MOOLARBEN COAL PROJECT

Stage 2

APPENDIX 16

Preliminary Hazard Analysis

Moolarben Coal Mine Pty Limited
Moolarben Coal Project – Stage 2
Preliminary Hazard Analysis

- ND00077-RPTFinal(Rev0)-08Oct08
- 20 November 2008

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EXECUTIVE SUMMARY

Introduction, Objectives and Scope

Stage 1 of the Moolarben Coal Project (MCP), which is located in the western coalfields of NSW, was approved by the NSW Department of Planning on 6 September 2007. The project is located 40 kilometres (km) north-east of Mudgee and 25 km east of Gulgong. The development of the resource has been staged to ensure the effective recovery of the coal resource. The approved Stage 1, and proposed Stage 2, will operate as an integrated mining complex. To ensure the safe and effective development of Stage 2, it is necessary to assess the potential hazards and risks to ensure these are effectively controlled. MCP has commissioned Sinclair Knight Merz to perform a preliminary hazard analysis (PHA) of the Stage 2 development in support of the development application.

This document reports on the findings of the PHA study for the Moolarben Coal Project Stage 2 development.

Methodology

The methodology selected for the PHA study is that published by the Department of Planning (DoP) in its document “Multi Level Risk Assessment”(Ref.3). The methodology consists of hazard analysis (to identify those hazards that have a potential to impact offsite), consequence assessment (to quantify impacts and determine their offsite effects), frequency analysis (for those incidents identified by consequence analysis to have an offsite impact), and risk assessment (by combination of consequence and likelihood). The results of the analysis are then compared to the published risk criteria and where criteria is exceeded, risk reduction measures are employed until the risks are below the accepted criteria.

Brief Description of Mine Operations

Stage 2 of the MCP is located east of Stage 1 and comprises an open cut coal mine and two (2) undergrounds coal mines with associated infrastructure (i.e. stockpiles, coal handling plant, mine services such as workshops, offices and fuel/oil storages). The brief description below is presented to assist in understanding the surface and underground mine operations.

Surface Mines – Surface mine operations will commence with the removal of topsoil using earthmoving equipment. The topsoil will be stockpiled for mine rehabilitation. The subsurface rock (overburden) covering the coal will then be blasted using explosives. The loosened rock will be removed using hydraulic excavators and end dump trucks. The rock will be stockpiled for filling open cut pits in the mine rehabilitation process. The run of mine (ROM) coal will then be loosened or “ripped” using a bull dozer or, when required blasted..

Hydraulic excavators will then load the coal to end dump trucks for transport to the dump hopper for sizing and treatment prior to stockpiling and dispatch by rail.

Underground Mine – The underground mine will operate using the longwall mining technique. This will commence with the establishment of two drifts located north of the rail line and adjacent to the coal handling and preparation plant (CHPP). Continuous mining machines (large rotating drum cutting machines) will be used to drive "roadways" underground and to establish longwall panels. Longwall mining is performed in a nearly continuous operation using specialised, integrated mining and roof support equipment. At the Moolarben Coal Project, the longwall panels are 250m across some running north south and others east west. The ROM coal will be transported to the surface using underground conveying equipment. The coal will be sized, treated and stockpiled prior to dispatch by rail.

Pit Top Facilities – The pit top facilities will include shared facilities for Underground No.1 and Underground No..2, located adjacent to the portal entries in open cut 1, main facilities area at the Stage 2 ROM station and facilities for Open Cut No.4. Facilities at Open Cut 4 will include administration buildings (including offices, a service workshop, storage facilities and bath houses) and explosive storage (magazine). The shared underground pit top facilities will include administration buildings (including offices, workshop storage facilities and bath houses), coal stockpiles and a conveyor system for transporting the coal. The main facilities area at the Stage 2 ROM station will include administration buildings (including workshop, storage facility and bath house), coal stockpiles, a coal surge bin and diesel fuel storage. The stockpiled coal will be reclaimed and transferred via conveyors to the coal surge bin. Coal from this bin will be fed, via a conveyor, at a constant rate to the coal handling and preparation plant (CHPP). The coal will be washed prior to stockpiling, ready to be transported off-site by rail.

Hazard Analysis

A detailed hazard analysis was conducted (**Appendix A**) and incidents with the potential to result in off-site impact were identified. Those incidents with no potential for off-site impact were screened from further analysis. Incidents with off-site impact potential were carried forward for detailed hazard analysis. Further screening was performed to identify those incidents with the potential to impact adjacent properties. A list of hazardous incidents was developed and carried forward for consequence analysis. Those incidents carried forward for detailed consequence analysis, as a result of surface mining, were:

- Mix Truck roll over, fuel leak and fire;
- Explosion on the shotfirers vehicle;
- Premature explosion of the ANFO mix on the mix truck;
- Diesel fuel storage fire;
- Lubricating oil storage fire; and

- Magazine explosion.

Hazards that may occur underground include fire, explosions, roof collapse, toxic gas release (H_2S), etc. However, all incidents that may occur underground are confined to the underground section of the mine itself. There are no impacts from underground incidents that occur at the surface and particularly offsite. Whilst incidents that may occur underground can have significant impact on personnel within the mine, there are no impacts at the surface, hence, as the scope of the PHA is to determine offsite impacts, and there are none as a result of underground operations, no underground incidents have been carried forward for further analysis.

Consequence Analysis

A detailed consequence analysis was conducted for each of the hazardous incidents carried forward from the hazard analysis. The detailed analysis is conducted in **Appendix B**. **Table 1** summarises the results of the consequence analysis.

TABLE 1
SUMMARY RESULTS OF CONSEQUENCE ANALYSIS

Fire Incident	Heat Radiation at Site Boundary
Mix truck fire	$0.2kW/m^2$
Diesel storage bund fire	$0.26kW/m^2$
Oil storage bund fire	$0.11kW/m^2$
Explosion Incident	**Explosion Overpressure at Site Boundary**
Shotfirers vehicle – detonators explosion	7kPa
Mix truck ANFO explosion	5kPa
Magazine explosion	4kPa

* $4.7kW/m^2$ and 7kPa are the maximum levels for heat radiation and explosion overpressure (respectively) at the site boundary above which further assessment is required (e.g. risk assessment) – Ref.2

Conclusions

The hazard and consequence analysis concluded the following:

- All hazardous incidents underground (e.g. fires, explosions, etc.) would be confined within the underground workings and would not result in an offsite impact.
- The impact of the consequences of all identified hazards in the surface mine and pit top facilities do not have the potential to impact offsite due to the application of buffer zones around the open cut workings, and the location of the site explosives magazine well clear of the site boundary.

Notwithstanding the majority of analysis results indicating no off-site impact, a number of risk reduction recommendations have been made to enhance the hazard mitigation and site emergency response, these are detailed below.

Recommendations

Whilst it was identified that the majority of hazardous incidents have no offsite impact, the following recommendations are made in relation to risk reduction to ensure the ALARP (as low as reasonably practicable) principle is applied.

1. It is recommended that the incidents listed in **Appendix A**, and detailed in **Section 4.3**, be included in the site Emergency Response Plan, along with other incidents identified to have onsite impact to mine equipment and personnel.

2. It is recommended that during the regular emergency response drills, conducted as part of the Mine Rescue Team (MRT) exercises, the hazards listed in **Appendix A** be included in the drill exercises to ensure MRT readiness.

3. As the study indicated that fire in vehicles was a potential hazard on site, and that fire growth has the potential to result in serious damage to vehicles, it is recommended that all vehicles on site be fitted with at least one dry powder type extinguisher. Larger vehicles should carry at least one 9kg dry powder extinguisher and smaller vehicles at least one 4.5kg dry powder extinguisher.

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ABBREVIATIONS

Abbreviation	Description
ANFO	Ammonium Nitrate-Fuel Oil
AS	Australian Standard
CM	Continuous Mining
CPP	Coal Preparation Plant
DG	Dangerous Goods
DG Regs	OH&S (Dangerous Goods Amendment) Regulation 2005
DoP	NSW Department of Planning
EA	Environmental Assessment
HIPAP	Hazardous Industry Planning Advisory Paper
K	Kelvin (temperature measurement)
Kg	Kilograms
kg/m^3	kilo grams per cubic metre
km	Kilometres
kPa	kilo Pascals
kph	kilometres per hour
kV	kilo Volts
kW/m^2	kilo Watts per square metre
m	Metres
m/s	metres per second
m^2	square metres
m^3	cubic metres
mm	Millimetres
mm/min.	millimetres per minute
MCP	Moolarben Coal Project
Mtpa	Million tonnes per annum
OH&S	Occupational Health and Safety
PHA	Preliminary Hazard Analysis
QRA	Quantitative Risk Assessment
ROM	Run of Mine
SKM	Sinclair Knight Merz
TNT	Tri-Nitro-Toluene

1. INTRODUCTION

1.1 Background

The Moolarben Coal Project (MCP), Stage 1 of which was approved on 6 September 2007, is located in the western coal fields of NSW, 40 kilometres (km) north-east of Mudgee and 25 km east of Gulgong. In order to facilitate the orderly, economic and progressive extraction of the available coal resource, MCP has staged the mine development. As stage 1 has been approved, and is currently under development, the timing of the project requires the commencement of the Stage 2 process. Stage 1 and Stage 2 (when approved) will operate as an integrated mining complex.

As part of the application to the regulatory authorities for the Stage 2 development, it is necessary to review the potential hazards and risks that may occur as a result of the proposed operation. To assist with the hazard and risk review of the Stage 2 development, MCP has commissioned Sinclair Knight Merz to conduct a Preliminary Hazard Analysis of the proposed Stage 2 operations and top report on the findings of the study.

This document reports on the findings of the PHA study for the Moolarben Coal Project Stage 2 development.

1.2 Objectives

The objectives of the study are to:

- Conduct a hazard and risk analysis of the MCP Stage 2 development using the hazard analysis guidelines issued by the NSW Department of Planning (Ref.1);
- Identify areas of operation at the MCP Stage 2 that may exceed acceptable hazard and risk criteria (Ref.2) and recommend upgrades to ensure operations are within the acceptable criteria; and
- Report on the findings of the study in support of the development application.

1.3 Scope of Work

The scope of work is for the assessment of hazards and risks associated with the MCP Stage 2 only and for the development of a report for submission to the regulatory authorities in support of the development application.

2. METHODOLOGY

2.1 General Approach

The NSW Department of Planning (DoP) Multi Level Risk Assessment (Ref.3) approach was used for this study. The approach considered the development in context of its location and its technical and safety management control. The Multi Level Risk Assessment Guidelines are intended to assist industry, consultants and the consent authorities to carry out and evaluate risk assessments at an appropriate level for the facility being studied.

The Multi Level Risk Assessment approach is summarised in **Figure 2.1**. There are three levels of assessment, depending on the outcome of preliminary screening. These are:

- **Level 1 – Qualitative Analysis**, primarily based on the hazard identification techniques and qualitative risk assessment of consequences, frequency and risk;
- **Level 2 – Partially Quantitative Analysis**, using hazard identification and the focused quantification of key potential offsite risks; and
- **Level 3 – Quantitative Risk Analysis (QRA)**, based on the full detailed quantification of risks, consistent with Hazardous Industry Planning Advisory paper No.6 – Guidelines for Hazard Analysis.

Since the proposed MCP Stage 2 is an extension of an existing coal mine located in a rural area and the site operations areas are some considerable distance from residential areas, the most appropriate approach is **Level 2** for this analysis.

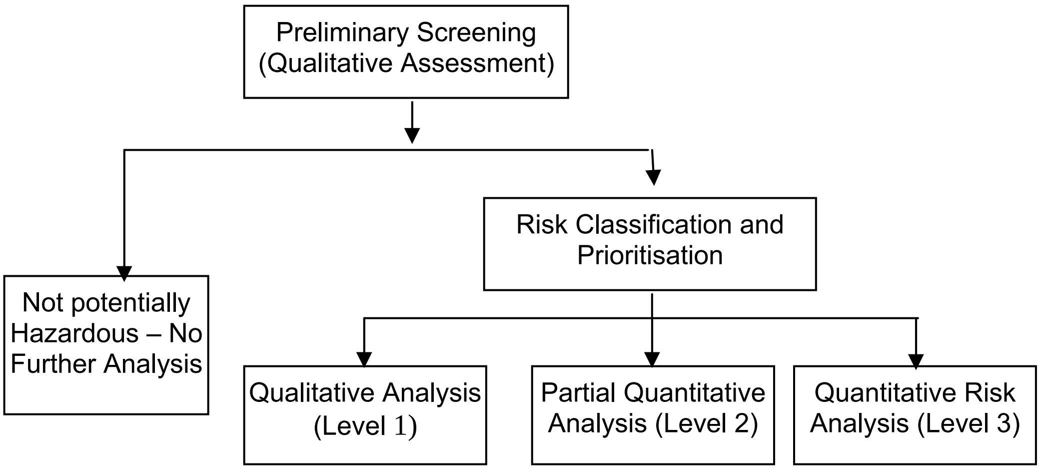

FIGURE 2.1
THE MULTI LEVEL RISK ASSESSMENT APPROACH

2.2 Detailed Approach

2.2.1 Hazard Analysis

A detailed hazard identification was conducted for all site operations described in **Section 3**. Where an incident was identified to have potential off site impact, it was included in the recorded hazard identification word diagram (**Appendix A**). The hazard identification word diagram lists incident type, causes, consequences and safeguards. This was performed using the word diagram format recommended in HIPAP No.6 (Ref.1). Each postulated hazardous incident was assessed qualitatively in light of proposed safeguards (technical and management controls). Where a potential offsite impact was identified, the incident was carried into the main report for further analysis. Where the qualitative review in the main report determined that the safeguards were adequate to control the hazard, or that the consequence would obviously have no offsite impact, no further analysis was performed.

