This section provides a brief summary of the key changes in land use surrounding Dartnrook Mine since the granting of DA 231-7-2000 with reference to land zoning and significant land use change.

### 2.5.1 Summary Findings

The findings of the land use analysis show that since the granting of DA 231-7-2000:

- Limited material changes have occurred in land zoning adjoining and proximate to the Dartbrook Mine in the LGAs of UHS or Muswellbrook. Rural land zonings remain the dominant land use zoning proximate to the mine site.
- The locations of Equine and Viticulture Critical Industry Clusters (CIC) and Biophysical Strategic Agricultural Land (BSAL) have been mapped across both the UHS and Muswellbrook LGAs, including across areas located within the Mining Authorities Boundary for the Dartbrook Mine.
- The UHSC has articulated strong opposition to coal and coal seam gas activities with the release in 2015 of a *Position Statement – Coal and Coal Seam Gas Activities* (UHSC, 2015).
- The most significant land use change in the area proximate to the Mining Authorities Boundary is the commencement of operations at the adjoining Mt Pleasant Mine.
- At a regional level the most significant land use changes relate to the expansion in the coal mining industry with the approval of new mining operations (i.e. Mangoola Mine and the significant expansions to existing operations e.g. Bengalla Mine and Mt Arthur Mine).
- There has been limited change in the amount of land designated for future residential development in the UHS LGA and particularly in Aberdeen township. Residential subdivision and associated residential development has occurred in Aberdeen, however this additional development has equated to approximately 10-12 houses per year based on ABS census data for the Aberdeen UCL.
- Muswellbrook continues to develop and grow as a regional centre to support the surrounding mining, power generation, agriculture and viticulture industries. This growth includes significant growth in the residential environment of Muswellbrook in line with the expansion of the surrounding coal mining industry.

Submissions in opposition to the Modification note the growth of the Hunter Valley equine industry since the granting of DA 231-7-2000. Analysis of mining industry information indicates that the reported growth in the Hunter Valley equine industry has occurred in parallel with the operation of existing mines and expansions in operations, particularly in the Muswellbrook area. This would suggest that existing mining operations (including Dartbrook Mine) have not restricted the growth of the equine industry.

### 2.5.2 Land Zoning

The zoning of land within and adjoining the Dartbrook Mine for the period 2000 to 2020 was reviewed to inform an understanding of land use changes in the area surrounding the Dartbrook Mine since the granting of DA 231-7-2000.

The Mining Authorities Boundary for Dartbrook Mine straddles the LGAs of Muswellbrook and UHS. At the time DA 231-7-2000 was granted land use zoning within and adjoining the Mining Authorities Boundary was controlled by the provisions of either the:

- *Muswellbrook Local Environment Plan 1985* (Muswellbrook LEP 1985); or
- *Scone Local Environment Plan 1986* (Scone LEP 1986).

The Muswellbrook LEP 1985 has since been replaced by the *Muswellbrook Shire Local Environment Plan 2009* (Muswellbrook LEP 2009). The Scone LEP 1986 has been replaced by the *Upper Hunter Shire Local Environment Plan 2013* (UHS LEP 2013).

Table 11 summarises the applicable land zonings for land within and outside the Mining Authorities Boundary since the granting of DA 231-7-2000. Table 11 confirms that there has been little change in the land use intent for land within and adjoining the Mining Authorities Boundary for the period 2000-2020. Rural land zonings and associated rural land uses remain the dominant land use proximate to the Dartbrook Mine.

When the Muswellbrook LEP 2009 was gazetted a substantial amount of land in Muswellbrook and Denman (a significant distance from Dartbrook Mine) was rezoned to R1 General Residential and R5 Large Lot Residential as Urban Release Areas to meet the projected future housing demands of the LGA.

The existing mining landscape within the LGAs of Muswellbrook and UHS is predominately covered by the RU1 Primary Production Zone with some areas zoned E3 Environmental Management.

Since 2009 the Muswellbrook LEP has been amended several times, in order to ensure that the LEP remains current and is able to respond appropriately to emerging development trends to achieve desired development outcomes. In 2017 MSC released the Muswellbrook LEP 2009 Review Discussion Paper (MSC, 2017a). The MSC highlights the need for a review of the Muswellbrook LEP 2009 in light of the introduction of the Hunter Regional Plan 2036 (DP&E, 2016). The Review will inform amendments to the Muswellbrook LEP 2009 and its accompanying Development Control Plan.

**Table 11**
**Summary of Land Zonings**

| Instrument | Description of Zoning |
|---|---|
| **Superseded Planning Instruments** | |
| Muswellbrook LEP 1985 | Land within and adjoining the Dartbrook Mine, where located within the Muswellbrook LGA was zoned Rural 1(a) and Environmental Protection General (Alluvial Area) 7 (L1)[1]. |
| Scone LEP 1986 | Land within and adjoining the Dartbrook Mine, where located within Scone Shire was zoned Rural 1(a)[1]. |
| **Current Planning Instruments** | |
| Muswellbrook LEP 2009 | The majority of land proximate to the Dartbrook Mine is designated as RU1 – Primary Production land, with the remainder primarily designated as E3 – Environmental Management land. |
| UHS LEP 2013 | Land within and adjoining the Dartbrook Mine is currently designated as RU4 – Primary Production Small Lots. |

[1]Zoning information has been drawn from the zoning maps included in the *Dartbrook Extended Environmental Impact Statement* (EIS) (HLA Envirosciences Pty Limited, 2000).

### 2.5.3 Local Land Use and Land Use Change

***Existing 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. There are no operational mines in the UHS LGA.

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

Kayuga Locality

The gazetted locality of Kayuga is immediately south-east of the Proposed Bord and Pillar Mining Area and within the Mining Authorities Boundary. The majority of land in this locality is

owned by the proponent. 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.

Biophysical Strategic Agricultural Land and Critical Industry Clusters

As shown in Figure 3, the Mining Authorities Boundary includes areas of land that are mapped as BSAL and Equine 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 3).

Equine CIC and Equine Activities

Small parcels of land mapped as Equine CIC are located within the Mining Authorities Boundary. Figure 3 shows the distribution of horse facilities around Dartbrook Mine. The nearest thoroughbred breeding stud to the Dartbrook Mine is the Kelvinside Stud owned by Godolphin Australia and located on Rouchel Road in Aberdeen. Kelvinside Stud is located on Rouchel Road to the north-east of the Dartbrook Mine. The nearest boundary of the Kelvinside Stud is located approximately 1.2 km from the East Site (where the existing surface infrastructure is located). Godolphin Australia purchased Kelvinside Stud in 2003 (Godolphin, 2018) and since this time has developed the property into a world-class racehorse breeding facility. In 2008, Godolphin Australia also purchased the Woodlands Stud at Denman. The Kelvinside and Woodlands properties operate as one integrated operation (Godolphin, 2018).

Whilst the Kelvinside property predates the granting of DA 231-7-2000 (Kelvinside Homestead was built in 1898) (Godolphin, 2018), it is notable that the purchase of the establishment by Godolphin Australia occurred post granting of DA 231-7-2000 and prior to the commencement of the Dartbrook Mine care and maintenance period.

Brooklyn Lodge thoroughbred facility (Newgate Stud) is located nearby Kelvinside Stud approximately 5 km north-east of the Mining Authorities Boundary. Brooklyn Lodge (Newgate Stud) is also located to the north east of Dartbrook Mine proximate to Kelvinside Stud. Newgate purchased Brooklyn Stud in 2013 (Newgate, n.d.).

There are a number of other studs located to the far north and north east of the Mining Authorities Boundary (a distance of more than 5 km). There are also studs located a significant distance south of the Mining Authorities Boundary. Other thoroughbred breeding establishments in the Upper Hunter include Glastonbury Farm, Dalmore and Darley Kelvinside.

Viticulture Industry

Viticulture CIC is mapped across the LGAs of UHS and Muswellbrook. There is no mapped Viticulture CIC located within Dartbrook Mine, however an area of Viticulture CIC is mapped to the south of Dartbrook Mine.

Major viticulture establishments in the surrounding area include Hollydene, James Estate Wines, Small Forest, and Two Rivers. These establishments are all located near to the locality of Denman, more than 20 km away from the Dartbrook Mine. Tilse's Apple Truck Cider, and St Albans Scone Pty Ltd are located north of Dartbrook Mine near.

***Local Land Use Change***

Google Earth imagery from 2002 to 2020 was reviewed to identify key land use changes in the local area since the granting of DA 231-7-2000.

At the time of granting of DA 23-7-2000, the dominant land uses within an approximate 2 km radius of the Mining Authorities Boundary were:

- Residential; and
- Agriculture – grazing, dairy farming, and horse breeding.

As of 1 July 2020, the dominant land uses remain the same as in 2000 with the addition of open-cut mining (Mt Pleasant Mine).

Residential

Residential land uses proximate to the Mining Authorities Boundary continue to be concentrated in the township of Aberdeen to the north-east of Dartbrook Mine. The existing Dartbrook CHPP is located at the East Site, 1.3 km from the southernmost extent of Aberdeen and 2.3 km from the town centre. Recent (2011-2020) residential growth in Aberdeen has been concentrated in the south eastern area of the township around Perth Street. In 2011 the Upper Hunter Shire Council (UHSC) subdivided land along Perth Street and released the land for residential development.

Agriculture - Grazing and Dairy Farming

Agricultural land uses to the north, east and west of the Mining Authorities Boundary have changed little in the period since the granting of DA 231-7-2000. Grazing remains the dominant land use within and adjoining the Mining Authorities Boundary. The Hunter and Dartbrook River flats continue to be a focus of agricultural activities, in particular dairy farming. However, areas of agricultural land use previously located on land to the south of the Mining Authorities Boundary within the Mt Pleasant Mining Lease have been displaced due to the construction and operation of the Mt Pleasant Mine.

The Garoka Dairy operates under a lease arrangement with AQC. Since the granting of DA 231-7-2000 Garoka Dairy has undergone significant infrastructure improvements which have supported expanded production. The operational area of Garoka Dairy covers an estimated 350 hectares (ha) with most of the land located along the Hunter and Dart brook flats.

Since the granting of DA 231-7-2000 areas of Equine CIC and BSAL have been mapped within and adjoining the Mining Authorities Boundary. There is 254,900 ha of Equine CIC land mapped in the UHS LGA. This includes extensive areas to the north and east of Aberdeen (Figure 3). Approximately 286 ha of Equine CIC (0.1% of all mapped Equine CIC) is located within the Mining Authorities Boundary. Of this 286 ha, an estimated 154 ha is located within the approved Kayuga Seam Mining Area and would be subject to the effects of subsidence.

The potentially affected Equine CIC within the Mining Authorities Boundary is not currently used for equine industry activities and is understood to have not been used for equine activity since the Equine CIC designation was introduced.

Agriculture - Horse Breeding

Figure 3 shows the distribution of horse facilities around Dartbrook Mine. The largest concentration of horse breeding land uses in the local area continues to be located in the UHS LGA north of Aberdeen.

City Plan Services (2016) reports that in 1982 there were approximately 20 stud horse breeders in the Scone Shire. Estimates from NSW Department of Planning (Department of Planning, 2005) suggest that in 2005 there were over 70 horse studs located within the two former Shires of Murrundi and Scone, *concentrated on the alluvial lands associated with the Pages River between Murrundi and Blandford and around Segenhoe, in the Middle Brook and Dart Brook valleys and north east of Aberdeen on the Hunter River* (City Plan Services, 2016).

The most recent data show there were 119 studs in the UHS LGA in 2006. Mapped Equine CIC includes a substantial part of the centre of the UHS LGA aligning with the alluvial areas described above.

Further information on regional equine activity is provided in Section 2.5.4.

Mining Activities

Since the granting of DA 231-7-2000 the most significant land use change in the 2 km radius of Dartbrook Mine is the construction and commencement of operations at Mt Pleasant Mine. Mt Pleasant Mine is an open cut mining operation. The Mt Pleasant Mining Lease Boundary adjoins the southern boundary of the Dartbrook Mine Mining Authorities Boundary. Mt Pleasant Mine was granted development consent in 1999 however construction did not commence until November 2016. Mt Pleasant has been granted a six-year extension to its planning approval which takes mining out to 2026.

### 2.5.4 Regional Land Use and Land Use Change

***Residential Development***

At a regional level residential growth has occurred primarily in the urban area of Muswellbrook and to a lesser extent in Aberdeen and Scone. This growth is reflected in the population and dwelling count increases discussed in Section 2.2.3

***Mining Activity***

There are no operating coal mines in the UHS. Mining industry activity in the Muswellbrook LGA has increased significantly (as evidenced in industry sector employment and economic output, and a review of aerial imagery) since the granting of DA 231-7-2000. There are currently six operating coal mines in the Muswellbrook LGA (Table 12). Dartbrook Mine is the most northern mine in the Muswellbrook LGA and one of few underground mines approved for operations in the Muswellbrook LGA.

The expansion in mining activity has occurred in the areas to the far south and west of Dartbrook Mine and to the south of the regional centre of Muswellbrook. Whilst the effects of this expansion in mining have been experienced across all LGAs of the Hunter Valley (due to employment, workforce demands and economic output), these effects have been somewhat less in the communities of Aberdeen and Scone due to geographical distance from the mining areas.

**Table 12**
**Operating Coal Mines in Muswellbrook LGA**

| Operating Mines | Mining Type | Approval |
|---|---|---|
| Bengalla Mine | Open Cut | Approved in 1996. Bengalla Mine is approved to produce up to 15 Mtpa of ROM coal until 28 February 2039 under Development Consent (SSD-5170), as modified. |
| Liddell Mine | Open Cut | Approved 1950s and scheduled to close in 2028. |
| Mangoola Mine | Open Cut | Approved 2007. Mangoola Coal is approved to mine up to 13.5 Mtpa of ROM coal for 21 years under Project Approval (06_0014), as modified. |
| Mount Arthur Mine | Open Cut | Approved 2000. The Mt Arthur Coal Mine is approved to mine up to 32 Mtpa of ROM coal until 30 June 2026 under Project Approval (09_0062), as modified. |
| Muswellbrook Mine | Open Cut | Approved 1944 and consented to carry out mining operations to 2022, producing a maximum of 2 Mtpa of product coal. |
| Mt Pleasant | Open Cut | Approved 1999 and approved to mine up to 10.5 Mtpa ROM coal until 2026 under DA 92/97, (as modified). |

*Source:* (MSC, 2017a; Just Add Lime, 2020)

### *Equine Land Uses*

Equine related land uses and enterprises are prevalent across the Hunter Region, with high concentrations in the Upper Hunter and specifically in the UHS LGA (as previously discussed). The most prevalent equine land use and enterprise in the region is thoroughbred breeding (as discussed in Section 2.4) .The Equine industry data from the NSW Government (IER Pty Ltd, 2014) confirms that the Hunter Valley region is the dominant thoroughbred industry region in NSW, and home to 27.5% of all thoroughbred stud breeders in Regional NSW and 22.9% of all thoroughbred stud breeders in NSW (IER Pty Ltd, 2014).

In 2014 in the Hunter Region there were:

- 470 thoroughbred breeders employing 1,013 people; and
- 85 registered thoroughbred stallions and sires representing 40% of NSW stock (IER Pty Ltd, 2014).

There is limited data available at the LGA level on the number of studs. Research suggests that within the Upper Hunter Region the greatest concentration of studs and stud horses is in the Muswellbrook and UHS LGAs. In 2011 an estimated 86 thoroughbred horse studs were located in the Upper Hunter area (Howey, 2017a). There is little detailed information on changes in the number of studs (thoroughbred or other) since 2000. According to Howey (2017b), between 2000 and 2006 the Hunter Valley Research Foundation conducted biennial surveys of owners and managers of horse studs in the Upper Hunter. The results of these surveys have not been reviewed, however with respect to the number of thoroughbred studs in the Upper Hunter, Howey (2017b) reports that:

> *"The current* [2006] *research findings reflect an increase in the number of studs since the initial survey conducted in 2000. Both the number of studs contacted and the number of studs participating has grown, with the majority of the increase being located in the Upper Hunter Shire."*

There were 77 Upper Hunter thoroughbred studs identified for the 2006 survey and 65 studs identified for the 2000 survey (Howey, 2017b). However, Howey (2017b) comments that survey limitations suggest the number of studs recorded in 2000 may have been an underestimation.

### *Viticulture*

The Hunter region is Australia's oldest wine-making region and "the economic value and cultural significance of viticulture and wine tourism are essential components of the region's identity and economy" (DPI, 2013b). Limited data is available for the LGAs of interest from which to judge the presence and or change in viticulture land use in the regional area.

Wine Australia (2020) producers data for defined wine growing regions. Dartbrook Mine is located within the Hunter Region of the Hunter Valley Zone. Within the Hunter Region there are three primary Sub Regions: Upper Hunter Valley, Pokolbin and Broke Fordwich. The Dartbrook Mine is located within the Upper Hunter Valley Sub Region. The majority of vineyards in the Hunter Region are densely concentrated around Cessnock in the Pokolbin and Broke Fordwich Sub Regions (Wine Australia, 2020). Within the Upper Hunter Valley Sub Region vineyards are small scattering of vineyards occurs to the south and west of Muswellbrook, principally nearby the township of Denman. Based on existing Wine Australia (2020) vineyard mapping there are no vineyards proximate to Dartbrook Mine or around Aberdeen. An indication of the number of vineyards in the Hunter Region can be gleamed from the results of the National Vintage Survey (Wine Australia, 2020). In 2020, there were 23 respondents from the Hunter Region to the National Vintage Survey. This suggests there were at least 23 vineyards in the Hunter Region crushing more than 1,000 tonnes of grapes.

An analysis of trends in the Australian wine making industry and ABS data provides an indication of likely changes in the viticulture industry in the LGAs of interest and the broader Hunter Region.

ABS Census Data

In the Hunter Region, there were 279 businesses in the Viticulture industry recorded in 2008-09, and 1,469 across NSW. Since 2008-09, there has been a 57.3% decrease in Viticulture businesses in the Hunter Region, and a 49.5% decrease in Viticulture businesses across NSW.

Table 13 presents the total vineyard area, weight of grape production for winemaking, and number of Viticulture businesses from 1998 to 2018-19 for the Hunter Region and NSW. In the Hunter Region, there were 279 businesses in the Viticulture industry recorded in 2008-09, and 1,469 across NSW. Since 2008-09, there has been a 57.3% decrease in Viticulture businesses in the Hunter Region, and a 49.5% decrease in Viticulture businesses across NSW.

Table 13 suggests that some expansion of the Viticulture industry occurred between 1998 and 2006, with increases in vineyard area and grape production for wine making in the Hunter Region and across NSW. However, between 2006 and 2014-15 there was a substantial drop in both total area and production in the Hunter Region. From 2014-15 to 2018-19, there was a further drop in total vineyard area, but an increase in production, suggesting increased rationalisation.

Data from ACCC (2019) shows that of the top 32 growing regions across Australia the Hunter Region had the lowest production yield (measured as average tonnes per hectare).

In the Hunter Region, there were 279 businesses in the Viticulture industry recorded in 2008-09 (ABS, 2009), and 1,469 across NSW. Since 2008-09, there has been a 57.3% decrease in Viticulture businesses in the Hunter Region, and a 49.5% decrease in Viticulture businesses across NSW.

**Table 13**
**Grapes for Wine Production**

| Geographic Area | Year | | | |
|---|---|---|---|---|
| | **1998** | **2006** | **2014-15** | **2018-19** |
| **Total Area (ha)** | | | | |
| Hunter Region[1] | 3,593 | 4,390 | 2,376 | 1,969 |
| NSW | 21,887 | 40,198 | 34,024 | 31,565 |
| **Production (t)** | | | | |
| Hunter Region | 18,998 | 24,945 | 7,516 | 10,196 |
| NSW | 174,468 | 473,580 | 495,789 | 478,700 |
| **Agricultural Businesses (No.)** | | | | |
| Hunter Region | - | - | 156 | 119 |
| NSW | - | - | 965 | 742 |

*Source:* (ABS, 1998; ABS, 2007; ABS, 2015; ABS, 2020)

[1]*Defined as "Hunter Valley Principal Grape Producing Region" in 1998, "Hunter Valley Geographical Indication" in 2006, "Hunter Valley Geographical Indication Zone" in 2014-15, and as "Hunter Valley exc Newcastle Statistical Area Level 4" in 2018-19.*

## 2.6 LOCAL ISSUES AND COMMUNITY PERCEPTIONS

This section provides a high level overview of the different values and perceptions of the communities of the LGAs of UHS and Muswellbrook and a summary of the key issues and trends evident in the LGAs. This information informs the social impact assessment of the Extension Period.

### 2.6.1 Muswellbrook LGA

The Muswellbrook LEP 2009 Review Discussion Paper (MSC, 2017a) describes the Muswellbrook and larger Upper Hunter district as going through a time of significant change.

