12. Hazard and Risk

This section provides a summary of the hazard and risk assessment undertaken in regards to the Project (Mine) during construction, operation and decommissioning. The assessment was undertaken in accordance with the requirements of the Terms of Reference (ToR) and a table cross-referencing these requirements is provided in Volume 4 Appendix C ToR Cross Reference Table.

12.1 Introduction

12.1.1 Overview

The objective of this section is to identify potential hazards and risks to the people and property, inclusive of public health and safety considerations as per Section 6.0 of the ToR for the Project (Mine) EIS and describe actions for eliminating or reducing the level of risk.

12.1.2 Methodology

This assessment of hazards and risks associated with the Project (Mine) is based on a Preliminary Hazard Analysis (PHA). The purpose of the PHA is to identify potential hazards and risk associated with the Project (Mine). This allows for identification and prioritisation of risks based on the current level of project planning, and to guide more detailed analysis when detailed design progresses. The outcome of the PHA serves to assist with mitigation of risks, but is not intended to provide a comprehensive quantitative assessment of risks.

The methodology employed includes:

- Review of Federal, State and local regulatory framework
- Review of relevant standards, guidelines and codes
- Identification and description of sensitive receptors
- Review of the Project (Mine) activities throughout the construction, operations and decommissioning phases
- Review of the hazardous substances that will be used during the phases of the Project (Mine)
- Review of the natural hazards that pose a risk to the Project (Mine)
- Evaluation of the risk associated with each hazard
- Development of proposed mitigation measures
- Review of residual risk with mitigation measures in place
- Development of a risk management plan, particularly emergency management planning procedures.

12.1.3 Regulatory Requirements, Standards, Codes and Guidelines

A number of key regulatory requirements and standards, codes and guidelines are applicable to the Project (Mine) PHA. Key legislation and policy relevant to the risk assessment include:

- *Coal Mining Safety and Health Act 1999*
- *Coal Mining Safety and Health Regulation 2001*
- Queensland Government 2003**,** State Planning Policy 1/03, Mitigating the Adverse Impacts of Floods, Bushfire and Landslide, Brisbane

Standards, codes, manuals and guidelines reviewed as a part of this risk assessment include:

- Standards Australia, Australian and New Zealand Standards *AS/NZS ISO 31000:2009 Risk management – Principles and guidelines*
- Manual for Assessing Hazard Categories and Hydraulic Performance of Dams, DERM 2012
- Urban Stormwater Quality Planning Guidelines (DERM, 2010)
- Standards Australia, Australian Standard *AS 1940:2004, The storage and handling of flammable and combustible liquids*.
- Australian/New Zealand Standard *AS/NZS 4801:2001, Occupational health and safety management systems—Specification with guidance for use*.
- Standards Australia, Handbook HB 203: 2012, Handbook: Managing environment-related risk.
- Standards Australia, Australian Standard, *AS 1692-2006 Steel tanks for flammable and combustible liquids*.
- Commonwealth of Australia, 2007 Australian Dangerous Goods Code 7th edition, National Transport Commission, Melbourne (ADG Code)
- New South Wales Government, Department of Planning 2011, Guidelines under State Environmental Planning Policy No. 33 - Hazardous and Offensive Development Application Guidelines Applying SEPP33 (SEPP33).

12.1.4 Risk Assessment Criteria

In accordance with the requirements of the Australian and New Zealand Standards *AS/NZS ISO 31000:2009 Risk management – Principles and guidelines*, a qualitative risk assessment for all identified hazards has been performed and a risk register prepared. The risk register identifies the Project (Mine) risks for the construction, operations and decommissioning phases.

The risk assessment process is based on the assumption that assessment of hazards and risks will continue throughout detailed design, construction, operation and decommissioning phases of the Project (Mine).

Table 12-1 outlines the Adani Project Risk Ranking Matrix used to rank each of the hazards. Table 12-2 outlines the consequence criteria used and Table 12-3 outlines the likelihood criteria used to determine the rank of a risk.

Table 12-1 Adani Risk Ranking Matrix

Likelihood	Consequence				
	Major (5)	Severe (4)	Moderate (3)	Minor (2)	Insignificant (1)
Almost certain (5)	Extreme	Extreme	High	Medium	Medium
Likely (4)	Extreme	Extreme	High	Medium	Medium
Possible (3)	High	High	Medium	Medium	Low
Unlikely (2)	High	Medium	Medium	Low	Low
Rare (1)	Medium	Medium	Medium	Low	Low

Table 12-2 Consequence Criteria

Descriptor (Rating)	Environment	Public Health and Safety	Community and Reputation
Insignificant (1)	Negligible, reversible environmental effect. Any impacts are contained within the mining lease/ rail corridor and are short term in nature. Minimal resources required to respond to an incident.	First aid treatment or medical treatment in hospital.	No media coverage. No community complaints.
Minor (2)	Minor, unplanned localised environmental impact, contained within the mining lease/ rail corridor or with negligible off site effects. Planned or unplanned impacts do not result in degradation of overall conservation status of ecosystems. Minor resources required to respond to the incident. Impacts are reversible within a year.	Medium term, largely reversible injury or illness to one or more persons. Restricted work injury. Lost time injury < 2 weeks.	Local media coverage. Complaint to site and/or regulator.

Descriptor (Rating)	Environment	Public Health and Safety	Community and Reputation
Moderate (3)	Moderate, unplanned environmental impact contained within the mining lease/ rail corridor or minor impact that is off-site. Unplanned impacts do not result in degradation of overall conservation status of ecosystems. Resources will be required for responding to the incident and implementing mitigation measures over a period of time. Impacts are reversible within 1 to 5 years.	Serious bodily injury or illness (e.g. fractures) and/or lost time injury > 2 weeks.	Local media coverage over several days or State media coverage. Negative impact on local economy. Persistent community complaints.
Severe (4)	Major or widespread, unplanned environmental impact on- or off-site. Degradation of overall conservation status of ecosystems. Significant resources required to respond and rehabilitate. Impacts are reversible within 5 to 10 years.	Single fatality and/or severe disability (permanent disabling injury) or illness to one or more persons, but fewer than ten	National media coverage over several days. Community / NGO legal actions. Impact on local economy.
Major (5)	Extensive long term environmental harm and/or harm that is extremely widespread. Significant resources required to respond to the incident and rehabilitate. Impacts unlikely to be reversible within 10 years.	Multiple fatalities and/or significant irreversible effects to ten or more people	Prominent negative international media coverage over several days. Significant negative impact on share price for months.

Table 12-3 Likelihood Criteria

Descriptor (Rating)	Definition
Rare (1)	Frequency of occurrence expected to be < 1% Only likely to occur in exceptional circumstances Not likely to occur in the next 30 years
Unlikely (2)	Frequency of occurrence expected to be 1% to 20% May occur in some circumstances but not anticipated Could occur once in the next 5 to 30 years
Possible (3)	Frequency of occurrence expected to be 20% to 50% May occur some of the time but a distinct possibility it won't Could occur in the next 2 to 5 years
Likely (4)	Frequency of occurrence expected to be 50% to 99% Will probably occur in many circumstances Could occur annually
Almost certain (5)	Frequency of occurrence expected to exceed 99% Impact is occurring now or is almost certain to occur Could occur within months

12.1.5 Sensitive Receptors

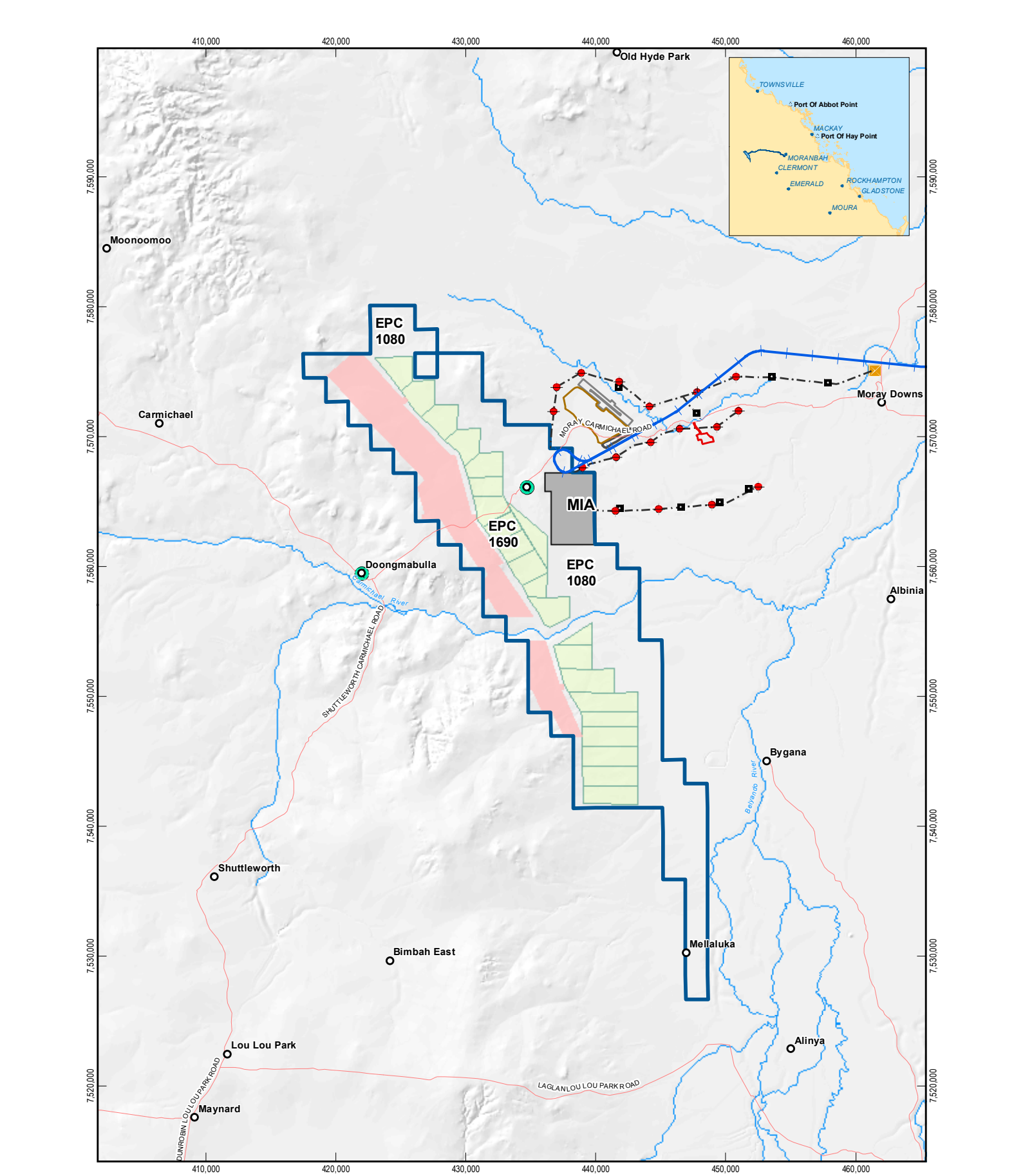
A desktop review of publicly available information and a GHD GIS database was undertaken to identify sensitive receptors (people and property) within 15 km of the Project (Mine).

The key human sensitive receptors include the seven homesteads that have been identified within proximity to the Project (Mine) (refer to Volume 2 Section 2 Description of the Project). Labona homestead is currently located within the mine infrastructure area (MIA) footprint and will be removed, and as such, will not be a sensitive receptor during any phase of the Project (Mine). Mellaluka is within the southern portion of EPC1080. With the exception of Lignum and industrial area, the remaining sensitive receptors are located further than 2 km away from the Mine. These potential sensitive receptors are listed in Table 12-4 and shown in Figure 12-1.

Figure 12-1 illustrates the location of sensitive receptors considered as a part of the PHA.

Table 12-4 Sensitive Receptors Immediately Within or Surrounding Project Area

Homestead Name	Location/Distance to Project (Mine)
Immediately within Project Area	
Lot 5091 on PH1882 Mellaluka	On the southern boundary of Project (Mine), specifically EPC1080
Surrounding the Project Area	
Lot 662 on PH1491 Moray Downs	22.6 km east of the Project (Mine), specifically EPC1080
Lot 663 on SP228220 Doongmabulla	5.77 km west of Project (Mine), specifically EPC1690
Lot 1 on AY 35 Carmichael	11 km west of Project (Mine), specifically EPC1690
Lot 1 on SP164918 Lignum	1.4 km to the south east of Project (Mine), specifically EPC1080
Lot 1 on SP228220 Bimbah East	18 km to the south west of Project (Mine), specifically EPC1690
Lot 2 on SP177201 Bygana	4.9 km to the south-east of Project (Mine), specifically EPC 1080
Lot 3 on DR17 Albinia	17.9 km east of Project (Mine), specifically EPC1080
Lot 5158 on PH991 Moonoomoo	17 km north west of Project (Mine), specifically EPC1690
Workers accommodation village	2.4 km to the north-east of Project (Mine), specifically EPC1080
Airport terminal	3.18 km to the north-east of Project (Mine), specifically EPC1080
Industrial area	0.66 km to the north-east of Project (Mine), specifically EPC1080



LEGEND

- Homestead
- Noise Logger
- Local Road
- Watercourse
- Mine Infrastructure Area
- Open Cut Blocks
- Underground Mine Plan
- Rail (West)
- Mine (Onsite)
- Mine (Offsite)
- Borehole
- Storage Site (Instream)
- Storage Facility (Offstream)
- Pipeline Network
- Airport Location
- Rail Siding
- Industrial Area
- Workers Accommodation Village

1:375,000 (at A4)

0 2 4 6 8 10 12

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Job Number 41-25215
Revision C
Date 14-11-2012

Homestead Locations

Figure 12-1

G:\41\25215\GIS\Maps\MXD\700_Environment\41-25215_735_rev_a.mxd Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: DME: EPC 1690 (2010)/EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment Opt9 Rev3 (SP1 & 2) (2012); Gassman/Hyder: Mine (Offsite) (2012); GHD: Sensitive Receptor, Noise Logger (2012). Created by: JVC

12.2 Project Hazards and Risks

12.2.1 Overview

Project (Mine) hazards and risks are those that may affect the Project (Mine) itself, as well as Project (Mine) activities and hazardous substances that may affect sensitive receptors. Hazards and risks can occur during any phase of the Project (Mine). The relevant phase or phases of the Project (Mine) are listed against each hazard event identified in Table 12-7.