The hazard analysis and safety systems review was conducted during discussions with the MCP Stage 2 project team.

2.2.2 Consequence Analysis

For those incidents qualitatively identified in the hazard analysis to have a potential offsite impact, a detailed consequence analysis was conducted. The analysis modelled the various postulated hazardous incidents and determined impact distances from the incident source. The results were compared to the criteria listed in HIPAP No.4 (Ref.2). Where an incident was identified to result in offsite effect, it was carried forward for frequency analysis. Where an incident was identified to have an offsite effect, and a simple solution was evident (i.e. move the proposed equipment further away from the site boundary), the solution was recommended and no further analysis was performed.

2.2.3 Frequency Analysis

In the event a simple solution for managing consequence impacts was not evident, each incident identified to have potential offsite impact would be subjected to a frequency analysis. The analysis considered the initiating event and probability of failure of the safeguards (both hardware and software).

2.2.4 Risk Assessment

As the selected approach for this analysis was a Level 2 assessment (Ref.3), where incidents were identified to impact offsite and where a consequence and frequency analysis was conducted, the consequence and frequency analysis for each incident would be combined and compared to the risk criteria published in HIPAP No.4 (Ref.2). Where the criteria was exceeded, a review of the major risk contributors would be performed. Recommendations would then be made regarding risk reduction measures.

3. BRIEF DESCRIPTION OF THE MOOLARBEN COAL PROJECT STAGE 2

3.1 Site Location and Background

The Moolarben Coal Project (MCP) is located in the western coal fields of NSW, 40 kilometres (km) north-east of Mudgee and 25 km east of Gulgong. The MCP area is located immediately to the east of the Ulan Coal Mine and to the west the Wilpinjong Coal Mine. The Goulburn River runs through the north of the area, and forms a natural extraction limit. Adjoining national parks include the Goulburn River National Park to the north-east and the Munghorn Gap Nature Reserve to the south-east. The location of the MCP is shown by **Figure 3.1**.

The mine consists of a number of exploration leases (EL); EL 6288 covers an area of 11,000ha, EL 7073 an area of 1,110ha and EL 7074 an area of 35ha, comprising rural land, private and public lands and some public infrastructure. It is characterised by substantial topographical relief, with land elevation ranging from about 400 metres (m) Australian Height Datum (AHD) in valleys to 620m AHD on adjacent ranges. A substantial portion of the exploration area is vegetated, with some cleared land for pastoral use on the valley floors. A small airstrip is located adjacent the Ulan – Mudgee Road, for use by the Ulan Coal Mine.

The development of the MCP has been staged to facilitate the orderly, economic and progressive extraction of the available coal resources, these include Stage 1 – Open Cuts 1, 2, and 3 and Underground 4 (existing approval dated 6 September 2007) and Stage 2 – Open Cut 4 and Undergrounds 1 and 2 (the subject of this study).

The purpose of this document is to provide a review of the hazards and risks associated with the operation of the MCP Stage 2 facility in support of a development submission the NSW Director General of Planning.

Stage 2 of the MCP is described in the following sections.

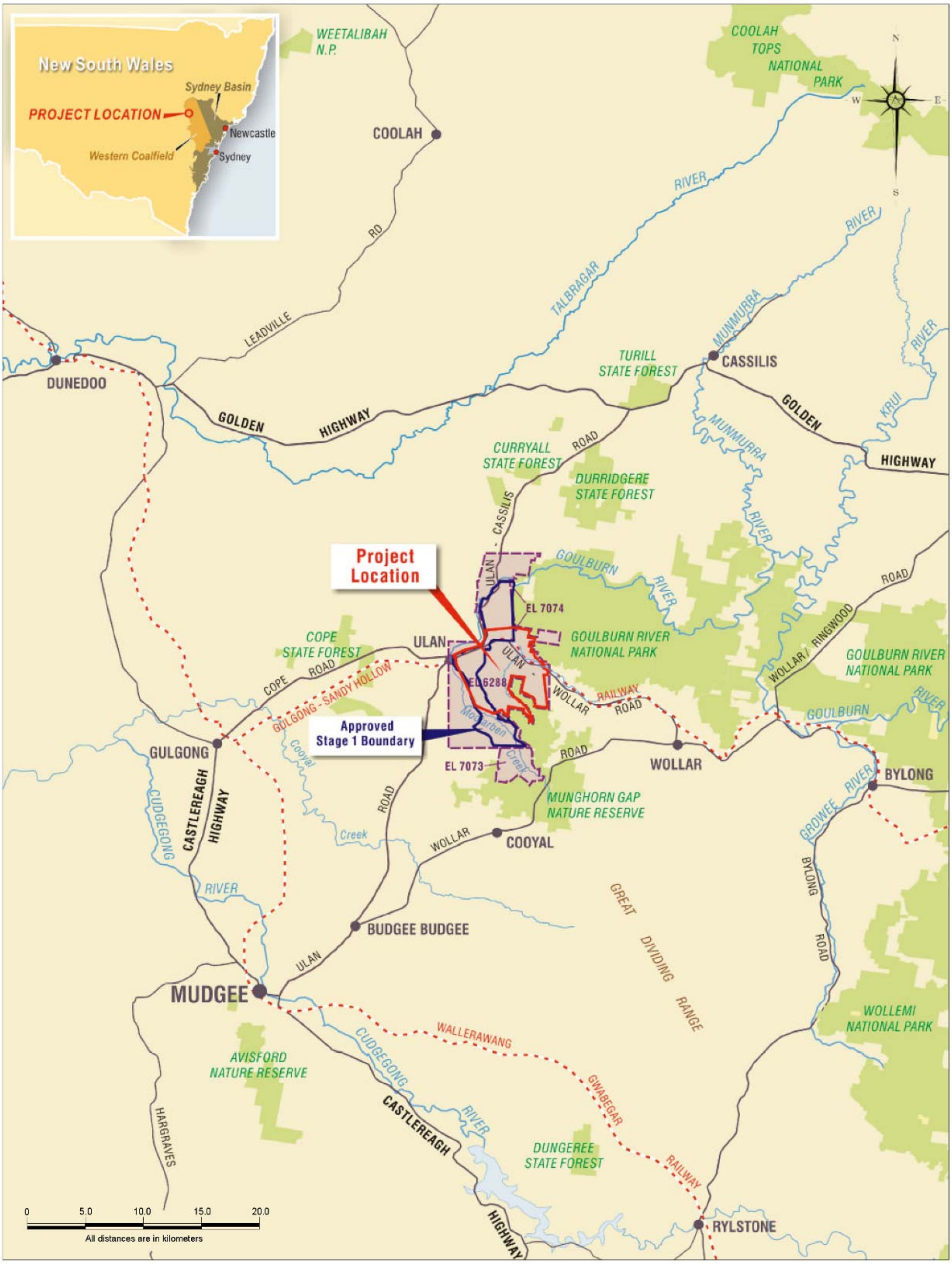

FIGURE 3.1
REGIONAL LOCATION OF THE POPOSED MINE

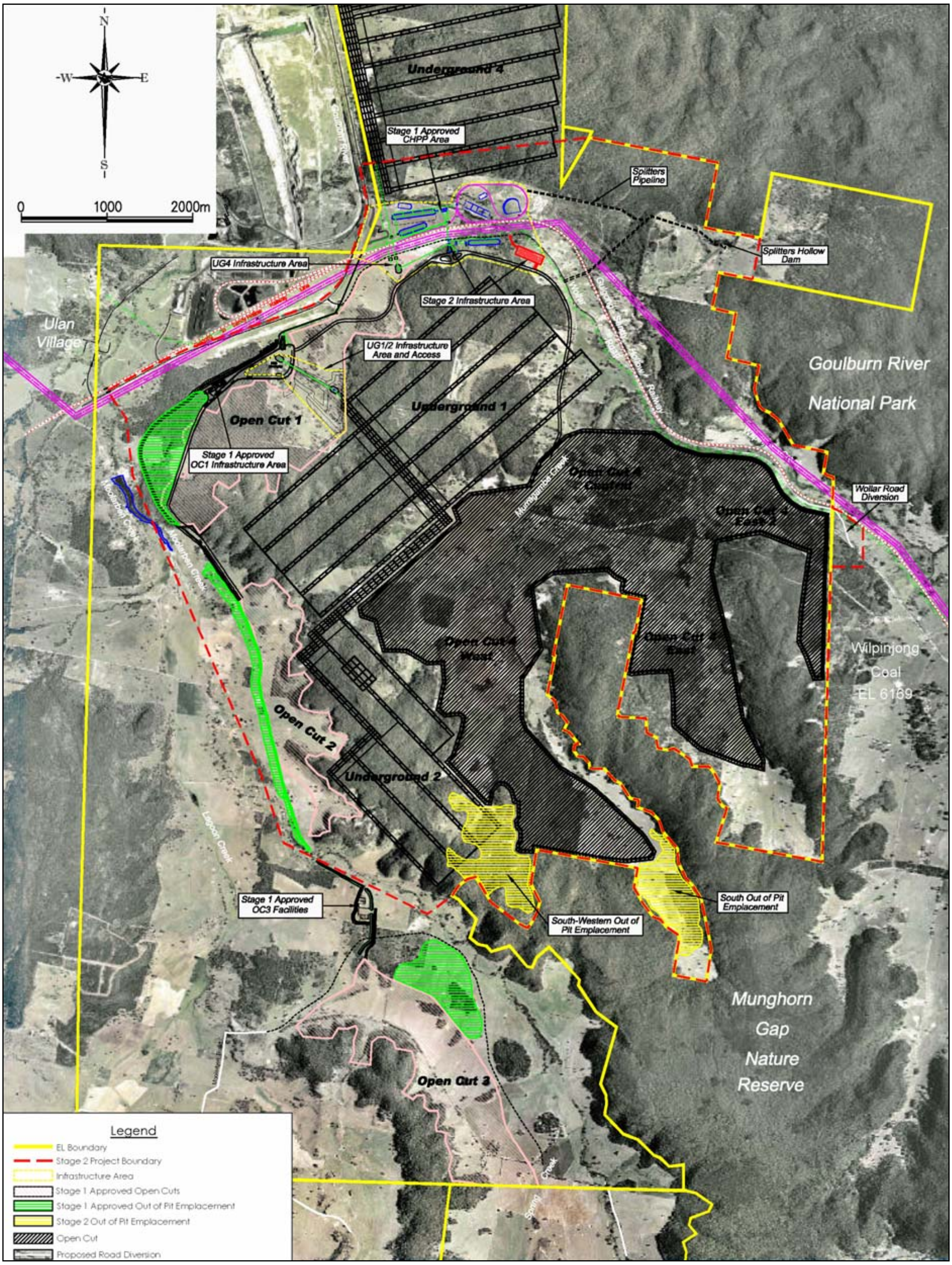

FIGURE 3.2
MCP STAGE 2 GENERAL MINE LAYOUT

3.2 Overview of the MCP Stage 2 and Coal Resource Location

Stage 2 of the MCP is located east of Stage 1 and comprises an open cut coal mine and two (2) undergrounds coal mines with associated infrastructure. The major components of Stage 2 include:

- Open Cut 4 (O/C4);
- Underground mines 1 and 2 (U/G1 & U/G2);
- Extraction of up to 17Mtpa of ROM coal;
- Production of up to 13Mtpa of product coal;
- Coal handling and processing facilities for Stage 1 and Stage 2 coal; and
- Supporting infrastructure (such as; roads, fuel supplies, workshops, bath houses and offices).

Figure 3.2 illustrates the general arrangement of Stage 2.

The underground mines are located below sandstone ridges, whilst the open cut mine is in the floor of the Murragamba Valley and adjoining valley to the east. The Ulan Seam, which ranges from around 11 metres (m) to about 13m in thickness, will be mined with the full seam recovered in the open cut mines and a partial section in the underground mines. Both domestic and export thermal coal will be produced.

3.3 Open Cut Mining Overview

The proposed O/C4 occupies an area of approximately 1270ha, (refer to Figure 3.2 for location of O/C4). The full Ulan seam (up to 13m thick) will be mined in two passes and processed separately to produce an estimated coal resource of about 230Mt.

The initial out of pit overburden from the box cut and developing open cut will be located adjacent to the sandstone ridgelines where the depth of cover exceeds economical strip ratios for Open Cut mining. In pit dumping will be undertaken as soon as practical.

Conventional truck and shovel mining systems will be used with a haul back system to maximise in-pit backfill of waste (see **Section 3.6**). Variations including throw blasting and dozer push may also be used. Blasting of both the overburden and coal will be required. The use of a shiftable conveyor for transport of ROM coal will also be investigated.

Access to O/C4 will be from a private haul road for both heavy and light vehicles. Light vehicles may utilise the Ulan-Wollar Road to access some areas of the open cut.

Mining in O/C4 will commence at the southern end of the Murragamba Valley and progress to the north and east.

The mine will have a life span of approximately 23 years at full extraction rates. The open cut pits will operate 24 hours per day, 7 days per week. The Stage 2 open cut mine would employ around 122 additional persons to that already approved for Stage 1. Manning of the Stage 1 and 2 Projects will be coordinated to reduce traffic impacts associated with shift changes.

The final void of O/C4 will be located along the eastern boundary of EL 6288. The dimensions of this void will be determined during further mine planning. The location of this void allows potential access to adjoining potential underground resources (see **Section 3.4**).

3.4 Underground Mining Overview

Stage 2 will include U/G1 and U/G2 that have a combined area of approximately 990ha (see **Figure 3.2**). U/G1 is located beneath the sandstone ridgelines that divide Open Cut 1 and O/C4, while U/G2 is located beneath the sandstone ridgeline that divide Open Cut 2 from O/C4.