> *"AGL has notified its intentions to close both major coal fired power generators – Liddell and Bayswater in 2022 and 2035 respectively. Over the next 12 years, three of the six operating coal mines will close. There are new approved mining operations likely to commence, and it is likely that others will be proposed, and existing operations modified." (p. 4)*

The Muswellbrook LEP 2009 Review Discussion Paper (MSC, 2017a) acknowledges the dominance of coal mining industry in the community and the benefits that have accrued i.e. jobs, investment. However, it describes other industries as feeling threatened by mining sector dominance and cites the importance of other industries such as the thoroughbred industry and viticulture industry.

The Muswellbrook LEP 2009 Review Discussion Paper (MSC, 2017a) described the economy as being "unstable" because it is so reliant on the coal and electricity sectors, and a downturn in these industries and associated loss of jobs would have a major impact on the economy. However it also describes the local economy as relatively diverse in its scope (equine, agriculture, viticulture, power generation, mining and government services) (MSC, 2017a).

***Community Perceptions***

In May 2019, Muswellbrook Shire Council (MSC) commissioned Jetty Research to conduct a random and statistically valid telephone survey of over 500 adult residents living within the LGA. Residents were asked (in an unprompted question) what they believed to be the major challenges for the future of the Muswellbrook Shire.

Economic diversification was the more frequently mentioned challenge (22%) (Jetty Research, 2019). This was followed by job security/unemployment (11%), future of the coal industry (9%), impact of mining (9%) and more retail/entertainment (6%) (Jetty Research, 2019). Housing affordability was 2%. A wide range of other challenges were mentioned including roads, rates, infrastructure, facilities for young and old people, drug use and communication with rate payers (Jetty Research, 2019).

Residents were also asked to consider major opportunities for the future.

> *While a fifth of residents were unsure of future opportunities, a large proportion of those who were able to identify opportunities focussed on energy (with 19% seeing opportunity in coal mining and 7% in renewable energy). Some 18% were vaguer in mentioning opportunities for more business and jobs and 10% in tourism* (Jetty Research, 2019).

Residents were also asked, in an unprompted question, if they had seen anything outside of the region that could work well locally or improve the quality of life of residents. Almost three quarters of survey participants responded to the question.

> *Responses were varied with equal proportions mentioning town beautification, more facilities for children/youth and more retail/attract businesses (13%). Community events/festivals, attracting tourist and better roads/the bypass were also mentioned (by 8%, 6% and 5% respectively.* (Jetty Research, 2019).

Three percent of respondents to the question identified the removal of coal dust from the air.

### *Local Issues and Trends*

The MSC Community Strategic Plan (2017-2027) (MSC, 2016), identifies a non-exhaustive list of local issues and mega-trends, which are replicated in Table 14.

**Table 14**
**Summary of Local Issues and Trends**

| Issue | Description |
|---|---|
| Local economic prosperity issues | Structural decline or uncertainty in the thermal coal industry, associated job losses, and the need to diversify the Shire's economic base.<br>A rising middle class – particularly in south east Asia, and an associated growing demand for agricultural products.<br>The growth of the knowledge, creativity, and digital economy and a reshaping labour market.<br>The continued growth of the services sector and the concentration of services in Regional centres.<br>A growing visitor economy.<br>The movement from a linear to a circular economy. |
| Local cultural vitality issues | A variety of opportunities for cultural participation.<br>Opportunity to experience high quality national and international arts and culture. |
| Local community infrastructure issues | Integrated footpath and cycleways.<br>Improved accessibility to Council's facilities.<br>Maintain and expand infrastructure to support Muswellbrook achieve Regional Centre status.<br>Ageing Water and Wastewater Infrastructure. |
| Local community leadership issues | Community consultation and participation in council planning.<br>Workforce and asset management.<br>Business Improvement. |
| Local social equity issues | An aging population and changing retirement patterns.<br>Social disadvantage and social exclusion – particularly in Muswellbrook South.<br>Early childhood education and social advantage.<br>Improving local liveability and amenity.<br>Easily accessible venues to appreciate and participate in arts and culture. |
| Local environmental sustainability issues | Climate change.<br>Loss/re-establishment/rehabilitation of native vegetation and vegetation connectivity.<br>Poor riparian environments and poor public access to waterways. |

*Source:* (MSC, 2016)

### 2.6.2 Upper Hunter Shire LGA

The UHSC Community Strategic Plan 2027 (UHSC, ud), describes residents' enjoyment of living in the Shire because of its relaxed, healthy rural lifestyle, the community spirit, environment, affordable living and access to other places. In the future, people would like the UHS to maintain its rural, beautiful environment, and country lifestyle; to remain quiet, but with improved roads, facilities, services and economy (UHSC, ud).

***Community Perceptions***

In 2013, 2015 and 2017, UHSC commissioned Micromex Research to conduct a random telephone survey of between 400 and 450 adult residents living within the LGA.

In 2013 survey participants were asked (in an unprompted question) about the things they value about living in the UHS. The *rural atmosphere and lifestyle* and the *sense of community* were identified by respondents as the most valued attributes. Participants were also asked to identify the biggest issues facing the UHS in the next 5 years (from 2013). *Road maintenance* was the highest response (17%) followed by *coal mining* (14%) and *rail crossings* (12%) (Micromex Research, 2013).

In 2017 survey participants were asked to rate their quality of life living in the UHS. More than 60% of respondents rated their quality of life as very good or excellent. Similar to the 2013 survey, participants were asked (in an unprompted question) about the things they value about living in the UHS. *Community spirit/network, friendly people* was identified by 27% of respondents and *atmosphere – peace and quiet/relaxed/rural living* identified by 20% of respondents (Micromex Research, 2018).

Participants were also asked to identify the biggest issues facing the UHS in the next 5 years (from 2017). Thirty per cent of respondents cited the *effects/completion of the bypass* [Scone Bypass] and *Maintenance of Roads* as the biggest issue. The *Economy/lack of investment and funding/financial management of Council* and was raised by 10% of respondents, *Maintenance/lack of infrastructure, services and facilities to cater for the growing population* was raised by a further 10% and *mining/pollution* by another 10% of respondents (Micromex Research, 2018).

### 2.6.3 Regional Perceptions

The Hunter Research Foundation (HRF) Wellbeing Watch research program, developed in 2006 provides an indication of the health and wellbeing of the regional community. The latest survey was conducted in 2016 and involved a cross sectional telephone survey of 649 Hunter residents. The findings of the 2016 survey showed that the average level of wellbeing for the Hunter as a whole remained stable (Hunter Research Foundation, 2016).

The following findings of the survey were highlighted for further consideration:

- Average wellbeing for residents in the Upper Hunter was slightly lower than for residents in the Lower Hunter.
- One-fifth experienced a decline in job security and levels of unemployment continue to increase. Declining job security and unemployment have a negative impact on wellbeing and detrimental effects on communities.
- Decreasing household incomes were reported with one-fifth reporting being worse off than a year ago. This has resulted in a decreased ability to raise money in an emergency and more than a quarter of households experiencing a shortage of money to meet everyday needs.
- Satisfaction with local neighbourhoods has declined since 2009 including the provision of natural environments which encourage residents to spend time outdoors and impacts on wellbeing.
- A related concern is the reduction of sporting or recreational activities due to changes in household financial situations.
- Negative impacts from development and noise in local areas continue to be associated with lower wellbeing (Hunter Research Foundation, 2016).

# 3 EQUINE CRITICAL INDUSTRY CLUSTER CONSIDERATIONS

## 3.1 INTRODUCTION

This section presents an analysis of the potential impacts of Dartbrook Mine (as approved) on mapped areas of Equine CIC. The IPC contends that:

> *(ii) the social impact on the Equine Critical Industry Cluster (Equine CIC) was not considered, given that areas of ECIC land overlap the mining lease, and the proximity of the mine to thoroughbred industry enterprises;*

The assessment presented below considers the potential impacts of longwall mining rather than bord and pillar. This is because bord and pillar mining will not result in perceptible subsidence and therefore have no impact on the land mapped as Equine CIC. The approved longwall mining therefore represents a worst-case scenario.

This section draws on the information presented in Section 2 and the findings of the following technical assessments:

- *Dartbrook Mine Modification 7 – Air Quality Assessment* (ERM, 2020);
- *Dartbrook Modification 7 – Acoustic Assessment* (Bridges Acoustics, 2020); and
- *Dartbrook Mine – Revised Mod7 – Groundwater Assessment* (AGE Consultants Pty Ltd, 2020)

## 3.2 CONSIDERATION OF IPC CONTENTIONS

### 3.2.1 Critical Industry Clusters

Critical Industry Clusters (CICs) are defined as concentrations of highly productive industries within a region that are related to each other, contribute to the identity of that region and provide significant employment opportunities (DPIE, 2018). CICs were introduced under the *State Environmental Planning Policy (Mining, Petroleum Production and Extraction Industries) 2007*.

The Equine CIC is mapped based on a combination of factors (including location, infrastructure, heritage and natural resources), to protect high quality agricultural land critical to the persistence of equine industries from the impacts of coal seam gas and mining activities (DP&I, 2012).

### 3.2.2 Mapped Equine Critical Industry Cluster

The mapped Equine CIC covers approximately 254,900 ha (less than 10%) of the Upper Hunter region (calculated by Hansen Bailey using DP&E Mapping). Approximately 286 ha of mapped Equine CIC is located within the south-western extent of the Approved Kayuga Seam Mining Area. Of this, approximately 154 ha is located above the Kayuga Seam Mining Area and may be subject to subsidence from future longwall mining activity. The area of Equine CIC that may be mined beneath is considered negligible on a regional scale. The area in question was mapped as Equine CIC at a time when it was already approved to be mined beneath.

### 3.2.3 Current use of Mapped Equine Critical Industry Cluster

The 154 ha of Equine CIC located above the Approved Kayuga Seam Mining Area is under private freehold ownership, is not currently used for Equine CIC related activities and has not been used for Equine CIC related activities since the introduction of the Equine CIC designation.

### 3.2.4 Surrounding Equine Industry Activities

The distribution of equine industry operations proximate to the site is described in Section 2.5.3 and shown on Figure 3.

The nearest thoroughbred stud to Dartbrook Mine is Kelvinside Stud. The nearest boundary of the Kelvinside Stud is located approximately 1.2 km from the East Site (where the existing surface infrastructure is located). Other thoroughbred studs and broodmare farms are located to the north, north-east and north-west of Kelvinside more than 5 km from the Mining Authorities Boundary.

### 3.2.5 Equine Industry Sector Concerns

In submissions to the IPC and DPIE, the Hunter Thoroughbred Breeders Association Inc (HTBA) and Godolphin (Godolphin, 2018; HTBA, 2018; HTBA, 2019a) raised a number of concerns in relation to the Modification, including:

- Potential impacts of the project on mapped Equine CIC;
- Livelihood impacts associated with any project induced changes in water accessibility;
- Potential cumulative air quality impacts of the project; and
- Potential impacts of the project on the reputation and image of the Upper Hunter thoroughbred breeding industry.

Previous government inquiries (Planning Assessment Commission and IPC) have recognised that the Equine CIC is highly sensitive to potential mining impacts. This sensitivity relates to its image. The equine industry seeks to maintain an image that has been described by HTBA as:

> *"…clean, green, bucolic, rural idyll designed to reassure investors of the safe, healthy and caring environment the stud farms provide for their horses."* (HTBA, 2019b, p. 4)

The HTBA considers 'reputation' to be paramount in the horse business because of the inherent risks associated with horse breeding.

### 3.2.6 Assessment of Potential Impacts

***Direct Impacts to Equine CIC Land***

An area of mapped Equine CIC is located within the south-western extent of the Approved Kayuga Seam Mining Area. At this location, the minimum depth to the Kayuga Seam is approximately 170 m. Mining of the Kayuga Seam directly beneath this area of Equine CIC may result in deformations of ground surface (such as cracking and formation of humps). Such deformations are able to be remediated (as required) to avoid impacts to the values that supported the land's designation as Equine CIC. Surface deformations and will be managed in accordance with the Extraction Plan that will be prepared in accordance with DA 231-7-2000. The impact of mine subsidence on land use has a much reduced effect compared to direct disturbance of the land.

AQC will prepare an Extraction Plan prior to the commencement of longwall mining. A series of Property Subsidence Management Plans (PSMPs) will be prepared in consultation with private landholders prior to mining beneath their property. The Extraction Plan will include a subsidence monitoring program, as well as a contingency plan to manage any greater than expected subsidence effects (if they occur).

Given that impacts to the land surface (if they occur) are able to be remediated, subsidence will not result in the displacement of any existing Equine CIC activity. Further, it is highly unlikely that the predicted impacts to Equine CIC within the Mining Authorities Boundary will impact the sustainability and growth of the existing surrounding equine industry.

***Impacts to Surrounding Equine Industry***

The following potential impacts of the Extension Period on the surrounding equine industry are considered below:

- Changes to the character and amenity of the local area that may affect the reputation and image of the equine industry with resulting impacts on equine industry livelihood; and

- Changes in access to groundwater that may affect equine industry livelihood.

Character and Amenity

The Extension Period will not result in a discernible alteration to the landscape which forms the backdrop within which existing equine industries operate. No additional surface infrastructure is proposed as part of the Extension Period. Subsidence impacts will not detract from the character and amenity of the surrounding landscape. AQC has committed to not mining the Piercefield Seam within the approved period. Therefore the subsidence impacts of the Extension Period are anticipated to be within those approved under DA 231-7-2000 (Byrnes Geotechnical Pty Ltd, 2020). Actual impacts may be less because only a subset of the approved mining activities can be conducted within the remaining duration of DA 231-7-2000. Extraction Plan(s) will be prepared for all longwall mining areas prior to the commencement of mining. The Extraction Plans will provide a detailed assessment process describing how the performance measures for natural and built features would be achieved and the management and/or mitigation measures to be applied.

The Extension Period will have no impact on the buffer that already exists between the Dartbrook Mine and Darley Kelvinside or the Mount Pleasant Mine and Darley Kelvinside.

The noise and air quality assessments have confirmed that noise and dust emissions during the Extension Period are not significantly different to the impacts already approved under DA 231-7-2000.

The Air Quality Assessment (ERM, 2020) has considered the air quality impacts of the existing approval for longwall mining being fully operational, in addition to the proposed modification, in the context of changes in background air quality since the granting of DA 231-7-2000. The findings of the Air Quality Assessment (ERM, 2020) show that:

- The Extension Period would comply with all annual air quality criteria including cumulative emissions; and
- The incremental contribution of the Extension Period to cumulative air quality is small compared to other sources.

Potential air quality impacts of the Extension Period will be managed through:

- Preparation of an Air Quality and Greenhouse Gas Management Plan;
- Sealing of the haul route for trucks carrying rejects;
- Minimising the exposed area of the Rejects Emplacement Area (REA) through progressive rehabilitation;
- Establishing dust fences adjacent to exposed areas of the REA; and
- Continuation of all existing controls such as shielded conveyors and water sprays.

With respect to noise, AQC proposes the following additional noise controls at the East Site:

- Upgrading elevated conveyors with additional shielding and low noise idlers;
- Refurbishment of coal reclaimers with lower noise components;
- Construction of a noise barrier north of the CHPP;
- Upgrading building cladding on the north and western facades of the CHPP; and
- Avoiding reject emplacement near the southern limit of the reject emplacement area (REA) at night time and/or unfavourable weather conditions.

Taking into consideration these additional noise mitigation measures, findings of the Noise Assessment (Bridges Acoustics, 2020, p. 9) show:

- Calculated noise levels at closest receivers are predicted to meet the existing Development Consent noise criteria at all except for three privately owned receivers. Receivers 303 and 422, located west of the New England Highway south of Dartbrook Mine's East Site, are predicted to receive a noise level that is 1 decibel over the noise criteria during the night period under noise enhancing weather conditions. As the NSW *Voluntary Land Acquisition and Mitigation Policy* (VLAMP) regards a 1 decibel exceedance of a noise criterion to represent a negligible impact, and as these residences are subject to significant traffic noise from the adjacent New England Highway during all time periods, the predicted noise levels at these residences are considered acceptable. Receiver 391 is predicted to experience noise levels up to 1 decibel above the criteria; however, this receiver is already entitled to acquisition by the Mt Pleasant Mine; and
- Cumulative noise levels, including noise from Dartbrook Mine and from other major sources of industrial noise in the area such as Mt Pleasant Mine, are predicted to exceed relevant cumulative noise criteria at four residences within Kayuga Village. Cumulative noise levels at these receivers are primarily affected by Mt Pleasant Mine noise, and all are subject to acquisition by Mt Pleasant Mine. Dartbrook Mine's contribution to cumulative noise levels is therefore considered acceptable to all receivers.

Based on the findings of the noise assessment the noise levels associated with the Extension Period are able to be managed consistent with regulatory expectations.

In conclusion, the recommencement of longwall mining operations for the Extension Period is unlikely to adversely impact the reputation and image of the surrounding equine industry. The consequence of any unlikely impact is predicted to be minor and of low significance for the following reasons:

- The Extension Period will not result in a discernible alteration to the landscape which forms the backdrop within which existing equine industries operate;
- The predicted changes in existing noise and air quality conditions are minor and therefore:
  - Unlikely to be discernible to nearby equine industry operators; and
  - Unlikely to detract from the existing character and amenity of the local area upon which the reputation of the equine industry is reliant.

Access to Water

The Modification does not seek to alter any aspects of the approved longwall mining. The potential groundwater impacts of the approved longwall mining were assessed by Mackie Environmental Research (MER) (2000) using a numerical groundwater model. A review of the MER (2000) assessment was conducted by Australasian Groundwater and Environmental Consultants (AGE) to advise whether the predictions of the model are likely to remain accurate.

AGE (2020) assessed the impacts of the Extension Period and assumed that mining will recommence in the Kayuga seam and progress through the remaining approved longwall panels in the order represented in the numerical model by MER (2000) including the Mt Arthur seam panels. This reflects an assumption that the mine plan modelled by MER (2000) cannot practically be mined in five years if the Modification were to be approved.

The impact of the Modification may be different from the impacts approved under DA 231-7-2000 because the actual footprint of mining and period of active mining will be less than anticipated by the approval. AGE (2020) considers it:

- Unlikely that the impact associated with the Modification will be greater than impacts approved under DA 231-7-2000 as the mining footprint and timing is reduced by removal of the Piercefield seam.
- Highly unlikely the proposed Extension Period will allow sufficient time to mine the remaining Kayuga seam longwall panels which would further serve to reduce the impact of the Modification compared with the already approved impacts.

MER (2000) identified five private water supply bores within the predicted drawdown limit. AGE (2020) considers that the potential for impact at the identified private bores remains if the Extension Period is approved and longwall mining of the remaining Kayuga seam panels is undertaken. Since the granting of DA 231-7-2000 the NSW Government has introduced the *Aquifer Interference Policy* (AIP) (New South Wales Office of Water, 2012). Make good provisions (as directed by the AIP) will be required (in consultation with private landholders) if mining results in any reduction in the landholder's groundwater supply.

With respect to water take and licensing AQC hold 950 units from the Dart Brook Water Source (aquifer) and 1,249 units from the Hunter Regulated River Alluvial Water Source. AGE (2020) considers that the small indirect take from alluvial aquifers due to the Extension Period can be readily accounted for by water licences already held by AQC. Further, given the limited take from the alluvial aquifer, AGE (2020) considers that incidental take from streamflow will be very limited and accounted for as AQC hold 3,071.8 units from the regulated river.

With respect to the surrounding equine industry, and considering the findings of AGE (2020) AQC will not require any further water licences. As such, the Modification will not adversely impact existing and future water security for the surrounding existing equine industry and therefore the existing and future livelihood of the industry.

The existing groundwater monitoring network at Dartbrook Mine has been well maintained and should serve to assess the impact of the Extension Period should it be approved. AQC will also update the Dartbrook Site Water Management Plan to include contemporary water performance measures.

# 4 ASSESSMENT OF SOCIAL IMPACTS

## 4.1 INTRODUCTION

This section presents the findings of a desktop social impact assessment of Dartbrook Modification 7, specifically the proposed extension of operations for a further five years until 2027. The SIA responds to the IPC assessment findings in relation to the Dartbrook Modification 7 development application. The IPC contends that the social impact has not adequately assessed the extension of the project.

> *(iii) no assessment has been conducted on the social and economic impact of Mod 7 in its entirety for the further five year period until 2027, as the social impacts of the Project were assessed against the mine in care and maintenance mode, or against the mine during longwall operation*

## 4.2 PROJECT DESCRIPTION

The SIA has assessed the impacts of the project based on the following assumptions:

- The mine is operating pursuant to its current development consent but that the coal resource authorised for extraction will not have been completely extracted by 5 December 2022. This involves an assumption that all necessary mining equipment is in place and the existing washery is operating in accordance with its approval;
- The workforce authorised by the development consent is employed at the mine. Dartbrook Mine has approval to employ up to 292 operational personnel (employees and contractors);
- There is no construction period associated with the Modification;
- During the five year extension period, it is to be assumed that 30 Mt of ROM Coal resulting in 22.5 Mt of product coal will be produced (i.e. 6 Mt of ROM coal per year consistent with current approval); and
- Voluntary planning agreements (VPAs) will be entered into with MSC and UHSC consistent with Appendix 5 of DA 231-7-2000 (as modified by the determination of MOD7).