12.2.2 Mining and Infrastructure Hazards

12.2.2.1 Overview

The PHA is based on hazards potentially arising from the project components and activities as described in the Volume 2 Section 2 Description of the Project, and the Carmichael Macro-conceptual Mining Study (Runge Limited 2011).

Hazard identification focuses on non-routine or unplanned events that may result in impacts on identified sensitive receptors. The focus of the PHA is therefore based on occurrence of a hazard event. Potential impacts arising from the day-to-day normal construction, operational and decommissioning activities were not considered as a hazard event given that they would be managed by reasonable environmental practices and compliance with environmental requirements, approvals and licences. The hazard identification process applied therefore assumes compliance with regulatory requirements and does not consider deliberate exposure of hazards, for example, planned releases of pollutants.

The following key hazard areas have been identified through the PHA:

- Water management
- Wastewater management
- Tailings dams
- Coal seam fires
- Coal handling and stockpiling
- Roads and traffic
- Chemical use
- Air transit

As outlined in Section 12.1.2, the purpose of this PHA is to identify high levels of hazards and risks associated with the Project (Mine). This allows for identification and prioritisation of hazards for more detailed analysis based on available information, and as detailed design progresses.

Hazard events associated with water management have been assessed under two separate methodologies. First, a qualitative risk assessment (refer to Section 12.1.4) has been applied to hazard events associated with levees, pipes and drainage infrastructure (refer to Section 12.2.2.2). Second, the Queensland Government Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (the Manual) has been used to assess mine affected water (MAW) storages and sediment basins (refer to Section 12.2.2.3).

12.2.2.2 Levees, Pipes and Drainage Infrastructure

Hazard events associated with levees, pipes and drainage infrastructure include:

- Failure of the levees protecting the mine form flood waters of the Carmichael River
- Failure of pipes and pumps used for conveying water
- Failure of pit protection levees
- Failure of cross drainage infrastructure
- Failure of general stormwater drainage infrastructure

The Carmichael River levee has been designed for an annual exceedance probability (AEP) of 1:1,000 (with 0.5 m freeboard) suitable for a regulated structure in the Manual. As such, the risk of a levee failure is very small. In the event of a levee break, damage would be confined to the Mine area, with some of the nearby pits being flooded. Risks to human beings are considered very small as the rainfall event leading up to the 1:1,000 year flood will cause all work on the mine site to stop.

Water, including MAW, will be pumped between various water storages on the Mine site. MAW will for example be pumped from the in-pit sumps to MAW storages, or between MAW storages. Pipe failure may occur during the operation of the Project (Mine). However, it is expected that such failures would be rare. If a pipe fails the volume of uncontrolled release is likely to be minimal as it is likely to be detected quickly. Once detected, any uncontrolled releases will be stopped by switching off the pump.

The major roads like the haul road and potentially some of the temporarily roads will have cross drainage infrastructure. This infrastructure is normally designed to allow for frequent flow events, often to maximum AEP of 1:10. Sizing for larger events is generally considered not necessary as failure of the cross drainage infrastructure generally leads to limited damage as stormwater will simply flow over the road.

Besides the main (storm)water management infrastructure, like the Carmichael Levee, creek diversions and pit protection levees, range of smaller local stormwater management infrastructure is proposed including road drainage and temporary drainage along the pit protection levees. This type of drainage infrastructure is normally identified and designed during final design stages. As it concerns relatively small infrastructure, risks associated with any failures of this local stormwater management infrastructure are small.

The creek diversions on the mine lease are designed to provide a 1 in 1,000 year ARI flood immunity to the pits through the mine site. It is expected that a 1 in 1,000 year ARI flood immunity will be provided to pit protection levees across the 21 pits, to prevent overland flows from entering.

Management and Mitigation

Inspection of the stormwater drainage systems will be undertaken:

- Following any rainfall event exceeding 25 mm in 24 hours
- Monthly to identify any failures and assess first flush capture and accumulations of contaminants

A record of these inspections will be kept as required. This inspection regime is in accordance with Industry Standards - in particular IECA 2008, Best Practise Erosion & Sediment Control. International Erosion Control Association Australasia. This standard is supported by Stormwater Industry Association (Qld) Inc. Engineers Australia and Environment Institute of Australia and New Zealand.

12.2.2.3 Mine Affected Water Storages and Sediment Dams

A PHA of mine affected water (MAW) storages and sediment basins was undertaken in accordance with the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (the Manual) (DERM, 2012). In accordance with the Manual, MAW storages and sediment basins with a 'significant' or 'high' hazard category must be designed with a design storage allowance (DSA) and a mandatory reporting level (MRL) over and above the normal operation volume (NOV). The DSA is defined by its ability to prevent discharge during storm events with a prescribed AEP. The DSA for MAW storages was determined by the highest annual rainfall within the 120 year period modelled for the preliminary water balance.

The MAW in the storages is likely to be contaminated with coal fines possible selenium. The total dissolved salts (electrical conductivity) of the co-disposal material and concentrations of selenium and salinity are not known at this stage. This assessment assumes that the selenium concentration is not high (about 0.02 mg/L or less in the liquids and 150 mg/L or less in the solids) and salinity is 5,000 µS/cm or less. However, water quality is expected to exceed the threshold contaminant concentrations in Table 3 of the Manual (DERM, 2012) and the MAW storages must therefore be rated with a significant or high hazard. The hazard category may change if water quality constituent concentrations differ significantly from assumptions.

Functional designs of all MAW storage dams have not yet been undertaken. For the purposes of the dam break assessment, the expected peak discharges during a break of the largest MAW storage (storage number 3) in 2016 (8,903 ML) is calculated to be around 3,800 m^3/s. Discharges have been determined with DERM's simplified dam break equation which is based on an empirical relationship between discharge and the volume and depth of storage.

A number of sediment basins are proposed to treat surface runoff from the spoil areas throughout the operational period of the Mine and continuing throughout the initial periods of rehabilitation until closure criteria are achieved.

Runoff from the spoil areas is directed to sediment basins that range in volume from 95 ML to 385 ML, inclusive of the sediment storage and settlement zone volumes. The basins are designed to overflow during storm rainfall to safeguard the integrity of the structure via a weir and open drain to the nearest creek tributary of the Belyando River.

MUSIC modelling with a conservative scenario applied indicates that discharge water under normal circumstances meets the water quality objectives adopted for target pollutants in accordance with the Urban Stormwater Quality Planning Guidelines (DERM, 2010) for the Western Districts region.

Functional design of the sediment basins has not yet been undertaken. For the purposes of the dam break assessment, it is conservatively assumed that the total 3.2 m depth of the basins (1 m for sediment storage, 1 m for the permanent pool volume and 1.2 for design flow depths and freeboard) is constructed above ground, and that the embankment height is approximately 3.2 m. The peak dam break discharges have been determined with DERM's simplified dam break equation which is based on an empirical relationship between discharge and the volume and depth of storage.

The assessment was made against the following 'categories of harm' defined in the Manual for both the 'failure to contain' and 'dam break' scenarios.

- Loss of life or harm to humans
- General environmental harm

- Loss of stock
- General economic loss of property damage

Mine Affected Water Storages – Failure to Contain Scenario

- Loss of life or harm to humans – Low hazard

  There are no known homesteads or water supply bores along the flow path between the dams and Bowen River. The nearest homestead is about 21 km from the mine site along the Belyando River, however, it is understood that the Belyando River is used for recreational purposes. Overflows from the dams will occur during extreme rainfall events and are likely to coincide with more widespread storm events resulting in elevated flows within the Belyando River. Several studies of the catchment areas indicate that flows in the Belyando River are likely to be several orders of magnitude greater than discharges from the dam. Therefore, any incremental effect on water quality or water levels and velocity generated by outflows from the dam would be limited.

- General environmental harm – Significant hazard

  The water quality of stored water is expected to exceed the threshold values of contaminant concentrations listed in Table 3 of the DERM 2012 manual. However, areas of concern dominant vegetation are located over 25 km downstream along Belyando River. Furthermore, a comparison of the relative catchment areas of the MAW dams and receiving watercourse (Belyando River) show that flows in Belyando River during extreme events would be at least an order of magnitude greater than overflows from the dams and thus provide a significant measure of dilution. Discharge to the downstream environment through overflows or seepage could cause some environmental harm.

- Loss of stock – Low hazard

  The absence of homesteads near the mine site means that bores along the Belyando River are likely to be for livestock watering. Overflows during an extreme storm event would experience dilution by elevated flows in the Belyando River. Therefore loss to stock is not expected.

- General economic loss or property damage – Low hazard

  There are no known third party industries or public utilities along the immediate path of outflows from the dams. Once outflows reach the Belyando River any incremental change in the magnitude of flow is likely to be minor and its effect on infrastructure or services, further downstream, is unlikely. Therefore, no significant economic loss is expected due to discharges from the dam.

Mine Affected Water Storages – Dam Break Scenario

- Loss or harm to humans – High hazard

  There are no known homesteads or water supply bores along the flow path between the dam and the Belyando River. The nearest homestead is about 21 km from the mine site along the Belyando River, however, it is understood that the Belyando River is used for recreational purposes. If a sunny day failure occurred at the largest dam (storage dam 3) the expected discharge is likely to have a significant impact on water levels and velocity along the immediate reach of the Belyando River and it is conceivable that recreational users of the Belyando River could be at harm. However, the flood wave is likely to have dissipated to some degree by the time it reaches the first homestead and residents would be at lesser risk.

- General Environment – Significant hazard

  Dam break flows from the largest dam (storage dam 3) would result in a high discharge of 3,800 m^3/s over a relatively short duration. Any scour damage is expected to be restricted to the creek beds in the immediate vicinity of the outfalls before the flows have a chance to spread out. However, should a sunny day failure of the dam occur the dam break discharge would result in a substantial increase in water levels and velocity along the Belyando River which may cause damage to river banks and riparian vegetation. The impact is likely to be less at the areas of concern dominant vegetation which are some 20 km downstream of the entry point and if water levels have exceeded river banks the flood wave may have dissipated to some degree.

- Loss of stock – High hazard

  The only known water supply bores within a 20 km radius of the proposed mine are located to the east of the mine site. The bores along the Belyando River are of unknown use. The volume of outflow is likely to lead to significant infiltration along its flow path especially if a sunny day failure occurred. The high discharge and velocity of outflows represents a significant threat to livestock in areas immediately downstream of the dam.

- General economic loss – Significant hazard

  There are no known third party industries or public utilities between the dam and Belyando River. Should a 'sunny day' failure occur it is conceivable that infrastructure along Belyando River could experience elevated and faster moving flow over a relatively short period. However, the long distance (over 20 km) to areas which may contain third party industries or public utilities suggests that such an increase would not represent a high threat

Mine Affected Water Storages – Summary

The hazard category is Significant for the 'failure to contain' scenario and High for the 'dam break' scenario. Therefore, in accordance with DERM 2012 manual, the initial MAW dams require provision for a DSA in addition to the needs of normal operation storage requirements. More detailed investigation in terms of potential recreational use of the Belyando River and the purpose of bores may provide evidence to adjust this assessment.

Sediment Basins – Failure to Contain Scenario

- Loss of life or harm to humans – Low hazard

  There are no homesteads or water supply bores along the flow path between the discharge points and the Belyando River. During a wet weather overflow, significant dilution and dissipation will occur meaning any incremental effect on water quality or water levels and velocity generated by outflows from the basin is likely to be limited. During dry weather conditions a dam failure is very unlikely and will not lead to releases of significant flows.

- General environmental harm – Low hazard

  Based on the expected water quality of runoff from spoil stockpiles and the results of the Project (Mine) AMD assessment (refer to Volume 4 Appendix V Acid Mine Drainage), the quality of water stored and treated in the sediment basins is not expected to exceed the threshold values of contaminant concentrations listed in Table 3 of the DERM 2012 manual. However, for the purpose of assigning a hazard category to the sediment basins, it has been conservatively assumed that water quality will exceed these values. If an extreme rainfall event leads to overtopping, flows in

the Belyando River would likely be greater by an order of magnitude and thus provide a significant measure of dilution, based on the relatively smaller storage volumes in the basins In addition, the load of suspended sediment attributed to extreme storm events is also relatively small compared to the total load generated across all rainfall events. MUSIC modelling for an extended period of historical real-world rainfall, including rainfall events that lead to spills, predicts that high quantities of total suspended sediment will be removed from the runoff prior to discharge.