Underground coal extraction will generally be within the D section of the Ulan Seam. Longwall methods will be used with an extraction thickness of approximately 3m in panels widths of up to 300m. The longwall will operate at approximately 2500 tonnes per hour (t/hr). The underground mines have a probable coal reserve of 54Mt (UG1 – 38Mt, UG2 16Mt) of which approximately 36Mt will be extracted. U/G1 and U/G2 have a, a depth of cover ranging from 60m to 147m, with the seam dipping 1.5 to 3 degrees to the north east.

Access to U/G1 will be via the approved Stage 1 high wall access within Open Cut 1, this will occur at approximately Years 3 to 4 of mining in Open Cut 1. Access into U/G2 will be via the high wall of O/C4, or from the U/G1 entry. Associated with the access to the underground mines will be coal stockpile and handling facilities that will convey coal to a hopper for transport via truck or conveyor to the central ROM system. Access to the Stage 1 approved Underground No.4 will be relocated south to enter from the Open Cut 1 northern high wall, this access will include the necessary coal handling facilities.

3.5 Mining Operations - Detail

The mining operations, including mining and ancillary operations, have been split into a number of areas, each is detailed in the following sections. The aim of these sections is to provide sufficient detail in order to facilitate a hazard identification and analysis so that potential incidents that may impact offsite can be identified for further analysis.

3.5.1 Coal Handling and Preparation Facilities Overview

To adequately handle and process the coal from Stages 1 and 2 the Stage 2 facilities have been designed to integrate with the approved surface facilities to create surface facilities that service the whole MCP (Stages 1 and 2). The facilities are illustrated in **Figure 3.3**.

The MCP surface facilities will have the capacity to handle approximately 17Mtpa ROM coal and produce approximately 13Mtpa product coal for transport by rail. Increased tonnage from the MCP will require an increase in the approved handling capacity of the Stage 1 infrastructure.

The Coal Preparation Plant (CPP) will be fed via overhead conveyors from the approved Stage 1 or proposed Stage 2 raw coal stockpile located south of the Ulan-Sandy Hollow Railway line and Ulan-Wollar Road. A CPP bypass will be incorporated into the system that allows good quality raw coal to report directly to the product coal stockpile without washing. The Stage 2 ROM dump system, located adjacent to the raw coal stockpile will crush and screen the ROM coal before raw coal stockpiling.

U/G1 and 2 will require ROM stockpile and handling facilities that will feed coal into the approved Open Cut 1 ROM system that will be upgraded to cater for additional coal, offices, bath houses and storage area adjacent to the underground entry.

Facilities such as offices, bath-houses, workshops, and fuel stores will be constructed adjacent to the Stage 2 ROM dump system. Access to these facilities will be from the Ulan-Wollar Road. These facilities will service the MCP as a whole.

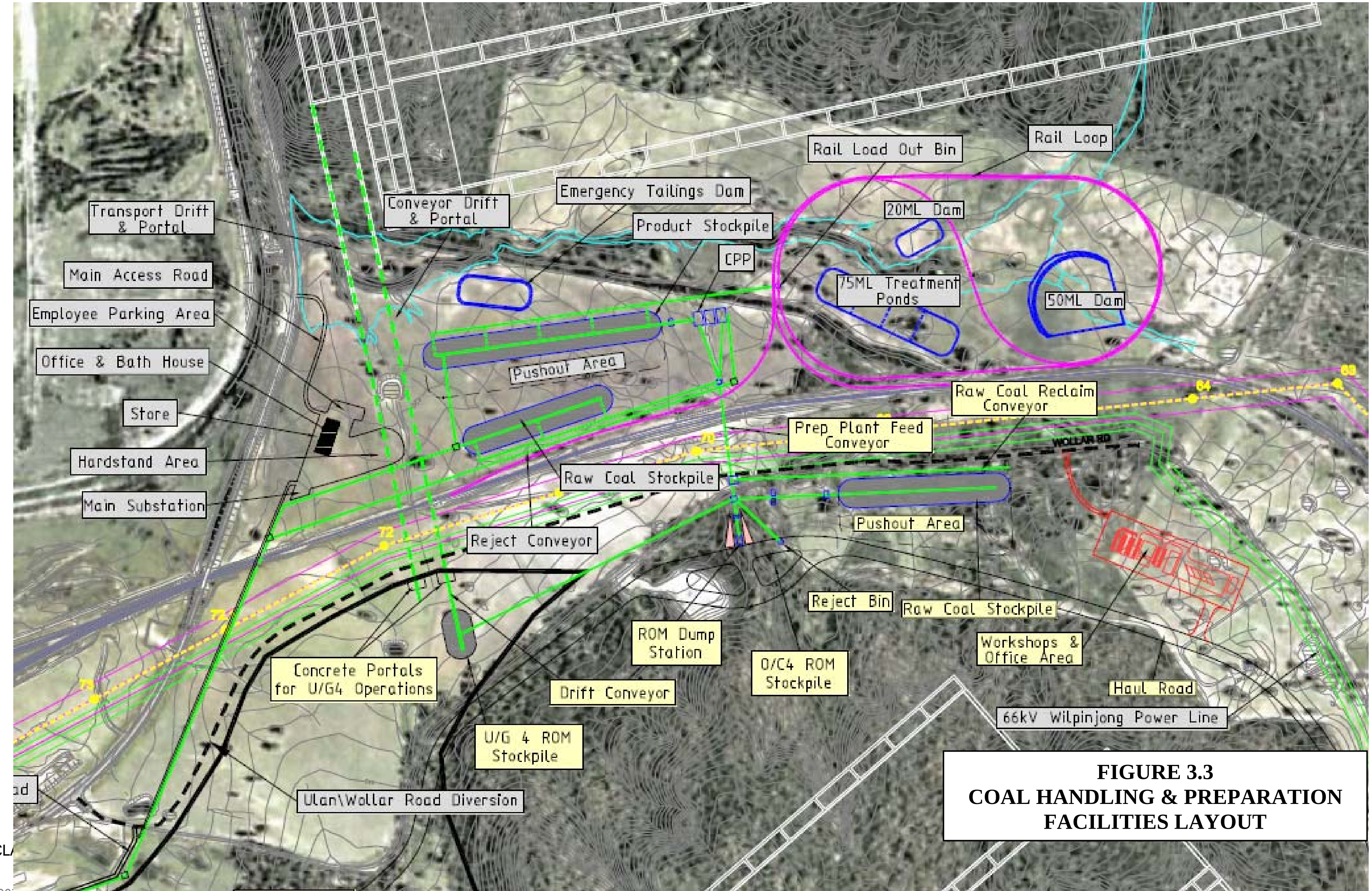

FIGURE 3.3
COAL HANDLING & PREPARATION FACILITIES LAYOUT

3.5.2 Pit Top and Infrastructure/Services Overview

The approved Stage 1 surface facilities will require an increase in the approved processing limit to create infrastructure that services the whole MCP (Stages 1 and 2). The MCP surface facilities will have the capacity to handle approximately 17Mtpa ROM coal and produce approximately 13Mtpa product coal for transport by rail

Power will be supplied at 66kV from the existing Country Energy Ulan Switchyard. The 66kV power line will be run adjacent to the road and rail corridor to the coal handling facilities where a 66/11kV substation will be constructed.

A water supply system including storage dams and tanks will be installed. Water will be sourced for mining operations according to an approved water management strategy.

3.6 Detailed Mining Operations – Surface Mining

In order to ensure all potential hazards with offsite impact have been identified, it is important to fully understand the operations at the proposed MCP. The description below details the open cut mine operations. The hazard analysis was based on this description of operations. **Table 3.1** lists the basic operations in open cut mining.

TABLE 3.1
LIST OF OPERATIONS AT THE PROPOSED MOOLARBEN COAL PROJECT SURFACE MINE

Operation	Operation
1. Surveying	2. Topsoil Stripping
3.Drill Pad Preparation	4. Drilling
5. Blasting	6. Excavator and truck operations
7. Coal Ripping	8. Coal Mining (excavators/trucks)
9. Coal Haulage	10. CHPP
11. Backfill (Spoil)	12. Grading
13. Re-topsoil	14. Re-vegetation

Each operation in **Table 3.1** is explained briefly in the section below. **Figure 3.4** may be used to assist in understanding some of the terminology used in the description.

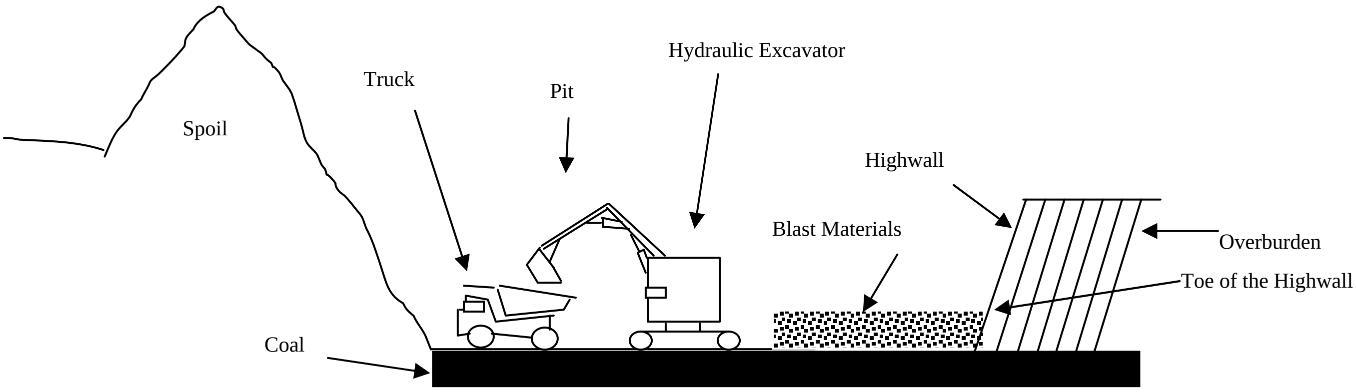

FIGURE 3.4
SECTION OF AN OPEN CUT MINE OPERATION

3.6.1 Surveying

Mine surveyors are used to establish levels on site and to ensure the operations are conducted at the correct locations. Surveyors access all parts of the surface operations using "light" vehicles (e.g. four wheel drive, utilities, etc.). Surveyors access high hazard areas such as the top and toe of the high wall and interact regularly with heavy vehicle traffic around the mine.

3.6.2 Topsoil Stripping

Once the appropriate area for mining has been established, the topsoil is removed using scrapers, a large articulated vehicle that moves relatively fast over the surface of the ground collecting the top layers. The topsoil is then stockpiled for later use in regeneration of mined areas. The topsoil removal area is accessed by a number of "light" vehicles, including surveyors and supervisors.

3.6.3 Drill Pad Preparation

Once the topsoil removal is complete, preparation for drilling is performed. This involves the clearing of areas using a bull dozer (dozer). Areas are levelled by the dozer to permit the drill machine to access for drilling. In some cases, drill pad preparation is performed adjacent to an area that has already been blasted. In this case there is a potential for the dozer to stray into the area that has been blasted and contact holes that have misfired. However, to limit this potential, a berm is placed between the blast and non-blast areas.

3.6.4 Drilling

Once the drill pad has been prepared, the drilling machine is used to drill holes at set depths and patterns. The drill machine is a vehicle that is powered by a diesel engine and hydraulic systems. The diesel engine drives hydraulic pumps, which are used to operate the two drills and drive the tracks on the drill. The drill operates up and down the drill pad until the drill hole pattern has been established.

3.6.5 Blasting

The blasting is performed using a mix of ammonium nitrate and fuel oil (ANFO). The ammonium nitrate and fuel oil used in the blasting operation is not stored on site. The ammonium nitrate and fuel oil will be brought to site by a contract mix truck which will bring the products to site unmixed ready for charging to the holes.

Prior to charging the holes with ANFO, it is necessary to prime the holes with detonators and primer. These are stored in a portable magazine and are collected by the blast personnel on a daily basis. Detonators and primer for a single day operation only is taken to the blast site. In the event of left over materials, these are taken back to the magazine at the end of the day. Detonators and primer are not stored at the blast area. The detonators and primer are first prepared on the surface, next to the blast hole, and then lowered into the hole. The blast charge (ANFO) is then loaded.

The mix truck takes the ammonium nitrate and fuel oil (stored in separate tanks on the truck) to the blast area in readiness for charging the holes. The truck drives alongside each hole and a truck mounted mix pump prepares the ANFO mix and charges the hole. The hole is then stemmed, which involves filling the hole with a material to prevent the blast from directly ejecting from the hole rather than breaking up the surrounding rock.

Once all holes have been charged and stemmed, the primer chords are tied-in and the main chord laid out. A blast zone is established and all personnel moved out of the zone to ensure blast waves and fly rock does not impact people close to the blast area. Once safety checks have been completed the blast is initiated and the ANFO exploded.

A safety check is then performed to ensure all holes have initiated and that no misfires have occurred. Once this has been completed the area is declared safe for access.

3.6.6 Truck and Hydraulic Excavator Operations

Once the overburden has been loosened by blasting, a large hydraulic excavator will extract the loosened material and load it to trucks. **Figure 3.5** illustrates the truck-hydraulic excavator operation. The loaded trucks will transport the material to the laydown area where the overburden will be stored until re-use in the reclamation stage.

Operations at the hydraulic excavator may require a dozer to push the coal towards the excavator bucket. This introduces inherent hazards of collision between the end dump trucks, excavator and dozer.