## 4.3 SOCIAL AREA OF INFLUENCE

The Social Area of Influence (SAI) of the Dartbrook Mine extends beyond the boundary of the existing Dartbrook Mine to the communities and LGAs that may experience changes to social conditions. The SAI is defined in Table 15.

**Table 15**
**SIA Study Area Definition**

| SIA Study Area Components | Description |
|---|---|
| Local Area | The local area is generally defined by the ABS Census boundaries of the Kayuga, Dartbrook and Aberdeen State Suburbs. |
| Regional Area | The regional area is defined as the Muswellbrook and UHS LGAs. The primary communities of interest are Aberdeen, Scone and Muswellbrook |

## 4.4 IMPACT AND OPPORTUNITIES ASSESSMENT

This section considers the potential social impacts associated with the Extension Period.

### 4.4.1 Scoping of Impact and Opportunities

Scoping of potential social and opportunities of the Extension Period has been undertaken to ensure the SIA focusses on material social impacts and opportunities.

***Identification of Material Issues***

The operations approved under DA 231-7-2000 would be unchanged for the Extension Period. There would be no change in the size of the approved operational workforce or to the approved coal production rate. There would also be no change in the area of land affected by longwall mining.

There would be no material alteration to the social impacts approved under DA 231-7-2000 and associated with the:

- Workforce i.e. regional population effects associated with the operation of the mine. This includes demand for housing and community services and facilities in neighbouring communities;
- Mine access arrangements and project traffic generation;
- Changes in visual amenity due to the operation of Dartbrook Mine; and
- Damage to or removal of items of Indigenous or non-Indigenous heritage. A range of heritage sites have previously been identified within, or proximal to the mining areas. Management of these sites will be undertaken in accordance with existing approved management measures.

A number of amenity and land use changes have occurred in the local area since granting of DA 231-7-2000 that may have a material effect on the scale and magnitude of the social impacts considered as part of DA 231-7-2000. These changes have been discussed in Section 2 and in summary are:

- The introduction of Equine CIC and BSAL mapping within the Mining Authorities Boundary;
- Significant expansion in the mining industry in the Muswellbrook LGA including the commencement of operations at Mt Pleasant Mine and at Mangoola Mine;
- Intensification of horse breeding activity in the LGAs of UHS and Muswellbrook;
- Residential growth in the nearby community of Aberdeen and further away in Muswellbrook; and
- Population growth in the rural areas proximate to Dartbrook Mine.

Based on the existing experiences of stakeholders residing proximate to the Dartbrook Mine and the changes in the local area, the primary components of the Extension Period likely to give rise to material social impacts (positive and negative) are:

- Longwall mining beneath land designated as Equine CIC;
- Ongoing AQC agricultural operations;
- Continuation of employment opportunities;
- Operation of the CHPP;
- Rail operations and the transportation of coal;
- Mine local spend (i.e. economic stimulus); and
- Community contributions.

The assessment of social impacts therefore considers the following potential adverse impacts of the Extension Period:

- Impacts on rural and residential amenity including the use and enjoyment of private property;
- Impacts on human health and wellbeing;
- Impacts to personal and property rights including.
  - Property acquisition;
  - Property values;
  - Agricultural livelihoods (including equine and dairy operations); and
  - Land capability i.e. Equine CIC.
- Impacts on nearby communities including community character and cohesion; and
- Impacts on other industry sectors e.g. the tourism and horse breeding industries.

The SIA also considers the following potential positive impacts of the Extension Period:

- Economic opportunities;
- Benefits to health and wellbeing through employment and local supply opportunities; and
- Ongoing benefits of AQC's agricultural operations.

The SIA draws on the findings of technical assessments undertaken to inform the assessment of impacts associated with the Extension Period. The potential noise and air quality impacts associated with the Extension Period are described in the Acoustics Assessment and the Air Quality Assessment which have been prepared separate to this SIA.

***Affected Communities***

The people likely to experience the impact of the Extension Period are the same as those currently experiencing impacts of the existing Dartbrook Mine and neighbouring mine operations e.g. the Mt Pleasant Operation. Table 16 presents a summary of the different social groups likely to be affected by the Extension Period.

**Table 16**
**Stakeholder Groups likely to be Affected by an extension to Mine Life**

| Stakeholder | Operational Components | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Underground Mining** | **AQC Agricultural operations** | **Mine Workforce** | **CHPP Operation** | **Rail/Coal Transport** | **Community Contributions** | **Mine Local Spend** |
| AQC Leaseholders | ✓ | ✓ | | | | | |
| Private landowners within the mine site | ✓ | ✓ | | ✓ | ✓ | | |
| Near neighbours | ✓ | | | ✓ | ✓ | ✓ | |
| Aboriginal stakeholders | ✓ | | ✓ | | | | |
| Nearby towns and villages: | | | | | | | |
| Aberdeen Village | ✓ | | ✓ | ✓ | ✓ | | |
| Scone | | | ✓ | | | | |
| Muswellbrook | | | ✓ | ✓ | ✓ | | |
| Singleton | | | ✓ | | ✓ | | |
| UHS Council | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ |
| Muswellbrook Shire Council | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ |
| Community service providers | | | ✓ | ✓ | ✓ | ✓ | ✓ |
| Surrounding Industry: | | | | | | | |
| Thoroughbred Breeding | ✓ | | | ✓ | | | |
| Agricultural | ✓ | ✓ | | ✓ | | | |
| Tourism | ✓ | ✓ | | ✓ | | | |
| AQC workforce and families | | ✓ | ✓ | | | | ✓ |
| AQC suppliers | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |

### 4.4.2 Impact Assessment Outcomes

This section presents the potential impacts and opportunities of the Extension Period and assesses the significance of the identified impacts and opportunities. Assessment of impact significance has been undertaken generally in accordance with the NSW SIA Guideline (DP&E, 2017). Table 17 and Table 18 describe the measures for impact probability and consequence respectively.

**Table 17**
**Probability of Occurrence**

| Rating | Description |
|---|---|
| Almost Certain | Very likely to occur or be an opportunity at either a specific stage of the project lifecycle or more broadly. |
| Likely | Likely to occur or be an opportunity at either a specific stage of the project lifecycle or more broadly. |
| Possible | Possible to occur or be an opportunity at either a specific stage of the project lifecycle or more broadly. |
| Unlikely | Unlikely to occur or be an opportunity at either a specific stage of the project lifecycle or more broadly. |
| Rare | Very unlikely to occur or be an opportunity at either a specific stage of the project lifecycle or more broadly. |

*Source: DP&E (2017)*

**Table 18**
**Consequence of the Potential Social Impact**

| Rating | Description |
|---|---|
| Minimal | • Local, small-scale, easily reversible change on social characteristics or values of the communities of interest. |
| Minor | • Isolated issues or complaints that can be resolved via routine site procedures<br>• Short-term recoverable changes to social characteristics and values of the communities of interest.<br>• Minor social harm. |
| Moderate | • Medium-term recoverable changes to social characteristics and values of the communities of interest. |
| Major | • Repeated incidents or community complaints that require significant adjustment to overall site level and business level procedures.<br>• Long-term recoverable changes to social characteristics and values of the communities of interest. |
| Catastrophic | • Significant, widespread, and enduring community issue or dissent.<br>• Irreversible changes to social characteristics and values of the communities of interest. |

*Source: DP&E (2017)*

Table 19 presents the risk ranking matrix that has been used to determine the significance of potential social impacts.

**Table 19**
**Risk Ranking Matrix**

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


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


*Source: DP&E (2017)*

Table 20 presents the assessment of social impacts and opportunities.

**Table 20**
**Impact and Opportunities Assessment**

| Potential Social Impact / Benefit Considered | Affected Stakeholders | Unmitigated Risk | Mitigation Measures | Residual Risk | Rationale for Residual Risk Ranking |
|---|---|---|---|---|---|
| **Impact Area – Way of Life - Employment and Business Opportunities** | | | | | |
| Continuation of employment opportunities (maximum of 192 direct and 100 contract) for an additional five years.<br>Support for the financial security and wellbeing of project employees and their families. | Project employees, contractors and family members<br>Job seekers interested in mining industry employment | A2 (Positive) | AQC would implement employment and contracting strategies for the project that support the participation of workers from within the UHS and Muswellbrook LGAs. | A3 (Positive) | Provision of employment for up to 292 people for an additional five years is a significant benefit to household wellbeing, particularly given the current unemployment rate in the UHS and Muswellbrook LGAs and the cumulative impacts of both drought and COVID 19.<br>The project would also support the continuation of indirect employment opportunities through its supply arrangements and through its contribution to the continuation of the Garoka Dairy operation. |
| **Impact Area - Community – Character, Identity and Sense of Place** | | | | | |
| The potential of the Extension Period to adversely impact the character and identity of the local area. | Near neighbours including Aberdeen Community<br>Visitors<br>UHS Residents | C2 | AQC proposes additional controls at the East Site to minimise potential noise and dust emissions during operations. These additional controls will also minimise impacts of the Extension Period on the rural character and identity of the immediate locality.<br>The project is an underground mining operation. Any impacts to valued Equine CIC land will be remediated. | D2 | The continuation of operations at Dartbrook Mine is consistent with the long standing identity of Muswellbrook LGA as a mining community. As an existing and underground mine the continuation of operations at Dartbrook Mine will not detract from the rural character of the immediate area.<br>The Extension Period will not require any material changes to existing and long standing surface infrastructure on the |

| Potential Social Impact / Benefit Considered | Affected Stakeholders | Unmitigated Risk | Mitigation Measures | Residual Risk | Rationale for Residual Risk Ranking |
|---|---|---|---|---|---|
| | | | AQC will continue to support the ongoing operation of the Garoka Dairy, which strongly benefits the character and identity of the local area. | | project site that may affect the existing visual amenity and character of the local area.<br>The extension period will not result in the displacement of any existing equine operations or adversely impact the operations of equine facilities proximate to the site. The area of Equine CIC present on the site and temporarily impacted by the project represents a negligible amount of the total Equine CIC in the Hunter Region. |
| The potential for subsidence impacts to detract from the rural character of the local area. | Near neighbours including Aberdeen Community<br>Visitors<br>UHS Residents | D2 | Preparation of Extraction Plans for underground mining. | E1 | Surface deformations and will be managed in accordance with the Extraction Plan that will be prepared in accordance with DA 231-7-2000. The impact of mine subsidence on land use has a much reduced effect compared to direct disturbance of the land. The area of land potentially affected by subsidence will be less than that approved in DA 231-7-2000 due to the smaller mining footprint resulting from the Extension Period. |
| Potential impacts on local heritage connections (Indigenous and Non-Indigenous). | Indigenous and Non-Indigenous people with connection to the land | | Review and update the existing Dartbrook Mine Aboriginal Cultural Heritage Management Plan (ACHMP). | | The project site does not include any items listed on the State Heritage Register or known historic archaeology.<br>There is an approved ACHMP for the site.<br>The project does not involve the destruction or disturbance of items or areas of Indigenous and Non-Indigenous |

| Potential Social Impact / Benefit Considered | Affected Stakeholders | Unmitigated Risk | Mitigation Measures | Residual Risk | Rationale for Residual Risk Ranking |
|---|---|---|---|---|---|
| | | | | | heritage beyond that already approved under DA 231-7-2000. |
| **Impact Area - Community – Sense of Community** | | | | | |
| Existing residents who experience dissatisfaction with changes in amenity conditions may seek to relocate away from the area. | Near neighbours and resident of Aberdeen | C2 | Implementation of additional controls at the East Site will reduce potential noise and air emissions minimising any change in the existing cumulative environment.<br>No additional property acquisitions beyond those already approved under DA 231-7-2000. | D2 | The Extension Period will not result in the direct displacement of any existing residents. It is also unlikely that the Extension Period on its own (given the minor scale of potential change) would influence any decision by existing residents to move from the area. The surrounding existing open cut mining operations are likely to have a greater influence on any resident's decision to move out of the local area due to dissatisfaction with surrounding environment. |
| **Impact Area - Access to Services and Infrastructure – Local and Regional Infrastructure** | | | | | |
| The potential of the Extension Period to adversely impact access to services and infrastructure including housing is low. The Extension Period would | Workforce<br>Service providers<br>Communities of UHS and | D1 | AQC will continue to make financial contributions to the UHSC and MSC in accordance with Voluntary Planning Agreements to be entered into with these councils. | D1 | Funding from the VPAs will compensate for demands on the social infrastructure network (although these impacts are predicted to be negligible) due to the Extension Period. |

| Potential Social Impact / Benefit Considered | Affected Stakeholders | Unmitigated Risk | Mitigation Measures | Residual Risk | Rationale for Residual Risk Ranking |
|---|---|---|---|---|---|
| see a continuation of workforce related impacts as currently approved under DA 231-7-2000. | Muswellbrook LGAs | | | | |
| **Impact Area - Health and Wellbeing - Health** | | | | | |
| Access to continued employment will support the health of project personnel and their families by enabling income security and maintaining social connections. The wellbeing of business owners who supply the project will also be supported. | Project employees, contractors and family members<br>Suppliers and their families | A3 (Positive) | Positive impacts. No further mitigation required. | A3 (Positive) | NA |
| The Extension Period has the potential to exacerbate landowner fears in relation to water security. Whilst agricultural operations in the vicinity of the Mining Authorities Boundary have | Nearby agricultural operations | C3 | AQC holds sufficient Water Access Licences (WALs) to account for all water that may be taken for mine operations and for the continued operation of existing AQC owned agricultural activities e.g. the Garoka Dairy.<br>The majority of water made available through the WALs held by AQC provides for the operation of the Garoka Dairy and not mining activity. The continued operation of | C2 | The Extension Period will not impact water security for existing agricultural operations. No changes are proposed to operations that may necessitate a requirement for additional water allocation beyond that approved under DA 231-7-2000. The predicted impacts of the Extension Period on nearby agricultural operations with respect to surface water and groundwater |

| Potential Social Impact / Benefit Considered | Affected Stakeholders | Unmitigated Risk | Mitigation Measures | Residual Risk | Rationale for Residual Risk Ranking |
|---|---|---|---|---|---|
| experienced little change since the granting of DA 231-7-2000, the significant drought experienced in recent years has exacerbated landowner fears in relation to water security. | | | the Garoka Dairy is of significant benefit to the surrounding agricultural industry and UHS economy. | | impacts are not materially different to those impacts which have already been addressed through DA 231-7-2000 as modified.<br>Water Sharing Plans enacted under the NSW *Water Management Act 2000* impose limits on the total share components that can be issued for different types of licences. These limits ensure that sufficient water is reserved for different purposes, including stock and domestic purposes. This ensures that the availability of water for third parties will not be adversely affected. |
| **Impact Area - Health and Wellbeing – Community Investment** | | | | | |
| The Extension Period will ensure finance is available to support projects and infrastructure investment. | MSC and UHSC<br>Residents of Muswellbrook and UHS LGAs | C3 (Positive) | AQC would continue to make development contributions consistent with DA 231-7-2000. | A3 (Positive) | AQCs commitment to community enhancement in the Dartbrook Mine SAI would be maintained for the Extension Period and would continue to facilitate community benefits at local and regional levels. |
| **Impact Area - Personal and Property Rights – Rail and CHPP noise** | | | | | |
| The Extension Period will prolong the air quality and noise impacts associated with operation of Dartbrook Mine as | Rural residences proximate to the East Site | A2 | AQC will update its Air Quality and Noise Management Plans in consultation with the relevant regulatory authorities.<br>AQC proposes the following additional controls at the East Site: | B2 | The Extension Period does not involve any material alterations to the infrastructure at the East Site, however various refurbishments are proposed to facilitate best practice air quality and noise management. |

| Potential Social Impact / Benefit Considered | Affected Stakeholders | Unmitigated Risk | Mitigation Measures | Residual Risk | Rationale for Residual Risk Ranking |
|---|---|---|---|---|---|
| approved under DA 231-7-2000. Noise and dust emissions associated with the operation of the CHPP, rail and coal load-out facility would add to the existing cumulative environment and may be experienced as a minor change in amenity for rural residences proximate to the East Site. | | | Noise mitigation measures:<br>• Upgrading conveyors with additional shielding and low noise idlers;<br>• Refurbishment of coal reclaimers with lower noise components;<br>• Construction of a noise barrier north of the CHPP and additional cladding of the washery building; and<br>• Avoiding reject emplacement near the southern limit of the Rejects Emplacement Area (REA) at night time and/or unfavourable weather conditions.<br>Dust mitigation measures:<br>• Sealing of the haul route for trucks carrying rejects;<br>• Minimise the exposed area of the REA through progressive rehabilitation; and<br>• Establishing dust fences adjacent to exposed areas of the REA. | | The Extension Period is not expected to result in any exceedances of the acquisition criteria under the VLAMP for changes in either noise or air quality. The outcomes of the Noise Assessment show minor noise exceedances (less than 2 dB at three private residences (303, 391, 422) south of the Mining Authorities Boundary. One residence is already entitled to acquisition upon request from the neighbouring Mt Pleasant Mine.<br>Dartbrook Mine is an underground operation. The impacts will be short-term in nature as AQC is seeking only a five-year extension to DA 231-7-2000. |
| The Extension Period will prolong the air quality and noise impacts associated with operation of Dartbrook Mine as approved under DA 231-7-2000. Noise and dust emissions associated with the | Aberdeen township | B2 | AQC will update its Air Quality and Noise Management Plans in consultation with the relevant regulatory authorities.<br>AQC proposes the following additional controls at the East Site:<br>Noise mitigation measures:<br>• Upgrading conveyors with additional shielding and low noise idlers; | B1 | The Extension Period does not involve any material alterations to the infrastructure at the East Site, however various refurbishments are proposed to facilitate best practice air quality and noise management.<br>The Extension Period is not expected to result in any exceedances of the acquisition criteria under the VLAMP for changes in either noise or air quality. The |

| Potential Social Impact / Benefit Considered | Affected Stakeholders | Unmitigated Risk | Mitigation Measures | Residual Risk | Rationale for Residual Risk Ranking |
|---|---|---|---|---|---|
| operation of the CHPP, rail and coal load-out facility would add to the existing cumulative environment and may be experienced as a minor change in amenity for residences in nearby communities. | | | • Refurbishment of coal reclaimers with lower noise components;<br>• Construction of a noise barrier north of the CHPP and additional cladding of the washery building; and<br>• Avoiding reject emplacement near the southern limit of the Rejects Emplacement Area (REA) at night time and/or unfavourable weather conditions.<br>Dust mitigation measures:<br>• Sealing of the haul route for trucks carrying rejects;<br>• Minimise the exposed area of the REA through progressive rehabilitation; and<br>• Establishing dust fences adjacent to exposed areas of the REA. | | outcomes of the Noise Assessment show minor noise exceedances (less than 2 dB at three private residences (303, 391, 422) south of the Mining Authorities Boundary. One residence is already entitled to acquisition upon request from the neighbouring Mt Pleasant Mine.<br>Dartbrook Mine is an underground operation. The impacts will be short-term in nature as AQC is seeking only a five-year extension to DA 231-7-2000. |
| **Impact Area - Personal and Property Rights – Land Capability (Equine CIC)** | | | | | |
| Impacts on the potential future use of land mapped as Equine CIC due to project activities e.g. subsidence. | Land owner<br>Equine industry | C2 | Bord and pillar mining is proposed beneath areas of Equine CIC.<br>AQC, in consultation with the landholder, will prepare a PSMP for each private landholding.<br>The Extraction Plan will include a subsidence monitoring program, as well as a contingency plan to manage any greater than expected subsidence effects (if they occur). | D1 | The Equine CIC land has no recent history of equine use. Subsidence impacts will be localised and able to be remediated. As such, subsidence will not result in the displacement of any existing Equine CIC activity. The area of Equine CIC land potentially affected is small in the context of the Upper Hunter Equine CIC.<br>The predicted impacts to Equine CIC within the Mining Authorities Boundary will not impact the sustainability and growth of |

| Potential Social Impact / Benefit Considered | Affected Stakeholders | Unmitigated Risk | Mitigation Measures | Residual Risk | Rationale for Residual Risk Ranking |
|---|---|---|---|---|---|
| | | | | | the existing surrounding equine industry. Subsidence will not affect the characteristics of the land that informed its designation as Equine CIC land. |
| **Impact Area - Personal and Property Rights – Agricultural Livelihood (Water Security)** | | | | | |
| Potential impacts on the livelihood of nearby Agricultural enterprises (equine, viticulture, agriculture) due to changes in water security. | Nearby Agricultural operators | D3 | AQC holds sufficient WALs to account for all water that may be taken for mine operations and for the continued operation of existing AQC owned agricultural activities e.g. the Garoka Dairy. | D2 | The Extension Period will not impact water security for existing agricultural operations. No changes are proposed to operations that may necessitate a requirement for additional water allocation beyond that approved under DA 231-7-2000. The predicted impacts of the Extension Period on nearby agricultural operations with respect to surface water and groundwater impacts are not materially different to those impacts which have already been addressed through DA 231-7-2000 as modified.<br>Water Sharing Plans enacted under the NSW *Water Management Act 2000* impose limits on the total share components that can be issued for different types of licences. These limits ensure that sufficient water is reserved for different purposes, including stock and domestic purposes. This ensures that the availability of water for third parties will not be adversely affected. |
| **Impact Area - Personal and Property Rights – Agricultural Livelihood** | | | | | |