- Loss of stock – Low hazard

  During wet weather, there are unlikely to be stock in the creeks between the discharge points and the Belyando River. Although a dry weather spillage may encounter animals drinking within the low flow channels at seasonal billabongs, the main contaminant within the flow is suspended sediment which according is not considered to be a significant health risk for stock (ANZECC 2000).

- General economic loss or property damage – Low hazard

  There are no known third party industries or public utilities along the immediate path of outflows from the sedimentation basins, let alone those that might be affected by a potential decline in water quality. Once outflows reach the Belyando River, any potential decline in water quality is likely to be minor and therefore its potential effects on infrastructure or services are also considered minor. No significant economic loss is expected due to discharges from the basins.

Sediment Basins – Dam Break Scenario

- General environment – Low hazard

  Although peak dam break discharges may seem high, dam breaks are of short duration and released water would readily spill out the small capacity low flow channels of the flat gradient receiving creeks to dissipate widely and shallowly into their broad floodplains on the way to the Belyando River. Any scour damage would be restricted to the creek beds in the immediate vicinity of the outfalls before the flows have a chance to spread out. During further design stages scour protection surrounding the discharge point will need to be considered. The sediment basins are to be constructed offline from waterways, and are therefore not at risk of cascade failure. The volumes and flood levels of a wet weather dam break are small when compared to the storm events in the Belyando River.

- Loss or harm to humans - Low

  There are no known homesteads along the immediate flow path downstream of the sedimentation basins and mine site, with the closest being located over 25 km downstream. In case of overflowing, the sediment basin will add relatively little extra flow to the waterways to which it discharges. Peak flows resulting from a dam break as indicated in the table above are likely to be small when compared to the peak flows in the Carmichael River (1% AEP flows ~2500 m^3/s).

- Loss of stock – Low hazard

  There is no stock between the discharge point and the natural waterways to which the sedimentation basin will be discharging and therefore loss of stock in the event of a dam break is not expected. The internal diversion drains run through the mine site for several kilometres before leaving the mine area at the Carmichael River and the nearby creeks, as indicated in the Carmichael Coal Mine Preliminary Flood Mitigation and Creek Diversion Design (GHD, 2012). Since the only major contaminant is sediment and because of the short duration and significant dilution of outflows, impacts to water quality in the event of a dam break are expected to be

minimal. In the event of a dry weather failure, the resultant short term increase in sediment laden flows is unlikely to result in loss of stock.

- General economic loss – Low hazard

  There are no known third party industries or public utilities within the creeks between the basin outfalls and the Belyando River. Should a dry weather failure occur, it is unlikely that infrastructure along the Belyando River downstream would experience flow where it otherwise would not. The volume of the outflow compared with the much higher volume associated with natural major events makes any economic loss unlikely.

Sediment Basins – Summary

The hazard category is 'low' for the 'failure to contain' 'dam break' scenarios for each of the thirteen sediment basins. Moreover, the basins do not meet the 8 m embankment height trigger that would require the application of a Minimum Hazard Category. Therefore no sediment basin requires a DSA under the Manual.

Management and Mitigation

The PWB analysis for the Project (Mine) uses monthly climate data, groundwater flows and water demands representative of a 120 year period and is thus similar to the alternative and more complex DSA method suggested in the Manual. The performance of water containment for each year of record has been assessed in isolation by means of storage resetting at the beginning of each year. In the absence of estimates of NOV a storage reset level equivalent to the average storage level at the end of each year has been used which is obtained from a preliminary simulation of the water balance. The assumption has been made that the required capacity of water containment is indicated by a storage that prevents overflows during all years of the 120 year simulation. Therefore, the annual exceedance probability (AEP) of the design is equivalent to the AEP of the highest annual rainfall total within this record. Furthermore, the derived capacity of water containment is indicative of the combined NOV and DSA requirement and the DSA may exceed design criteria specified in the Manual.

Sediment basins are designed with a settling zone of 1 metre. Accumulation of sediment above the settling zone would prevent the sediment basins from functioning as designed. As such the sediment basins should be routinely excavated to prevent such over-accumulation.

A record of all maintenance checks for all water management infrastructure controls onsite should be kept to progressively develop an appropriate maintenance routine. The record which will also provide verification that maintenance procedures are being carried out, should include details of the following:

- The date of maintenance or inspection
- The name of the persons performing the maintenance or inspection
- Type of maintenance actions performed for each sediment; and
- The state of the device including an estimate of the amount of sediment captured and removed where appropriate.

Further detail on the assessment of MAW storages and sediment basins, including peak break discharge volumes, is provided in Volume 4 Appendix P2 Preliminary Water Balance.

12.2.2.4 Tailings Dam

The Project (Mine) tailings dam is expected to present a high hazard due contaminant concentrations that are likely to exceed the thresholds in Table 3 of the Manual. A hazard assessment consistent with the Manual will be conducted during the detailed design phase of the Project (Mine), once the design and characteristics of the tailings dam are determined.

12.2.2.5 Wastewater Management

Hazard Identification

Wastewater (sewage) will be produced from workers accommodation village, kitchens, laundries and Mine site amenities such as pit top facilities (refer to Volume 2 Section 2 Description of Project) can pose a hazard to humans and the environment in the event of leakage.

Sewage treatment is proposed to be in package treatment plants located close to the source. Treated wastewater will meet Class A requirements in relation to pathogens and will either be disposed of by irrigation or reused. Reuse opportunities may include mixing with mine water within the mining lease or use for vehicle washing.

Potential hazards associated with wastewater management arise from:

- Failure of the wastewater treatment plant resulting in production of untreated or partially treated water.
- Failure of pumps or pipelines resulting in releases of untreated wastewater.

In both of these scenarios, water quality and aquatic ecosystems may then be affected by high levels of nutrients in the untreated wastewater and humans may be exposed to pathogens.

If the sewage treatment plant fails to treat wastewater to the required levels, exposure pathways will depend on whether the treated wastewater is being irrigated or reused. If the treated wastewater is being irrigated, sustained irrigation with high nutrient water may affect soil structures and affect plant health in the irrigation area. Workers accessing the irrigation area may be exposed to pathogens. Runoff from the area may also mobilise pathogens and nutrients into nearby waterways with consequent impacts on aquatic ecosystems and health of downstream users.

Given the relatively small quantities of wastewater generated and treated, unless irrigation with improperly treated wastewater continues for a long period of time, significant impacts are not expected and in particular, downstream users are not expected to be exposed to pathogens.

If wastewater is being reused in vehicle wash areas, there is a high potential for workers to be exposed to pathogens in poorly treated wastewater. Environmental consequences are low as water in vehicle wash areas will be captured and recirculated or returned to mine water storages.

If wastewater is being mixed with other mine water for reuse in dust suppression or coal washing, the dilution factor is such that, even if wastewater is not treated, it is unlikely that environmental harm would arise. There are also minimal opportunities for workers to be exposed to untreated wastewater used in dust suppression or coal washing.

Management and Mitigation

Mitigation will largely be through surveillance and maintenance of the wastewater treatment plants to check that these are operating correctly. This will include monitoring of treated wastewater for

nutrients and pathogens. The package treatment plants will need to include alarm systems to indicate malfunctions.

Regardless of whether there has been a malfunction or not, workers accessing irrigation areas and workers using treated wastewater for vehicle washing will be required to wear personal protective equipment including skin covering.

While not directly in response to risk mitigation, routine monitoring of soils in irrigation areas will also detect any build-up of nutrients that might lead to mobilisation of contaminants off-site.

12.2.2.6 Coal Seam Fires

A hazard and risk assessment of coal seam fires will be conducted during the detailed design phase of the Project (Mine), once sufficient information is available on coal characteristics.

Response to fire on the Project (Mine) site will generally be in accordance with the Fire Management System outlined in Section 12.3.6.2.

12.2.2.7 Spontaneous Combustion

Hazard Identification

Coal in stockpiles can be subject to spontaneous combustion under conditions where sufficient oxygen is available, temperature rises to a certain level and moisture content is low. The temperature at which spontaneous combustion may occur differs for different coal types. When hot spot heating increases to about 400-425^{o}C, self-ignition and flame occur (US Department of Energy, 1993). .

Other potential hazards that might occur during coal stockpiling is failure of the coal stockpile resulting in spread of coal within the mine infrastructure area.

Management and Mitigation

The likelihood of spontaneous combustion occurring can be reduced by managing the turn over rate of stockpiles so that coal does not remain in the stockpile long enough to reach critical temperatures. Further studies will be undertaken on spontaneous combustion characteristics of coal from the proposed mine to determine optimum and maximum time in stockpiles and a coal inventory management system will be in place to track the age of stockpiles. If further testing indicates a high spontaneous combustion risk, temperature monitoring can also be introduced.

Additional preventative techniques that can be applied if necessary include keeping coal stockpiles wet, compacting surfaces to minimise air ingression and managing build-up of fines. Fire fighting equipment and emergency access to the stockpiles will also be provided for in the design.

Response to fire on the Project (Mine) site will generally be in accordance with the Fire Management System outlined in Section 12.3.6.2.

12.2.2.8 Coal Handling

Hazard Identification

Coal handling presents a potential fire hazard due to operations of the conveyor or accumulation of combustible material.

Management and Mitigation

The material handling facility for coal stockpiling and transfer is described in Volume 2 Section 2. The system is designed to minimise coal spillage, including the adoption of features such as:

- Partially covered conveyors
- Conveyors designed to facilitate the removal of spillage
- Heat detection and fire detection systems used where applicable
- Regular inspection of conveyors with maintenance/cleaning as required to remove accumulated coal spillage

These measures will significantly reduce the likelihood of coal fires.

12.2.2.9 Roads and Traffic

Hazard Identification

Transport of hazardous substances constitutes on and off site Project (Mine) activities and form a part of the risk assessment. The route from Townsville via Flinders Highway and Gregory Development Road is considered the appropriate haulage corridor for the Project (Mine) based on distance, asset condition and crash history (Refer to Volume 4 Appendix W Mine Transport Assessment). Mackay via Peak Downs Highway, Suttor Developmental Road, Bowen Developmental Road and Gregory Developmental Road may also be utilised as a haulage route for particular items or machinery where procurement constraints prevent use of the former haulage route.

There will be light vehicle movements at the workers accommodation village, including food transport, linen laundering, fuel supplies, waste management contractors and maintenance servicemen.

Diesel truck volumes are typically in the order of 10 per week during construction and 17 per day during the operation phase. The number of trips for trucks carrying explosives will be two per week. The explosives contactor will be responsible for transport, storage, handling and use of explosives.

Increased heavy vehicle traffic from the Project (Mine) along public transport corridors, including school bus corridors, present a potential safety risk. Although an assessment of traffic volumes indicates that volumes are within the capacity of the roads, increased traffic volumes associated with the Project (Mine) have a minor potential to increase the likelihood of traffic accidents.

Mitigation and Management

Transportation will comply with the Australian Code for Transport of Dangerous Goods by Road and Rail 7th edition (ADG Code).

Traffic management issues will be addressed through the preparation and implementation of construction and operation Traffic Management Plans, which will be developed during the detailed design phase. The Traffic Management Plans will be developed in consultation with the Department of Transport and Main Roads, police and local authorities. Initiatives to be undertaken as part of the

development and execution of Traffic Management Plans are included in Volume 4 Appendix W Mine Transport Assessment.

12.2.2.10 Air Transport

Hazard Identification

It is expected that almost the entire Project (Mine) workforce will be employed with a fly-in-fly-out (FIFO) arrangement. The Project (Mine) workforce will fly-in from anywhere on the east coast of Australia. Prior to operation of the proposed airport, the Project (Mine) FIFO workforce will arrive at the existing Doongmabulla airstrip. Once the proposed airport is operational, the Project (Mine) workforce will be flown to this location for transport to the workers accommodation village. Due to the extent of utilisation of air transport by the Project (Mine) workforce, aircraft crash is considered to have high initial risk.

Mitigation and Management

A number of design considerations, preventative measures and response measures are available to mitigate the likelihood of crash. Licensed contractors and aircraft operators will transport the Project (Mine) FIFO workforce whether arriving at the proposed airport or Doongmabulla airstrip. The airport will be designed to CASA requirements and, once operational, thorough inspection and maintenance protocols for the airstrip will be developed. Project (Mine) safety personnel will be trained in aviation safety and an emergency response plan will be developed. The proposed airstrip and associated terminal facilities will be fenced to prevent the incursion of foreign objects on the airstrip.

12.2.3 Hazardous Substances

12.2.3.1 Overview

The Project (Mine) will use hazardous substances during construction and operation, including those listed in the Australian Dangerous Goods Codes. Table 12-5 provides an indicative list of substances to be used and the likely quantities to be stored on-site, and the phase during which the substance will be used. Material Safety Data Sheets (MSDS) will be available at locations where these substances are stored or used. The potential impact of these substances is outlined below, along with the management and mitigation of the risks associated with transport, storage and handling of the substances. Potential hazard events associated with hazardous substances will be in part managed by emergency response procedures, developed in consultation with the relevant emergency services, and the provision of PPE to conform to Australian Standards.