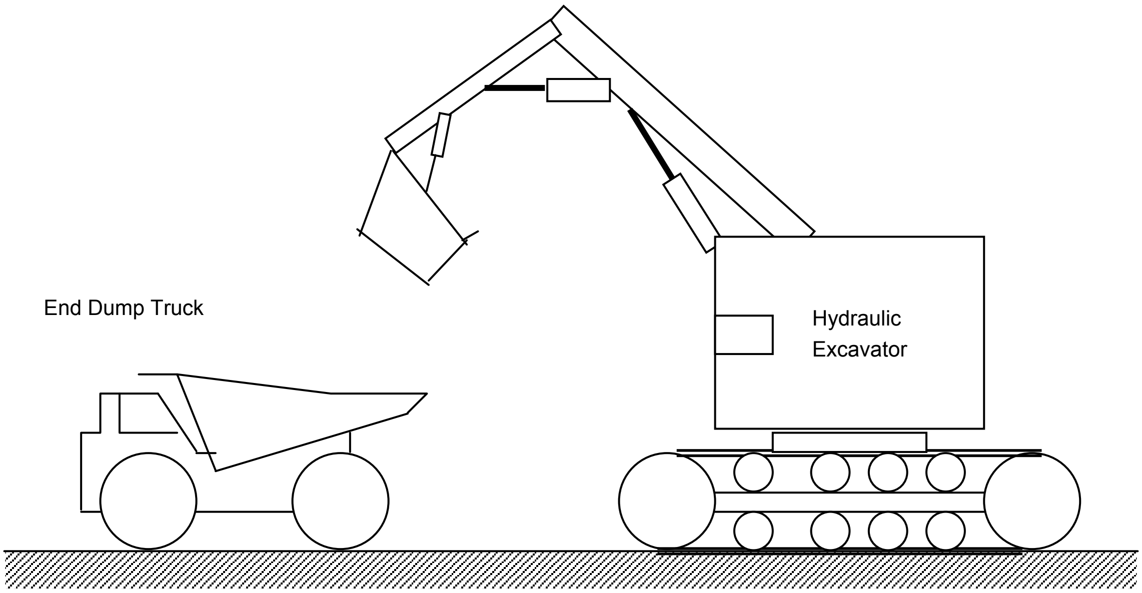

FIGURE 3.5
HYDRAULIC EXCAVATOR AND END DUMP TRUCK SCHEMATIC

3.6.7 Coal Ripping

Once the overburden has been removed (i.e. the material covering the coal), coal is ripped using a dozer. This is performed to loosen the coal in preparation for coal mining using the hydraulic excavator. Coal may also be blasted in a similar method to that described above.

3.6.8 Coal Mining

The coal that has been ripped or blasted is then removed using the hydraulic excavator-end dump truck operation. A large dozer is used to assist the excavator and clean up around the coal loading area and under the excavator itself. The dozer is also used to trim the pit in the toe area, maintaining a stable highwall.

Problems may occur when the dozer and excavator interact, resulting in collisions between these two pieces of machinery. In some cases, dozers working close to the high wall edge or toe may fall from the wall or be struck by falling rocks or covered by a slippage from the highwall.

Loaded trucks transport the coal to the Stage 2 ROM Station, north east of the Open Cut 1. The coal is then crushed and sized before being conveyed to the CCP for processing.

3.7 Underground Mining

Underground mining is performed in two distinct modes; continuous mining and longwall mining. Continuous mining is usually performed as part of the preparation for longwall mining and is used to drive roadways throughout the mine. Longwall mining is performed as the main mining method. These processes are described briefly below.

3.7.1 Continuous Mining

Figure 3.6 shows a diagrammatic representation of a continuous mining operation. In continuous mining, a single machine called a “Continuous Miner” (CM) mechanically cuts coal using a rotating drum fitted with dozens of cutting picks. The continuous miner also has means of gathering cut coal and loading it onto a shuttle car. The CMs at the MCP Stage 2 will be remotely operated so that as the miner cuts under unsupported roof, personnel will not be required to move in the area where the roof is not supported. As shuttle cars fill, they are removed and the coal is transferred to a conveyor system for transport to the surface.

Once the CM cut is completed, the miner is removed from the cut area (normally about 6m) and a machine called a roof bolter is used to secure the roof prior to entry into the area by personnel. The roof bolter is fitted with its own roof support mechanism providing safe access to unsupported roof areas during the roof bolting process. Using this method of mining, no mining personnel need work under unsupported roof.

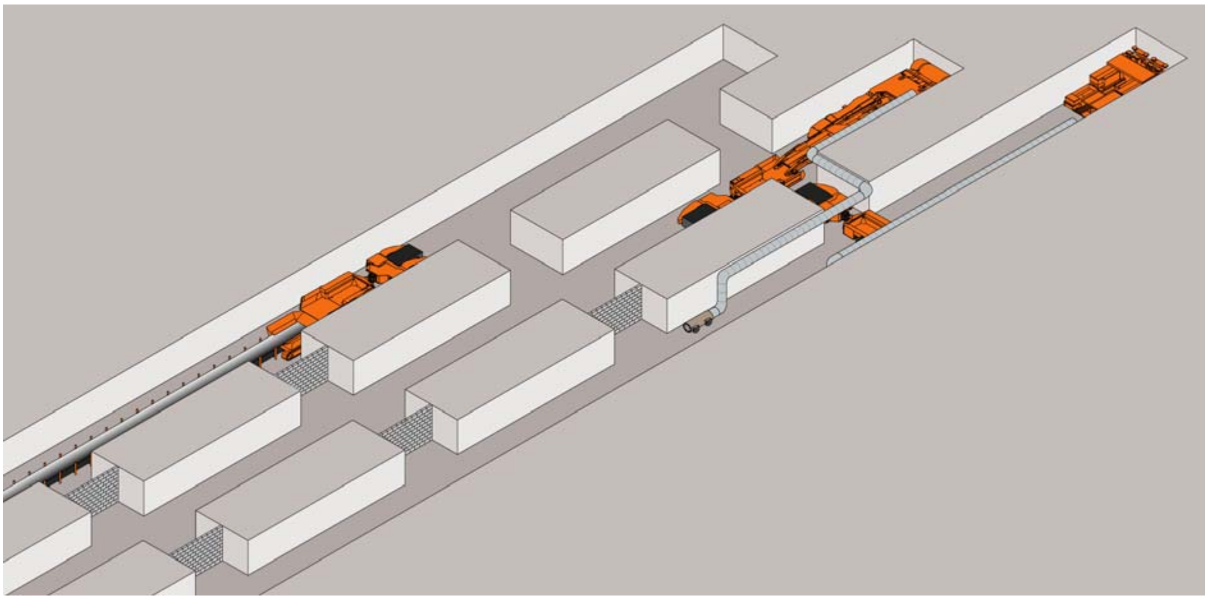

FIGURE 3.6
SCHEMATIC DIAGRAM OF A CONTINUOUS MINING OPERATION

3.7.2 Longwall Mining

Longwall mining is performed in a nearly continuous operation using specialised, integrated mining and roof support equipment (**Figure 3.7**). Using standard continuous mining techniques, blocks of unmined coal, called longwall panels, are prepared. At the MCP Stage 2, these panels will be up to 300m across.

Each longwall panel is mined in linear slices at full seam height (or selected height as required) by a mechanical cutting machine or shearer drawn back and forth across the short face. Cut coal falls onto a chain conveyor that extends the full length of the face. The cut coal is transported to one end of the face where it is transferred to a belt conveyor for transport to the surface. Large, self advancing hydraulic jack units, called chocks, support the roof immediately adjacent to the face. As the cut advances, the roof support line also advances, maintaining roof support over the whole face. The roof behind the advancing chocks is permitted to cave.

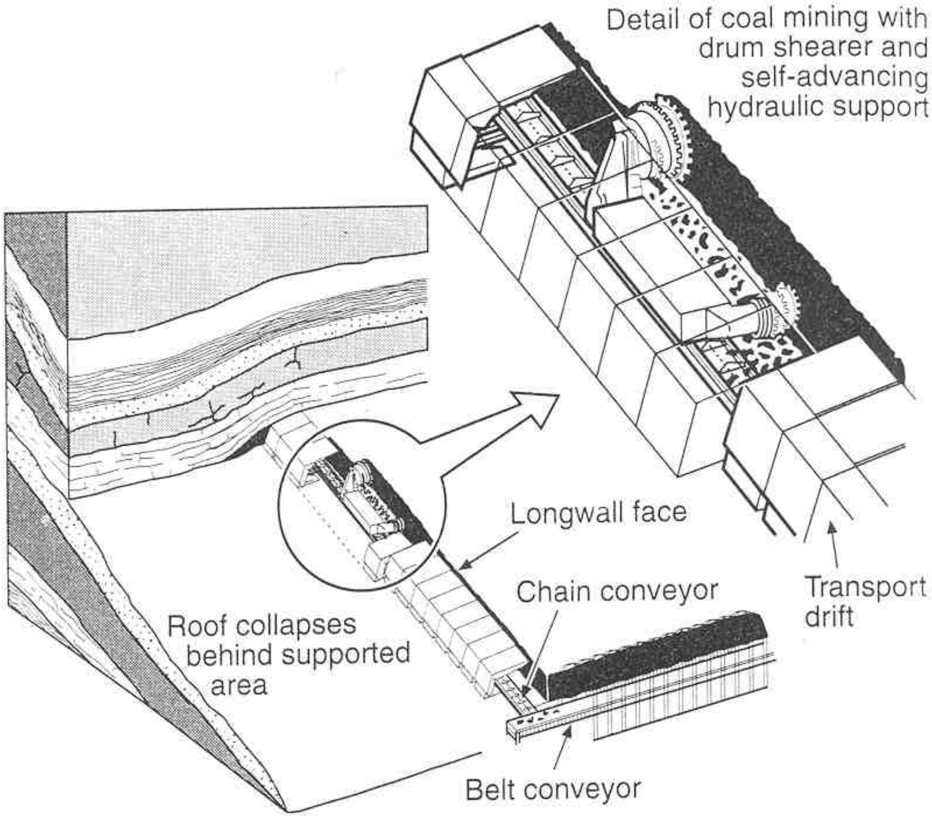

FIGURE 3.7
SCHEMATIC DIAGRAM OF LONGWALL MINING

3.7.3 Ventilation

Throughout all mining operations, ventilation is provided by surface mounted ventilation fans. A mine ventilation plan is established for all development work and longwall operations. The ventilation plan provides fresh air in areas where personnel are working and extracts exhaust air through mainly uninhabited areas.

3.8 MCP Staffing

The Approved Stage 1 of the MCP will employ approximately 200 personnel during construction and up to 317 staff for 14-15 years at peak production across the open cut mines, underground mine and the coal handling and preparation facilities.

The construction of Stage 2 will also require up to approximately 200 personnel during construction. Depending on timing, these construction personnel will be made up largely from the existing construction activities as part of Stage 1.

Stage 2 will employ an additional 122 staff and extend the mining life and employment of the MCP to 27-28 years. The MCP will therefore at peak production employ up to 439 staff.

The additional 122 staff will constitute additional open cut mining fleet, with shift times occurring outside of peak times associated with school bus routes where feasible.

4. HAZARD ANALYSIS

4.1 Hazard Identification and Screening

Hazards associated with the operation of the proposed mine were identified in discussion with MCP representatives to identify scenarios that may lead to offsite impacts as a result of the storage and handling of dangerous goods at the site and operations involving the use of dangerous goods. The following operations were reviewed:

Open-Cut Mining

- Surveying;
- Topsoil Stripping;
- Drill Pad Preparation;
- Drilling;
- Blasting (overburden); and
- Truck and Shovel Operations (overburden and coal).

Underground Mining

- Continuous Mining; and
- Longwall Mining.

Pit Top Facilities

- Mined Coal Stockpiles;
- Conveyor Systems for Coal Crushers;
- Surge Bin;
- CPP;
- Product Coal Pile;
- Offices, Stores and Workshops; and
- Hazardous/Dangerous Goods Storage, handling and use (e.g. explosives & fuel).

A hazard identification table was developed for the proposed MCP, this table is presented at **Appendix A**. As a result of the hazard analysis study, a number of incidents were identified with the potential to impact offsite, these are:

Open-Cut Mining

- Topsoil Stripping Scraper Operations - Hydraulic oil or fuel spill under the scraper, ignition of fuel resulting in fire;
- Drill Pad Preparation, Overburden & Coal Mining, Truck, Shovel & Dozer Operations - Hydraulic oil or fuel spill under the scraper, ignition of fuel resulting in fire;

- Mix truck accident leading to rollover, fuel spill, ignition and pool fire.
- Detonators, primer and charge cord initiated in shotfirers vehicle resulting in localised explosion;
- ANFO mixing in the pump and pipework on the mix truck initiates and leads to an explosion; and
- Blast pattern explosion leading to flyrock.

Pit Top Facilities

- Surge Bin – Dust explosion;
- Hazardous/Dangerous Goods Storage and Handling
  - Diesel fuel storage fire;
  - Ammonium Nitrate storage explosion;
  - Magazine explosion

Each incident has been reviewed in detail in **Section 4.2**.

4.2 Details of Hazardous and Dangerous Goods Stored, Handled and Used at the Proposed Mine

4.2.1 Diesel Fuel Storage

Diesel fuel is listed in the NSW Occupational Health and Safety (Dangerous Goods Amendment) Regulation-2005(DG Regs. - Ref.4) as a Class C1 Dangerous Good. Diesel fuel will be stored at both the open cut mines and the underground mine.

Open Cut Mines - Diesel will be stored in three 110,000 litre tanks located in a bunded area adjacent to the site services area (worhsops & amenities). The storage will be designed and operated in accordance with the NSW Occupational Health and Safety (Dangerous Goods Amendment) Regulation 2005 (Ref.4) and AS1940-2004 (Ref.5).

Underground Mine – Diesel is stored in one 55,000 litre tank located in a bunded area in the pit top facilities located adjacent to the UG1 and UG2 entry. Like the open cut storage, the diesel storage at the underground pit top facilities will be designed and operated in accordance with the NSW Occupational Health and Safety (Dangerous Goods Amendment) Regulation 2005 (Ref.4) and AS1940-2004 (Ref.5). This storage is currently approved as part of Stage 1 development, and is not subject to assessment in this study but has been included to identify the location of the supply of fuel for underground facilities.