| Potential Social Impact / Benefit Considered | Affected Stakeholders | Unmitigated Risk | Mitigation Measures | Residual Risk | Rationale for Residual Risk Ranking |
|---|---|---|---|---|---|
| The Extension Period will support the continued operation of the Garoka Dairy on land leased from AQC. The Garoka Dairy is valued for its economic contribution to the agricultural industry and its contribution to the character and identity of the surrounding landscape. | Garoka Dairy leaseholders<br>Agricultural industry<br>Visitors | A4 (Positive) | AQC has made a commitment to maintain the agricultural productivity of its land holdings including the operation of the Garoka Dairy. | A4 (Positive) | The Garoka Dairy commenced operation on mine owned land approximately 19 years ago. Since acquiring Dartbrook Mine, AQC has made significant financial investments in the Garoka Dairy, thereby paving the way for the use of additional new technology into the future. |
| **Impact Area - Personal and Property Rights – Property Values** | | | | | |
| The Extension Period may exacerbate existing resident fears in relation to property values. This can be attributed in part to the cumulative growth in the mining industry in the Hunter Valley, growth in rural residential population and residential growth in Aberdeen. | Nearby private landowners<br>Aberdeen residents | C3 | Implementation of additional noise and dust controls at the East Site will minimise potential noise and dust emissions during operations. | C2 | Dartbrook Mine is an existing mine. Neighbouring property values will have already adjusted to the presence of the mine and the presence of other more recent mining operations e.g. Mt Pleasant Mine. The Extension Period is unlikely to give rise to any significant changes in the approved noise and dust emissions that may have a material effect on property values. |
| **Impact Area - Way of life – Industry Sector Operations - Agriculture** | | | | | |

| Potential Social Impact / Benefit Considered | Affected Stakeholders | Unmitigated Risk | Mitigation Measures | Residual Risk | Rationale for Residual Risk Ranking |
|---|---|---|---|---|---|
| The Extension Period has some potential to result in reduced land capability, displacement of existing agricultural land uses and indirect impacts on the economy of the agricultural industry in the UHS and Muswellbrook LGA.<br>Since the granting of DA 231-7-2000, BSAL and Equine CIC have been mapped within the Mining Authorities Boundary. | Existing agricultural operations within the Mining Authorities Boundary<br>Broader Agricultural industry sector in the UHS and Muswellbrook LGAs | C2 | No longwall mining is proposed in areas of BSAL. Bord and Pillar mining is proposed beneath Equine CIC areas which will significantly reduce the effects of subsidence. Only a small area of Equine CIC will be impacted by subsidence. Any subsidence impacts within the Equine CIC area will be localised and able to be remediated. No equine activities will be displaced by the Extension Period.<br>A PSMP will be prepared for each private landholding. | D1 | The predicted impacts of subsidence on agricultural land are not materially different to the impacts approved under DA 231-7-2000.<br>Land within the longwall mining area is predominantly used for grazing. |
| The potential of the Extension Period to directly or indirectly impact the existing equine industry in the UHS and Muswellbrook LGAs due to cumulative noise and dust emissions. | Equine Industry enterprise operators, employees and customers | C2 | Implementation of additional noise and dust controls at the East Site will minimise potential noise and dust emissions during operations. | D2 | The predicted noise and air quality impacts of the Extension Period are not significantly different to the impacts approved under DA 231-7-2000. The predicted impacts of the Extension Period on nearby agricultural operations with respect to surface water and groundwater impacts are not materially different to those impacts which have already been addressed through DA 231-7-2000 as modified. |

| Potential Social Impact / Benefit Considered | Affected Stakeholders | Unmitigated Risk | Mitigation Measures | Residual Risk | Rationale for Residual Risk Ranking |
|---|---|---|---|---|---|
| | | | | | The Extension Period will not result in any displacement of existing equine activities and will therefore have negligible impact on the operation of the broader equine industry in the Upper Hunter. |
| The potential for the Extension Period to detract from the attractiveness of the local area as a tourist destination. | Visitors to the local area<br>Business operators including accommodation providers | D2 | Implementation of additional noise and dust controls at the East Site will minimise potential noise and dust emissions during operations. | D1 | Dartbrook Mine is an existing underground mining operation. Some changes have occurred in the tourism sector of the Hunter Valley since the granting of DA 231-7-2000. The Extension Period does not involve any changes to surface infrastructure that would have a material impact on the attractiveness of the local area. The Extension Period will not result in any additional material changes in the surroundings that may further detract from the attractiveness of the location as a tourist destination. |
| **Impact Area - Cumulative Impacts – Health and Wellbeing** | | | | | |
| Residents who are already affected by cumulative noise and dust issues in the local area have experienced stress. Expansion in the Hunter Region mining industry (particularly an increase in open cut | Near neighbours<br>Aberdeen Community<br>Residents of the broader UHS and Muswellbrook LGAs | A3 | AQC proposes additional controls at the East Site to minimise potential noise and dust emissions during operations.<br>AQC would provide regular updates to affected residents and ongoing engagement with residents, if required.<br>AQC would proactively manage mining operations during unfavourable weather conditions. | B1 | Dartbrook Mine is an underground operation. Noise and dust emissions from the operation are largely associated with the East Site where the main surface infrastructure is located.<br>The dust model predicts that the Extension Period will comply with all annual air quality criteria, under both an incremental and cumulative basis. |

| Potential Social Impact / Benefit Considered | Affected Stakeholders | Unmitigated Risk | Mitigation Measures | Residual Risk | Rationale for Residual Risk Ranking |
|---|---|---|---|---|---|
| operations) has resulted in elevated concerns amongst residents in relation to health and wellbeing. These concerns are expected to continue and be exacerbated by the Extension Period. | | | | | The contribution of the Extension Period to the cumulative noise and air environment in the local and regional area is minimal in the context of surrounding open cut operations. |
| **Impact Area - Cumulative Impacts – Equine Industry Operations** | | | | | |
| Equine industry operators hold existing concerns regarding the cumulative impacts of mining in the Upper Hunter on the health and wellbeing of valued equine stock. | Existing equine industry operators in the Upper Hunter | D3 | AQC proposes additional controls at the East Site to minimise potential noise and dust emissions during operations. | D2 | Dartbrook Mine is an underground operation. Noise and dust emissions from the operation are largely associated with the East Site where the main surface infrastructure is located.<br>The dust model predicts that the Extension Period will comply with all annual air quality criteria, under both an incremental and cumulative basis.<br>The contribution of the Extension Period to the cumulative noise and air environment in the local and regional area is minimal in the context of surrounding open cut operations. |
| Equine industry operators hold existing concerns regarding the cumulative impacts of mining in the Upper | Existing equine industry operators in the Upper Hunter | D2 | AQC proposes additional controls at the East Site to minimise potential noise and dust emissions during operations. | D1 | Dartbrook Mine is an underground operation. Noise and dust emissions from the operation are largely associated with the East Site where the main surface infrastructure is located. |

| Potential Social Impact / Benefit Considered | Affected Stakeholders | Unmitigated Risk | Mitigation Measures | Residual Risk | Rationale for Residual Risk Ranking |
|---|---|---|---|---|---|
| Hunter on the reputation and image of the Thoroughbred Breeding industry. There is concern that the Extension Period may have a cumulative adverse impact on the attractiveness of the Upper Hunter Thoroughbred Breeding industry. | | | | | The Extension Period will result in no significant changes to the surrounding landscape that may detract from the visual character of the locality and adversely impact the locations attractiveness as a horse breeding location. |
| **Impact Area - Cumulative Impacts – Character** | | | | | |
| The potential cumulative impact of the Extension Period on the attractiveness of local area as a tourist destination. | Business operators and Visitors | D2 | AQC proposes additional controls at the East Site to minimise potential noise and dust emissions during operations.<br>AQC would provide regular updates to affected residents and ongoing engagement with residents, if required.<br>AQC would proactively manage mining operations during unfavourable weather conditions. | D1 | Dartbrook Mine is an underground operation. The Extension Period will result in no significant changes to the surrounding landscape that may detract from the visual character of the locality and adversely impact the locations attractiveness as a tourist destination.<br>The contribution of the Extension Period to the cumulative noise and air environment in the local and regional area is minimal in the context of surrounding open cut operations.<br>The Extension Period will not place additional demands on short-term accommodation that may in term reduce |

| Potential Social Impact / Benefit Considered | Affected Stakeholders | Unmitigated Risk | Mitigation Measures | Residual Risk | Rationale for Residual Risk Ranking |
|---|---|---|---|---|---|
| | | | | | the attractiveness of the location as a tourist destination. |

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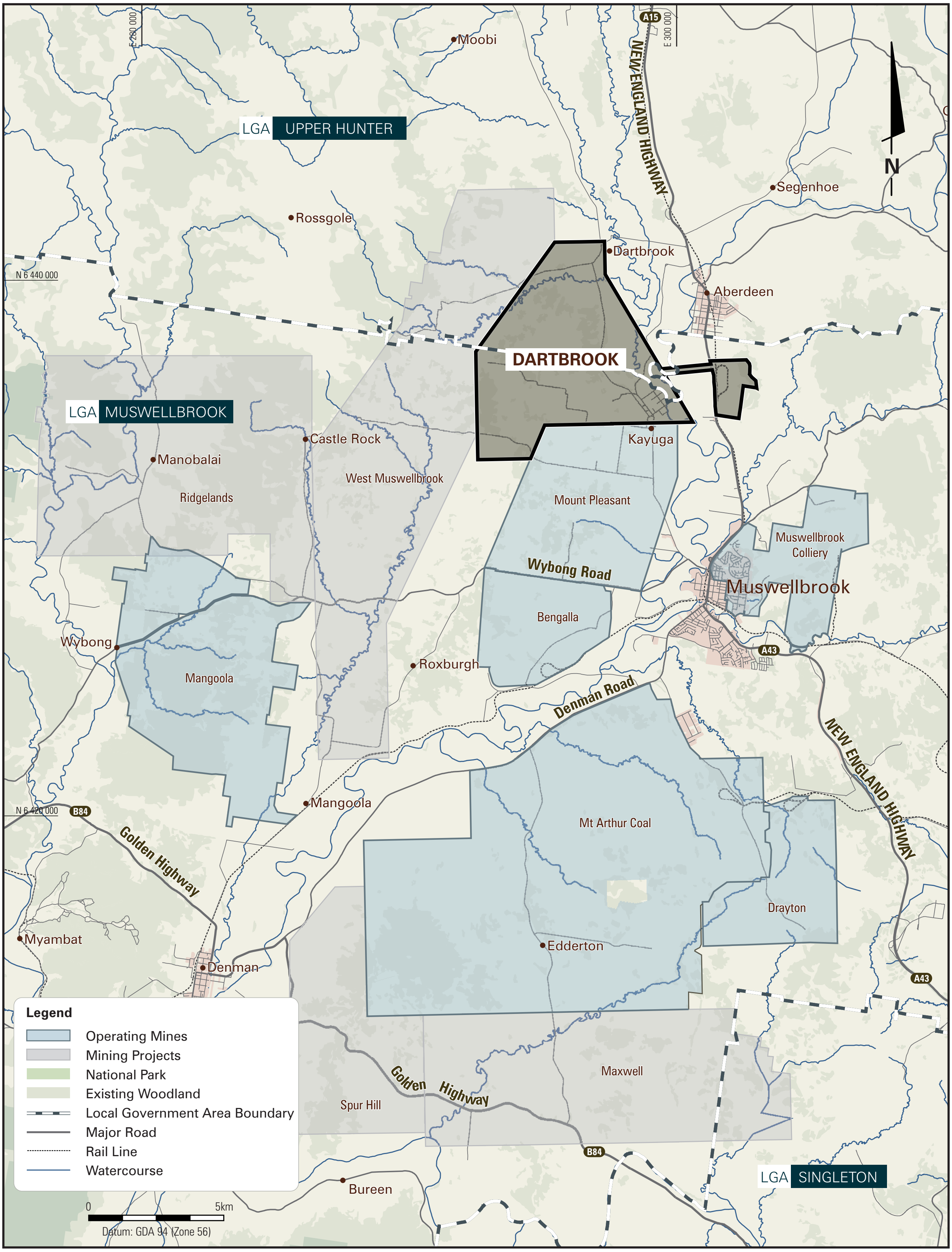
for
**HANSEN BAILEY**

Bronwyn Pressland
*Principal Social Planner*

James Bailey
*Director*

# FIGURES



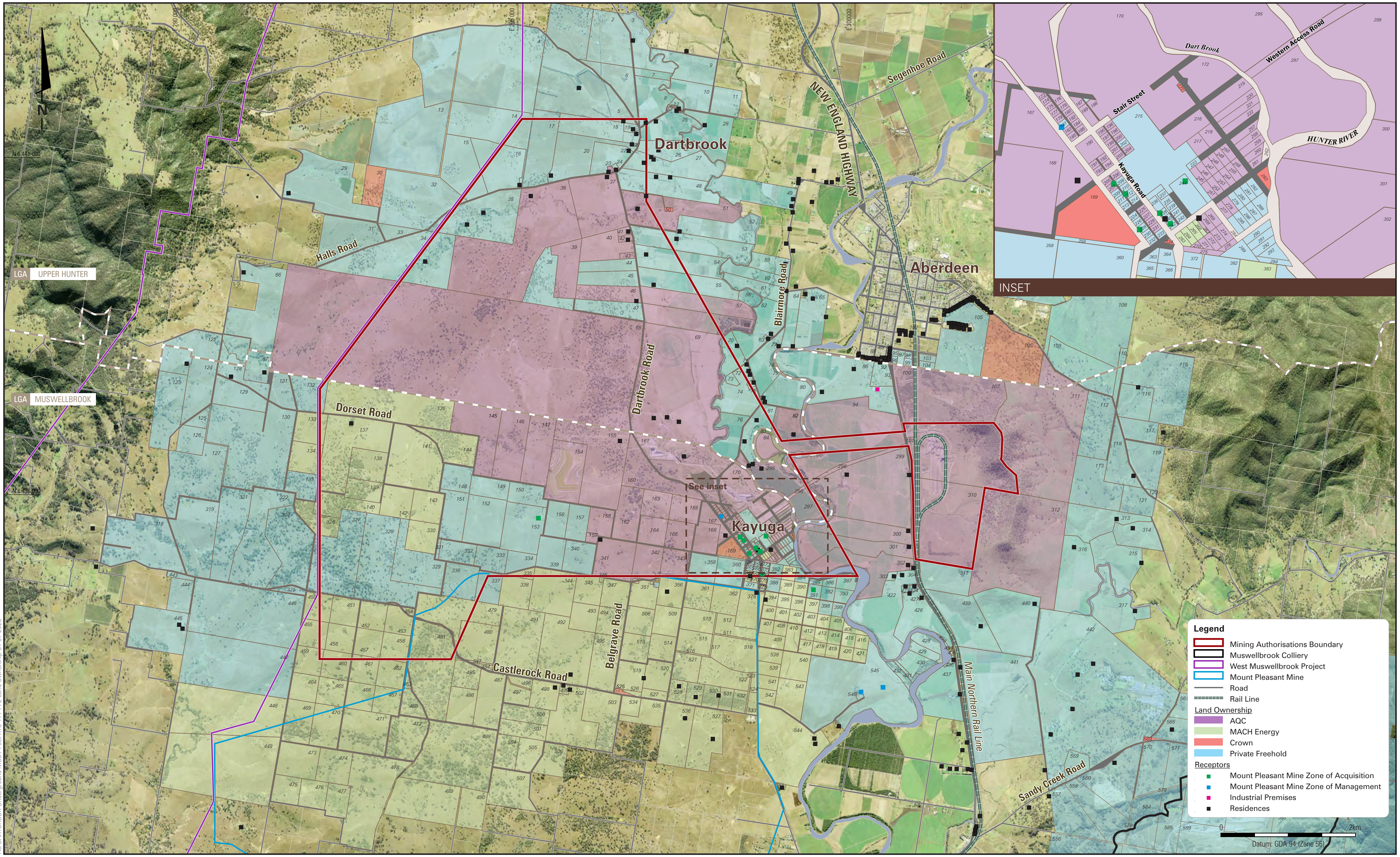

DARTBROOK MINE

HansenBailey ENVIRONMENTAL CONSULTANTS

Australian Pacific Coal

Regional Locality

**FIGURE 1**




H8 DARTBROOK Underground MOD7 Post RTS 1774 F2 Land Ownership 01 07 2020

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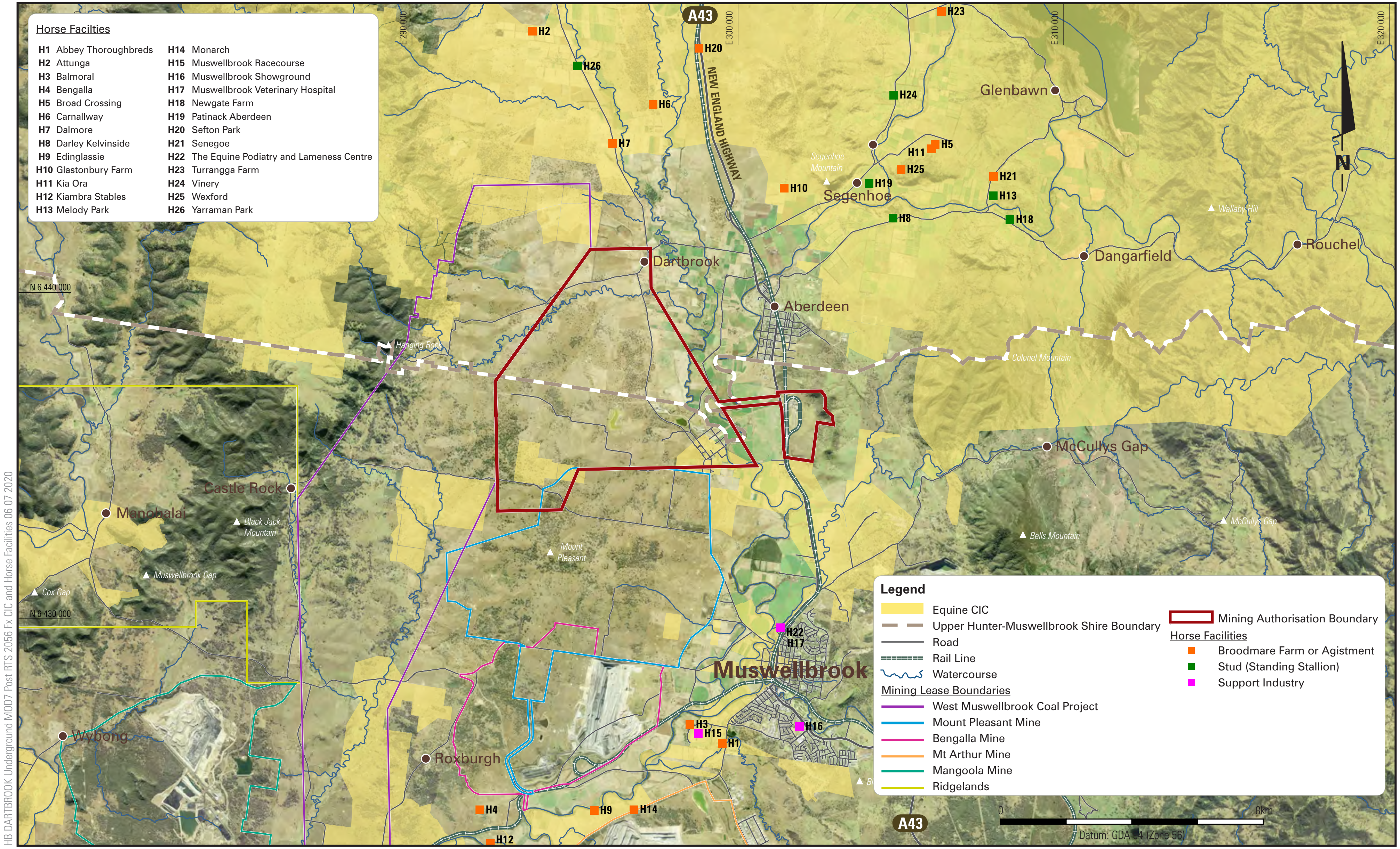
Australian Pacific Coal

DARTBROOK MINE

Land Ownership

**FIGURE 2**




DARTBROOK MINE

Equine CIC and Horse Facilities

**FIGURE 3**

HansenBailey ENVIRONMENTAL CONSULTANTS

Australian Pacific Coal

***APPENDIX F***

***Economic Impact Assessment***

# Dartbrook
# Modification 7
# Economic Impact Assessment

*Prepared for*

**AQC Dartbrook Management Pty Limited**

**By**

**Gillespie Economics**
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**July 2020**

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# EXECUTIVE SUMMARY

AQC Dartbrook Management Pty Limited (AQC) is the proprietor of the Dartbrook Mine, located in the Upper Hunter Valley of NSW. The Dartbrook Mine is the subject of Development Consent DA 231-7-2000 and its subsequent modifications.