Table 12-5 Indicative List of Hazardous Substances from Mine Operations

Chemical Name / Shipping Name	Raw Conc. %wt	Operation Storage Conc. %wt	D.G. Class	UN No	Packaging group	Indicative Maximum Inventory on site		Purpose/ Use
						Construction	Operation	
Diesel	N/A	N/A	3 (Class C1)*	1202	III	500 kL	10,000 kL	Fuel for heavy vehicle operations
Lubrication/ Hydraulic Oils	N/A	N/A	3 (Class C2)**	N/A	N/A	5 kL	2,500 kL	Lubricate plant and equipment and replenish hydraulic systems
Ammonium Nitrate Fuel Oil	N/A	N/A	1.1D	0082	N/A	Nil	600 t	Blasting at mine site
Emulsion	94	94	5.1	3375	II	Nil	45 t	Blasting at mine site
Methyl isobutyl carbinol	99.5	99.5	3	2053	III	Nil	400 kL	Coal handling and processing plant (CHPP) flotation agent
Nitrogen gas	> 99	> 99	2.2	1066	N/A	144 m^3	144 m^3	Pneumatic equipment
Acetylene	> 98	> 98	2.1	1001	N/A	200 m^3	100 m^3	Welding / Oxy-acetylene cutting
Oxygen	> 98	> 98	2.2	1072	N/A	200 m^3	100 m^3	Welding / Oxy-acetylene cutting
Aluminium sulphate	47	47	N/A	N/A	N/A	Nil	4 kL	Water treatment
Sodium hypochlorite	10-15 available chlorine	10-15 available chlorine	8	1791	II or III	Nil	2 kL	Water treatment
Herbicides and Pesticides	NA	NA	NA	NA	NA	< 200 kL	< 200 kL	Pest and weed control

Chemical Name / Shipping Name	Raw Conc. %wt	Operation Storage Conc. %wt	D.G. Class	UN No	Packaging group	Indicative Maximum Inventory on site		Purpose/ Use
						Construction	Operation	
Vehicle batteries (Sulphuric Acid)	15-51	15-51	8	2796	II	0.25 t	0.5 t	Spent batteries from vehicles
Used vehicle tyres	N/A	N/A	N/A	N/A	N/A	550 pa	550 pa	Spent tyres from mine vehicles
Waste oil	N/A	N/A	N/A	N/A	N/A	01.0 kL	7 kL	From vehicles / equipment

* Class C1 – a combustible liquid that has a flashpoint of 150°C or less.

** Class C2 – a combustible liquid that has a flashpoint exceeding 150°C.

Hazchem Code: Description as per ADG Code

N/A Not Applicable / None Allocated.

No aviation fuel will be stored at the airstrip near the mine.

12.2.3.2 Diesel

Hazard Identification

Diesel is a combustible liquid with a flash point of > 61.5^{o}C, vapour pressure < 1 mm Hg @ 25^{o}C and specific gravity 0.85 at 15^{o}C. Diesel has very low solubility in water and is incompatible with strong oxidising agents. Due to the properties of diesel, there is no risk of an explosion with a diesel fire.

Diesel is toxic to plants and animals. Contact with skin and eyes will cause irritation. Inhalation by humans in high concentrations will result in dizziness, headaches, nausea, vomiting, drowsiness or narcosis.

Diesel will be used to fuel heavy and light vehicles for the construction and operation of the Project (Mine). Indicative quantities of diesel to be stored during this time are displayed in Table 12-5.

Management and Mitigation

Indicative maximum diesel storage during the construction phase is 500 kL and for operation phase is 10,000 kL. The bulk storages for the construction and operation phase will consist of above ground tanks and day tank storage. Design and construction of tanks will comply with *AS 1692-2006 Steel tanks for flammable and combustible liquids*. The storage and handling will comply with the requirements of *AS 1940 – The storage and handling of flammable and combustible liquids*. All diesel storage tanks will be installed on impervious surfaces and fully bunded.

All diesel transfer operations, including refuelling and storage, will be on impervious surfaces with a spill collection system. Dedicated filling points will be established for fuel trucks, with containment using rollover bunds and a drainage sump in one corner. Build-up of electrostatic charges on storage tanks and refuelling equipment will be prevented by bonding and grounding.

Spill response equipment, including a spill response truck, will be stationed at the Project (Mine) site for deployment in the event of a spill. Spill response equipment will also be available with each fuel truck. In the event of a spill, the spilled material will be collected and placed in a labelled container for management with oily wastes, as described in Volume 2 Section 13 Environmental Management Plan.

Portable petroleum-product fuel containers will comply with the requirements under *AS/NZS 2901:2001 Fuel containers - Portable - Plastic and metal*.

Mobile fuel trucks will be used to refuel equipment that is operating on the mine site where it is time consuming to transport this equipment to the maintenance area for refuelling or where the nature and size of equipment precludes moving the equipment to a dedicated refuelling station. Refuelling trucks will be fitted with automatic shut off valves and will comply with requirements of the ADG Code and all refuelling activities will be supervised.

Fire fighting systems will be provided at major storage and handling areas and in the event of a fire, the emergency response will include the use of carbon dioxide, dry chemical or foam. On-site emergency response teams and workers regularly involved in handling of diesel will be trained to respond to spills and fires involving diesel.

12.2.3.3 Oils

Hazard Identification

Oils are typically clear amber viscous liquids with specific gravity of 1.01 to 1.03 and a boiling point of 100 – 105^{o}C. Prolonged exposure may irritate eyes and skin and when released into the environment, will absorb to the sediment and soil. Bioaccumulation is unlikely due to the very low water solubility and therefore bioavailability to aquatic organisms is minimal. Oils are toxic to plants/animals and coating of plants and animals with oil can cause death.

Oils will be used to lubricate plant and replenish hydraulic systems during the construction and operation of the Project (Mine). Indicative quantities of lubricating and hydraulic oils to be stored during this time are displayed in Table 12-5.

Management and Mitigation

Oils will be stored in above ground tanks and will be fully bunded. Activities involving oils will be undertaken on a hard stand area, or using mobile drip trays. Controls and management procedures will adopted for servicing of machinery outside the workshop.

Spillages will be prevented from entering drains or water courses and absorbent material will be placed on spillages which will be collected for disposal and any contaminated soil removed for treatment and disposal.

12.2.3.4 Ammonium Nitrate Fuel Oil

Hazard Identification

Ammonium Nitrate Fuel Oil (ANFO) is relatively insensitive and must be detonated by a primer, a cartridge of high explosive with detonator. However, in the event of uncontrolled detonation, ANFO can cause serious injury or death. Several risks to health and safety are associated with ANFO, including the risk of explosion by shock, friction, fire or other sources of ignition and irritation to eyes and respiratory system.

ANFO is 90 – 95 per cent miscible in water and unexploded residue can cause toxicity to plants. Spills can also cause algal blooms in static waters and affect local species population balance in the aquatic environment due to the increased available of nitrogen. If water is used to disperse ammonium nitrate spilled on soil, or spills are subject to rainfall, the solution produced can contaminate groundwater.

ANFO will be used for blasting during the operation of the Project (Mine).

Management and Mitigation

A specialist explosives company will provide trucks, operators, ammonium nitrate and emulsions to be used during blasting operations. Adani will ensure that the company's personnel will be licensed and trained in the transport, handling, mixing and use of explosive materials.

The explosives magazine will be approved under the *Explosive Act 1999*. Blasting operations will comply with the *Explosive Act 1999* and the *Coal Mining Safety and Health Act 1999***.** The location of the explosives magazine will take into consideration the requirements in accordance with *AS2187.1: 'Explosives—Storage, transport and use Part 1: Storage, Section 2 Design Requirements*'.

ANFO will be stored in a clean, well ventilated and dry magazine licensed for Class 1 Explosives, segregated from all other reagents including sunlight, specific incompatibilities, combustibles (including wooden pallets) and foodstuffs.

The transportation, handling, storage and use of explosives, detonators and boosters, will be subject to a task specific risk assessment and the implementation of controls. The contractor responsible for transport of ammonium nitrate will comply with the requirements of *AS1678.5.1.002-1998 Emergency procedure guide – Transport Ammonium nitrate*.

The Mine will have, amongst other requirements, standard operating procedures as required under the *Coal Mining Safety and Health Regulation 2001.*

12.2.3.5 Methyl Isobutyl Carbinol

Hazard Identification

Methyl Isobutyl Carbinol (MIBC) is a colourless liquid with a sweetish / alcohol like odour and is non-combustible with a boiling point of approximately 130^{o}C. MIBC has low toxicity to aquatic organisms, however may deoxygenate surface waters and is expected to be slightly toxic to mammalian wildlife. In mining frothing applications, MIBC is used in the concentrations less than 1000 ppm, and at these levels toxicity is expected to be low.

MIBC will be used as a flotation agent at the CHPP during the operation of the Project (Mine). Indicative quantities of MIBC to be stored during this time are displayed in Table 12-5.

Management and Mitigation

MIBC is common reagent in coal processing and will be stored in properly bunded and vented tanks away from heat, sparks, open flame and strong oxidizing agents. The MIBC storage tank will be located in close proximity to the CHPP and will be automatically dosed into the flotation system at the required rate to minimise risk of human contact and accidental release.

12.2.3.6 Nitrogen

Hazard Identification

Nitrogen is a non-flammable, colourless and odourless gas having a vapour density of 0.967 and a boiling point of -195.8^{o}C. It is a non-toxic gas but in confined spaces will displace oxygen, potentially causing asphyxiation. Nitrogen is a major component of air and is non-toxic to plants.

Nitrogen will be used in pneumatic equipment during the construction and operation of the Project (Mine). Indicative quantities of nitrogen to be stored during this time are displayed in Table 12-5.

Management and Mitigation

Nitrogen will be transported to site in individual cylinders. Compressed nitrogen gas cylinders will be stored at the maintenance area in a specific storage area. They will be secured in an upright position in a secure area.

12.2.3.7 Acetylene

Hazard Identification

Acetylene is a highly flammable and explosive gas that is colourless with a garlic like odour. It has a vapour pressure of 4,700 kPa at 25^{o}C and a flash point of < 23^{o}C. Acetylene has a lower explosion

limit of 2.5 per cent. It is a non-toxic and non-irritating gas but in confined spaces will displace oxygen, potentially causing asphyxiation.

Acetylene will be used for welding and oxy-acetylene cutting during the construction and operation of the Project (Mine). Indicative quantities of acetylene to be stored during this time are displayed in Table 12-5.

Management and Mitigation

Acetylene will be transported to site in individual cylinders. Acetylene cylinders will be secured in an upright position in a secure area. Cylinders will not be stored near sources of ignition, oxidising agents, poisons, flammable liquids or combustible materials.

Emergency response procedures will be developed and implemented for leaks from a cylinder. Personnel will be trained in safe use and emergency response. These procedures will minimise the risk of fire resulting from an incident involving acetylene.

12.2.3.8 Oxygen

Hazard Identification

Oxygen is an oxidizing, colourless and odourless gas. Contact with combustible material may cause fire. It is not toxic to humans or other organisms.

Oxygen will be used for welding and oxy-acetylene cutting during the construction and operation of the Project (Mine). Indicative quantities of oxygen to be stored during this time are displayed in Table 12-5.

Management and Mitigation

Oxygen will be transported to site in individual cylinders. Compressed oxygen gas cylinders will be stored in a specific storage area. The gas cylinders will be secured in an upright position.

12.2.3.9 Sodium Hypochlorite

Hazard Identification

Sodium hypochlorite is a pale yellow-green coloured liquid that is alkaline and miscible with water. It is stable under normal storage and handling conditions. It is incompatible with acids and metals. It is toxic to humans and will cause severe eye irritation and can result in permanent injury. It is a severe skin irritant and corrosive contact may cause skin burns. Sodium hypochlorite is soluble in water and causes acute toxic effects to aquatic organisms.

Sodium hypochlorite will be used for water treatment during the operation of the Project (Mine). Indicative quantities of sodium hypochlorite to be stored during this time are displayed in Table 12-5.

Management and Mitigation

Sodium hypochlorite will be transported in bulk containers by road and stored in a secured, bunded, cool, dry, well-ventilated area and away from incompatible materials. Dosing at the water and wastewater treatment plants will be automated to minimise risk of human contact and accidental release.

12.2.3.10 Aluminium Sulphate

Hazard Identification

Aluminium sulphate is used as a water treatment chemical. It is a colourless odourless liquid with specific gravity of 1.30 to 1.32. Aluminium sulphate is slightly corrosive and incompatible with alkalis (e.g. sodium hydroxide) and may be corrosive to most metals. It is non-flammable but may evolve toxic aluminium/sulphur oxides when heated to decomposition. Prolonged exposure to aluminium sulphate can cause chronic toxicity effects in aquatic organisms.

Aluminium sulphate will be used for water treatment during the operation of the Project (Mine). Indicative quantities of aluminium sulphate to be stored during this time are displayed in Table 12-5.

Management and Mitigation

Aluminium sulphate will be transported in bulk containers and stored in a dry well-ventilated bunded area and away from alkalis and most metals. Dosing at the water treatment plant will be automated to minimise risk of human contact and accidental release.

12.2.4 Natural Hazards

Identified natural hazards include flooding, severe rainfall and tropical cyclones, earthquake, bushfire and climate change (refer to Volume 2 Section 3 Climate, Natural Hazards and Climate Change). While the Project (Mine) activities and substances pose hazards and risks to sensitive receptors, there are potential natural disasters that also pose a risk to the Project (Mine). Natural disasters may also exacerbate certain hazards associated with the Project (Mine).

Flooding poses a potential risk to the integrity of MAW storages, sediment basins and tailings dams. As such these structures are required to be assessed in accordance with the DERM Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (refer to Section 12.2.2.3 and Section 12.2.2.4). A general assessment of flooding potential is provided in Volume 2 Section 3 Climate, Natural Hazards and Climate Change.