Diesel fuel will be delivered to the tanks by a diesel road tanker. Fuel will be transferred by a truck mounted pump. Vehicles will be fuelled from a fuelling point using a fuel bowser arrangement. All fuel delivery and filling points will be bunded.

Figures 4.1 shows the location of the main diesel storage facility adjacent to the site services area.

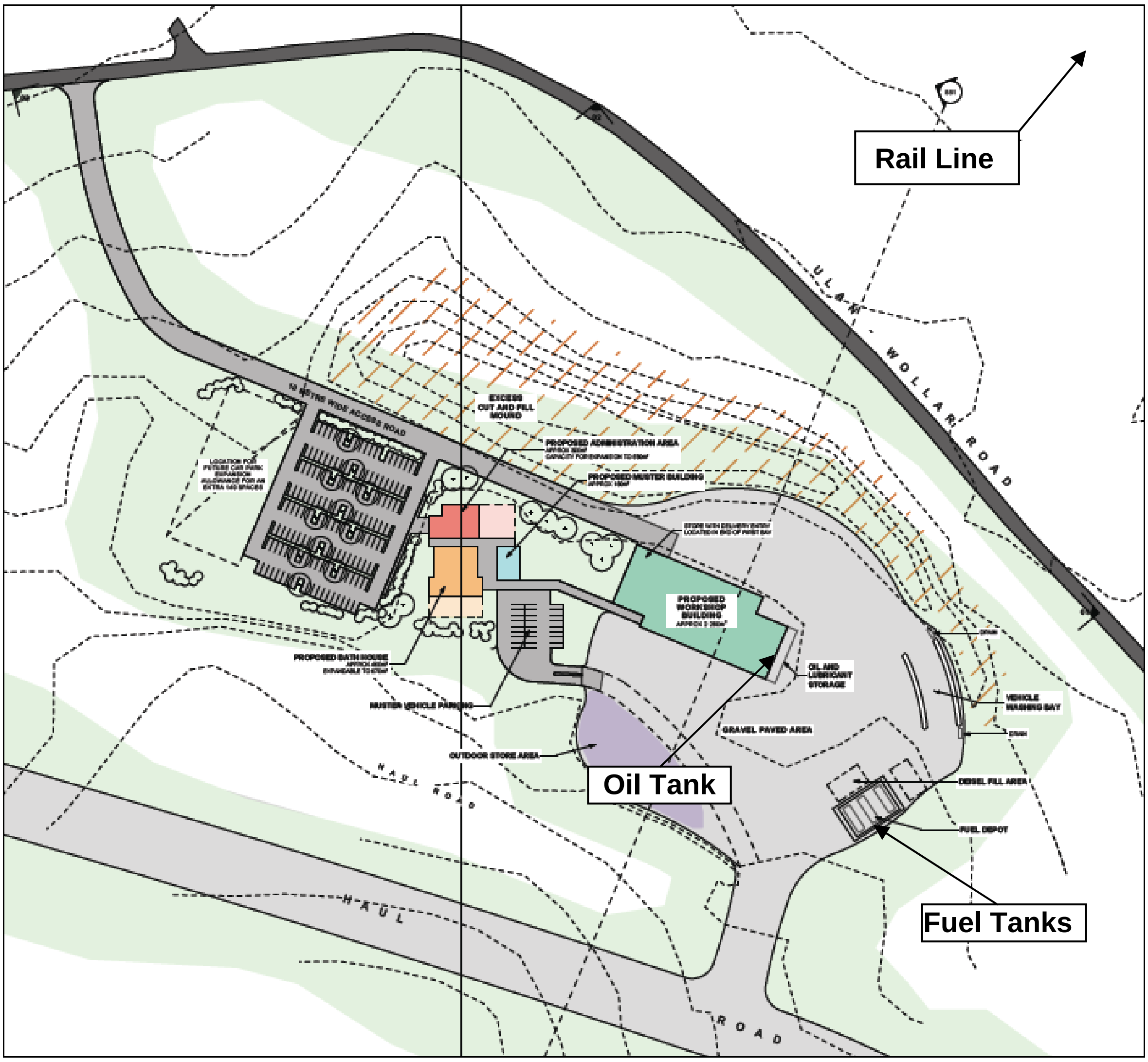

FIGURE 4.1
LOCATION AND LAYOUT OF THE MINE SERVICES AREA

4.2.2 Explosives Storage

Explosives are Class 1 Dangerous Goods and will be stored in a semi portable magazine that will be located close to the blast area. The magazine will store a mixture of explosives including detonators, boosters and high explosives. The following quantities will be stored:

- Detonators – 200kg
- Boosters – 2300kg
- High Explosives - 14,000kg

The total quantity stored will be 16,500kg.

The magazine will be designed and operated in accordance with the regulatory requirements (NSW DG Regs and NSW Mineral Resources Regs).

The magazine will be located inside the open cut areas and a minimum of 500m from the site boundary.

4.3 Detailed Hazard Analysis

4.3.1 Scraper Fuel/Hydraulic Line Failure - Pool Fire

In the event of failure of a hydraulic line or fuel line in a scraper, there is a potential for fuel/oil to leak under the vehicle causing a pool. Fuel/oil may also spray near the engine exhaust and ignite leading to a spray/pool fire under the vehicle. This would result in heat radiation impact to the area surrounding the vehicle.

Scrapers operating in the majority of the open cut areas would get no closer than 40-50m from the site boundary. Along the north eastern edge of the open cut area, the scrapers would operate adjacent to the boundary. For the majority of areas where the scrapers operate, in the open cut pits, the operational area would be far enough away from the site boundary so that heat radiation would not impact off site. Where the scrapers operate adjacent to the site boundary on the northern eastern side of the open cut, the 6m site bund would prevent any offsite heat radiation to areas to the north of the site. Hence this incident has not been carried forward for consequence analysis.

4.3.2 Dozer/Truck/Shovel Fuel/Hydraulic Line Failure - Pool Fire

This incident would be similar to **Section 4.3.1** above. Where dozers/Trucks/shovels operate towards the centre of the pit or deep in the pit, in the latter stages of open-cut mining, heat radiation would not impact off-site. However, in the early stages of operations where the equipment may be located towards the edge of the pit and where the pit is not deep, there is a potential for heat to radiate off-site. The majority of areas in the open cut workings are over 40-50m from the boundary. However, the north eastern area of the open cut is located adjacent to the boundary that runs parallel to Wollar Road. The 6m earthen bund, located parallel to the site boundary, will provide protection for areas to the north east of the site. Hence, there is sufficient distance between the majority of postulated incident and the boundary such that heat radiation will not impact offsite. Where the open cut workings are close to the boundary, the 6m bund will provide protection such that the radiation will not impact offsite. This incident has not been carried forward for consequence analysis.

4.3.3 Mix Truck Accident – Roll Over and Fire

The mix truck is used to carry ammonium nitrate and diesel fuel to the drill pad (blast area) for ANFO mixing and charging of holes. In the event of an accident involving collision or roll over there is a potential to pierce the diesel fuel tank on the truck leading to a pool of diesel fuel around the truck. Ignition of the fuel (e.g. from hot exhaust or collision) would result in a pool fire radiating heat into the surrounding area.

Incidents of this type occurring in the open-cut pit would not result in impact off-site due to the heat radiation containment by the pit walls. In the early stages of open-cut mining there is a potential for mix trucks to operate nearer site boundaries, particularly in the north eastern corner of the open cut workings. However, the closest infrastructure in this area is the Wollar Road and the rail line to the north east, which is about 40-50m from the pit edge. This the closest operational area for mix trucks (excluding site entrance).

A collision involving a mix truck and another vehicle, resulting in diesel tank damage, would also result in Ammonium Nitrate tank damage and spill. This material would burn along with the diesel, however, as it is not tightly confined (e.g. in a blast hole), there is no potential for explosion, and fire would be the main result.

Hence, as the mix truck travels close to the site boundary, on the north eastern side of the open cut (about 40-50m) and as the mix truck fire incidents are larger than the smaller fuel tank fires on the earthmoving equipment, these incidents have the potential to impact the road and rail line area to the north east. Therefore the mix truck fuel fires have been carried forward for consequence analysis to determine the potential for heat radiation impact at off-site infrastructure.

4.3.4 Detonators/Explosives Initiate in Shotfirers Vehicle

During the blast program, the shotfirer collects detonators, primer and charge cord from the explosives magazine on a daily basis. The ‘explosives’ are taken to the blast pad and the holes primed ready for the ANFO charge. In the event of an accident involving a shotfirers vehicle, there is a potential for detonators and charge cord to be initiated resulting in explosion. Vehicle accidents may occur as a result of collision or rollover, other initiating events may result from human error.

Incidents of this type occurring in the open-cut pit would not result in impact off-site due to the blast containment by the pit walls. However, in the early stages of open-cut mining there is a potential for shotfirers to operate nearer site boundaries (adjacent to the boundary on the north east of the open cut, but about 40 to 50m from the closest infrastructure, being Wollar Road and the railway line to the north east) and at further distances for other open cut areas.

As there is a potential for impact to Wollar Road and the rail line to the north, this incident has been carried forward for consequence analysis to determine the potential for overpressure impact offsite.

4.3.5 ANFO Mixing and Premature Explosion

Diesel fuel and ammonium nitrate is mixed using a truck mounted pump. The ANFO is charged to the blast hole using pipework from the pump to the top of the hole. In the event of a pump failure (e.g. shaft, bearings, impeller, etc.) there is a potential for heat to be generated and the ANFO to be initiated, resulting in explosion on the mix truck.

Incidents of this type occurring in the open-cut pit would not result in impact off-site due to the blast containment by the pit walls. However, in the early stages of open-cut mining there is a potential for mix trucks to operate nearer site boundaries (within 40m-50m at the north eastern end of the pit.

This incident has been carried forward for consequence analysis to determine the potential for blast overpressure to project off-site.

4.3.6 Coal Surge Bin – Dust Explosion

The coal surge bin will be used as an intermediate storage facility to provide a steady feed to the CHPP. Bin level fluctuates constantly as the conveyor from the stockpiles and the feed conveyor to the CHPP deliver and withdraw coal as required. At this stage of the plant design, the proposed bin dimensions are; 15m diameter and 12m high. The bin is located on support stanchions, which raises the bin base to a height of 5m from the ground.

Coal is delivered to the bin by the feed conveyor from the stockpile area to the top of the bin. Coal falls freely into the bin, an action which has the capacity to generate dust. Coal dust is explosive, however, an ignition source is required to initiate an explosion of the dust in the bin. There are no electrical instruments located in the bin or other ignition sources which may initiate an explosion.

As the bin is relatively open at the top, in the unlikely event of an explosion, the vented gases would exhaust through the top of the bin, being projected vertically, rather than horizontally. The potential blast wave would therefore not be projected towards the site boundary.

As there is no potential for impact offsite, this incident has not been carried forward for consequence analysis.

4.3.7 Diesel Fuel Storage Fire

Diesel fuel is stored on site for fuelling trucks, vehicles and heavy earthmoving equipment. The fuel is stored in three tanks in a bunded area adjacent to the site services areas (i.e. workshop, car park and offices). In the event of a tank leak and fuel ignition (e.g. from hot work or maintenance), a bund fire would occur, radiating heat into the surrounding area.

Diesel fuel is delivered to site by road tanker and transferred to the tanks using a truck mounted pump. The diesel delivery tanker will park in a bunded area that will drain back to the main storage tank bund. Any leaks from tanker incidents (e.g. delivery hose failure) will drain back to the storage bund area. In the event of ignition of the leak, a bund fire would result. This would lead to the same incident as detailed for the full bund fire above.

This incident has been carried forward for consequence analysis to determine whether the tank location is sufficient distance from the site boundary to ensure heat radiation does not impact off-site.

4.3.8 Lubricating Oil Storage

Oil is stored on site for the replenishment of lubricant in gearboxes, tuck engines and other machinery. The oil is stored in a tank in dedicated, bunded, storage compound and, in the event of a tank leak, the oil would pool in the base of the bund, however, there would be no offsite discharge as the bunded compound would retain any spill or releases.

In the event of an ignition of spilled oil a pool fire would result in the base of the bund, radiating heat to the surrounding area. The oil storage would be located adjacent to the main mine workshop, on the north eastern part of the site and south west of Wollar Road. Heat radiation from this fire may impact the boundary of the site to the north east, hence, this incident has been carried forward for further analysis.

4.3.9 Explosion in Explosives Magazine

Magazine Location - Open Cut Areas

The explosives magazine will be designed in accordance with the appropriate codes, standards and regulations. The magazine will be a semi-portable unit that will be located a minimum of 500m from the site boundary.

During the blast program, the shotfirer collects detonators, primer and charge cord from the explosives magazine on a daily basis. During access to the magazine there is a potential for the shotfirer to accidentally initiate explosives in the magazine, albeit extremely unlikely. Whilst the magazine will be located over 500m from the closest site boundary, a major explosion in the magazine would generate an overpressure wave that may project off-site.

This incident has been carried forward for consequence analysis.

4.4 Underground Mining Hazards

Hazards that may occur underground include fire, explosions, roof collapse, toxic gas release (H_2S), etc. However, all incidents that may occur underground are confined to the underground section of the mine itself. There are no impacts from underground incidents that occur at the surface and particularly offsite. Whilst incidents that may occur underground can have significant impact on personnel within the mine, there are no impacts at the surface, hence, as the scope of the PHA is to determine offsite impacts, and there are none as a result of underground operations, no underground incidents have been carried forward for further analysis.

4.5 Summary of Hazardous Incidents Carried Forward for Consequence Analysis

The following incidents have been carried forward for consequence analysis:

- Mix Truck roll over, fuel leak and fire;
- Explosion on the shotfirers vehicle;
- Premature explosion of the ANFO mix on the mix truck;
- Diesel fuel storage fire;
- Lubricating oil storage fire; and
- Magazine explosion.