A proposal for a further modification to the Consent to enable an alternative method of underground mining (bord and pillar mining) at a rate of up to 1 Mtpa, an alternative coal clearance system (truck haulage of the ROM coal) and a five-year extension to the approval duration, was approved by the Independent Planning Commission (IPC), except for the five-year extension to the approval period. The IPC's determination is currently the subject of Class 1 proceedings in the Land and Environment Court (LEC).

The IPC's refusal of the time extension component of the Modification is largely on the grounds that the potential impacts of the approved longwall mining during the additional five-years had not been assessed. Consequently, Gillespie Economics was engaged to act as an independent expert to undertake an Economic Impact Assessment of the Modification.

From an economic perspective there are two important aspects of the Modification that can be considered:

- its economic efficiency (i.e. consideration of the economic costs and benefits of the Modification) which is evaluated using cost benefit analysis (CBA); and
- its effects on the local economy, which is evaluated using local effects analysis (LEA) and input-output (IO)analysis.

A CBA of the Modification indicated that it would have net production benefits to Australia of $500M (relative to the economic base case) and $509M (relative to the legal base case). Net production benefits to NSW are estimated at $247M (relative to the economic base case) and $229M (relative to the legal base case).

Provided the residual environmental, social and cultural impacts of the Modification that accrue to Australia and NSW are considered to be valued at less than the level of net production benefits, the Modification can be considered to provide an improvement in economic efficiency and hence is justified on economic grounds.

Instead of leaving the environmental, cultural and social impacts unquantified, an exercise was undertaken to quantify them. Most impacts were considered to be immaterial from an aggregate economic efficiency perspective. The main quantifiable environmental impacts of the Modification, which have not already been incorporated into the estimate of net production benefits, relate to the opportunity cost of water access licences (WALs) and the impacts of greenhouse gas (GHG) emissions. The opportunity cost of WALs are estimated at $7M. GHG impacts to Australia and NSW are estimated at $0.1M and $0.03M, respectively, relative to the economic base case, and $0.07M and $0.02M, respectively, relative to the legal base case. These economic costs are considerable less than the estimated net production benefits of the Modification.

Overall, the Modification is estimated to have net social benefits to both Australia and NSW relative to both the economic base case and legal base case, and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts have been quantified and included in the Modification CBA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than $240M (relative to the economic base case) and $222M (relative to the economic base case) for the Modification to be questionable from an NSW economic efficiency perspective.

The local economy comprises Singleton, Muswellbrook and Upper Hunter Shire Local Government Areas. The Modification will provide direct economic activity, including jobs, to the local economy, and indirect economic activity to the local area via both wage and non-wage expenditure. A summary of local economic effects of the Modification is provided in Table ES1.

**Table ES1 - Summary of Effects on the Local Community (Excluding AQC)**

| **Local Effects** | **Direct Total** | **Direct Already Resident in the Local Area** | **Net** |
|---|---|---|---|
| Employment FTE | 196 | 156 | 58 |
| Income ($M) | 23 | 19 | 5 |
| Non-labour expenditure in the Local Area | 96 | | |
| **Regional Impacts** | **Direct** | **Flow-on** | **Total** |
| Output ($M) | 424 | 153 | 577 |
| Value-added ($M) | 199 | 78 | 276 |
| Income ($M) | 19 | 30 | 49 |
| Employment | 196 | 424 | 620 |
| **Other Local Economic Impacts** | | | |
| Contraction in other sectors | No material impact* | | |
| Displaced activities | No material impact* | | |
| Wage rise impacts | No material impact* | | |
| Housing impacts | No material impact* | | |
| **Local Environmental Impacts** | | | |
| Greenhouse gas emissions | $0.0002M | | |
| Operational noise | Modelled 1 dBA exceedance of criteria at three residences during the night only – exceedences of 0-2dBA are not discernible | | |
| Air quality | Modelled cumulative 24-hour PM10 criteria exceeded one day per year at 7 private residences – can be avoided by modifying mining operations when weather conditions are unfavourable | | |
| Subsidence | Any subsidence damage caused by active mining compensated by AQC | | |

# 1 INTRODUCTION

AQC Dartbrook Management Pty Limited (AQC) is the proprietor of the Dartbrook Mine, located in the Upper Hunter Valley of New South Wales. The Dartbrook Mine is the subject of Development Consent DA 231-7-2000 and its subsequent modifications. These enable production of 6 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal production until December 2022, using longwall mining methods.

In February 2018, AQC sought a further modification to the Consent to enable an alternative method of underground mining (bord and pillar mining), an alternative coal clearance system (truck haulage of the ROM coal) and a five-year extension to the approval duration.

This was approved by the Independent Planning Commission (IPC), except for the five-year extension to the approval period. The IPC's determination is currently the subject of Class 1 proceedings in the Land and Environment Court (LEC).

Under current approvals, underground mining of up to 6 Mtpa of ROM coal mining until December 2022 is approved. However, the Mine is in care and maintenance, and with the approval time limited to 2022 it is not economic to commence any mining.

The IPC's refusal of the time extension component of the Modification is largely on the grounds that the potential impacts of the approved longwall mining during the additional five-years had not been assessed. Consequently, Gillespie Economics was engaged to act as an independent expert to undertake an Economic Assessment of a revised Modification that comprises:

- extraction of up to 37.4 Mt of ROM coal using bord and pillar and/or longwall mining methods between 2021 and 2027 (inclusive). All mining will occur within the currently approved mining footprint and maximum production rate of 6 Mtpa.
- during the five-year extension period an assumed 30 Mt of ROM coal resulting in 22.5 Mt of product coal being produced.
- delivery of ROM coal from the mine workings to the East Site using the Hunter Tunnel i.e. truck haulage is no longer proposed.
- use of the existing Coal Handling and Preparation Plant (CHPP) at the East Site to wash all ROM coal extracted.
- no new surface infrastructure.
- an operational workforce of up to 292 personnel.

Consistent with the NSW Government (2015) *Guideline for the economic assessment of mining and coal seam gas proposals*, two types of economic assessment of the Modification are required:

- a cost benefit analysis (CBA) which is the primary way that economists evaluate the net benefits of projects and policies, provide economic justification for a project and address the public interest;

- a local effects analysis (LEA) to assess the impacts of the Modification in the locality, specifically:

  - effects relating to local employment;
  - effects relating to non-labour project expenditure; and
  - environmental and social impacts on the local community.

Economic analysis tools such as CBA and LEA are not mechanised decision-making tools, but rather a means of analysis that provides useful information for decision-makers to consider alongside the performance of a project in meeting other government goals and objectives.

# 2 COST BENEFIT ANALYSIS

## 2.1 Introduction

CBA of the Modification involves the following key steps:

- identification of the “with” and “without” Modification scenarios;
- identification and valuation of the incremental benefits and costs;
- consolidation of value estimates using discounting to account for temporal differences;
- application of decision criteria;
- sensitivity testing;
- consideration of non-quantified benefits and costs; and
- consideration of the distribution of costs and benefits.

What follows is a CBA of the Modification based on the production schedule proposed by AQC, and financial, technical and environmental advice provided by AQC and its specialist consultants. An explanation of CBA is provided in Attachment 1.

## 2.2 Identification of the “Without” Modification Scenarios

A starting point for CBA is to establish the "without" Modification scenario for the land impacted by the Modification. This becomes the base case against which to assess the potential economic, social and environmental impacts of changes due to the Modification.

Two base cases can be identified:

- The economic base case - the continued care and maintenance of the Dartbrook Mine with decommissioning at the end of current approvals in December 2022. The existing approval allows mining of up to 6 Mtpa of ROM coal mining until December 2022. However, the Mine is in care and maintenance, and with the approval time limited to 2022, it is not economic to commence any mining.

- The legal base case – approved mining of 6 Mtpa, with decommissioning at the end of current approvals in December 2022. While it is not economic to commence any mining, the proponent has an approval that allows it to mine at 6 Mtpa. Essentially, under this base case, it is assumed that mining is occurring in accordance with the existing approval. Under this assumption, capital costs required to commence mining under the existing approval i.e. noise attenuation, mining equipment, upgrade of coal washing plant etc. would already have been spent.

## 2.3 Identification of the “With” Modification Scenario

“With” the proposed Modification, mining of 6 Mtpa of ROM, with up to 1.5 Mtpa sourced from bord and pillar mining, would be permitted until December 2027, with all mining occur within the currently approved mining footprint.

Table 2.1 provides the ROM production schedules for the two base cases, the “with” Modification scenario, and the incremental production schedules.

**Table 2.1 – Run-of-Mine Production Schedules (Mtpa)**

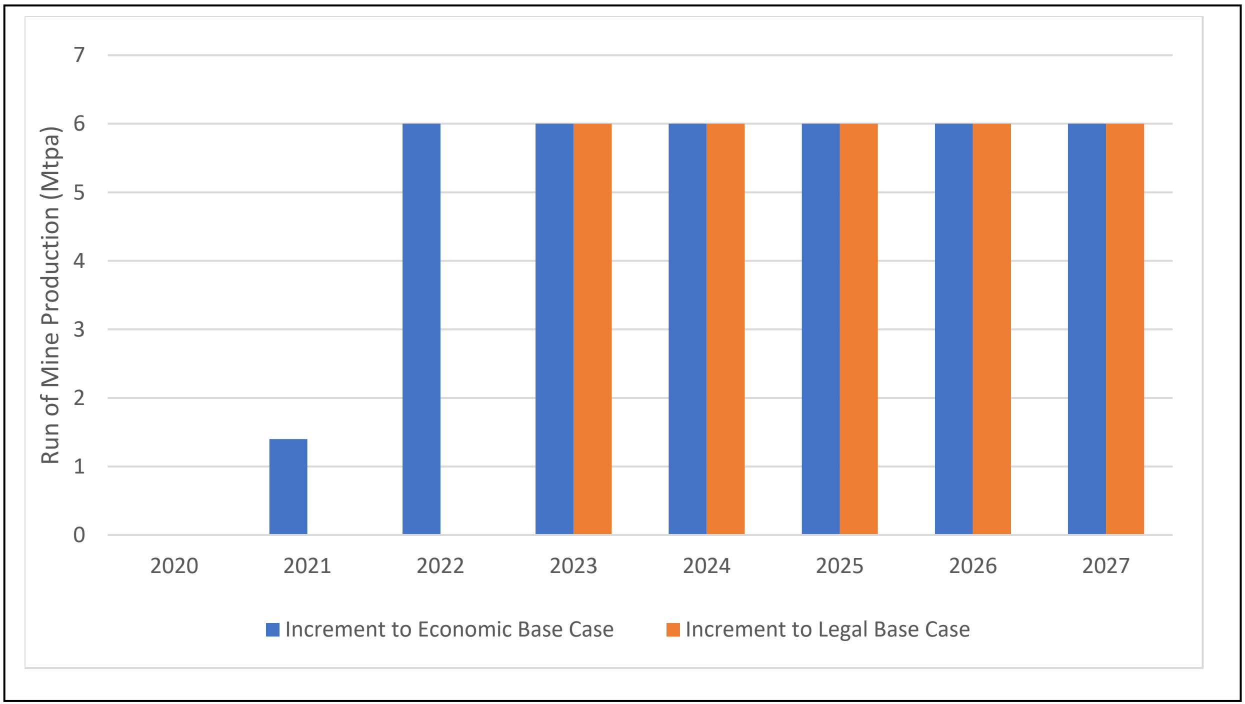
| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | Total |
|---|---|---|---|---|---|---|---|---|---|
| **Economic Base Case** | 0 | 0 | 0 | | | | | | **0** |
| **Legal Base Case** | 0 | 6 | 6 | | | | | | **12** |
| **With Modification Scenario** | 0 | 1.4 | 6 | 6 | 6 | 6 | 6 | 6 | **37.4** |
| **Increment to Economic Base Case** | 0 | 1.4 | 6 | 6 | 6 | 6 | 6 | 6 | **37.4** |
| **Increment to Legal Base Case** | 0 | 0 | 0 | 6 | 6 | 6 | 6 | 6 | **30** |

Compared to the economic base case, the "with" Modification scenario would permit incremental mining of up to 37.4 Mt of ROM coal using bord and pillar and/or longwall mining methods between 2021 and 2027 (inclusive). This is because approval of an extended mine life allows for mining to ramp up from care and maintenance to 6 Mtpa during the time-period of the existing approval and then continuation of this level of production during the extended mine life.

Compared to the legal base case, the five-year extension period would enable mining of 30 Mt of ROM coal. This is because the legal base case assumes mining is already at the approved level of 6 Mtpa of ROM.

Figure 2.1 illustrates the incremental production of the Modification relative to the two base cases.

**Figure 2.1 – Incremental Production from the Modification Relative to Different "Without" Modification Scenarios**



## 2.4 Identification of Benefits and Costs

Relative to the base cases, or "without" Modification scenarios, the Modification may have the potential incremental economic benefit and cost categories shown in Table 2.2.

It should be noted that the potential externality costs, listed in Table 2.2, are only economic costs to the extent that they affect individual and community wellbeing through direct use of resources by individuals or non-use. If the potential impacts are mitigated to the extent where community wellbeing is insignificantly affected, then no external economic costs arise.

**Table 2.2 - Potential Incremental Economic Benefits and Costs of the Modification**

| Category | Costs | Benefits |
|---|---|---|
| Production | • Opportunity cost of land<br>• Opportunity cost of capital<br>• Development costs<br>• Operating costs, including administration, mining, ore processing, transportation, mitigation measures and offsets (but excluding royalties)<br>• Decommissioning costs at cessation of the Modification | • Avoided care and maintenance costs<br>• Avoided decommissioning and rehabilitation costs in 2022<br>• Sale value of coal<br>• Residual value of capital and land at the cessation of the Modification |
| Externalities | • Greenhouse gas generation<br>• Operational noise impacts<br>• Road transport impacts<br>• Air quality impacts<br>• Groundwater impacts<br>• Surface water impacts<br>• Subsidence impacts<br>• Biodiversity impacts<br>• Aboriginal heritage impacts<br>• Historic heritage impacts<br>• Visual impacts<br>• Agriculture impacts<br>• Net public infrastructure costs<br>• Loss of surplus to other industries | • Wage benefits to employment<br>• Economic benefits to existing landholders<br>• Economic benefits to suppliers |

Framed in another but equivalent way the potential incremental costs and benefits of the Modification are as per Table 2.3.

**Table 2.3 - Alternative Frame of Potential Economic Benefits and Costs of the Modification**

| Costs | Benefits |
|---|---|
| ***Direct costs*** | ***Direct benefits*** |
| Nil | Net production benefits<br>• *Royalties*<br>• *Company tax*<br>• *Net producer surplus* |
| ***Indirect costs*** | ***Indirect benefits*** |
| Net environmental, social, cultural and transport related costs | Wage benefits to employment |
| Net public infrastructure costs | Economic benefits to existing landholders |
| Loss of surplus to other industries | Economic benefits to suppliers |

The magnitude of costs and benefits varies depending on whether the Modification is compared to the economic base case or the legal base case.

## 2.5 Quantification/Valuation of Benefits and Costs

Consistent with NSW Government (2015), the CBA was undertaken in 2020 real values, with discounting at 7 percent (%) and sensitivity testing at 4% and 10%.

The analysis period is eight years, coinciding with the proposed life of the Modification. Any impacts that occur after this period are included in the final year of the analysis as a terminal value.

Where competitive market prices are available, they have generally been used as an indicator of economic values. Environmental, cultural and social impacts have initially been left unquantified and interpreted using the threshold value method.[1]

An attempt has also been made to estimate environmental, cultural and social impacts using market data and benefit transfer[2] and incorporate them into an estimate of the net social benefit of the Modification. This estimated net social benefit of the Modification provides another threshold value that any residual or non-quantified economic costs would need to exceed to make the Modification questionable from an economic efficiency perspective.

### *2.5.1 Production Costs and Benefits*[3]

***Economic Costs***

*Opportunity Cost of Land and Capital*

Under both base case scenarios, the Dartbrook Mine would be decommissioned in 2022 and residual land and capital value would be realised.

With the Modification the Mine life would be extended to 2027 and hence there would be an opportunity cost of continuing to use the land and capital equipment at Dartbrook Mine. This opportunity cost is estimated at $25M for land and $10M for capital equipment.

*Capital Cost of the Modification*

Compared to the economic base case, the Modification would require additional capital expenditure primarily associated with:

- purchasing a longwall miner,
- refurbishment of the coal clearance system for transferring ROM coal to the East Site (i.e. Hunter Tunnel)
- recommissioning of the wash plant;
- the implementation of noise control measures at Dartbrook Coal Handling and Preparation Plant

This cost is estimated at $202M over a two-year period, followed by $5M per year in sustaining capital.

---

[1]The threshold value method uses the value of quantified net production benefits as the amount that unquantified environmental, social and cultural costs would need to exceed to make a project questionable from an economic efficiency perspective.
[2] Benefit transfer refers to transferring economic values that have been determined for other study sites.
[3] All values reported in this section are undiscounted unless specified.

Compared to the legal base case, the $202M of capital expenditure would not be required since this capital expenditure would be required under the base case in order to operate the mine at 6Mtpa. Incremental capital costs would only relate to the $5M per year in sustaining capital.

*Annual Operating Costs of the Modification*

Compared to the economic base case, operating costs of the Modification are associated with seven years of mining, ramping up from 1.4 Mtpa in 2021 to 6 Mtpa in 2022 and then an additional 5-years production at 6 Mtpa. Compared to the legal base case incremental production is only associated with an additional 5-years of production from 2023.

Operating costs are associated with:

- Pit top costs;
- CHPP and coal handling;
- Overheads;
- Rail;
- Port; and
- Marketing.

The incremental operating costs of the Modification (excluding royalties) at 6 Mtpa are in the order of $250M per annum. While royalties are a cost to AQC they are part of the overall net production benefit of the mining activity that is redistributed by government. Royalties are therefore not included in the calculation of the resource costs of operating the Modification.

Depreciation has also been omitted from the estimation of operating costs since depreciation is an accounting means of allocating the cost of a capital asset over the years of its estimated useful life. The economic capital costs are included in the years in which they occur.

*Decommissioning and Rehabilitation Costs*

With the Modification decommissioning and rehabilitation of the surface infrastructure would occur in 2027 at an estimated cost of $9M.

***Economic Benefits***

*Avoided Costs of Care and Maintenance*

Under the economic base case, the Dartbrook Mine will continue in Care and Maintenance until 2022 at an estimated annual cost of $5.5M. With the Modification these costs are avoided, as they form part of operating costs associated with mining and ancillary activities.

No such benefit accrues when comparing the Modification to legal base case.

*Avoided Decommissioning and Rehabilitation Costs*

Without the Modification, in 2022 the existing consent will expire and the Dartbrook Mine would be decommissioned and rehabilitated, at an estimated cost of $9M. With the Modification these costs in 2022 are not incurred.

*Revenues*

Compared to either base case, the Modification will result in additional revenues. Compared to the legal base case these relate to 5 years of production at 6 Mtpa. Compared to the economic base case there are two additional years of production in 2021 and 2022.