An earthquake might cause damage to fuel storage structures or water management structures, resulting in releases of diesel or mine affected water. During detailed design, earthquake risk will be confirmed and appropriate structural design standards adopted for the potential risk.

'Upper level' climate change projections, their potential impacts on and in combination with the Project (Mine), and associated mitigation and management are provided in Volume 2 Section 3 Climate, Natural Hazards and Climate Change.

Potential for anthropogenic fire to occur as a result of the Project (Mine) is assessed in Section 12.3.3 and Section 12.3.6.2.

12.2.4.1 Disease Vectors

Hazard Identification

In Queensland, mosquitos have been identified as carriers of dengue fever, Ross River virus (RRv) and other viruses. Environmental factors such as the temperature and humidity influence the life cycles of mosquito. Various studies have indicated that residents who live within 3 km of major breeding sites of the mosquito vector of RRv have a higher risk of contracting the disease than those residing further away.

Potential breeding sites for mosquitoes are habitats which are located within the Carmichael River which flows across the mine lease, Eight Mile Creek which is located at the north of the mine lease area and Cabbage Tree Creek which is located to the south of the Carmichael River, both are ephemeral creeks. Other potential breeding sites include sewage treatment plant, culverts at road crossing water bodies and dams within the Mine.

The Mine has the potential to provide extensive breeding sites for mosquitoes of pest and disease significance.

Sensitive receptors are not located within 3 km of water bodies which could be potential breeding sites and as such potential health issues are minimal.

Management and Mitigation

Adequate drainage arrangements will be provided to avoid ponding of water which has potential to result in breeding grounds for disease vectors in areas of the workers accommodation village. Workers and visitors at the Mine will wear appropriate PPE in the field and where appropriate use insect repellent. Adequate first aid kits will be provided at multiple locations so that these are easily available to the workers.

Table 12-6 outlines the Management and Mitigation techniques to be employed for disease vectors. With implementation of relevant mitigation measures identified, it is not expected that the workers, visitors and communities will be exposed to disease vector.

Table 12-6 Management of Mosquito and Biting Midge – Worker Accommodation Village

Mosquito/Biting Midge Management Plan	
Elements	Potential hazards due to mosquito and biting midges.
Management Objectives	To avoid ponding of water that promotes local populations of potential mosquitoes and biting midges.
Performance Criteria	No potential mosquito/biting midge breeding sites within mine lease area, accommodation camp, airstrip and infrastructure corridor.
Implementation Strategy	**Responsibility**
The following strategies will be implemented to achieve the objectives of the mosquito/ biting midge management plan:	
Stormwater drainage not to cause ponding of water. Provide culverts of sufficient size on roads across the drainage lines to prevent upstream flooding for periods that will enable mosquito/biting midge breeding. Provide erosion prevention structures on the downstream side of culverts provided.	Design Contractor during the design phase. Construction Contractor during the construction phase and Adani Site Manager during the operation phase.
Repair of open channels, culverts and any other structure that collect water or has potential to collect water, to prevent ponding.	Construction Contractor during the construction phase and Adani Site Manager during the operation phase.

Mosquito/Biting Midge Management Plan	
Provide erosion protection at both the inflow and overflow for sediment traps,	Design Contractor during the design phase.
Ensure that water does not remain in sediment traps for a period of more than five days after flooding.	Construction Contractor during the construction phase and Adani Site Manager during the operation phase.
Storage containers capable of ponding water will be either discarded after use or stored under roof or stored in an inverted position when empty or emptied on a weekly basis.	Construction Contractor during the construction phase and Adani Site Manager during the operation phase.
Rainwater tanks if provided must be adequately screened. ◗ Cleaning of the first flush device ◗ Mosquito-proof screens and flap valves for rips, holes or any other defects. ◗ Roof and gutters for accumulated debris ◗ Evidence of animal, bird or insect access and checks inside the tank for accumulated sediment	Design Contractor during the design phase.
Conduct regular inspection of rainwater tanks and roof drains to prevent the formation of mosquito/ biting midge breeding sites.	Construction Contractor during the construction phase and Adani Site Manager during the operation phase.
For storing Class A+ quality treated effluent, provide day storage capacity tanks with cover. The storage to be designed at average flows.	Design Contractor during the design phase.
Ensure that the treated sewage is not stored for more than three days in this tank at average flow rates.	Construction Contractor during the construction phase and Adani Site Manager during the operation phase.
Disposal of treated sewage to irrigation areas must ensure that water does not pool	Construction Contractor during the construction phase and Adani Site Manager during the operation phase.
If larvae are detected in large numbers, contact Queensland Health for assistance in choosing a suitable treatment method. Treatment could either be aerial, ground or adulticiding (fogging)	Construction Contractor during the construction phase and Adani Site Manager during the operation phase.
As a mine closure commitment, the rehabilitation must be done in a manner that ensures there are no actual or potential artificial mosquito breeding sites.	Adani Site Manager during the operations and closure phase.

Mosquito/Biting Midge Management Plan	
Monitoring	The Environmental Representatives will inspect any potential mosquito breeding areas following rain to monitor the presence of mosquito larvae. The representative will also monitor the frequency of mosquito bites at the mine site and accommodation village. Through consultation with residential sensitive receptors identify where mitigation measures are not currently successful and to see whether eradication programs should be implemented.
Reporting	Should a large number of larvae or bites be experienced, the local Council will be contacted for advice on appropriate remedial measures.
Corrective Action	Should an incident or failure to comply occur, a selection of the following actions will be taken: ◗ Conduct investigations into why directives are not being carried out. ◗ Re-educate employees on desired practices. ◗ Change work policies and procedures to improve the situation.

12.2.5 Hazard Analysis and Risk Assessment

Table 12-7 provides an analysis of potential hazards to sensitive receptors as a result of the Project (Mine) activities, hazardous substances and risks posed to the Project (Mine). It describes these has hazard events, and then assesses them against the risk assessment matrix along with description on the consequence and likelihood of occurrence (as described in Section 12.1.4).

The assessment has been undertaken in accordance with the *AS/NZS ISO 31000: 2009 Risk management – Principles and guidelines.*

The qualitative criteria considered in the assessment of hazards and risks were as follows:

- All ‘avoidable’ risks have been avoided.
- The risks from a major hazard are reduced wherever practicable.
- The consequences (effects) of the more likely hazardous events (i.e. those of high probability of occurrence) are where possible contained within the boundaries of the mine.

Table 12-7 Hazard Analysis and Evaluation

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
1	Fuel tanker crash – single vehicle with rupture of one or more tanks Construction, Operation and Decommissioning phase (C,O,D phase)	Release of diesel to soils if tank ruptures, resulting in soil contamination and vegetation health impacts. As quantities are reasonably small, effects would be localised. Remote locations may delay mobilisation of response and clean up.	3	Number of truck trips is 10 trips per week during construction phase. Road sealed and contains few hazards, except in wet weather. Average number of truck trips during operation phase is 17 trips per day. Road is sealed and contains few hazards, except in wet weather. Number of truck trips for decommissioning phase is expected to be one per quarter. Based on the above it is unlikely that this event will occur.	2	Medium	All vehicles conform to ADG Code. Licenced drivers. Drivers trained in safe driving of the vehicle, including any speed limit restrictions. Fatigue management strategies for drivers. Drivers trained in spill response. Consult with emergency services regarding emergency response provisions First aid, spill response and fire fighting equipment will be available with each fuel truck. Spill response equipment available at mine site for deployment.	Responsive measures will be the primary responsibility of the fuel delivery contractor. Emergency Response Plan to include spills of diesel. Containment and immediate clean-up of spills. Removal of contaminated soils and sediments and rehabilitation of damaged vegetation. Notify Emergency Services in case of spills on public roads. Notification to DEHP as required under the Environmental Authority (EA) conditions. Fulfilment of notification requirements under the EP Act, where relevant.	2	2	Low

[1] Consequence

[2] Likelihood

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
2	Fuel tanker crash – single vehicle with rupture of one or more tanks Construction, Operation and Decommissioning phase (C,O,D phase)	If spills occur during stream flow conditions, release of diesel to creeks in the Burdekin River catchment resulting in sediment and water contamination downstream. Aquatic organisms may be killed or harmed. Contamination of downstream water supplies might occur. If streams are flowing, diesel could be transported some distance downstream, although dilution and biodegradation effects will tend to reduce severity of impact with distance.	4	Number of truck trips is 10 trips per week during construction phase. Road sealed and contains few hazards, except in wet weather. Average number of truck trips during operation phase is 17 trips per day. Road is sealed and contains few hazards, except in wet weather. Number of truck trips for decommissioning phase is expected to be one per quarter. Based on the above it is unlikely that this event will occur.	2	Medium	All vehicles conform to ADG Code. Licenced drivers. Drivers trained in safe driving of the vehicle, including any speed limit restrictions. Fatigue management strategies for drivers. Drivers trained in spill response. Consult with emergency services regarding emergency response provisions First aid, spill response and fire fighting equipment will be available with each fuel truck. Spill response equipment available at mine site for deployment.	Responsive measures will be the primary responsibility of the fuel delivery contractor. Emergency Response Plan to include spills of diesel. Containment and immediate clean-up of spills. Removal of contaminated soils and sediments and rehabilitation of damaged vegetation. Notify Emergency Services in case of spills on public roads. Notification to DEHP as required under the	2	2	Low

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
3	Vehicle carrying lubricating oils crashes and ruptures oil container (C,O,D phase)	Release of oil to soils if tank ruptures, resulting in soil contamination and vegetation loss if direct contact with oil occurs. Impacts as per item 1, but more localised due to lower volumes likely to be released and more viscous nature of material.	3	Truck trips are 12 trips per year during operation phase and one trip per quarter during construction phase. Road is sealed and contains few hazards, except in wet weather.	2	Medium	As for item 1	As for item 1	2	2	Low
4	Vehicle carrying waste oil crashes and ruptures waste oil container (C,O,D phase)	Release of oil to soils if tank ruptures, resulting in soil contamination and vegetation loss if direct contact with oil occurs. Impacts as per item 1, but more localised due to lower volumes likely to be released and more viscous nature of material.	3	Number of truck trips is four trips per year during operation phase and two trips per year during decommissioning phase. Road is sealed and contains few hazards, except in wet weather.	2	Medium	As for item 1	As for item 1 Use licenced contractor for removal and disposal of spilled and clean-up material.	2	2	Low
5	Spills or leaks of untreated sewage. (C,O,D phase)	Potential impacts will be dependent on size of spill or leaks and the receiving environment. Likely impacts will be limited; however will include pollution of soil and groundwater with nutrients and pathogenic organisms.	2	Likelihood greatest for spills associated with transfers. Based on the above it is therefore considered that this event is unlikely to occur.	2	Low	Design storage, pumping and transmission systems designed to Australian Standards. Monitoring of untreated sewage tanks and pipes for leaks.	Prompt cessation of transfer operations and clean-up of affected areas.	2	1	Low

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
6	Spills or leaks of untreated sewage during storage or transfer. (C,O,D phase)	Nuisance odour generation. Potential impacts will be dependent on size of spill or leaks.	2	Likelihood greatest for spills associated with transfers. Based on the above it is therefore considered that this event is unlikely to occur.	2	Low	Design storage, pumping and transmission systems designed to Australian Standards. Monitoring of untreated sewage tanks and pipes for leaks.	Prompt cessation of transfer operations and clean-up of affected areas.	2	1	Low
7	Vehicle carrying acetylene, oxygen or nitrogen gas cylinders crashes and results in gas leakage. (C,O,D phase)	Very localised and very short term impact only. Release volumes will be negligible. Damage to plants and animals unlikely. Release of acetylene/ oxygen may result in fire and explosion in presence of an ignition source. Oxygen displacement is unlikely as this hazard event will not occur in a confined space.	2	Number of truck trips is very low. Cylinder design minimises risk of rupture, even in accident situations. The trucks with comply with the requirements for transporting dangerous materials, including compatibility requirements. Based on the above it is therefore considered that this event is unlikely to occur.	2	Low	All vehicles conform to ADG Code. Drivers trained in safe driving of the vehicle. First aid and fire extinguishing equipment will be available with each truck. Drivers trained in the use of fire extinguishers.	None required - quantities of gas small and will dissipate quickly.	2	1	Low

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
8	Traffic accident on Bowen Developmental Road, Gregory Developmental Road, Suttor Developmental Road, Flinders Highway, Peaks Down Highway or other public road between project related vehicle and private vehicle. (C,O,D phase)	Death or injury to occupants of the other vehicle. Distance from emergency services may cause delays in providing emergency medical assistance to injured parties	5	Accident statistics for the period from 2005 to 2009 for Flinders Highway, Gregory Developmental Road, Bowen Developmental Road and Suttor Developmental Road had 5 – 6 per cent fatalities. Based on the above it is possible that this event will occur.	3	High	Mine generated traffic will operate mostly daylight hours; however some trips may be done at night time. Develop Traffic management plan in consultation with DTMR and Council and emergency services. Drivers with valid driving permit. Drivers trained in safe driving. First aid kits in all Project related vehicles. Safety induction to staff and contract workers which will include awareness regarding traffic rules. In-vehicle communication. Fatigue management strategies for drivers. Specific traffic management plan for oversized loads.	Incorporate vehicle accident response in incident response plan. Develop the plan in conjunction with emergency services. Notify emergency services of any accidents immediately.	5	2	High