5. CONSEQUENCE ANALYSIS

A detailed consequence analysis was conducted for each of the hazardous incidents carried forward from the hazard analysis, **Section 4**. The detailed analysis is conducted in **Appendix B**. Summary consequence analysis results for each of the incidents is presented in this section.

5.1 Mix Truck Roll Over, Fuel Leak and Fire

In the event of mix truck accident, roll over, fuel leak and fire, there is a potential for the heat radiation from the fire to impact areas of site. Mix trucks will drive on roads that approach site boundaries, particularly the Wollar Road on the north eastern side of the open cut pits. In this area the mix truck will be within 40-50m of the roads, hence, a fire may impact these areas. A detailed fire impact analysis has been conducted in **Section B1** (**Appendix B**), the results of this analysis indicated that the heat radiation impact at the site boundary, 40m from where an incident may occur, was $2kW/m^2$.

Hazardous Industry Planning Advisory Paper No.4, "Risk Criteria for Land Use Safety Planning" (Ref.2) indicates that heat radiation impact in excess of $4.7kW/m^2$ at the site boundary should be reviewed and assessed for risk. Values below this level of heat radiation are considered to be of negligible risk. Hence, the heat radiation impact at the boundary is below the recommended criterion and, therefore, this incident has not been carried forward for further analysis.

5.2 Explosion on the Shotfirers Vehicle

The shotfirer will collect detonators, etc., from the site magazine and transport them to the blast area. In the event of an ignition of detonators in the shotfirers truck, there is a potential for an explosion and blast wave that could result in explosion overpressure at the site boundary. A detailed explosion analysis has been conducted in **Section B2** (**Appendix B**).

HIPAP No.4 (Ref.2) indicates that explosion overpressure exceeding 7kPa at the site boundary requires further analysis for risk impact offsite. The detailed analysis conducted in **Appendix B** indicates that the distance to 7kPa, from an explosion in the shotfirers truck, would be 44m. A review of the site layout indicates that the shotfirers truck would get close to the north eastern boundary, particularly Wollar Road on the north eastern side of the open cut areas. In these areas the shotfirers vehicle will be within 40-50m of the roads, hence, an explosion in the shotfirers truck may impact these areas. Whilst it is recognised that the site 6m bund is located at these boundaries, the impact reduction as a result of this structure has not been included in the analysis for the sake of conservatism. Hence, the overpressure at the site boundary, as a result of an explosion in the shot firers truck, would be in the order of 7kPa (i.e. at 45m). Whilst this is close to the published criterion, it is noted that the analysis was conducted using TNT as a base explosive and no account of explosive impact reduction as a result of the 6m bund was taken into consideration. TNT would have a higher energy load than detonators and other initiating explosives and the 6m bund would reduce the impact consequence. Hence, the analysis is conservative and the explosion overpressure at the site boundary as a result of mix truck explosions would be less than 7kPa. Hence, this incident has not been carried forward for further analysis.

5.3 Premature Explosion of the ANFO Mix on the Mix Truck

In the event of a premature ignition of ANFO in the mixing area of the mix truck there is a potential for an explosion which could result in explosion overpressure at the site boundary. A detailed explosion analysis has been conducted in **Section B3** (**Appendix B**).

HIPAP No.4 (Ref.2) indicates that explosion overpressure exceeding 7kPa at the site boundary requires further analysis for risk impact offsite. The detailed analysis conducted in **Appendix B** indicates that the distance to 7kPa, from an explosion in the mix truck, would be 34m. A review of the site layout indicates that the mix truck would get close to the north eastern boundary, particularly Wollar Road on the north eastern side of the open cut areas. In these areas the mix truck will be within 40-50m of the roads, hence, an explosion in the mix truck would not impact these areas above the published criteria, therefore, this incident has not been carried forward for risk analysis.

5.4 Diesel Fuel Storage Fire

In the event of a fuel leak, ignition and fire in the diesel storage area, the worst case incident would be a full fire in the diesel tank bund. This incident could result in the potential for the heat radiation from the fire to impact areas offsite. The closest site boundary to a diesel fuel storage is about 140m to the north east (Wollar Road). A detailed fire impact analysis has been conducted in **Section B4** (**Appendix B**), the results of this analysis indicated that the heat radiation impact at the site boundary, 140m from where an incident may occur, was 0.26kW/m^2.

Hazardous Industry Planning Advisory Paper No.4, “Risk Criteria for Land Use Safety Planning” (Ref.2) indicates that heat radiation impact in excess of 4.7kW/m^2 should be reviewed and assessed for risk. Values below this level of heat radiation are considered to be of negligible risk. Hence, the heat radiation impact at the boundary is below the recommended criterion and, therefore, this incident has not been carried forward for further analysis.

5.5 Lubricating Oil Storage Fire

Like the diesel fuel storage fire detailed above, the worst case incident at the lubricating oil storage area is a full bund fire. This incident could result in the potential for heat radiation impact beyond the site boundary, however, the closest site boundary to an oil storage is the boundary closest to the storage adjacent to the workshop area. This boundary o sabot 140m from the oil storage area. A detailed heat radiation impact analysis was conducted for this incident (**Section B4**, **Appendix B**), which indicated the heat radiation at the site boundary was 0.11kW/m^2.

Hazardous Industry Planning Advisory Paper No.4, "Risk Criteria for Land Use Safety Planning" (Ref.2) indicates that heat radiation impact in excess of 4.7kW/m^2 should be reviewed and assessed for risk. Values below this level of heat radiation are considered to be of negligible risk. Hence, the heat radiation impact at the boundary is below the recommended criterion and, therefore, this incident has not been carried forward for further analysis.

5.6 Magazine Explosion

Magazine Explosion - Open Cut Areas

The magazine will be located inside the open cut areas at the mine. The magazine will be located at least 500m from the site boundary. A detailed explosion analysis was conducted for this incident in **Section B6** (**Appendix B**).

HIPAP No.4 (Ref.2) indicates that explosion overpressure exceeding 7kPa requires further analysis for risk impact offsite. The detailed analysis conducted in **Appendix B** indicates that the distance to 7kPa, from an explosion in the explosive magazine, would be 380m. A review of the site operations indicates that the explosives magazine(s) would be no closer than 500m from the closest site boundary. Hence, the overpressure at the site boundary, as a result of an explosion in the explosives magazine, would not exceed 7kPa. Hence, this incident has not be carried forward for further analysis.

5.7 Summary of Consequence Analysis Results

The detailed consequence analysis conducted in **Appendix B**, and summarised in **Sections 5.1** to **5.6**, demonstrates that in the event hazardous incidents occur at the MCP Stage 2, there will be no offsite impact that exceeds the risk criteria published by the NSW Department of Planning.

Hence, there should be no restriction for approval of the mine in relation to offsite hazards and risks.

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APPENDIX A

HAZARD IDENTIFICATION TABLE

HAZARD IDENTIFICATION – MOOLARBEN COAL MINE			
Incident	**Cause**	**Consequence**	**Safeguards (Prevention, Protection, Detection)**
1. Surveying – No identified hazards with offsite impact, surveyors operate in vehicles around the mine and may be involved in minor vehicle accidents or may fall from high walls or benches. OH&S issues only.			
2. Topsoil Stripping			
2.1 Scraper collides with other vehicles in topsoil strip area or scraper driver loses control & rolls scraper	- Driver (human) error - Equipment failure - Unauthorised vehicles access topsoil removal area	- Vehicle damage - Lost Time Injury	- Compulsory for seat belts to be worn in all earthworks vehicles - Drivers have clear view from vehicle cab - Restriction on vehicle access to topsoil striping area - Vehicles in constant radio contact (vehicle to vehicle and vehicle to control centre) **Mainly onsite impact, may impact area to north east of open cuts. Incident carried forward for detailed hazard analysis**
2.2 Hydraulic line failure or fuel line leak on scraper leading to spray of oil/fuel onto engine exhaust, ignition and fire	Equipment failure (hydraulic hose or fuel line)	Fuel/oil pool under vehicle leading to pool fire Heat radiation into the area immediately surrounding the vehicle fire	- Vehicle inspection at the beginning of each shift/operation - Regular vehicle maintenance (including hose change out schedule) - Localised fire only, no major heat radiation impacts beyond the vehicle incident **Potential for vehicle to get close to the site boundary (roads to north east of pits). Fire impacts may reach beyond the site boundary, hence, incident has been carried forward for detailed hazard analysis**

HAZARD IDENTIFICATION – MOOLARBEN COAL MINE			
Incident	**Cause**	**Consequence**	**Safeguards (Prevention, Protection, Detection)**
3. Drill Pad Preparation, Overburden & Coal Mining, Truck/Shovel Operations			
3.1 Hydraulic line failure or fuel line leak on dozer, truck or shovel leading to spray of oil/fuel onto engine exhaust, ignition and fire	Incident impact is the same as 2.2 above **Incident not carried forward for further analysis, results of incidents from 2.2 above will cover this incident**		
4. Blasting			
4.1 Detonators/explosives initiate in the shot firers vehicle	- Vehicle accident - Unstable detonators/explosives - Human error	Localised explosion in the immediate vicinity of the shot firers vehicle	- Dedicated vehicle used for transport of detonators and explosives - Detonators and explosives separated in the shot firers vehicle - Only licensed shot firer permitted to handle explosives **Shotfirers vehicle may access roads close to the site boundary (north east of pits), hence, incident has been carried forward for further analysis**
4.2 Detonator initiates in the hole after hole is primed	- Unstable detonators - Lightning strike	- Minor explosion in the blast hole - Material exhausted from the hole in a vertical direction	- Explosion is relatively small - Explosion is not directed towards the site boundary **No offsite impact. Not carried forward for detailed hazard analysis**

HAZARD IDENTIFICATION – MOOLARBEN COAL MINE			
Incident	**Cause**	**Consequence**	**Safeguards (Prevention, Protection, Detection)**
4.3 Mix truck fire	Mix truck accident leading to roll over, fuel spill and fire	Heat radiation to the surrounding area, potential to project offsite if mix truck is close to site boundary	- Speed limit for vehicles on site (40 kph) - Mixing is conducted in the pit area well clear of the site boundary - Trained and dedicated mix truck drivers **Mix trucks may drive close to site boundaries (north east of pits) and, hence, collision/roll over may occur close to the boundary. This incident has been carried forward for further analysis.**
4.4 ANFO explosion in a hole after loading	ANFO is loaded to a “hot hole” (i.e. a hole that is heated by burning coal in the seam)	- Premature blast and unplanned explosion - Material exhausted from the hole in a vertical direction	Explosion is projected in a vertical direction and hence there is no impact towards the site boundary **Not carried forward for detailed hazard analysis as there is no potential for offsite impact from a single hole blast**
4.5 ANFO detonates in the mix pump and delivery lines during hole loading	Equipment (pump) failure resulting in pump overheating and initiation of ANFO	- Explosion in the pump/lines on the mix truck - Blast wave and fire in the immediate vicinity of the mix truck	- Regular pump maintenance - Only small quantity of ANFO involved in the explosion - Mix truck may operate close to the boundary (roads) north east of pits. This may be within 40-50m from Wollar Road. **Incident is carried forward for further analysis due to the potential for offsite impact (i.e. beyond the site boundary)**

HAZARD IDENTIFICATION – MOOLARBEN COAL MINE			
Incident	**Cause**	**Consequence**	**Safeguards (Prevention, Protection, Detection)**
4.6 Flyrock	Blast pattern is initiated for blasting of overburden or coal	Potential for fly rock to impact offsite areas	- Blast zone is established based on experience with set blast patterns - Where blast is closer to site boundary, traffic control on local roads, rail lines and Ulan Coal Mines Air Strip is maintained (i.e. vehicles/trains prevented from passing through the blast zone during the blast) - Where blast is close to site boundary and adjacent properties, blast zone is established so that buildings on properties are not impacted **Safe controls are sufficient to eliminate risk by preventing people from entering potential flyrock zones. Incident not carried forward for further analysis.**

HAZARD IDENTIFICATION – MOOLARBEN COAL MINE			
Incident	**Cause**	**Consequence**	**Safeguards (Prevention, Protection, Detection)**
5. Pit Top Facilities			
5.1 Fire/explosion in conveyor tunnels under stockpiles	- Hot roller starts conveyor fire - Sparking equipment ignites coal dust in tunnel	Localised heat radiation and blast	- Blast and heat radiation is confined to the tunnel by the tunnel walls and stockpile - Regular conveyor maintenance (i.e. rollers, head/tail end, etc.) - Daily inspections of conveyors - Housekeeping to minimise dust and coal build up on equipment **No potential for impact offsite due to tunnel and stockpile configuration. Not carried forward for detailed hazard analysis**
5.2 Surge bin explosion	Coal dust explosion in the surge bin	Blast wave projects offsite towards the new England highway	- No ignition sources in the bin (i.e. no electrical equipment) - Bin is relatively open at the top (i.e. conveyor head chute enters at large open top) - Coal is damp and does not generate large quantities of dust **Bin design prevents explosive destruction of the bin and, hence, no offsite impact is anticipated. Incident has been carried forward for detailed hazard analysis but no consequence analysis conducted**.