Revenues were estimated based on:

- saleable tonne yield of 75%;
- USD/t for Newcastle thermal coal as per the average KPMG Coal Price Forecasts based on various research and databases and broker reports (the Contributors) (KPMG, 2020) – refer to Table 2.4;
- conversion of nominal forecasts to real values assuming a 2% pa inflation rate;
- AUD:USD exchange rate as per the average KPMG exchange rate forecast based on various Contributors (KPMG, 2020) – refer to Table 2.5

**Table 2.4 – Newcastle Thermal Coal (USD/t Nominal)**

| Year ended 31 December | Reporting date | 2020 | 2021 | 2022 | 2023 | 2024 | LT (2020) |
|---|---|---|---|---|---|---|---|
| Contributor 1 | 23-Apr-20 | 55.0 | n/a | n/a | n/a | n/a | n/a |
| Contributor 2 | 23-Apr-20 | 59.0 | 61.0 | 70.0 | 75.0 | 75.0 | n/a |
| Contributor 3 | 15-Apr-20 | 66.2 | 72.0 | 80.0 | 74.9 | 76.7 | 70.0 |
| Contributor 4 | 9-Apr-20 | 62.9 | 67.2 | n/a | n/a | n/a | n/a |
| Contributor 8 | 6-Apr-20 | 66.0 | 65.0 | 66.0 | 67.0 | 70.0 | 77.0 |
| Contributor 10 | 1-Apr-20 | 68.0 | 69.0 | n/a | n/a | n/a | 67.0 |
| Contributor 11 | 1-Apr-20 | 77.7 | 66.8 | 62.8 | 63.5 | 62.5 | 56.6 |
| Contributor 12 | 1-Apr-20 | 71.0 | 72.0 | n/a | n/a | n/a | 75.0 |
| Contributor 13 | 27-Mar-20 | 65.0 | 70.0 | 75.0 | 75.0 | 78.0 | 70.0 |
| Contributor 14 | 24-Mar-20 | 65.0 | 68.0 | 71.0 | 66.0 | 68.0 | 56.0 |
| Contributor 15 | 24-Mar-20 | 63.0 | 68.0 | 72.0 | 75.0 | 75.0 | 65.5 |
| Contributor 16 | 23-Mar-20 | 75.0 | 85.0 | 90.0 | n/a | n/a | 90.0 |
| Contributor 17 | 18-Mar-20 | 66.0 | 69.0 | 75.0 | 76.0 | n/a | 75.0 |
| Contributor 19 | 16-Mar-20 | 58.0 | 66.0 | 70.0 | 70.0 | 65.0 | 65.0 |
| Contributor 20 | 11-Mar-20 | 67.8 | 65.0 | n/a | n/a | n/a | n/a |
| **Low** | | **55.0** | **61.0** | **62.8** | **63.5** | **62.5** | **56.0** |
| **High** | | **77.7** | **85.0** | **90.0** | **76.0** | **78.0** | **90.0** |
| **Average** | | **65.7** | **68.9** | **73.2** | **71.4** | **71.3** | **69.7** |
| **Median** | | **66.0** | **68.0** | **71.5** | **74.9** | **72.5** | **70.0** |

**Source: KMPG (2020), p. 3.**

**Table 2.5 – AUD:USD Exchange Rate**

| Year ended 31 December | Reporting date | 2020 | 2021 | 2022 | 2023 | 2024 | LT (2020) |
|---|---|---|---|---|---|---|---|
| Contributor 2 | 6-Mar-20 | 0.69 | 0.72 | 0.78 | 0.77 | 0.77 | n/a |
| Contributor 3 | 5-Apr-20 | 0.64 | 0.68 | n/a | n/a | n/a | 0.73 |
| Contributor 4 | 9-Apr-20 | 0.59 | 0.58 | 0.61 | 0.64 | 0.69 | n/a |
| Contributor 5 | 8-Apr-20 | 0.70 | 0.71 | 0.71 | 0.71 | 0.71 | 0.71 |
| Contributor 6 | 7-Apr-20 | 0.63 | 0.66 | 0.71 | 0.74 | 0.78 | 0.81 |
| Contributor 7 | 6-Apr-20 | 0.73 | 0.77 | 0.75 | 0.75 | 0.75 | 0.75 |
| Contributor 8 | 6-Apr-20 | 0.61 | 0.67 | 0.70 | 0.72 | 0.73 | 0.74 |
| Contributor 10 | 1-Apr-20 | 0.63 | 0.61 | n/a | n/a | n/a | 0.74 |
| Contributor 11 | 1-Apr-20 | 0.63 | 0.66 | 0.70 | 0.75 | 0.75 | 0.75 |
| Contributor 12 | 8-Apr-20 | 0.66 | 0.65 | n/a | n/a | n/a | n/a |
| Contributor 13 | 27-Mar-20 | 0.62 | 0.70 | 0.71 | 0.73 | 0.74 | 0.75 |
| Contributor 14 | 24-Mar-20 | 0.55 | 0.63 | 0.68 | 0.69 | 0.70 | 0.75 |
| Contributor 15 | 24-Mar-20 | 0.65 | 0.70 | 0.70 | 0.70 | 0.70 | 0.71 |
| Contributor 16 | 23-Mar-20 | 0.67 | 0.69 | 0.71 | n/a | n/a | 0.75 |
| Contributor 17 | 18-Mar-20 | 0.70 | 0.72 | 0.75 | 0.75 | n/a | 0.75 |
| Contributor 18 | 18-Mar-20 | 0.65 | 0.65 | 0.72 | 0.77 | 0.77 | n/a |
| Contributor 19 | 16-Mar-20 | 0.61 | 0.66 | 0.69 | 0.69 | 0.69 | 0.69 |
| Contributor 20 | 30-Mar-20 | 0.60 | 0.68 | n/a | n/a | n/a | n/a |
| **Low** | | **0.55** | **0.58** | **0.61** | **0.64** | **0.69** | **0.69** |
| **High** | | **0.73** | **0.77** | **0.78** | **0.77** | **0.78** | **0.81** |
| **Average** | | **0.64** | **0.67** | **0.71** | **0.72** | **0.73** | **0.74** |
| **Median** | | **0.64** | **0.68** | **0.71** | **0.73** | **0.74** | **0.75** |

**Source: KMPG (2020), p. 4.**

Based on this approach, the USD/t and AUD/t price assumptions are summarised in Table 2.6.

**Table 2.6 – Central Price Assumptions**

| | 2020 | 2021 | 2022 | 2023 | 2024 | LT Real 2020 |
|---|---|---|---|---|---|---|
| **Average USD//t Nominal** | $65.70 | $68.90 | $73.20 | $71.40 | $71.30 | $69.70 |
| **Average USD//t Real** | $65.70 | $67.55 | $70.36 | $67.28 | $65.87 | $69.70 |
| **FX** | 0.64 | 0.67 | 0.71 | 0.72 | 0.73 | 0.74 |
| **Real AUD/t** | **$102.66** | **$100.82** | **$99.10** | **$93.45** | **$90.23** | **$94.19** |

There is obviously considerable uncertainty around future coal prices in USD and the AUD/USD exchange rate and hence the value of incremental revenue has been subjected to sensitivity analysis (Section 2.8).

*Residual Value at End of the Evaluation Period*

At the end of the Modification, the land and capital equipment required for the Modification would have some residual value that could be realised by sale. This is estimated at $25M for land and $10M for capital equipment.

### *2.5.2 External Costs and Benefits*

***Greenhouse Gases***

Only the costs and benefits associated with the Modification for which approval is sought i.e. continued mining and rail of product coal to the port of Newcastle for sale to the export market, are relevant to a CBA of the Modification.

NSW Government (2018) *Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals* confirm that only Scope 1 and Scope 2 GHG emissions of a project should be included, consistent with the accounting framework under the *UN Framework Convention on Climate Change*.

The potential incremental Scope 1 and Scope 2 GHG emissions associated with the Modification have been estimated at 1.6M t $CO_{2\text{-}}$e and 1.2 Mt $CO_{2\text{-}}$e, relative to the economic base case and legal base case, respectively.

To place an economic value on CO2-e emissions, a shadow price of CO2-e is required. An average of three shadow prices was used, the Forecast European Union Emission Allowance Units price, the Australian Treasury Clean Energy Future Policy Scenario and the US Environmental Protection Agency (EPA) Social Cost of Carbon. However, these represent the global damage cost of carbon (i.e. the cost of carbon emissions to the population of the whole world).

Consistent with the Guidelines (NSW Government 2015), the focus of this CBA of mining projects is on costs and benefits to the population of NSW. Accordingly, the Technical Notes (NSW Government, 2018) identify that the global social damage cost estimates of Scope 1 and 2 GHG emissions of the Modification therefore need to be apportioned to **NSW only.**

In the absence of any studies that have focused on the social damage cost of carbon emissions to Australian and then NSW residents, some means of apportioning global damage costs is required. For the purpose of the Economic Impact Assessment, apportionment has been undertaken using Australia's share of the global population (around 0.3%) and NSW's share of the Australian population (32%).

On this basis, the present value (at 7% discount rate) of the cost of the Modification GHG emissions to Australia and NSW is estimated at $0.1M and $0.03M respectively, relative to the economic base case, and $0.07M and $0.02M respectively, relative to the legal base case.

Scope 3 emissions are associated with the overseas burning of coal from the Modification to generate electricity. From an economic perspective, costs associated with Scope 3 emissions would be part of a CBA of a different project i.e. an electricity generation project, with its own set of costs and benefits, including the benefits of electricity in a developing country. Some of these costs of electricity generation in a developing country i.e. Scope 3 emissions, would accrue to NSW. Scope 3 emissions associated with the burning of Modification coal overseas are estimated at 113Mt of CO2-e, relative to the economic base case, and 90 Mt of CO2-e, relative to the legal base case. Using the same apportionment of global damage costs of carbon as outlined above, the present value (at 7% discount rate) of Scope 3 emissions on NSW would be $2.24M, relative to the economic base case, and $1.75M relative to the legal base case.

***Operational Noise***

There are no noise impacts associated with activities that occur underground, including coal extraction and delivery via the Hunter Tunnel. Noise generating activities will take place primarily at the East Site. The following controls will be implemented to minimise noise associated with surface activities:

- Upgrading conveyors with additional shielding and low noise idlers;
- Refurbishment of coal reclaimers with lower noise components;
- Construction of a noise barrier north of the CHPP;
- Additional cladding of the washery building; and
- Avoiding reject emplacement near the southern limit of the reject emplacement area (REA) at night-time and/or unfavourable weather conditions.

Noise modelling was undertaken to assess the potential acoustic impacts of all approved and proposed activities at Dartbrook Mine. The modelling predicts that the Modification will comply with the intrusive noise criteria under the Development Consent (DA 231-7-2000) at all private residences, except for three residences to the south (303, 422 and 391). Under worst case meteorological conditions, these three residences may experience exceedances of up to 1 dBA during the night period only. The Voluntary Land Acquisition and Mitigation Policy (VLAMP) 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. It should be noted that residence 391 is currently entitled to acquisition by Mount Pleasant Mine.

Consequently, there are no material economic impacts for inclusion in the analysis.

***Road Transport***

The operational workforce for the Modification is expected to be 196 full-time equivalent personnel, although DA 231-7-2000 authorises an operational workforce of up to 292 personnel. Dartbrook Mine personnel will primarily access the site via the New England Highway and Western Access Road. Traffic movements associated with the operational workforce 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 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.

There will be no transportation of coal along public or private roads.

Consequently, there are no material economic impacts for inclusion in the analysis.

***Air Quality***

There are no dust emissions associated with underground mining or transportation of coal via the Hunter Tunnel. Dust emissions will occur primarily as a result of activities at the East Site. The following dust controls will be implemented to minimise emissions due to surface activities:

- Shielded conveyors and enclosed transfer points;
- Water sprays on all coal and reject stockpiles;
- Sealing of the haul route for trucks carrying rejects;
- Minimise the exposed area of the REA through progressive rehabilitation; and
- Establishing dust fences adjacent to exposed areas of the REA.

Dust dispersion modelling was conducted to predict TSP, PM10 and PM2.5 concentrations at private residences. The Modification is expected to satisfy all air quality criteria with the exception of the cumulative 24-hour PM10 criterion. Seven private residences are predicted to experience one day above the criterion of 50 μg/m3. Under the VLAMP, the acquisition criteria for 24-hour PM10 is based on incremental impact (i.e. from the development alone). The incremental impact due to Dartbrook Mine is predicted to be less than 1 μg/m3 and therefore falls well below the acquisition criterion. Therefore, the Modification does not exceed any criteria prescribed by the VLAMP.

The modelled exceedances of the cumulative 24-hour PM10 criterion would only occur under highly unfavourable weather conditions. Mining activities can be modified on these days so as to avoid any impacts.

Consequently, in economic terms the residual impacts after management are not likely to be material.

***Groundwater***

Groundwater monitoring data indicates that the Hunter Tunnel typically receives approximately 156 ML/year of inflows. This component of the groundwater inflow is primarily sourced from the Hunter River alluvial aquifer, which is the subject of the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009.

The impacts of longwall mining on groundwater resources were modelled by Mackie Environmental Research (MER, 2000). This model predicted that depressurisation of the coal measures could result in downward leakage from the alluvial aquifer of approximately 0.1 ML/day (36.5 ML/year). AQC hold sufficient Water Access Licences (WALs) from the Hunter Unregulated and Alluvial Water Sources to account for both inflows to the Hunter Tunnel and induced leakage from the Hunter River alluvial aquifer. However, there is an opportunity cost associated with holding these WALs. This opportunity cost is assumed to be in the order of $2,000/ML.

MER (2000) predicted that the rate of inflow to the mine workings from the North Coast Fractured and Porous Rock Groundwater Sources will increase to 1.6 ML/day at the completion of the approved mining. The actual inflow will be less than this maximum because only a fraction of the approved mining can be completed within the remaining project duration. AQC will require 584 ML of WAL from the North Coast Fractured and Porous Rock Groundwater Sources 2009. There is an opportunity cost with holding this, assumed to be in the order of $800 per ML, based on market trades in similar deep groundwater aquifers in NSW.[4]

Combined the opportunity cost of holding groundwater licences is estimated at $1M.

***Surface Water***

Mine water and sediment laden runoff will be reused wherever possible to satisfy operational water demands. There is a large volume of water stored in the Wynn Seam goaf that can be used to for non-potable uses such as dust suppression and coal processing. Raw water will only be sourced from the Hunter River where recycled mine water is not sufficient to meet operational demands. AQC's water licences enable the taking of up to 3,053.8 ML/year from the Hunter River (assuming maximum available water determination). The maximum allocation is not expected to be required for the proposed mining activities. Nevertheless, there is an opportunity cost of holding these licences which is assumed to be in the order of $2,000/ML i.e. $6M.

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[4] No market trade information was available for the *North Coast Fractured and Porous Rock Groundwater Sources.*

If inflows to the water management system exceed the operational water demand, the surplus can either be stored in the Wynn Seam goaf or passively released from site (using the Evaporation Ponds). Discharges under the Hunter River Salinity Trading Scheme will only be undertaken where other management strategies are insufficient.

***Subsidence***

Subsidence from the Modification may potentially impact surface infrastructure located above the underground workings. Infrastructure above the underground workings includes one private residence and one residence owned by MACH Energy (Mount Pleasant Mine). No listed heritage items are located above the mine.

Recent reforms to the Mine Subsidence Compensation Act 1961 will see claims for subsidence damage caused by active mining compensated by the mine operator responsible. This will be managed by Subsidence Advisory NSW. Claims will be independently assessed by a new panel of expert assessors, and mine operators will be required to compensate property owners accordingly. In this way, any externality costs will be internalised into AQC's operating costs.

Subsidence costs would reduce the estimated company tax and net production benefits of the Modification. However, any impacts are unlikely to be material in nature.

***Biodiversity***

The Modification will operate within the existing mine footprint and hence will have no incremental impacts on biodiversity. Consequently, there are no material economic impacts for inclusion in the CBA.

***Aboriginal Heritage***

The Modification will operate within the existing mine footprint and hence will have no incremental impacts on Aboriginal heritage. Consequently, there are no material economic impacts for inclusion in the CBA.

***Historical Heritage***

The Modification will operate within the existing mine footprint and hence will have no incremental impacts on historic heritage sites. Hence, there are no material economic impacts for inclusion in the CBA.

***Visual Impacts***

Given that there will be no additional surface infrastructure, the Modification will maintain the existing visual profile of the Dartbrook Mine. These are not considered to be material.

***Agriculture***

There are no agricultural impacts of the Modification.

***Net Public Infrastructure Impacts***

No additional infrastructure is required for the Modification. Potential impacts of the Modification on existing infrastructure include the use of utilities. This will be paid for by user fees which are included in the Modification operating costs. Consequently, no net infrastructure costs to government are envisaged from the Modification.

***Loss of Surplus to Other Industries***

No loss of surplus to other industries will occur as a result of the Modification.

***Market Benefits to Workers***

Employment at Dartbrook under the economic base case (care and maintenance) is estimated at 11 people until 2022. Under the Modification employment would ramp up to 196 in 2022 and be maintained until 2027.

Under the legal base case, employment would be at 292 until 2022. The Modification would extend employment at this level for a further 5 years.

Relative to both base cases, there would be (at least) an additional 196 jobs for an additional 5-years.

In standard CBA, the wages associated with employment are considered an economic cost of production with this cost included in the calculation of net production benefits (producer surplus). This approach assumes labour markets clear, with no involuntary unemployment i.e. full employment, and no other distortions (Bartik, 2012). However, where there is involuntary unemployment a project may result in a wage benefit to workers. Workers who transfer to the mining sector and earn higher wages are in effect increasing their productivity. The value of their output for given work hours is increasing i.e. the marginal value product of labour. The real benefit for the worker is the difference between the wage that workers are paid in mining and their minimum reservation wage (i.e. the minimum wage they would accept) for working in the mining sector (which reflects their relative occupational preference) (NSW Government, 2012, p. 7).

The Guideline (NSW Government, 2015) identifies that an appropriate starting assumption is that workers do not receive a wage premium, even if they will earn more money in the mining sector, because:

- If workers are already in the mining sector, it is not generally the case that one mine will pay significantly more than other mines for doing a similar job in similar conditions;
- A mine may need to offer higher wages to compensate for more physically demanding work, tougher conditions etc. and so the higher wages is offset by the more cost of the more demanding work; and
- Higher wages may be required to relocate to a less desirable location.

However, the NSW Guidelines (2015) goes on to say that:

"*Although a zero wage premium is a useful starting assumption, the appropriateness of this assumption must be assessed on a case by case basis. This is because* ***benefits to workers can be one of the major economic benefits from a project.*** *If a proponent considers that a project will generate positive benefits for workers, the economic assessment should clearly explain the reasons for this conclusion and present evidence in support of the valuation that has been adopted.*"

The fundamental justification for inclusion of wage benefits from the Modification in the CBA is that the NSW economy is not currently at full employment and is unlikely to be at full employment during the life of the Modification. Consequently, it is unlikely to simply employ people from the mining sector at their existing wage rate. A mining project can directly employ people from unemployment pool, new entrants to the labour force or already employed people e.g. in mining, agriculture, construction, manufacturing etc. All these potential sources of labour are reflected on the labour supply curve for a project. The labour supply curve represents the lowest wage rate (allowing for risks and disutility) at which workers would be willing to accept a job in the mining sector. The labour supply curve is upward sloping. For those people at the margin, say those already employed in the mining sector, their reservation wage is likely to be similar to the wage that they receive in the new project. However, for infra-marginal labour there would be a wage benefit, with a larger wage benefits to people sourced from the involuntary unemployment pool i.e. lower down the labour supply curve. The wage benefit for otherwise unemployment people can be even greater when search and retraining costs, scarring, stigma and physical and mental health effects of unemployment are taken into account (Haveman and Weimer 2015). For people already employed in other sectors the direct wage benefit would likely be between those of the unemployed and those already in the mining sector. However, even the direct wage benefit for those employed from the mining sector or other sectors but may be larger than the estimated direct wage benefits, due to job chain effects and occupational upgrading i.e. where a person is employed from another job, which creates a vacant job for others to upgrade their employment, which creates a further vacancy to be filled, and so on (Bartik, 2012). With job chain effects what is important is not the reservation wage of those immediately hired by the project, but the reservation wage of those at the end of the job chain (Bartik, 2012).

Furthermore, it is not clear that any wage premium can be explained away by compensation for mining jobs being more physically demanding or requiring relocation to a less desirable area. Source sectors for the Modification labour are likely to include agriculture, manufacturing, transport and construction etc, where physically demanding work is common place. The Hunter Valley is also a highly desirable place to live and hence wage premiums for relocation are likely to be minimal.

Notwithstanding, any estimation of the potential economic value of employment from the Modification requires a number of assumptions such as what proportion of the Modification workforce would otherwise be unemployed or underemployed, the duration of time that this would occur and the opportunity cost of labour in an unemployed or underemployed state (i.e. the reservation wage rate). Estimates of wage premium benefits are likely to be sensitive to these assumptions.

Some indication of the potential magnitude of these benefits can be gained by making a number of assumptions. Following the general approach of Streeting and Hamilton (1991)[5] if it were assumed that 10% of the maximum direct workforce of the Modification[6] (29 out of a total of 292 jobs) would otherwise be unemployed for three years and that the reservation wage for these people was $48,000[7] compared to a mining wage of $120,000, then the market employment benefit in terms of income would be $3M present value, at a 7% discount rate, for both base cases. Values at alternate discount rates and percentages of unemployed are provided in the following table. These calculations exclude any consideration of search and retraining costs, scarring, stigma and physical and mental health effects of unemployment (Haveman and Weimer 2015).

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[5] Streeting and Hamilton (1991) *An Economic Analysis of the Forests of South-Eastern Australia*, Resource Assessment Commission, Research Paper Number 5.

[6] All sourced from NSW.

[7] As estimated by the unemployment benefits plus income tax payable on a mining wage, following the reservation wage rate approach used by Streeting and Hamilton (1991).