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
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9	Community member (pedestrian) accident with project related buses or trucks through Mackay, Townsville, Bowen, Collinsville, Newsland, Mount Coolon, Mount Cotton, Charters Tower and other township enroute to the mine and accommodation village. (C,O,D phase)	Injury or death to member of the community. Distance from emergency services may cause delays in providing emergency medical assistance to injured parties	4	Considering the number of trips for truck and bus, likelihood of interactions between members of community and truck/bus activities. Based on the above it is possible that this event will occur.	2	High	Designated travel route through townships for heavy vehicles. Mine generated traffic will operate mostly daylight hours; however some trips may be done at night time. Develop Traffic management plan in consultation with DTMR and Council. Drivers with valid driving permit. Drivers trained in safe driving. First aid kits in all Project related vehicles. Safety induction to staff and contract workers which will include awareness regarding traffic rules. In-vehicle communication. Fatigue management strategies for drivers. Specific traffic management plan for oversized loads.	Incorporate vehicle accident response in emergency response plan. During detailed design phase, develop the plan in conjunction with emergency services. Notify emergency services of any accidents immediately.	4	2	Medium

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
10	Spill or leak from diesel storage tanks. (C,O,D phase)	Contamination of soil in the vicinity of storages. Extent of contamination will depend on the quantity released.	2	All storages will comply with AS 1940 requirements, thus minimising the likelihood of rupture or leak that results in release to the environment. Spills or leaks may be during the transfer operations. Based on the above it is possible that this event will occur.	3	Medium	Design, construction and operation of tanks, bunds and transfer facilities to comply with AS1940 requirements. Dirty areas of the site catchment will be drained to sumps. Procedures will be developed for fuel transfer operations. Personal protective equipment and spill response equipment available on site Personnel trained in procedures and use of equipment.	Emergency response plan to include diesel spills. Contaminated spill clean-up material to be contained for regulated waste disposal. Clean out sumps as required.	3	1	Low

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
11	Spill or leak from diesel storage tanks. (C,O,D phase)	Contamination of surface waters (Eight Miles Creek) either by direct release or leaching through soil. Contamination of surface waters may result in damage to aquatic ecosystems. Extent of damage will depend on the quantity released.	3	All storages will comply with AS 1940 requirements, thus minimising the likelihood of rupture or leak that results in release to the environment. Spills or leaks may be during the transfer operations. Based on the above it is possible that this event will occur.	2	Medium	Design, construction and operation of tanks, bunds and transfer facilities to comply with AS1940 requirements. Refuelling and vehicle maintenance areas will be drained to sumps. Procedures for fuel transfer operations. Personal protective equipment and spill response equipment available on site Personnel trained in procedures and use of equipment.	Emergency response plan to include diesel spills. Contaminated spill clean-up material to be contained for regulated waste disposal. Clean out sumps as required.	2	1	Low
12	Spill or leak of diesel from plant and equipment or a mobile fuel tanker. (C,O,D phase)	Contamination of soil. Quantities involved will be small, typically less than 400-500 L.	2	Minor spills may occur. Most spills will occur within the mining areas. Based on the above it is therefore considered that this event is unlikely to occur.	2	Medium	Spill response procedures, provision of personal protective equipment and spill response equipment and adequate training to personnel.	Emergency response plan to include diesel spills. All contaminated soil to be collected for treatment at bioremediation pad. Contaminated spill clean-up material to be contained for regulated waste disposal. Clean out dirty water dam, collection sumps and/or sediment ponds as required.	2	1	Low

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
13	Spill or leak of diesel from plant and equipment or a mobile fuel tanker. (C,O,D phase)	Contamination of surface waters (Eight Mile Creek, Cabbage Tree Creek, Carmichael River and other tributaries of these creeks and rivers) either by direct release or leaching through soil. Quantities involved will be small, typically less than 400-500 L.	3	Minor spills may occur. Most spills will occur within the mining areas where surface runoff will be drained to local collection sumps. Impacts on the environment are unlikely due to small quantities. Spills may have potential to reach creeks directly especially if spills occur from the mobile plant and equipment near creek/river crossings. Based on the above it is therefore considered that this event is unlikely to occur.	2	Medium	'Clean' catchment areas of the site to be segregated from dirty areas to prevent offsite contaminant flows. Spill response procedures, provision of personal protective equipment and spill response equipment and adequate training to personnel.	Emergency response plan to include diesel spills. All contaminated soil to be collected for treatment at bioremediation pad. Contaminated spill clean-up material to be contained for regulated waste disposal. Clean out dirty water dam, collection sumps and/or sediment ponds as required.	2	1	Low
14	Spill or leak from oil or waste oil storage (C,O,D phase)	Contamination of soil. Quantities are likely to be small (less than 200L) and material is viscous, reducing likelihood of flows to creeks.	2	Low likelihood of spills entering environment as oils and waste oils will be handled and stored in contained areas.	2	Low	Storages comply with AS 1940 requirements. Procedures developed for storing and handling oils and waste oils. Spill clean-up equipment available at workshop and other oil/waste oil storage areas. Personnel trained in use.	Collect any contaminated materials and place in secure containers for disposal through licenced contractor as a regulated waste. Clean out/surface drains and collection sumps as required.	2	1	Low

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
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15	Spill or leak from oil or waste oil storage (C,O,D phase)	Contamination of surface waters either by direct release or leaching through soil. Quantities are likely to be small (less than 200L) and material is viscous, reducing likelihood of flows to creeks.	2	Low likelihood of spills entering environment as oils and waste oils will be handled and stored in contained areas.	2	Low	Storages comply with AS 1940 requirements. Procedures developed for storing and handling oils and waste oils. Spill clean-up equipment available at workshop and other oil/waste oil storage areas. Personnel trained in use.	Collect any contaminated materials and place in secure containers for disposal through licenced contractor as a regulated waste. Clean out/surface drains and collection sumps as required.	1	1	Low
16	Failure of MAW Dams and Tailings Dam (O and D phase)	Risk assessed separately in accordance with Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (DERM, 2011) Tailings Dam risk assessment to be undertaken upon detailed design.		Refer to Section 12.2.2.3							

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
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17	Major rain event occurs on site (1 in 100 year ARI or greater) (C,O,D phase)	A major rain event would mobilise sediment from disturbed areas, ROM stockpile and other stockpiles. Sediment would be transported to surface waterways Eight Mile Creek, Cabbage Tree Creek, Carmichael River and other tributaries of these creeks and rivers) and degrade water quality. In a major rainfall and flood event, significant degradation of surface water quality and aquatic ecosystem health typically occurs naturally. Presence of the mining activity would exacerbate effects by contributing to sediment transport downstream and if significant quantities of sediment are transported, may contribute to geomorphological changes.	3	All mine workings are outside appropriate ARI flood extent of the Carmichael River. The proposed dirty water dam and tailings dam will assist in retarding runoff from the mined and otherwise disturbed areas. Based on the above it is possible that this event will occur.	3	Medium	A conceptual drainage scheme has been developed to protect the Project (Mine) from flooding. The conceptual drainage scheme is staged over the life of the Project (Mine) and includes minor and major levees, diversion drains, culverts and waterway crossings (refer to Volume 2Section 3 Climate, Natural Hazards and Climate Change). Secure and evacuate site if significant flood events predicted, as deemed appropriate. If possible, reduce volume of stockpile if significant flood events predicted.	Communicate with Queensland police in relation to evacuation of workers. Clean-up of downstream areas as required.	2	1	Low

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
18	Major rain event occurs on site. (C,O,D phase)	A major rain event would mobilise sediment from disturbed areas, ROM stockpile and other stockpiles. Sediment would be transported downstream damaging property of community members.	2	Human safety impacts unlikely as there are unlikely to be any community members immediately downstream of the mine where flooding may be exacerbated by the proposed development.	2	Low	If possible, reduce volume of stockpile if significant flood events predicted.	Communicate with Queensland police in relation to evacuation of workers. Clean-up of downstream areas as required.	2	1	Low
19	Major rain event occurs on site. (C,O,D phase)	Pits may flood and accumulated water would need to be disposed.	3	All mine workings are outside appropriate ARI flood extent of the Carmichael River. The proposed dirty water dam and tailings dam will assist in storing water from pit to reduce large releases. Based on the above it is possible that this event will occur.	3	Medium	Secure and evacuate site if significant flood events predicted, as deemed appropriate.	Dispose of accumulated waters in accordance with EP Act / EPP (Water) in consultation with DEHP.	2	1	Low

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
20	Bushfire threatening mining lease or accommodation village. (C,O,D phase)	Burning of cleared vegetation to be part of the rehabilitation strategy. Loss of native vegetation and habitat, including vegetation outside mining areas that would otherwise be undisturbed.	3	Current grazing land use on the mine and adjacent properties. Isaac Regional Council bushfire overlay map identifies the mine site as low to medium risk for bushfires. Based on the above it is possible that this event will occur.	3	Medium	Clear vegetation in all working areas and manage growth in other areas to prevent excessive fuel load accumulation. Maintain fire breaks around areas identified as being potential sources of bushfire risk. Incorporate bushfire response in the site emergency response plan and maintain fire fighting capability at site. Educate staff in relation to bushfire prevention, including management of cigarettes. Develop and train staff in procedures for welding and any other activities with high risk of starting fires.	Implement bushfire response procedures as per Emergency Response Plan. Should bushfire threaten areas outside Project, provide warnings. Communicate with Queensland Police in relation to need for road closure. Control weeds and erosion in burnt areas until regeneration occurs. In recently rehabilitated areas additional rehabilitation may be required.	2	2	Low

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
21	ROM or Product Coal Stockpile fire. (Operation phase)	Potential to significantly degrade air quality within the immediate vicinity, likely to impact accommodation village and sensitive receptors identified in Section 6.3.	3	Auto-ignition temperature of coal is relatively high (generally 100 - 500^{o}C) and is particularly a problem when coal is exposed to oxygen (air) for extended periods, which can occur as a result of stockpiling.	3	Medium	ROM and Product Coal Stockpiles are managed so that retention time in stockpiles is minimised. Maintain fire fighting capability at site, including availability of earthmoving equipment and water tankers to spread and extinguish the stockpiles.	During detailed engineering, the Project will develop appropriate coal stockpile fire response procedures. Should smoke threaten areas outside mine area warning will be provided to the affected stakeholders. Communicate with emergency services and Police in relation to response measures and need for road closure, as necessary.	2	1	Low
22	Rupture or leak of pipeline carrying fines from CHPP to the tailings dam. (Operation phase)	Release of fines to land. Depending on location of rupture or leak, fines may flow to Eight Mile Gully. Sediment release would cause direct smothering of aquatic and riparian ecosystems adjacent to discharge location, and would also impact downstream water quality. Severity of impacts would depend on quantity released.	3	Pipelines must be constructed to Australian Standards and maintained pipelines, making rupture or leak unlikely.	2	Medium	Construct pipelines from robust material. Conduct regular inspections of pipelines for corrosion, leaks or wearing.	Report any incidents of leaks or ruptures of pipelines immediately and shut down CHPP plant or divert flow to alternative disposal facility. Cease pumping if spill occurs. Clean-up of fines spills as required. Rehabilitation of impacted creeks if required.	2	1	Low

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
23	Hypochlorite spill from storage at water treatment plant. (Operation phase)	Potentially severe impacts on ecosystems if released to surface waters or land. However, quantities are small and effects would be localised	2	Storage and handling will comply with Australian Standards. Dosing will be automated, minimising risk of operator error. Likelihood of exposure is extremely low due to absence of sensitive receptors in vicinity of the storage area. Quantity of hypochlorite to be stored and used is very low and it is unlikely that, in the event of the spill, any would enter a surrounding waterway.	2	Low	Storages to comply with Australian Standards. Store and handle as per manufacturer's instructions. Minimise inventory on-site. Conduct routine inspections.	Address hypochlorite spills and leaks in Emergency Response Plan	2	1	Low
24	Spillage of coal to land during train loading. (Operation phase)	Potential for large spills to be washed in to Eight Mile Creek. Coal is from naturally occurring materials and does not contain any significant toxic components. Potential aesthetic impact.	2	Design and supervision of the loading equipment will minimise significant failures and spills. Given that train loading will be supervised, it is unlikely that any major failure of the train loading system would go unnoticed for any period of time.	2	Low	Design of train loaders and associated conveyors to minimise spillage. Routine maintenance and clean up. Inspection of equipment prior to start up.	Significant spills will need to be cleaned up.	1	1	Low

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
25	Persons accessing the mine site without authorisation. (O,C,D phase)	Accidental death or injury to intruder.	4	High risk parts of mine area will be securely fenced, for example access to high wall/deep excavations, MIA, fuel and explosives storages. Based on the above it is possible that this event will occur.	3	High	Restricted access to sensitive locations such as high wall/deep excavations, MIA, fuel and explosive storages. Security at mine access points. Legitimate persons working at the mine to wear clear identification. Install warning signs along any roads and tracks in the vicinity of the mine stating that access to the mine is prohibited without authorisation.	Remove any unauthorised persons from mine site immediately. Notification of Police / Emergency Services for evacuation and/or arrest of persons.	4	1	Medium