HAZARD IDENTIFICATION – MOOLARBEN COAL MINE			
Incident	**Cause**	**Consequence**	**Safeguards (Prevention, Protection, Detection)**
5.3 Explosion in the CHPP	Coal dust explosion in equipment in the CPP	Blast wave projects offsite towards the New England highway	- Coal preparation is a wet (water washing) process - Dust is not generated in the CPP **No dust explosion potential, not carried forward for detailed hazard analysis.**
5.4 Fire in conveyor systems (i.e. belt fires, head/tail end fires)	- Hot rollers igniting belts; - Oil spills at the head/tail end ignited by hot equipment (i.e. hot bearings)	Localised fire and heat radiation in the vicinity of the incident	- Regular maintenance and inspection (daily) of belts, drums and rollers - Mine Rescue Team on site and familiar with fire fighting operations - Localised fire, no conveyor systems located close to site boundaries near sensitive land uses (i.e. residential, schools, hospitals, etc.) **No potential for impact off-site in sensitive adjacent land uses Not carried forward for detailed hazard analysis**
6. Hazardous and Dangerous Goods Storages			
6.1 Explosion in the explosives magazine	- Unstable detonators/explosives - Detonators/explosives handling errors when collecting/returning materials	Potential for blast wave to project offsite	- Magazine is designed and maintained in accordance with NSW OH&S (Dangerous Goods Amendment) Regulations 2005 and NSW Dept. of Mineral Resources regulations - Magazine is located well clear of site boundaries (minimum 500m) - Magazine design is such that a large quantity of the explosive force would be absorbed in destruction of the magazine **Incident carried forward for detailed hazard analysis**

HAZARD IDENTIFICATION – MOOLARBEN COAL MINE			
Incident	**Cause**	**Consequence**	**Safeguards (Prevention, Protection, Detection)**
6.2 Bund fire at the diesel storage tanks (trucks and ANFO)	- Tank leak and ignition of diesel fuel - Maintenance on tanks (e.g. welding, cutting, grinding, etc.)	Potential for heat radiation offsite	- Diesel storage is bunded in accordance with the NSW Dangerous Goods Regulations and AS1940-2004 - Regular inspections and maintenance of diesel storage tanks and bunds - Work in diesel area will be conducted under hot-work permit - Mine Rescue Team on site with fire fighting capabilities **Incident carried forward for detailed hazard analysis**
6.3 Diesel fuel fire adjacent to the diesel fuel storage tanks	Delivery vehicle spill and ignition of fuel leading to pool fire	Potential for heat radiation offsite	- Operator in attendance during fill operations - Operator has access to first attack fire fighting equipment - Mine Rescue Team on site (i.e. back up fire fighting capabilities) **Incident carried forward for detailed hazard analysis**
6.4 Lubricating oil storage fire adjacent in the oil storage bund	Drum leak, oil spill in the base of the bund, ignition and fire	Potential for heat radiation offsite	- Lube oil storage is bunded in accordance with AS1940-2004 - Inspection of all drums on receipt to the store - Regular inspection of the drum store during operations - No ignition sources in the store **Incident carried forward for detailed hazard analysis**

APPENDIX B

DETAILED CONSEQUENCE ANALYSIS

B1. Mix Truck Roll Over, Fuel Leak and Fire

The ANFO mix is made up of about 94% ammonium nitrate and 6% diesel. The mix truck mainly carries Ammonium Nitrate with a relatively small diesel tank of about 500 litres.

An incident involving a collision between a mix truck and another vehicle may lead to diesel fuel tank damage, leak and spill of fuel on the ground around the vehicle. This incident would result in a pool of fuel oil under the vehicle and, if ignited, a pool fire would result. In a collision incident, resulting in truck rollover and tank damage, the impact could be relatively severe causing tank contents to release quickly. The resultant pool would spread over the ground to a depth of 5mm (Ref.6). This is conservative, as there would be some absorption into the ground, increasing the effective spread thickness.

B1.1 Pool Diameter

Based on a conservative pool depth of 5mm (Ref.6) and a volume of 500 litres, the pool diameter is calculated by:

Volume of Pool = $\pi/4 \times D^2 \times$ depth

$D = [(4/\pi \times 0.5)/0.005]^{1/2} = 11.3$m

B1.2 Flame Height

The flame height of a pool fire is given by the following correlation of Thomas (Ref.7):

$$L = 42D\left(\frac{m}{\rho_o\sqrt{gD}}\right)^{0.61} \quad \text{-----------------(B1.1)}$$

where: L= mean flame height (m)

D= pool diameter (m)

ρ_o= ambient air density (typically 1.2 kg/m^3)

m= mass burning rate (kg/m^{2}s) = 0.0667, based on 5mm/min burn down rate (Ref.8)

g= acceleration due to gravity (9.81 m/s^2)

Hence, flame height for the diesel truck fire is:

$L = 42 \times 11.3\ (0.0667/(1.2(9.81\times 11.3)^{0.5}))^{0.61} = 19.4$m

B1.3 Flame Configuration

Figure B.1 shows an illustration of a typical pool fire as a result of a fuel spill. It can be seen from this illustration that the flame burns as a cylinder and is affected by wind, causing the flame to tilt with the wind direction.

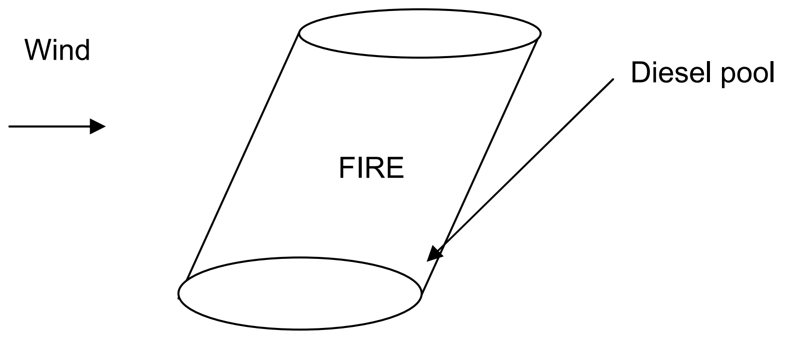

FIGURE B.1
EXAMPLE OF TYPICAL FUEL SPILL FIRE

The fire as a result of a fuel spill will act as a cylinder with the heat from the cylindrical flame radiates to the surrounding area. A number of mathematical models may be used for estimating the heat radiation impacts at various distances from the fire. The point source method is adequate for assessing impacts in the far field, however, a more effective approach is the view factor method, which uses the flame shape to determine the fraction of heat radiated from the flame to a target. The radiated heat is also reduced by the presence of water vapour and carbon dioxide in the air. The formula for estimating the heat radiation impact at a set distance is:

$Q = E\ F\ \tau$

Where: Q = incident heat flux at the receiver (kW/m^2)
E = surface emissive power of the flame (kW/m2)
F = view factor between the flame and the receiver
τ = atmospheric transmissivity

Figure B.2 shows the heat radiation path for the fire. It can be seen from this figure that flame tilt and height above ground level will have impacts on the amount of heat flux received by the target.

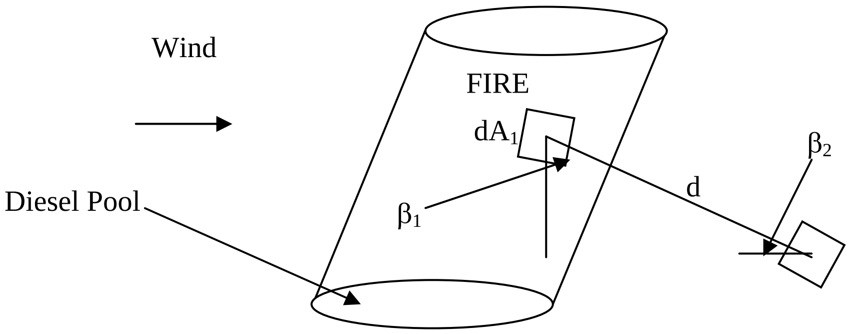

FIGURE B.2
HEAT RADIATION IMPACT ON A TARGET FROM A CYLINDRICAL FLAME

The calculation of the view factor (F) in **Figure B.2** depends upon the shape of the flame and the location of the flame to the receiver. F is calculated using an integral over the surface of the flame, S. The formula can be shown as:

$$F = \int\int_S \frac{\cos\beta_1 \cos\beta_2}{\pi d^2}$$

The above formula may be solved using the double integral or using a numerical integration method in spread sheet form. This is explained in **Section B1.4**.

B1.4 Development of the Numerical Integration Model

B1.4.1 Introduction

A spreadsheet calculator (SSC*) was developed for determining the radiation flux experienced at a "target" originating from a cylindrical fire. It is intended typically for fires of flammable liquids (Class 3) though it can be used with any material so long as the "emissivity" of the flame is known. This is the heat flux at the surface of the flame and is given in kilo Watts per square metre (kW/m^2). The other parameters needed are: diameter of the fire, height of the fire walls, distance to target, height of flame, tilt of flame caused by wind. It is assumed that the walls have some height although there is no reason not to use the calculator for pool fires at ground level by entering a zero height.

* The SCC was developed by Dr Wayne Davies, School of Chemical Engineering, University of Sydney and Mr. Steve Sylvester, Senior Consultant-Risk Engineering, SKM

B1.4.2 Design Basis

The SSC is designed on the basis of finite elements. The fire is assumed to be in the shape of a cylinder of the same diameter as the equivalent pool diameter. The height of the fire can be calculated using the following formula:

$$L = 42D\left(\frac{m}{\rho_o (gD)^{0.5}}\right)^{0.61}$$ (Ref.7)

where: L= mean flame height (m)

D= pool diameter (m)

ρ_o= ambient air density (typically 1.2 kg/m^3)

m= mass burning rate (kg/m2s) = 0.0667, based on 5mm/min burn down rate (Ref.8)

g= acceleration due to gravity (9.81 m/s^2)

Once the flame height is known, the surface of the cylinder can be divided into many separate plane surfaces. To do this, a plan view of the fire was drawn and the relevant distances and angles allocated. The plan view is for the target and the base of the fire in the same horizontal plane.

The angle “theta” is varied from zero to 90 degrees in intervals of 2.5 degrees. Zero deg. represents the straight line joining the centre of the tank to the target (x0, x1, x2) while 90 deg. is the point at the extreme left hand side of the fire base. In this way the fire surface is divided up into elements of the same angular displacement. Note the tangent to the circle in plan. This tangent lies at an angle, gamma, with the line joining the target to where the tangent touches the circle (x4). This angle varies from 90 deg at the closest distance between the tank and the target (x0) and gets progressively smaller as theta increases. As theta increases, the line x4 subtends an angle phi with x0. By similar triangles we see that the angle gamma is equal to 90-theta-phi. This angle is important because the sine of the angle give us the proportion of the projected area of the plane. When gamma is 90 deg, sin(gamma) is 1.0, meaning that the projected area is 100% of the actual area.

Before the value of theta reaches 90 degrees the line x4 becomes tangential to the circle. The fire cannot be seen from the rear and negative values appear in the view factors to reflect this. The SSC filters out all negative contributions.

For the simple case, where the fire is of unit height, the view factor of an element is simply given by the expression:

VF = ∆A. sin(gamma)/(π. x4. x4) .... Eq 1

where ∆A is the area of an individual element at ground level.

Note the denominator (π. x4. x4) is a term that describes the inverse square law for radiation assumed to be distributed evenly over the surface of a sphere.

Applying the above approach, we see the value of x4 increase as theta increase, and the value of sin(gamma) decreases as theta increase. This means that the contribution of the radiation from the edge of the circular fire drops off quite suddenly compared to a view normal to the fire. Note that the SSC adds up the separate contributions of Eq 1 for values of theta between zero until x4 makes a tangent to the circle.

It is now necessary to do two things: (i) to regard the actual fire as occurring on top of a fire wall (store) and (ii) to calculate and sum all of the view factors over the surface of the fire from its base to its top. The overall height of the flame is divided into 10 equal segments. The same geometric technique is used. The value of x4 is used as the base of the triangle and the height of the flame plus the tank, as the height. The hypotenuse is the distance from target to the face of the flame (called X4'). The angle of elevation to the element of the fire (alpha) is the arctangent of the height over the ground distance. From the cos(alpha) we get the projected area for radiation. Thus there is a new combined distance and an overall equation becomes:

$VF = \Delta A. \sin(gamma).\cos(alpha)/(\pi. x4'. x4')$ .... Eq 2

The SCC now turns three dimensional. The vertical axis represents the variation in theta from 0 to 90 deg representing half a projected circle. The horizontal axis represents increasing values of flame height in increments of 10%. The average of the extremes is used (e.g. if the fire were 10 m high then the first point would be the average of 0 and 1 i.e. 0.5 m), the next point would be 1.5 m and so on).

Thus the surface of the flame is divided into 360 equal area increments per half cylinder making 720 increments for the whole cylinder. Some of these go negative as described above and are not counted because they are not visible. Negative values are removed automatically.

The sum is taken of the View Factors in Eq.2. Actually the sum is taken without the ΔA term. This sum is then multiplied by ΔA which is constant. The value is then multiplied by 2 to give both sides of the cylinder. This is now the integral of the incremental view factors. It is dimensionless so when we multiply by the emissivity at the "face" of the flame, which occurs at the same diameter as the fire base (o pool), we get the radiation flux at the target.

B1.5 Analysis Results

Prior to the development of the model, parameters were developed (e.g. flame height, SEP, wind tilt, etc.).

Tank Diameter – 11.3m

Flame Height – 19.4m

Wind Tilt – a wind tilt of 30^{o} has been used for the analysis

Surface Emissive Power (SEP) – is a function of the fire magnitude (i.e. diameter and height), which governs the amount of heat at the surface of the fire. Larger fires tend to generate larger quantities of soot or smoke, which shields the more luminous components of the flame. Large diameter pool fires average an SEP of about 20kW/m^2. The average SEP of an 80m kerosene fire is about 10kW/m^2, suggesting the correlation is conservative (Ref.10).