**Table 2.7 - Potential Economic Benefits to Workers ($M @ 7% discount rate)**

| | Economic Base Case | Legal Base Case |
|---|---|---|
| **% Unemployed for 3 years** | | |
| Scenario 1 - 5% UE | 2 | 2 |
| Scenario 2 - 10% UE | 3 | 3 |
| Scenario 3 - 15% UE | 5 | 5 |
| **Wage premium benefit for Rest of Employment** | | |
| Scenario 1 – 95% | 22 | 19 |
| Scenario 2 – 90% | 21 | 18 |
| Scenario 3 – 85% | 20 | 17 |
| **Total Wage Benefit** | | |
| Scenario 1 | 24 | 21 |
| Scenario 2 | 24 | 21 |
| Scenario 3 | 25 | 22 |

*Differences in values between base cases relate to wage benefits occurring two years earlier with the economic base case.

This estimate makes no allowance for the wage benefits to already employed workers and job chain effects. Assuming, the remaining workers, after job chain effects, are evenly located along the labour supply curve, the average wage in NSW ($65,200[8]) gives an indication of a potential average reservation wage. Further, assuming a 10% increase in average reservation wage is required to reflect any disutility in the mining sector, and that these wage benefits are only obtained for 3 years, then the additional wage benefits associated with the 90% of workers who would otherwise be employed in other jobs is estimated at $21M and $18M (present value, at a 7% discount rate) for the economic base case and legal base case, respectively. Values at alternate discount rates and percentages of already employed people are provided in the Table 2.7.

Based on these assumptions the potential market-based benefits of employment are in the order of $24M and $21M (present value at 7% discount rate) for the economic base case and legal base case, respectively. However, it is recognized that there may be differing opinions around the inclusion and estimation of wage benefits in CBA and hence the results of the CBA are reported both with and without the inclusion of these benefits.

### *Economic Benefits to Existing Landholders*

Payments by the proponent for the purchase of land, that exceed the opportunity cost of the land, are an economic benefit to the landholder. However, no additional land needs to be purchased for the Modification and hence no additional benefits accrue to landholders. While historic land purchase costs may have been in excess of opportunity costs these can be considered "sunk" and do not vary with or without the Modification.

### *Economic Benefits to Suppliers*

The focus of CBA is generally on primary costs and benefits i.e. first round impacts. Secondary net benefits that accrue to firms that sell to or buy from a project are ignored. This is because in a competitive market, all resources are assumed to be fully employed, and so increases in the production of goods and services required as inputs to the project will withdraw labour and raw materials from other industries. The additional net benefits (surpluses) to suppliers to the Modification will be offset by

[8] Average NSW personal income in 2016-17 (ABS Estimates of Personal Income for Small Areas, 2011-2017).

decreases in net benefits in other industries and so there is no net secondary benefit to the economy as a whole.

However, where the economy is not at full employment some benefits to suppliers may accrue. It is estimated that the Modification will result in average annual additional non-labour operating costs of $213M when operating at 6 Mtpa of ROM. Based on ratios for the Coal Mining Sector in the National Input-Output table and NSW Input-Output table, 85% and 66% of non-labour coal mining expenditure is captured within the National and NSW economies, respectively. Assuming a ratio of producer surplus to output of 20%[9] for industries supplying non-labour inputs, the indirect economic benefits to Australian and NSW suppliers would be in the order of $158M and $123M (present value at 7% discount rate), respectively, when comparing the Modification to the economic base case. When comparing the Modification to the legal base case, the indirect economic benefits to Australian and NSW suppliers would be in the order of $119M and $92M (present value at 7% discount rate).

It is recognised that there may be differing opinions around the inclusion and estimation of economic benefits to suppliers in CBA and hence the results of the CBA are reported both with and without the inclusion of these benefits.

## 2.6 Consolidation of Value Estimates

### *2.6.1 Net Production Benefits*

The present value of production costs and benefits, using a 7% discount rate, is provided in Table 2.8.

The Modification is estimated to have global net production benefits of $552M (present value at 7% discount rate), relative to the economic base case and $549M (present value at 7% discount rate) relative to the legal base case.

AQC is estimated to be 90% Australian owned and third-party royalties are payable to an overseas company. Hence, the components of the net production benefits that accrue to Australia are government royalties, company tax (assuming a 30% company tax rate) and 90% of the residual net production benefits. On this basis, the net production benefits of the Modification that accrue to Australia are estimated at $500M (present value at 7% discount rate), relative to the economic base case and $509M (present value at 7% discount rate) relative to the legal base case.

The net production benefits can be further apportioned to NSW by assuming that company tax benefits and residual net production benefit accrue to NSW based on its population share and that all government royalties accrue to NSW. On this basis, the net production benefits of the Modification that accrue to NSW are estimated at $247M (present value at 7% discount rate), relative to the economic base case and $229M (present value at 7% discount rate) relative to the legal base case.

The estimated net production benefits that accrue to Australia and NSW can be used as a minimum threshold value or reference value against which the relative value of the residual environmental impacts of the Modification, after mitigation, may be assessed. This threshold value is the opportunity cost to society of not proceeding with the Modification. It is a minimum threshold value as it does not include potential wage benefits and benefits to suppliers.

Provided the value of the residual environmental impacts of the Modification, to Australian and NSW households, after mitigation, do not exceed the respective net production threshold values, then the Modification will have net benefits to the Australian and NSW communities.

[9] For all intermediate sectors in the NSW economy the ratio of gross operating surplus to output is 21%.

**Table 2.8 - Net Production Benefits of the Modification ($M Present Values at 7% Discount Rate)**

| | Economic Base Case | Legal Base Case |
|---|---|---|
| **Costs** | | |
| Opportunity cost of land | $20 | $20 |
| Opportunity cost of capital equipment | $8 | $8 |
| Capital costs, including noise attenuation | $189 | $17 |
| Operating cost (ex royalties) | $1,111 | $824 |
| Environmental monitoring and management costs for noise and dust to meet contemporary expectations | $11 | $7 |
| Decommissioning and rehab costs at cessation of Modification | $5 | $5 |
| ***Sub-total*** | ***$1,345*** | ***$882*** |
| **Benefits** | | |
| Avoided Cost of Care and Maintenance | $9 | $0 |
| Avoided decommissioning and rehab costs in 2022 | $7 | $7 |
| Revenue | $1,860 | $1,403 |
| Residual value of land | $15 | $15 |
| Residual value of capital equipment | $6 | $6 |
| ***Sub-total*** | ***$1,897*** | ***$1,431*** |
| **Global Net Production Benefits** | **$552** | **$549** |
| Royalties to NSW Govt | $129 | $97 |
| Royalties to third party | $24 | $10 |
| Company Tax | $120 | $139 |
| Residual Net Production Benefits to AQC | $280 | $303 |
| ***Global Net Production Benefits*** | **$552** | **$549** |
| Royalties to NSW Govt | $129 | $97 |
| Royalties to third party | $0 | $0 |
| Company Tax | $120 | $139 |
| Residual Net Production Benefits to AQC | $252 | $273 |
| ***Australian Net Production Benefits*** | **$500** | **$509** |
| Royalties to NSW Govt | $129 | $97 |
| Royalties to third party | $0 | $0 |
| Company Tax | $38 | $44 |
| Residual Net Production Benefits to AQC | $81 | $87 |
| ***NSW Net Production Benefits*** | **$247** | **$229** |

### 2.6.2 Externalities

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to qualitatively consider and where possible quantify the main environmental, cultural and social impacts of the Modification. Table 2.9 summarised the results of the consideration of externalities in Section 2.5.2.

**Table 2.9 – Externality Impacts of the Modification (Present Values at 7% Discount Rate)**

| | Economic Base Case | | Legal Base Case | |
|---|---|---|---|---|
| **Benefits** | **Australia** | **NSW** | **Australia** | **NSW** |
| Wage benefits to employment | $24 | $24 | $21 | $21 |
| Economic benefits to existing landholders | $0 | $0 | $0 | $0 |
| Economic benefits to suppliers | $158 | $123 | $119 | $92 |
| **Sub-total** | $183 | $147 | $140 | $114 |
| **Costs** | | | | |
| Greenhouse gas emissions (Scope 1 and 2) | $0.10 | $0.03 | $0.07 | $0.02 |
| Operational noise | No material impact* | | | |
| Road transport | No material impact* | | | |
| Air quality | No material impact* | | | |
| Groundwater | $1 | | | |
| Surface water | $6 | | | |
| Subsidence | Any subsidence damage caused by active mining compensated by AQC | | | |
| Biodiversity | No material impact* | | | |
| Aboriginal heritage | No material impact* | | | |
| Historic heritage | No material impact* | | | |
| Visual | No material impact* | | | |
| Agriculture | No material impact* | | | |
| Net public infrastructure costs | No material impact* | | | |

*Wage benefits are constant between geographic scopes as all employment is assumed to be sourced from NSW. Wage benefits differ between base cases due to benefits for the economic base case commencing earlier.
** Economic benefits to suppliers are higher in the economic base case due to two additional years of production.

From Section 2.5.2 it is evident that the main potential impacts of the Modification are internalised into the production costs of the Modification through mitigation measures, ownership of land and water allocations. Other costs not already included in the production costs of the Modification are associated with opportunity cost of WALs and greenhouse gas costs, although from Table 2.9 it is evident that these impacts to Australia and NSW are small or immaterial.

### 2.6.3 Net Social Benefits to Australia and NSW

The main decision criterion for assessing the economic desirability of a project to society is its net present value (NPV). NPV is the present value of benefits less the present value of costs. A positive NPV indicates that it would be desirable from an economic perspective for society to allocate resources to the project, because the community as a whole would obtain net benefits from the project.

The results from Table 2.8 and Table 2.9 are combined in Table 2.10 to estimate the net social benefits of the Modification to Australia and NSW, relative to both the economic base case and legal base case. Results are reported with and without the inclusion of wage benefits and benefits to suppliers, around which there is likely to be some debate.

**Table 2.10– Net Social Benefits of the Modification (present value @ 7% discount rate)**

| | Economic Base Case | | Legal Base Case | |
|---|---|---|---|---|
| **Benefits** | **Australia** | **NSW** | **Australia** | **NSW** |
| **Net Production Benefits** | | | | |
| Royalties to Government | $129 | $129 | $97 | $97 |
| Company Tax | $120 | $38 | $139 | $44 |
| Residual Net Production Benefits | $252 | $81 | $273 | $87 |
| **Sub-total** | ***$500*** | ***$247*** | ***$509*** | ***$229*** |
| **Other Benefits** | | | | |
| Wage benefits to employment | $24 | $24 | $21 | $21 |
| Economic benefits to existing landholders | $0 | $0 | $0 | $0 |
| Economic benefits to suppliers | $158 | $123 | $119 | $92 |
| ***Sub-total*** | ***$183*** | ***$147*** | ***$140*** | ***$114*** |
| **Total Benefits** | **$683** | **$395** | **$649** | **$342** |
| **Costs** | | | | |
| Greenhouse gas emissions (Scope 1 and 2) | $0.10 | $0.03 | $0.07 | $0.02 |
| Operational noise | No material impact* | | | |
| Road transport | No material impact* | | | |
| Air quality | No material impact* | | | |
| Groundwater | $1 | | | |
| Surface water | $6 | | | |
| Subsidence | Any subsidence damage caused by active mining compensated by AQC | | | |
| Biodiversity | No material impact* | | | |
| Aboriginal heritage | No material impact* | | | |
| Historic heritage | No material impact* | | | |
| Visual | No material impact* | | | |
| Agriculture | No material impact* | | | |
| Net public infrastructure costs | No material impact* | | | |
| ***Sub-total*** | ***$7*** | ***$7*** | ***$7*** | ***$7*** |
| **Net Social Benefits - excluding other benefits** | **$493** | **$240** | **$502** | **$222** |
| **Net Social Benefits - including other benefits** | **$676** | **$388** | **$642** | **$335** |

Overall, the Modification is estimated to have net social benefits to both Australia and NSW relative to both the economic base case and legal base case, and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts have been quantified and included in the Modification CBA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than $240M (relative to the economic base case) and $222M (relative to the economic base case) for the Modification to be questionable from an NSW economic efficiency perspective.

## 2.7 Distribution of NSW Costs and Benefits

CBA is primarily concerned with the single objective of economic efficiency. CBA and welfare economics provide no guidance on what is a fair, equitable or preferable distribution of costs and benefits. Nevertheless, CBA can provide qualitative and quantitative information for the decision-maker on how economic efficiency costs and benefits are distributed.

The costs and benefits of the Modification to NSW are potentially distributed among a range of stakeholders as identified in Table 2.11.

**Table 2.11 - Incidence of NSW Costs and Benefits**

| BENEFITS AND COSTS | INCIDENCE OF COSTS AND BENEFITS | ECONOMIC BASE CASE ($M) | LEGAL BASE CASE ($M) |
|---|---|---|---|
| ***Share of Net Production Benefits*** | | | |
| Net producer surplus | AQC and its NSW shareholders | $129 | $97 |
| Royalties | NSW Government and NSW households | $38 | $44 |
| Company tax | NSW Government and NSW households | $81 | $87 |
| ***Additional benefits*** | | | |
| Wage benefits to employment | Some of the local and NSW labour force | $24 | $21 |
| Economic benefits to existing landholders | Local landholders who sell land required for the Modification including buffer land | $0 | $0 |
| Economic benefits to suppliers | Regional and State suppliers of inputs to production | $123 | $92 |
| ***Environmental, social and cultural costs**** | | | |
| Greenhouse gas emissions (Scope 1 and 2) | Local and NSW households | $0.03 | $0.02 |
| Operational noise | Adjoining landholders | No material impact* | |
| Road transport | Local residents | No material impact* | |
| Air quality | Adjoining landholders | No material impact* | |
| Groundwater | AQC via WAL purchases | $1 | |
| Surface water | AQC via WAL purchases | $6 | |
| Subsidence | AQC and adjoining landholders | Any subsidence damage caused by active mining compensated by AQC | |
| Biodiversity | Local and NSW households | No material impact* | |
| Aboriginal heritage | Aboriginal people and other local and NSW households | No material impact* | |
| Historic heritage | Local and NSW households | No material impact* | |
| Visual amenity | Adjoining landholders and motorists on the New England Highway | No material impact* | |
| Agriculture | AQC | No material impact* | |
| Net public infrastructure costs | NSW Government and NSW households | No material impact* | |
| Loss of surplus to other industries | Not applicable | No material impact* | |

* NSW regulations require many impacts to be borne by the proponent via mitigation, offset and compensation. Where these measures perfectly mitigate, offset or compensate then no residual impacts occur and all impacts are borne by the proponent. This table identifies who bears residual impacts where mitigation, offset and compensation is imperfect.

## 2.8 Risk and Sensitivity Analysis

The main areas of environmental risks associated with mining projects relate to:

- the financial viability of a project from unexpected downturns in prices and any consequent environmental impacts from premature cessation of operations;
- ecological risk associated with whether the biodiversity offsets will adequately compensate for the direct ecological impacts; and
- other environmental, social and cultural impact estimations and required mitigation measures.

The NSW DPIE has previously identified that the financial viability of projects is a risk assumed by the project owners. Nevertheless, it should be noted that it is highly unlikely that AQC would invest in the Modification if it were not financially viable. However, any risk that the Modification may commence and then cease operation for financial reasons leaving unmet rehabilitation liabilities is mitigated by the fact that AQC is required to pay a rehabilitation security deposit to the NSW DPIE – Division of Resources and Energy (DPIE-DRE) as the holder of a mining authority under the Mining Act. This security deposit is held by DPIE-DRE to ensure that the legal obligations in relation to rehabilitation and safety of the site can be met following mine closure. If rehabilitation obligations are not met to the satisfaction of the Minister, then the security funds would be used by DPIE-DRE to meet the relevant requirements.

The provision of biodiversity offsets can be associated with a number risks. However, no biodiversity values will be impacted by the Modification and hence no risks with regard to biodiversity and offsets arise.

There is some risk associated with the estimation of environmental, social and cultural impacts of the Modification and the level of mitigation measures proposed. However, it should be noted that impacts have generally been assessed based on the maximum annual levels of production and hence are likely to be overstated. Ongoing monitoring will ensure that appropriate mitigation measures are implemented as required.

The net present value of the Modification to NSW (presented in Table 2.10) is based on a range of assumptions around which there is some level of uncertainty. Uncertainty in a CBA can be dealt with through changing the values of critical variables in the analysis (James and Gillespie 2002) to determine the effect on the NPV[10].

In this sensitivity analysis, the CBA results for NSW, relative to the legal base case, were tested for changes to the following variables at a 4%, 7% and 10% discount rate:

- opportunity cost of land;
- opportunity cost of capital;
- operating costs;
- capital costs;
- decommissioning and rehabilitation costs;
- revenue;
- residual value of land;
- residual value of capital;
- greenhouse gas costs;

[10] Quantitative risk analysis could also potentially be undertaken. However, this requires information on the probability distributions for input variables in the analysis. This information is not available and so the sensitivity testing is limited to uncertainty analysis.

- groundwater costs; and
- surface water costs.

Results are reported in Tables 2.12. What this analysis indicates is that CBA is most sensitive to changes in revenue (reflecting production levels, the value of coal in USD and the USD/ AUD exchange rate) and to a lesser extent operating costs. This is because changes in revenue directly impact royalties which is the main component of net production benefits to NSW and net producer surplus. Changes in revenue also impact company tax estimates and residual net production benefits, only a component of which accrues to NSW. Changes in operating costs do not impact royalties but do impact the estimates of company tax and residual net production benefits.

The sensitivity analysis indicated that the CBA results are not sensitive to changes in capital costs, or environmental costs that have not already been internalised into production costs, such as greenhouse gas, groundwater and surface water costs. Since mitigation, offset and compensation costs are a small component of the capital and operating costs of the Modification, it is unlikely that large changes in these cost levels would have any significant impact on the CBA results.

Under all scenarios examined, the Modification, relative to the legal base case, has net social benefits to NSW. Given the similar net social benefits of the Modification, relative to the economic base case, the same results would apply.

**Table 2.12 - NSW CBA Sensitivity Testing (Present Value $M) Legal Base Case excluding Other Benefits**

| | 4% Discount Rate | 7% Discount Rate | 10% Discount Rate |
|---|---|---|---|
| **CENTRAL ANALYSIS** | **$265** | **$222** | **$187** |
| **INCREASE – 20%** | | | |
| Opportunity cost of land | $263 | $221 | $186 |
| Opportunity cost of capital | $264 | $221 | $186 |
| Operating costs | $207 | $173 | $145 |
| Capital costs | $264 | $221 | $186 |
| Decommissioning and rehabilitation costs | $264 | $221 | $186 |
| Avoided decommissioning and rehabilitation costs | $265 | $222 | $187 |
| Revenue | $380 | $319 | $270 |
| Residual value of land | $266 | $223 | $187 |
| Residual value of capital | $265 | $222 | $187 |
| Greenhouse gas costs | $265 | $222 | $187 |
| Groundwater costs | $265 | $222 | $187 |
| Surface water costs | $263 | $220 | $185 |

| | 4% Discount Rate | 7% Discount Rate | 10% Discount Rate |
|---|---|---|---|
| **DECREASE – 20%** | | | |
| Opportunity cost of land | $266 | $223 | $188 |
| Opportunity cost of capital | $265 | $222 | $187 |
| Operating costs | $323 | $271 | $228 |
| Capital costs | $266 | $223 | $188 |
| Decommissioning and rehabilitation costs | $265 | $222 | $187 |
| Avoided decommissioning and rehabilitation costs | $264 | $221 | $186 |
| Revenue | $149 | $124 | $104 |
| Residual value of land | $264 | $221 | $186 |
| Residual value of capital | $264 | $221 | $186 |
| Greenhouse gas costs | $265 | $222 | $187 |
| Groundwater costs | $265 | $222 | $187 |
| Surface water costs | $266 | $223 | $188 |

# 3 LOCAL EFFECTS ANALYSIS

## 3.1 Introduction

The CBA in Section 2 is concerned with whether the incremental benefits of the Modification exceed the incremental costs and therefore whether the community would, in aggregate, be better off 'with' the Modification compared to 'without' it. This section examines local effects. It focuses on the operational phase of the Modification.

The local area is defined as the LGAs of Singleton, Muswellbrook and Upper Hunter, within which the Modification is located and is the region considered likely to be main source of labour and non-labour inputs for the Modification.

## 3.2 Direct Effects Related to Employment of Existing Residents Only

The Modification will provide an estimated 196 direct jobs when operating at 6 Mtpa. Eighty percent (156) of these are assumed to already reside in the local area,[11] with the remainder commuting from outside the local area.

Assuming that those that already reside in the local area are already employed and that job vacancies created by these people filling the mining positions remain unfilled (i.e. no job chain effects), the incremental disposable wages accruing to the region is $5.1M per annum when the Modification is operating at 6 Mtpa. This is equivalent to 58 direct full time equivalent (FTE) mining jobs. This is a minimum estimate as it assumes full employment in the region and hence the jobs from which people come to fill the mining jobs remain vacant.