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
26	Persons accessing the mine site without authorisation. (O,C,D phase)	Intruder causes environmental incident, for example deliberately breaches fuel storage tanks.	4	High risk parts of mine area will be securely fenced, for example access to high wall/deep excavations, MIA, fuel and explosives storages. Based on the above it is possible that this event will occur.	3	High	Restricted access to sensitive locations such as high wall/deep excavations, MIA, fuel and explosive storages. All authorised personnel to be issues with photo identification (smart card) Security at mine access points. Legitimate persons working at the mine to wear clear identification. Install warning signs along any roads and tracks in the vicinity of the mine stating that access to the mine is prohibited without authorisation.	Remove any unauthorised persons from mine site immediately. Notification of Police / Emergency Services for evacuation and/or arrest of persons.	4	1	Medium
27	Changes to surface topography. (Operation phase)	Potential degradation of ground water resources.	3	Underground and open cut mining is proposed in an area of 26,000 ha which is expected to be disturbed. This will disturb the underground aquifers in this area. Based on the above it is almost certain that this event will occur.	5	High	Adani to undertake groundwater investigations studies. Based on the findings of this study, consider developing appropriate management measures.	Develop a site specific groundwater monitoring regime and implement appropriate management measures.	2	4	Medium

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
28	Aircraft crash during take-off or landing. (Operation phase)	Injury or death of the aircraft occupants.	4	Potential for occurrence of foreign object (including wildlife) on the runway. Damage to runway. Based on the above it is likely that this event will occur.	4	High	Compliance with CASA requirements. Develop and implement thorough inspection and maintenance protocols for runway. Safety Team and dedicated personnel to complete Aviation Safety Training Routine inspection and maintenance of the runway. Provide fence to the airstrip and associated terminal building. Develop emergency response plan.	Execute emergency response plan.	4	3	High
29	Aircraft crash while in transit (Operation phase)	Multiple fatalities.	5	Potential for air crash while in transit. Considering the aviation history, air crash is possible.	3	High	Compliance with CASA requirements. Licenced contractors/ aircraft operators.	Develop emergency response plan.	5	2	High

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
30	Wildlife hazards such as snake bite. (C, O, D phase)	Potential for injury or death.	4	The majority of habitat types identified during field visits to EPC1690 were assessed as being suitable for snakes. Field visits confirmed the presence of pythons, eastern brown snake, pale headed snake and colubrid snake. Based on the above it is possible that this event will occur.	3	High	Provide adequate warning signs in areas with potential for presence of snakes. Provide adequate illumination if working at night in these areas. Wear adequate PPE while working in these areas. Staff on site will be trained in snake handling and relocation.	Provide immediate first aid to the victim. Transport him to the hospital for further medical attention.	4	2	Medium

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									C	L	Risk
31	Vehicle interactions with pedestrians at mine site. (C, O, D phase)	Potential for injury or death.	4	Historically such incidents have happened on mine sites. Based on the above it is possible that this event will occur.	3	High	Traffic within mine area on defined roads. Adequate lighting along the transport roads during night time. Provide appropriate and adequate traffic signs along the roads. Comply with requirements under *AS 1742 Manual of uniform traffic control devices*. Traffic management plan will be developed during the detailed design phase for vehicular traffic within mining area. Drivers with valid driving permit. Consider no go zones for mine workers. First aid kits in all Project related vehicles.	Incorporate vehicle accident response in emergency response plan. Notify emergency services and regulators of any accidents immediately. Provide training to mine workers and visitors. Provide PPE to workers such as high visibility vests.	4	2	Medium

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									C	L	Risk
32	Un planned detonation of explosives. (C, O, D phase)	Fire and explosion resulting in potential for injury or death.	4	Ignition of explosives at storage or on mine site which could be due to reaction with sulphide material, contact with fuel, oil or grease, faulty electrical equipment or wiring, workers carrying ignition source inside magazine or other causes. Based on the above it is possible that this event will occur.	3	High	Explosives are delivered just as needed on time. Batching will take place in purpose built truck. Appointment of a contractor who is qualified for this activity. Code requirements will be followed for storage and handling. Will comply with all applicable legislations and any specific license requirements. Audit programme in place.	Develop fire/ explosion response plan. Notify emergency services and regulators of any accidents immediately. Provide training to mine workers and visitors.	2	2	Low
33	Gas/ Coal dust explosion in UGM or above ground processing facilities (Operation phase)	Potential for injury and fatalities.	4	Coal handling equipment design to minimise coal dust explosion. However, it is considered that it is possible that this event will occur.	3	High	Mines inspection. Provide adequate ventilation. Provide gas monitors. Provide intrinsically safe and explosion protected equipment. Provide centralised monitoring at the mine control room.	Develop coal explosion management plan during the detailed design phase.	2	2	Low

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									C	L	Risk
34	Significant quantities of water influx in to the underground mine. (C, O, D phase)	Potential for injury and fatalities.	4	Historically such events have occurred in underground mine. More information will be available during the detailed design stage when more information on geology will be available. Based on the above it is possible that this event will occur. No water bodies above active mining area	3	High	Conduct adequate geological surveys. Levees or other measures to protect UGM access areas from flooding will be designed once these areas are confirmed.	Develop mine evacuation plans during the detailed design phase. Notify emergency services and regulators of any accidents immediately. Provide training to mine workers or visitors (if they are required to go underground).	3	2	Medium
35	Unsuitable land management during rehabilitation. (O, D phase)	Uncontrolled outbreaks of new weeds or an increase in existing weeds which destroy local land use and native vegetation.	3	Over the operating life of the mine the proponent will gain knowledge on how to achieve appropriate weed control. It is possible that this event will occur.	3	Medium	Washing of ground engaging vehicles entering and leaving site during rehabilitation . Manage fencing, tree guards to protect against stock and wallabies.	Develop weed management program during operations to ensure weeds are controlled at the time of closure process. Ongoing rehabilitation management to include weed control. Routine inspection for weeds.	2	2	Low

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									C	L	Risk
36	Unsuitable land management during decommissioning. (O, D phase)	Post closure mine area becomes a waste dumping ground for local community and others.	3	Over the operating life of the mine the proponent will gain knowledge on how to achieve appropriate weed control. . It is possible that this event will occur.	3	Medium	Washing of ground engaging vehicles entering and leaving site during decommissioning. Manage fencing, tree guards to protect against stock and wallabies.	Develop weed management program during operations to ensure weeds are controlled at the time of closure process. Ongoing rehabilitation management to include weed control. Routine inspection for weeds.	2	2	Low
37	Unsuccessful rehabilitation and stabilisation of rehabilitated areas and the final drainage system. (Decommissioning phase)	Potential water quality issues. Land erosion resulting in siltation of waterways. Inability to achieve proposed post mining land use.	3	Over the operating life of the mine the proponent will gain knowledge on how to achieve appropriate rehabilitation and stabilisation of rehabilitated areas. It is possible that this event will occur.	3	Medium	Conduct geological surveys during mine design phase. Dump designed to be able to be rehabilitated. Topsoil management plan and consideration of soil physical properties in rehabilitated landform (refer to Volume 4 Appendix L Mine Soils Assessment). Progressively revegetate inactive areas over the life of the Project (Mine) .	Progressive rehabilitation. Maintenance of rehabilitated area. Monitoring and remedial action as required. Local species revegetation and suitable species selection.	2	2	Low

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
38	Final void lakes due to open cut mining are unsafe for public use. (Decommissioning phase)	Injury or fatality to public and animals.	3	Without preventative measures, voids from open cut mining will remain. Based on the above it is possible that this event will occur.	3	Medium	Final pit design. Batter Down high walls, low walls and end walls. As mining progresses the Project intends for progressive rehabilitation.	Provide adequate signage. Consider fencing the area. As a part of rehabilitation measures, consider developing the voids into freshwater bodies which can be used for recreational purposes.	2	2	Low
39	Underground mine atmosphere. (Operation phase)	Atmosphere not suitable for workers which can result in heat stress.	3	Due to the nature of mining activity potential for heat stress in an underground mine. Based on the above it is possible that this event will occur.	3	Medium	Mine Atmosphere management plan. Provide centralised monitoring from the control room. Design and provide adequate ventilation system. Maintenance on ventilation fans. Intake air cooling when required.	Develop emergency evacuation system during the detailed design phase. Provide training to workers. Provide induction to visitors if they would be going underground.	2	2	Low

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									C	L	Risk
40	Underground mine atmosphere. (Operation phase)	Potential for explosive atmosphere which can result in an underground explosion resulting in an injuries or fatalities.	4	Due to the nature of mining activity potential for occurrence of unsuitable and explosive atmosphere. Based on the above it is possible that this event will occur.	3	High	Geological studies to know future problems. Gas monitoring system. Mine Atmosphere management plan. Provide centralised monitoring from the control room. Design and provide adequate ventilation system. Maintenance on ventilation fans.	Develop emergency evacuation system during the detailed design phase. Provide training to workers. Provide induction to visitors if they would be going underground.	4	2	Medium
41	Fire at accommodation village. (C, O, D phase)	Potential for injury or fatalities.	4	May result from an electrical fault or from the kitchen at the accommodation village. Based on the above it is possible that this event will occur.	3	High	Provide fire extinguishers. Smoke detectors in all rooms Fire suppression systems Design accommodation and infrastructure to Australian Standards and Building Codes. Provide adequate egress arrangements.	Emergency response plan. Adequate signage to provide warnings, exit points and emergency assembly areas. Information on first aid providers and fire wardens displayed on community notice boards.	4	2	Medium

Item	Hazard Event	Potential Impacts (Consequence)	C[1]	Likelihood of Occurrence	L[2]	Overall Risk	Preventative Measures	Responsive Measures	Residual		
									C	L	Risk
42	Vehicle carrying explosive meets with an accident. (C, O, D phase)	Potential for injury or fatalities to driver or member of public. Vehicle engine fire leading to detonation	4	Vehicle collision or roll-over while transport of explosives to the mine. Vehicle engine fire leading to detonation.	3	High	Licensed operators. Transport in accordance with Australian Explosive Code. Drivers with valid driving permit. Drive to road conditions. First aid kits in all Project related vehicles.	Emergency response plan. Provide training to workers.	2	2	Low

In summary the High risks before mitigation measures are in place include:

- Traffic accidents on public roads between a projects related vehicle and a private vehicle
- Community member (pedestrian) accident with Project (Mine) vehicle
- Persons accessing the Mine and associated offsite infrastructure without authorisation
- Changes to surface topography
- Aircraft crash
- Wildlife hazards such as snake bite
- Vehicle interaction with pedestrian at Mine site
- Unplanned detonation of explosives
- Gas / coal dust explosion
- Water influx to underground mine
- Underground mine atmosphere
- Fire at workers accommodation village
- Vehicle carrying explosive meets with an accident

The majority of risks were mitigated to Low risks once preventive measures were applied. Aircraft crash (hazards events 28 and hazard event 29) and traffic accident (hazard event 8) were residual High risks due to the severity and irreversibility of their consequence to multiple individuals in a worst case scenario. Vehicle accident involving a pedestrian (hazard event 9 and hazard event 31), unauthorised access to the Mine site (hazard event 25 and hazard event 26), wildlife hazards such as snake bite (hazard event 30), changes to surface topography (hazard event 27), water influx to underground mine (hazard event 34), hazardous UGM atmosphere (hazard event 40) and fire at the workers accommodation village (hazard event 41) were Medium residual risks due to the nature of the consequences.

12.3 Risk Management

12.3.1 Overview

In accordance with Adani's HSE management system,

- Systems shall be established and maintained, at each Adani Mining project, site and operation, to identify and document, on an on-going basis, workplace hazards (i.e. any situation which has the potential to adversely affect the safety and health of people or the environment).
- The risks associated with all identified hazards shall be assessed. The risk assessment shall take into consideration both the probability of a hazard becoming an actual incident and the potential severity of such an incident. The depth and extent of the risk assessment shall be as appropriate to the nature and magnitude of the risk.
- Control measures, in accordance with the risk management hierarchy of controls (i.e. eliminate, substitute, reduce, isolate, protect), shall be implemented to effectively manage identified and assessed risks. Such measures shall be prioritised and actions shall be selected and applied so as to ensure that final risk levels are as low as is reasonably practicable.

- If required, appropriate levels of residual risk transfer (i.e. insurance) shall be in place, and monitored regularly for their adequacy and appropriate coverage.
- Formal, documented procedures shall be established and maintained, to effectively manage all HSE risks associated with temporary or permanent changes. This shall include changes to:
  - plant, equipment or any other hardware
  - materials, including hazardous substances and dangerous goods
  - procedures and other site-specific documents
  - process method and parameters, control software and operating conditions
  - products, intermediates and raw materials
  - site or plant layout
  - organisational structure or responsibility and authority of personnel
  - any other change which has the potential to affect the safety and health of people or the environment.
- The depth and extent of the assessment of changes shall be as appropriate to the nature and inherent risk of the change.
- Where required, changes shall be reported to the appropriate authorities.
- The implementation of changes shall include:
  - consultation with affected personnel and their representatives
  - updating of drawings and other documents
  - appropriate training
  - communication of the changes

The following sections identify a range of matters arising from this hazard and risk assessment that will be incorporated into site safety, environmental and emergency response plans.

12.3.2 Safety in Design

The Project (Mine) will incorporate the following safety in design measures:

- Design of fuel, oil, chemical and explosives storage areas in accordance with relevant Australian Standards.
- Design of water management structures to the appropriate design level.
- Design of fire detection and response systems as per Australian Standards.
- Design of buildings to Building Code of Australia.
- Design of airstrip to CASA requirements.
- Appropriate fencing along the accommodation village and high risk mine areas such as MIA.

These measures will be identified in the design specifications in the engineering feasibility stage.