The correlation of Mudan and Croce (Ref.9) give the following formula for calculating the SEP of a flame:

SEP = SEPm exp(-sD) + Es (1-exp(-sD)) --------- (B1.2)

Where:
- SEP = the total surface emissive power of the flame
- SEPm = the maximum surface emissive power of luminous spots on a large hydrocarbon fuel flame (140kW/m^2)
- SEPs = the surface emissive power of a smokey flame (20kW/m^2)
- S = 0.12m-1 (an experimentally determined parameter)
- D = diameter of the pool

Based on the above formula, the calculated SEP for the diesel fuel tank fire is 51kW/m^2.

Transmissivity – is the reduction in heat radiation due to the presence of water vapour and carbon dioxide in the atmosphere between the radiation source and the target. This can be calculated using the following formula (Ref.11):

Transmissivity = 1.006 - 0.01171(log10X(H_2O) - 0.02368($\log_{10}$X(H_2O)))^2 - 0.03188($\log_{10}$X(CO_2) + 0.001164($\log_{10}$X(CO_2)))^2 ---------(B1.3)

Where:
- X(H_2O) = (RH x L x Smm x 2.88651 x 102)/T
- X(CO_2) = L x 273/T
- RH = relative humidity
- L = path length in metres
- Smm = saturated water vapour pressure in mm mercury (= 17.535 @ 293K)
- T = temperature in degrees Kelvin (293K)

The distance from the fire to the boundary of the proposed property (L) is 25m, relative humidity is selected as 70% (0.7). Using these values and the values listed above, the transmissivity parameter is calculated to be 0.8.

B1.6 Summary of Inputs to the SCC Model

Using the methodology presented in **Section 5.1** the following inputs have been developed for the heat radiation model.

Fire Diameter	11.3m
Fire height	19.4m
Flame tilt	30 degrees
SEP	51kW/m^2
Transmissivity	0.8 (at 25m from the fire)

B1.7 Consequence Analysis (SCC Model Results)

The SCC model was entered into a Microsoft Excel spread sheet and the data above input to the model. The heat radiation at the site boundary (≈50m) was estimated to be <2kW/m^2. The SCC was run for varying heat radiation levels to determine the distance to impacts as a result of the mix truck fire. **Table B5** summarises the results of the SCC analysis.

TABLE B.5
HEAT RADIATION IMPACT AT SELECTED DISTANCES FROM A MIX TRUCK FIRE INCIDENT

Heat Radiation Impact (Kw/m^2)	Distance from Flame(m)
35	13.6
23	15.3
15	17.5
12.5	18.7
10	20.3
6	24.5
4.7	27.3
2	39

B2. Explosion on the Shotfirers Vehicle

B2.1 Background

Detonators, primer and charge cords are not classified as high explosives (i.e. TNT or RDX). Detonators contain a small quantity of highly sensitive material (e.g. lead azide) that is readily initiated by electric current or impact pressure. This material is surrounded by a primer, (e.g. gun powder) which burns or decomposes rapidly when ignited. Primers burn rapidly releasing large volumes of hot expanding gases from a relatively small quantity of material.

ANFO is a low explosive and, when ignited, also decomposes rapidly producing large quantities of hot nitrogen gas and water vapour. In low explosives there is a fine line between rapid decomposition and detonation, hence in the mining environment, the explosive power of ANFO is produced by its confinement in a stemmed hole.

TNT (trinitrotoluene) is a high explosive and is manufactured to contain three nitro groups bonded around a single methylbenzene ring. Initiation of TNT results in detonation, releasing large quantities of explosive power. Invariably, detonators and primers are used to initiate TNT.

Based on the above details, TNT produces larger blast power than detonators or ANFO. In this study, TNT has been used as the basis for the blast impact calculations and, hence, the blast analysis provides a conservative screening tool for the study.

B2.2 Explosion in Shot Firers Truck

Shotfirers will typically carry about 25kg of explosives (detonators, primer and blast cord,etc.) from the magazine to the blast pad. An explosion involving this material may project an overpressure wave offsite. The maximum permissible offsite overpressure impact from an explosion is 7kPa (Ref.2). Assuming conservatively that detonators/ primer/blast cords have an equal explosive power to that of TNT (see Section B2.1), the distance from an explosion involving 25kg of TNT to an overpressure of 7kPa is calculated using Equation 5.1.

Scaled distance (λ) = $R/(M_{TNT})^{0.333}$ -----------(2.1)

Where: λ = Scaled distance read from the graph of Incident Overpressure for Surface Bursts (**Figure B2.1**, Ref.12)

R = Distance from the centre of the explosion (m)

M_{TNT} = Mass of TNT (kg)

For an overpressure of 7kPa the scaled distance is 15 (from **Figure B2.1**)

Hence,

$15 = R/(25)^{0.333}$

$R = 15 \times (25)^{0.333}$

R = 44m

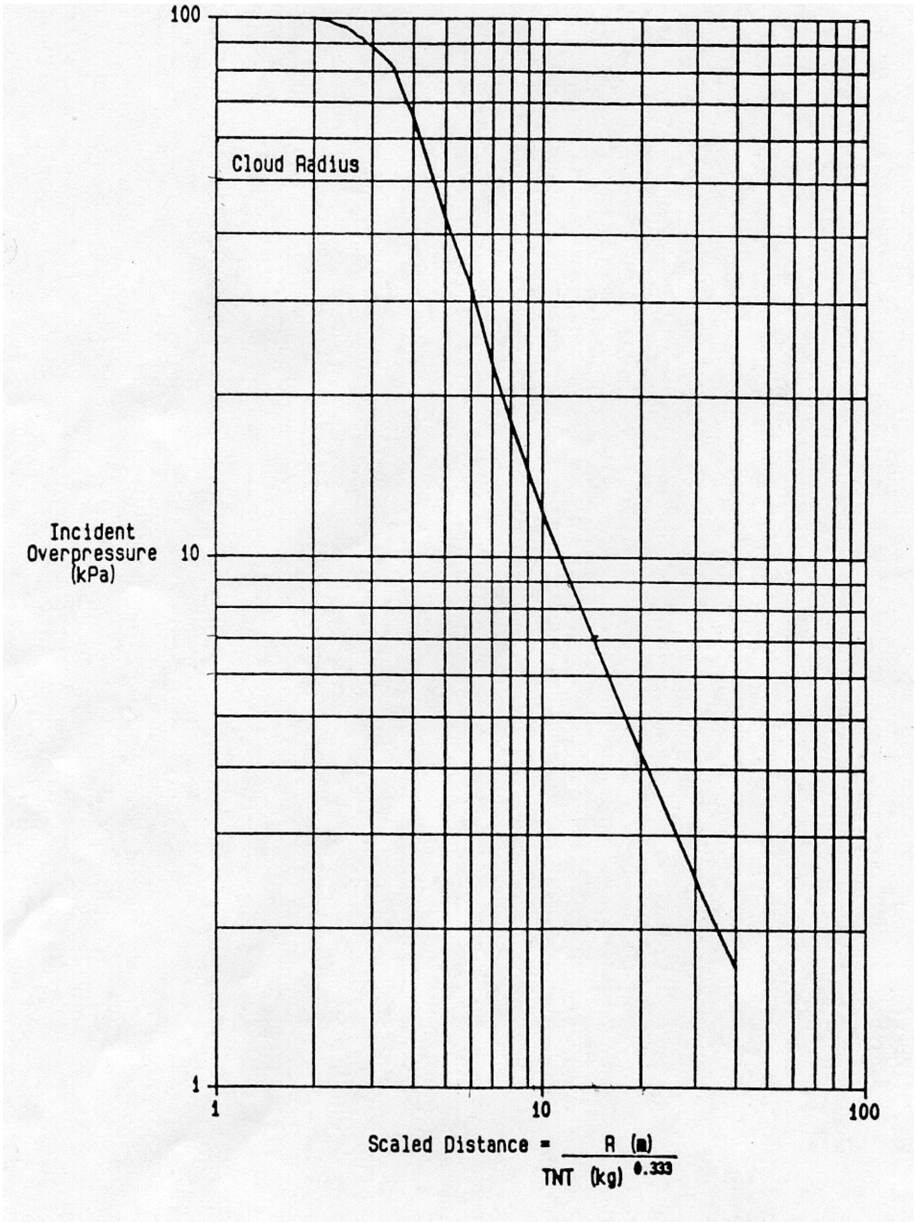

FIGURE B2.1
INCIDENT OVERPRESSURE FOR SURFACE BURST
(Source: Ref.12)

B3. Premature Explosion of the ANFO Mix on the Mix Truck

In the mix truck the only explosive mixture is the ANFO in the mix pump and pipework leading to the bore hole. An estimate of the quantity of ANFO in the pump and pipework has been made based on the pump and pipework volume and the density of Ammonium Nitrate, noting that ANFO is made up of 94% Ammonium Nitrate.

Pump volume (based on MONO pump) is 50mm diam x 300mm long

Volume = $\pi/4(0.05)^2 x0.3 = 6x10^{-4} m^3$

Pipework (50mm) from the mix pump to the bore hole is about 3m.

Volume = $\pi/4(0.05)^2 x3 = 0.006m^3$

Total volume of Ammonium Nitrate = $0.0066m^3$

Ammonium Nitrate has a density of 1730kg/m^3 (Ref.7). Mass of Ammonium Nitrate in the pump and pipework is:

Mass = $0.0066m^3$ x 1730 kg/m^3

Mass = 11.41kg

Assuming conservatively that ANFO has the equivalent explosive power of TNT, and using **Formula 2.1**, the blast distance to an overpressure of 7kPa from an explosion involving 11.41kg of ANFO is:

For an overpressure of 7kPa the scaled distance is 15 (from **Figure B2.1**)

Hence,

$15 = R/(11.41)^{0.333}$

$R = 15 \times (11.41)^{0.333}$

R = 34m

B3 Diesel Fuel Storage Fire

The diesel fuel will be stored in three 110,000L tanks in the services area of the proposed MCP Stage 2 expansion. The bunds will be designed in accordance with AS1940 (Ref.5), which requires specific separation distance between the bund and the tanks. Based on this, the initial bund design dimensions will be 30 long x 20m wide. An ignited leak of fuel in the bund would result in a bund fire, in the worst case covering full bund. Pool dimensions and heat radiation impacts are estimated below.

B3.1 Pool Diameter

Bund Area = $\pi/4 \times D^2$
$L = (4/\pi \times 30x20)^{1/2}$

L = 27.6m

B3.2 Flame Height

Using formula B1.1, the flame height is estimated as 35.9m

B3.3 Wind Tilt

A wind tilt of 30° has been used for the analysis

B3.4 SEP

Using formula B1.2, the SEP for the flame is estimated to be 24.4kW/m^2.

B3.5 Transmissivity

Using formula B1.3, for a distance to the site boundary of about 140m (closest boundary is adjacent to Wollar Road), the transmissivity is estimated to be 0.69.

B3.6 Heat Radiation Impact

Using the methodology presented in **Section 5.1** the following inputs have been developed for the heat radiation model.

Fire Diameter	27.6m
Fire height	35.9m
Flame tilt	30 degrees
SEP	24.4kW/m^2
Transmissivity	0.69 (at 140m from the fire)

Using the SCC model the heat radiation at the site boundary (140m) was estimated to be 0.26kW/m^2. The SCC was run for varying heat radiation levels to determine the distance to impacts as a result of the tank fire. **Table B5** summarises the results of the SCC analysis.

TABLE B.5
HEAT RADIATION IMPACT AT SELECTED DISTANCES FROM A DIESEL FUEL TANK BUND FIRE INCIDENT

Heat Radiation Impact (Kw/m^2)	Distance from Flame(m)
23	24
15	26.9
12.5	28.4
10	30.5
6	36.4
4.7	40
2	56

B4. Lubricating Oil Storage Fire

Preliminary site layouts indicate that the lubricating oil storage bund will be as follows:

Underground Mine – the oil will be stored in five 2000 litre tanks located adjacent to the main workshop area.

Open Cut Mines – hydraulic oil will be stored in a single 15,000 litre tank. Lubricating oils will be stored in a single 16,000 litre tank. Other oils will be stored in three 10,000 litre tanks. Tanks will be located adjacent to the workshop areas at the services area of the mine.

An ignited leak of oil in the bund would result in a bund fire, in the worst case covering full bund. The largest oil tank bund is estimated to be 10m x 10m, this is large enough to contain the largest tank proposed for oil storage. Pool dimensions and heat radiation impacts are estimated below.

B4.1 Pool Diameter

Bund Area = $\pi/4 \times D^2$
L = $(4/\pi \times 10 \times 10)^{1/2}$

L = 11.3m

B4.2 Heat Radiation Impact

Using the methodology presented in **Section 5.1** the following inputs have been developed for the heat radiation model.

Fire Diameter	11.3m
Fire height	19.4m
Flame tilt	30 degrees
SEP	51kW/m^2
Transmissivity	0.75 (at 140m from the fire, i.e. site boundary)

Using the SCC model the heat radiation at the site boundary (140m) was estimated to be 0.11kW/m^2. The SCC was run for varying heat radiation levels to determine the distance to impacts as a result of the oil storage fire. **Table B5** summarises the results of the SCC analysis.

TABLE B.5

HEAT RADIATION IMPACT AT SELECTED DISTANCES FROM AN OIL STORAGE TANK FIRE INCIDENT

Heat Radiation Impact (Kw/m^2)	Distance from Flame(m)
35	13.6
15	15.3
12.5	17.5
10	18.7
6	20.3
4.7	24.5
2	27.3
0.11	140 (site boundary)

B5 Magazine Explosion

The magazine onsite will store about 16,650kg of explosives (including high explosives, detonators, primer and cords). Assuming conservatively that ANFO has the equivalent explosive power of TNT, and using **Formula 2.1**, the blast distance to an overpressure of 7kPa from an explosion involving 16,500kg of explosives is:

For an overpressure of 7kPa the scaled distance is 15 (from **Figure B2.1**)

Hence,

$15 = R/(16{,}500)^{0.333}$

$R = 15 \times (16{,}500)^{0.333}$

R = 380m