**Table 3.1 - Analysis of Net Income Increase and FTE Job Increase Assuming No Job Backfilling**

| Attribute | No. |
|---|---|
| a) Direct incremental employment | 196 |
| Number that already reside in the region | 156 |
| b) Average net income in mining | $87,653 |
| c) Average net income in other industries* | $54,997 |
| d) Average increase in net income per job (b-c) | $32,656 |
| e) Increase in net income per year due to direct employment | $5,107,466 |
| f) FTE (e/b) | 58 |

*This information is not available from the ABS and hence average income across all sectors is used.

## 3.3 Direct Effects Related to Non-Labour Expenditure

The total annual non-labour expenditure (operating costs of the Modification after subtraction of wages) is $209M.

However, not all of this expenditure will accrue to the local area. From a 2016 input-output table of the local area economy developed by Gillespie Economics, approximately 46% i.e. $96M pa of non-labour expenditure is estimated to accrue to the local area.

[11] ABS 2016 Census of Population and Housing indicates that 78% of people working in the coal mining sector in Muswellbrook LGA, reside in the Local Area (Singleton, Muswellbrook and Upper Hunter LGAs).

## 3.4 Second Round and Flow-On Effects

The expenditure by employees, who reside in the region, and non-labour expenditure that is captured by the local area, provides flow-on economic activity to the local economy.

A recent study by Lawrence Consulting (2020) for the NSW Minerals Council confirms the existence of substantial flow-on effects from mining operations in the Hunter region but does not report multipliers.

Recognised methods for assessing second round and flow-on effects such as input-output analysis (but also computable general equilibrium analysis), do not utilise direct effects of employment and income effects as calculated above in accordance with the Guidelines (NSW Government, 2015). Instead they use the total employment working in the region, with total wages (rather than net additional wages to existing employed people) divided between those who live in the region and those who reside outside the region. They do utilise estimates of non-labour expenditure, however multiplier effects are not estimate in terms on non-labour expenditure but in terms of how this and labour expenditure contribute to the local area economy in terms of direct and indirect output, value-added, income and employment. This type of assessment is reported in the following section.

## 3.5 Regional Economic Impact Assessment

Standard regional economic impact assessment using input-output analysis, is not restricted to a focus on the existing labour force in the local area and does not assume an absence of job chain effects. The presence of job chain effects in a region, means that to the extent that jobs from which people come, to fill the mining jobs, are themselves filled and their jobs are also filled until the lowest paid jobs are filled by people from unemployment, new labour force participants, then new wages in the region will approximate the total incremental wages associated with the mining project. Refer to Attachment 2.

In this framework, the Modification will provide the following annual direct and indirect annual effects to the local economy:

- $577M in output;
- $276M in value-added;
- $49M in gross wages; and
- 620 jobs.

**Table 3.2 – Gross Annual Direct and Indirect Regional Economic Impacts of the Modification**

| Indicator | Direct Impacts | Production Induced Flow-ons | Consumption Induced Flow-ons | Total Flow-ons | Total Impacts |
|---|---|---|---|---|---|
| Output ($M) | 424 | 125 | 28 | 153 | 577 |
| *Type IIA Multiplier* | *1.00* | *0.30* | *0.07* | *0.36* | *1.36* |
| Value Added ($M) | 199 | 61 | 16 | 78 | 276 |
| *Type IIA Multiplier* | *1.00* | *0.31* | *0.08* | *0.39* | *1.39* |
| Income ($M) | 19 | 24 | 6 | 30 | 49 |
| *Type IIA Multiplier* | *1.00* | *1.29* | *0.33* | *1.62* | *2.62* |
| Employment (No.) | 196 | 313 | 111 | 424 | 620 |
| *Type IIA Multiplier* | *1.00* | *1.60* | *0.57* | *2.17* | *3.17* |

## 3.6 Effects on Other Industries

### *3.6.1 Regional Economic Impacts of Displaced Agriculture*

No agricultural activities will be displaced as a result of the Modification.

### *3.6.2 Other Wage Impacts*

In the short-run, increased regional demand for labour as a result of the Modification (relative to the "without Modification" scenario) could potentially result in some increased pressure on wages in other sectors of the economy. The magnitude and duration of this upward wages pressure would depend on the level of demand for labour, the availability of labour resources in the region and the availability and mobility of labour from outside the region. However, given the scale of the Modification and the availability of labour inside and outside the region, wage impacts are not likely to be significant. Where upward pressure on regional wages occurs, it represents an economic transfer between employers and owners of skills and would in turn attract skilled labour to the region leading to future downward pressure on wages.

### *3.6.3 Housing Impacts*

The Modification is not expected to result in any substantial in-migration of workers and their families and consequently the impact on housing prices is expected to be negligible.

## 3.7 Environmental and Social Impacts on the Local Community (Externalities)

The distribution of costs and benefits of the Modification are summarised in Table 2.11. The main potential effects on the local community (excluding to AQC) are noise criteria exceedances under worst case meteorological conditions that would not be discernible, minor GHG emission impacts, modelled cumulative 24-hour PM10 criteria exceedances one day per year at 7 private residences (that can be avoided by modifying mining operations when weather conditions are unfavourable) and potential subsidence impacts for two residences which would be remedied by AQC in accordance with recent reforms to the Mine Subsidence Compensation Act 1961.

## 3.8 Summary of Local Effects

A summary of local effects of the Modification is provided in Table 3.3.

**Table 3.3 - Summary of Effects on the Local Community (Excluding AQC)**

| Local Effects | Direct Total | Direct Already Resident in the Local Area | Net |
|---|---|---|---|
| Employment FTE | 196 | 156 | 58 |
| Income ($M) | 23 | 19 | 5 |
| Non-labour expenditure in the Local Area | 96 | | |
| **Regional Impacts** | **Direct** | **Flow-on** | **Total** |
| Output ($M) | 424 | 153 | 577 |
| Value-added ($M) | 199 | 78 | 276 |
| Income ($M) | 19 | 30 | 49 |
| Employment | 196 | 424 | 620 |
| **Other Local Economic Impacts** | | | |
| Contraction in other sectors | No material impact* | | |
| Displaced activities | No material impact* | | |
| Wage rise impacts | No material impact* | | |
| Housing impacts | No material impact* | | |
| **Local Environmental Impacts** | | | |
| Greenhouse gas emissions (Scope 1 and 2) | $0.0002M[1] | | |
| Operational noise | Modelled 1 dBA exceedance of criteria at three residences during the night only – exceedences of 0-2dBA are not discernible | | |
| Air quality | Modelled cumulative 24-hour PM10 criteria exceeded one day per year at 7 private residences – can be avoided by modifying mining operations when weather conditions are unfavourable | | |
| Subsidence | Any subsidence damage caused by active mining compensated by AQC | | |

[1] The Hunter Region population is 0.7% of the NSW population. NSW GHG impact have been apportioned accordingly.

# 4 CONCLUSION

A CBA of the Modification indicated that it would have net production benefits to Australia of $500M (relative to the economic base case) and $509M (relative to the legal base case). Net production benefits to NSW are estimated at $247M (relative to the economic base case) and $229M (relative to the legal base case).

Provided the residual environmental, social and cultural impacts of the Modification that accrue to Australia and NSW are considered to be valued at less than the level of net production benefits, the Modification can be considered to provide an improvement in economic efficiency and hence is justified on economic grounds.

Instead of leaving the environmental, cultural and social impacts unquantified, an exercise was undertaken to quantify them. Most impacts were considered to be immaterial from an aggregate economic efficiency perspective. The main quantifiable environmental impacts of the Modification, which have not already been incorporated into the estimate of net production benefits, relate to the opportunity cost of water access licences (WALs) and the impacts of greenhouse gas (GHG) emissions. The opportunity cost of WALs are estimated at $7M. GHG impacts to Australia and NSW are estimated at $0.1M and $0.03M, respectively, relative to the economic base case, and $0.07M and $0.02M, respectively, relative to the legal base case. These economic costs are considerable less than the estimated net production benefits of the Modification.

Overall, the Modification is estimated to have net social benefits to both Australia and NSW relative to both the economic base case and legal base case, and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts have been quantified and included in the Modification CBA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than $240M (relative to the economic base case) and $222M (relative to the economic base case) for the Modification to be questionable from an NSW economic efficiency perspective.

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# ATTACHMENT 1 - COST BENEFIT ANALYSIS

## Introduction to CBA

Cost Benefit Analysis (CBA) has its theoretical underpinnings in neoclassical welfare economics. Applications in New South Wales (NSW) are guided by these theoretical foundations as well as the NSW Treasury (2017). CBA applications within the NSW environmental assessment framework are further guided by the NSW Government (2015) *Guidelines for the economic assessment of mining and coal seam gas projects* and the *NSW Government (2018) Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals.*

CBA is concerned with a single objective of the *Environmental Planning and Assessment Act, 1979* (EP&A Act) and governments i.e. economic efficiency. It provides a comparison of the present value of aggregate benefits to society, as a result of a project, policy or program, with the present value of the aggregate costs. These costs and benefits are defined and valued based on the microeconomic underpinnings of CBA. In particular, it is the values held by individuals in the society that are relevant, including both financial and non-financial values. Provided the present value of aggregate benefits to society exceed the present value of aggregate costs (i.e. a net present value of greater than zero), the project is considered to improve the well-being of society and hence is desirable from an economic efficiency perspective.

While CBA can provide qualitative and quantitative information on how costs and benefits are distributed, welfare economics and CBA are explicitly neutral on intra and intergenerational distribution of costs and benefits. There is no welfare criterion in economics for determining what constitutes a fair and equitable distribution of costs and benefits. Judgements about equity are subjective and are therefore left to decision-makers.

Similarly, CBA does not address other objectives of the EP&A Act and governments. Decision-makers therefore need to consider the economic efficiency implications of a project, as indicated by CBA, alongside the performance of a project in meeting other conflicting goals and objectives of the EP&A Act and government.

## Definition of Society

CBA includes the consideration of costs and benefits to all members of society i.e. consumers, producers and the broader society as represented by the government.

As a tool of investment appraisal for the public sector, CBA can potentially be applied across different definitions of society such as a local area, state, nation or the world. However, most applications of CBA are performed at the national level. This national focus extends the analysis beyond that which is strictly relevant to a NSW government planning authority. However, the interconnected nature of the Australian economy and society creates significant spill-overs between States. These include transfers between States associated with the tax system and the movement of resources over state boundaries.

Nevertheless, "where major impacts spill over national borders, then CBA should be undertaken from the global as well as the national perspective" (Boardman *et al.,* 2001). For mining projects, impacts that spill over national borders include greenhouse gas costs and producer surplus benefits to foreign owners.

CBA at a sub-national perspective is not recommended as it results in a range of costs and benefits from a project being excluded, making CBA a less valuable tool for decision-makers (Boardman *et al*., 2001).

CBAs of mining projects are therefore often undertaken from a global perspective i.e. including all the costs and benefits of a project, no matter who they accrue to, and then truncated to assess whether there are net benefits to Australia. A consideration of the distribution of costs and benefits can then be undertaken to identify the benefits and costs that accrue to NSW and other regions.

However, a project is considered to improve the well-being of society if it results in net benefits to the nation, even if it results in net costs to the local area.

**Definition of the Project Scope**

The definition of the project for which approval is being sought has important implications for the identification of the costs and benefits of a project. Even when a CBA is undertaken from a global perspective and includes costs and benefits of a project that accrue outside the national border, only the costs and benefits associated with the defined project are relevant. For coal mining projects, typically only the costs and benefits from mining the coal and delivering it to Port or domestic users, are relevant.

Coal is an intermediate good i.e. it is an input to other production processes such as production of electricity and steel making. However, these other production processes themselves require approval and, in CBA, would be assessed as separate projects.

**Net Production Benefits**

CBA of mining proposals invariably involves a trade-off between:

- the net production (producer surplus) benefits of a project; and
- the environmental, social and cultural impacts (most of which are costs of mining but some of which may be benefits).

Net production benefits can be estimated based on market data on the projected financial[12] value of coal less the capital and operating costs of projects, including opportunity costs of capital and land already in the ownership of mining companies. This is normally commercial in confidence data provided by the proponent. Production costs and benefits over time are discounted to a present value.

**Environmental, Social and Cultural Impacts**

The consideration of non-market impacts in CBA relies on the assessment of other experts contributing information on the biophysical impacts. The environmental impact assessment process results in detailed (non-monetary) consideration of the environmental, social and cultural impacts of a project and the proposed means of mitigating the impacts.

At its simplest level, CBA may summarise the consequences of the environmental, social and cultural impacts of a project (based on the assessments in the relevant assessment document), for people's well-being. These qualitatively described impacts can then be considered alongside the quantified net production benefits, providing important information to the decision-maker about the economic efficiency trade-offs involved with a project.

These environmental, social and cultural impacts generally fall into three categories, those which:

- can be readily identified, measured in physical terms and valued in monetary terms;

[12] In limited cases the financial value may not reflect the economic value and therefore it is necessary to determine a shadow price for the coal.

- can be identified and measured in physical terms but cannot easily be valued in money terms; and
- are known to exist but cannot be precisely identified, measured or value (NSW Treasury, 2007).

Impacts in the first and second category can potentially be valued in monetary terms using benefit transfer or, subject to available resources, primary non-market valuation methods. Benefit transfer involves using information on the physical magnitude of impacts and applying per unit value estimates obtained from non-market valuation studies undertaken in other contexts.

Primary non-market valuation methods include choice modelling and the contingent valuation method where a sample of the community is surveyed to ascertain their willingness to pay to avoid a unit change in the level of a biophysical attribute. Other methods include the property valuation approach where changes in environmental quality may result in changes in property value.

In attempting to value the impacts of a project on the well-being of people there is also the practical principle of materiality. Only those impacts which are likely to have a material bearing on the decision need to be considered in CBA (NSW Government, 2012).

Where benefits and costs cannot be quantified these items should be included in the analysis in a qualitative manner (NSW Treasury, 2007).

**Consideration of Net Social Benefits**

The consideration of the net social benefits of a project combines the value estimate of net production benefits and the qualitative and quantitative estimates of the environmental, social and cultural impacts.

In combining these considerations, it should be noted that the estimates of net production benefits of a project generally include accounting for costs aimed at mitigating, offsetting or compensating for the main environmental, social and cultural impacts. This includes the costs of purchasing properties adversely affected by noise and dust, providing mitigation measures for properties moderately impacted by noise and dust, the costs of providing ecological offsets and the cost of purchasing groundwater and surface water entitlements in the water market etc. Including these costs effectively internalises the respective and otherwise, non-monetary environmental, social and cultural costs. To avoid double counting of impacts, only residual impacts, after mitigation, offset and compensation, require additional consideration.

Even when no quantitative valuation is undertaken of the environmental, social and cultural impacts of a project, the threshold value approach can be utilised to inform the decision-maker of the economic efficiency trade-offs. The estimated net production benefits of a project provides the threshold value that the non-quantified environmental, social and cultural impacts of a project (based on the assessments in the relevant assessment document), after mitigation, offset and compensation by the proponent, would need to exceed for them to outweigh the net production benefits.

Where the main environmental, social and cultural impacts of a project are valued in monetary terms, stronger conclusions can be drawn about the economic efficiency of a project i.e. the well-being of society.

Any other residual environmental, cultural or social costs that remain unquantified in the analysis[13] can also be considered using the threshold value approach. The costs of these unquantified environmental,

[13] Including potential impacts that were unknown at the time of the preparation of the relevant assessment document or arise during the Environmental Impact Assessment process due to differences in technical opinions.

cultural and social impacts would need to be valued by society at greater than the quantified net social benefit of a project to make it questionable from an economic efficiency perspective.

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## ATTACHMENT 2 – COMPARISON OF INPUT-OUTPUT ANALYSIS AND THE LEA METHOD

IO analysis begins with identification of the direct gross regional economic activity footprint of a project for the region. If a project provides 100 jobs at the mine site then all these jobs are counted in IO analysis as a direct effect i.e. direct employment in the region, because the jobs are located in the region. All income paid to employment is also included as it is generated in the economy and IO tables are based on place of work. However, in assessment of the impacts of a project on the regional economy only the income of employees living in the region are counted as direct income effects since it is only wages expenditure of those living in the region that flows through the regional economy. In IO analysis, if 40% of a project's jobs are filled by people who already reside in the region then the **total** wages of these people is counted as a direct regional income effect of the project. Similarly, if 40% of the new jobs are taken by people who migrate into the region this is also counted as direct income for the region, as it is income that will accrue to people living in the region even though they are new residents. In impact assessment using IO analysis, the income of those residing outside the region is excluded as most of their income will be taken home after shift and spent where they live or elsewhere.

These direct employment and income effects for the region are those **associated** with the project i.e. the gross footprint, rather than specifically an assessment of **incremental** effects. This is partly because assessment of incremental effects becomes highly contentious and difficult. However, as will be shown below, these gross direct effects associated with a project can also be a reasonable approximation of incremental effects when "job chain" effects are considered.

However, first is a comparison between how IO analysis treats direct employment and income effects (as explained above) and that in the NSW (2015) guideline.

The guideline splits labour into those ordinarily resident in the region and those not ordinarily resident in the locality. For those ordinarily resident in the region the guideline suggests calculation of incremental income as the difference between a mining (including quarrying) income and the average level of income in other industries in the region. Incremental direct employment is then calculated by dividing this incremental income by the average wage in mining.

The guideline ignores workers who migrate into the region to work. However, using the rationale of the guideline, workers who migrate into the region to take jobs in a project provide a greater level of incremental income and spending in the region than those to take jobs in a project and who already reside in the region. The entire wage of those migrating into the region is additive to regional income in comparison to wage increments for those already residing in the region.

Table 1 provides an example of incremental wages using the guideline method and when income from those migrating into the region is counted. If only the incremental wages of those who already reside in the region are counted the incremental impact is $1.4M in annual wages. However, if the incremental wages to the region from those who migrate into the region are included, this increases to $5.4M.

**Table 1 - Incremental Income when Immigrating Workforce is Included**

| Categories of Workers | Direct Empl | Current Wages @$65k | New Wages @$100k | Incremental New Wages for Workers | Incremental New Wages to the Region |
|---|---|---|---|---|---|
| Already Live in Region | 40 | 2,600,000 | 4,000,000 | 1,400,000 | 1,400,000 |
| Migrate into Region to Live | 40 | 2,600,000 | 4,000,000 | 1,400,000 | 4,000,000 |
| Commute from outside | 20 | 1,300,000 | 2,000,000 | 700,000 | 0 |
| **Total Direct Empl** | **100** | **6,500,000** | **10,000,000** | **3,500,000** | **5,400,000** |

Even for those already living in the region who are already employed, the incremental income estimated using the guideline will substantially understate additional regional income effects. This is because new jobs in a region create a chain of job opportunities (referred to in the literature as the "job chain" - see Persky et al, 2004 What are jobs worth?, Employment Research Vol. 11 , p. 3).

An already employed person in the region moving into a mining (including quarrying) job, creates a job vacancy, which can be filled by those in the region (already employed, unemployed or attracted into the labour force) or by in-migration. Where this job is filled by those already employed in the region this in turn creates another vacancy etc. Following the entire chain through, the cumulative increase in wages to a region would approach the wages of the total direct mining jobs. It would only be discounted if the chain ends with employment of those from local residents in the unemployment pool (who are receiving an allowance and hence already are spending income in the region), if jobs remain unfilled or if jobs are filled by a commuter workforce. The latter is less likely for lower paying jobs down the job chain. In periods of higher unemployment rates, jobs along the job chain remaining unfilled is unlikely. If the chain ends with in-migrating employment or employment of those in the region that are new to the workforce then the incremental wages is equal to the total wages of the new jobs.

Table 2 demonstrates the "job chain" effect in relation to 40 new mining jobs filled by already employed local workers. It shows that the total annual wages of the new mining jobs is $4M. Under the job chain approach where all jobs are backfilled including ultimately by 40 local residents from the unemployment pool the incremental wages to the region are $3.5M. If some of these jobs filled from the unemployment pool are ultimately filled by in-migration the difference between the incremental wages to the region and the total annual mining jobs wages will lessen.

The guideline does not take account of the "job chain" effect and essentially assumes that the previous jobs of "job movers" in the region remain vacant for the life of the Project.

Incorporation of consideration of the "job chain" effect means that the direct incremental income to a region approximates that assumed in IO analysis (i.e. the gross footprint of economic activity estimated using IO analysis is also an indicator of the net effect).

**Table 2 - Demonstration of the Job Chain Effect for 40 Jobs Filled by Locals Who are Already Employed in the Region**

| | Total wages | Increment Wages Gain to Region |
|---|---|---|
| 1. New mining wage for 40 workers @$100k | $4,000,000 | $1,400,000 (1-2) |
| 2. Current Wages for 40 workers @$65k | $2,600,000 | $1,000,000 (2-3) |
| 3. Wage of people filling above 40 positions @$40k | $1,600,000 | $800,000 (3-4) |
| 4. Wage of people filling above 40 positions @$20k | $800,000 | $ 255,664 (4-5) |
| 5. Wages of the unemployed filling above 40 positions (Newstart - single no children) | $544,336 | |
| **Total** | | **$3,455,664** |