12.3.3 Building Fire Safety

Design and layout of the facility and operating procedures and arrangements are essential to fire prevention. A review of Bushfire Risk Analysis map prepared in June 2008 for Isaac Regional Council by the QFRS indicates the mine area has been classified as having a low to medium bushfire hazard.

The Project (Mine) will aim to ensure the safety of personnel and assets for all structures within the Project including buildings at the mine site, accommodation village and airstrip for event like fire or hazardous material spills/emergencies. The buildings will be designed with attention to:

- Means of escape from building - evacuation routes, exit doors, fire/smoke doors, evacuation signs/diagrams
- Occupancy limits for buildings
- Maintenance of fire safety installations - exit signs/emergency lighting, fire extinguishers, fire hose reels, fire detection and alarm system, evacuation system, sprinkler system, hydrant system, smoke and ventilation system, standby power supply
- Housekeeping, in relation to ignition sources and flammable materials
- Evacuation planning, instructions and drills - fire and evacuation plans, fire and evacuation instructions

All buildings, structures and fixed plant will be protected with a suitable water supply, water reticulation and hydrant system. For buildings and occupied facilities a fire hose system, or a fire hydrant system, and/or pump sets, will be in compliance with the Building Code of Australia (BCA).

The Project will ensure compliance with the QFRS guidelines for buildings constructed at mine site and accommodation village. The fire safety systems installed in a building will be any one or combination of the methods in a building to warn people of emergency, provide for safe evacuation, restrict the spread of fire and extinguish fire.

The Project will develop a fire and evacuation plan with adequate instructions to people concerning the action to be taken by them in the event of fire and will be provided in a building as required under the *Fire and Rescue Service Act 1990*. The *Building Fire Safety Regulation 2008* sets of the requirements for a fire and evacuation plan and each plan will contain information such as:

- Name of the building
- Contact details for occupier of the building
- Evacuation coordination procedures for the building
- Instructions for evacuating the building safely in accordance with the evacuation coordination procedures for the building in the event of a fire or hazardous material emergency
- Method of operation of fire fighting equipment and manually operated fire alarms in the building
- Procedures for giving fire and evacuation instructions to people working in the building

12.3.4 Training

All personnel will undergo induction and refresher training which will include both preventative and responsive measures in relation to environmental and community hazards. Personnel will undergo specific training in hazard prevention and response in relation to their work area.

12.3.5 Services Provided by Contractors

It is expected that certain services will be provided by contractors. During construction, a number of contractors will undertake activities at this site. During operation, services provided by contractors may include transportation of diesel fuel and other potentially hazardous substances, explosive

storage and handling, general materials transportation and waste management and disposal. The Project will incorporate incident prevention and response requirements into contracts.

12.3.6 Safety and Fire Management Systems

12.3.6.1 Safety Management Systems

The Project will establish and implement a Safety Management System (SMS) for the management of risk to a level that is as low as reasonably practical. The SMS will provide a systematic way to identify hazards and control risks while maintaining assurance that the risk controls are effective. The overall management system will include appropriate organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the workplace health and safety policy, and so managing the risks associated with the business of the organization. A safety and health management system will also be established for the Project (Mine) under the *Coal Mining Safety and Health Act 1999*.

12.3.6.2 Fire Management System

The Project will develop a fire management system (FMS) for the prevention, early detection and suppression of fires at the proposed Mine and workers accommodation village. A Fire Management Pan (FMP) will be developed during the detailed design phase with an approach to safety. The FMS and SMS will link to the RMP. Typically the FMP will address the following:

- Identification of fire hazard which will include fuel sources, ignition (heat) sources and oxygen sources
- Fire risk assessment and risk control for activities at the mine site and accommodation village
- Safe systems of work through use of tools such as Job Safety and Environmental Analysis
- Provision of adequate information, instruction, training and supervision on fire hazards and fire risk controls
- Consultation with all stakeholders
- Monitoring, review and revision of the fire risk management process

A fire risk management assessment will be carried out in accordance with Australian and New Zealand Standards *AS/NZS ISO 31000:2009 Risk management – Principles and guidelines*.

Fire detection measures proposed include provision of:

- Smoke or other fire detection systems
- Use of plant monitoring systems such as bearing temperatures, vibrations, infra-red sensors, brake release, belt tracking, belt slip and other systems
- Effective inspection and corrective action system
- Communications with people within mine and with external response agencies

An adequate supply of water for fire fighting purposes will be provided to all fire risk areas and fire risk locations throughout the mine. The acceptable sources of water supply will be in accordance with *Section 4 Water Supplies* of Australian Standard AS *2419.1-2005 Fire hydrant installations Part 1: System design, installation and commissioning* (AS 2419.1), as applicable.

Water storage tanks and their capacities will be in accordance *Section 5 Water Storage* of AS 2419.1, as applicable. Maintenance of onsite storages will be carried out during periods of least risk, e.g. nonproduction and kept to a minimum time frame.

Fire protection pump sets will be installed in accordance with Australian Standard *AS 2941-2008 Fixed fire protection installations-Pumpset systems*. All fire extinguishers should be maintained in accordance with Australian Standard *AS 1851-2005 Maintenance of Fire Protection Systems and Equipment*.

A fire station, fully equipped with fire truck and other fire fighting equipment will be constructed at the mine site. During the detailed design phase, the Project will consult the emergency services (including QFRS) to comply with their requirements.

12.3.7 Emergency Response Priorities

Following emergency response priorities have been identified by the Project:

- Safety and well-being of all on-site personnel and community members
- To extent possible, minimise the environmental harm
- Minimise impacts on business assets as well as assets in the neighbourhood

12.3.7.1 Emergency Response Team

An emergency response team will be established at the mine site to ensure trained and equipped personnel are available in the event of an incident. The team will consist of personnel trained in emergency response as well as volunteers from each operation shift and on-duty maintenance staff.

Members of the internal emergency services will be trained in the following in relation to environmental and community hazards:

- Chemical/ Diesel/ Oil spill response and clean-up
- Fire fighting
- Bushfire rescue
- Response to intrusion by people
- Responding to vehicular accidents
- First aid and resuscitation
- Rescue – underground mines, heights, water, confined spaces, vehicles and remote locations
- Handling chemicals and explosives

Trained first aid personnel will be employed on-site. Refresher training will be provided to these personnel. The emergency response team will be stationed at the workers accommodation village during the operational phase.

12.3.7.2 External Emergency Services

Adani will seek to be as self-sufficient as possible in relation to medical and fire fighting services and will also have security at the workers accommodation village. However, in the event of certain hazard events occurring, emergency services support will be required. For example, fire services may be

required to assist if a large fire occurs, whereas Queensland Police Service and Queensland Ambulance Service are likely to be required to attend where any road accidents occur.

In such cases, the Project will interface with the following external emergency services to assist in emergency response:

- Queensland Mines Rescue service for assistance in recovery operations for underground and open cut incidents
- Queensland Ambulance Service – in relation to evacuation of injured persons
- Queensland Police Service – in relation to road closures, evacuations and unauthorised entry
- Queensland Fire and Rescue Service – in relation to support in bushfire or coal seam fire fighting where required
- Queensland Health – acute and emergency services

Adani will continue to liaise with emergency services and involve emergency services in development of emergency management and response plans. Adani will also provide regular information updates to emergency service providers and provide support to emergency services personnel required to attend the proposed mine.

The interface and roles and responsibilities including communication protocols will be outlined in the various management plans. Further details regarding on-going consultations with emergency services providers are provided in Volume 4 Appendix G Social Impact Management plan.

12.3.7.3 Emergency Response Equipment

The following equipment will be available at the mine site to support incident response:

- A fully equipped first aid kit in each mine vehicle
- Oil and chemical spill response equipment suitable for spills to land and creeks
- A weather station
- Personnel protective equipment as required to protect personnel involved in incident response activities
- Suitable communication equipment to communicate during emergencies
- Ambulance
- Fire trucks
- A central first aid room equipped with response facilities such as oxygen cylinder, defibrillators and basic medical supplies

12.3.7.4 Incident Reporting and Investigation

An incident investigation will be undertaken for every incident and near miss. Incident investigation reports will cover a description of the event, description of any damage, photographs, planning actions to respond to the incident, details of communication which took place during the incident, comment on the ERP adequacy and any recommendations or suggested changes to the ERP.

12.3.7.5 Emergency Response Plan

The Proponent will prepare an Emergency Response Plan (ERP) for construction, operations and decommissioning phase, which will incorporate the requirements for workplace health and safety, community and environmental hazard management. Hazards identified in Table 12-7 will be addressed in the ERP. An outline of response plan contents for hazards identified in Table 12-7 is provided as follows.

Vehicle Accident Response

The Project will develop a plan for vehicle accident response. This plan will be developed prior to activities commencing on the site, and will include measures to minimise impacts associated with the above factors, including notification of emergency services via calling '000' as the first priority.

Spill Response

An emergency spill response plan will be developed in accordance with the requirements of the *Environmental Protection Act 1994* and will include reporting of the spill to the Incident Controller. The spill will be assessed to identify the type of oil (lube oil, diesel, chemical or other), location of the spill source, the quantity of oil spilled and its environment, community, health and safety impact. The Incident Controller will undertake immediate steps to spill containment/control, recovery of spill material and waste management. Recovery operations are then commenced which includes provision of welfare, reconstruction/clean up and replenishment of material stocks.

Dam Failure Response

The standards used for design, construction, operation, maintenance and inspection of dams are intended to minimise the risk of dam failure. However, unusual circumstances could result in dam failure, which requires emergency planning. Issues to be considered in planning include:

- Determination and identification of conditions that should be warned in an emergency
- Identification of actions to be taken and in what sequence
- Identification and provision of required resources, tools and equipment and indicate where they can be located and how to access these if required in an emergency
- Identification and preparation of a list of all persons and entities (including contact details) involved in an incident
- Identification primary and secondary communication systems, both internal and external
- Briefing of all stakeholders on response plans
- Testing and revision of the plan at regular intervals and if any changes occur

Spontaneous Combustion Management Plan

The Project will develop a Spontaneous Combustion Management Plan to address this hazard. A number of stockpile management measures will be in place to reduce the likelihood of spontaneous combustion in coal stockpiles. .

Stockpile management and turnover will be achieved by maintaining records on coal stored in the stockpiles, including date of arrival at the stockpile and coal quality. The aim will be to ensure that coal is not retained within the stockpile for more than six-eight weeks, and to initiate additional visual and temperature monitoring once coal has been in the stockpile for more than eight weeks.

A FMS will be installed at the stockpile to allow prompt and effective response in the event that combustion occurs. Site staff will be trained in fire fighting with the intent that the Project can provide its own fire response capabilities. Local and regional Fire and Rescue service representatives will be consulted in the design of the FMS and provided with copies of relevant response plans to assist Fire and Rescue services in the event that off-site assistance is required.

Fire Emergency Response

The ERP will outline the procedure for responding to a fire and link to a detailed FMP. The FMP and ERP will have all necessary information on responsibilities, emergency contact details, communication procedures, training, fire protection equipment, first aid, post incident follow-up and review.

Natural Hazard Response

The ERP will include responses for natural events such as cyclones, stormwater flooding, and earthquakes.

12.3.8 Construction Safety

The Project will undertake construction safety studies which will relate to:

- The construction program
- The safety and emergency procedures
- Safeguards required ensuring safety on site and in surrounding areas during the construction phase of the mine

The construction safety studies will include the following key elements:

- A review of the construction program and operations
- Identification of hazards specific to construction operations and assessment of associated safeguards. Assessment of operational safeguards for the construction period
- A review of the relevant safety assurance system
- Finalisation of construction programs
- Review of procedures for management of change during construction

12.3.9 Project Decommissioning

At project decommissioning the Mine will be rehabilitated. The Project (Mine) will ensure that any dangerous substances, empty tanks will be removed from the site and any contaminated areas remediated to eliminate or minimise danger to the environment and public. If required some of the areas will be fenced off and warning signs placed prohibiting access to public. The Project will undertake an assessment during the operational phase and conduct a detailed evaluation of the likely risks at the decommissioning phase. Relevant authorities will be consulted as a part of the Project closure process so as to comply with the regulation and legislative requirements.

12.4 Public Health and Safety

Adani will implement its Health Safety and Environment Policy (refer to Volume 4 Appendix A Adani Environment and Sustainability Policy) which provides the basis for management of employee and public health and Safety.

12.5 Summary

The hazard and risk assessment for the Project (Mine) identified a range of hazards and risks likely to occur during the construction, operation and decommissioning phases.

Forty one potential hazard events were identified. A range of preventative and response measures were identified and assessed to mitigate the risks associated with the 42 hazard events from an uncontrolled scenario of 8 low, 18 medium and 15 high risks to a controlled scenario of 29 low, 9 medium and 3 high residual risks

A range of preventative and response measures were identified and included in Table 12-7.

Risk assessments have been undertaken for dam failure in accordance with DERM guidelines. The MAW is identified as significant risk for failure and as such a 5 per cent AEP has been added to the design.

The range of hazards and risks identified also impact on the health and safety of the Project (Mine) workforce and the general community. The implementation of workplace health and safety procedures and the mitigation measures identified will minimise the potential risks to acceptable levels.

Based on the studies conducted, it is concluded that there are no hazards during normal operations which have offsite impacts from mine construction, operation or decommissioning. The proposed controls identified and outlined in this assessment adequately safeguard against risks associated the Project (Mine).