# 15. Conclusions and Recommendations

## 15.1 Conclusions

Adani Mining Pty Ltd (Adani) is proposing to develop a 60 million tonne (product) per annum (Mtpa) thermal coal mine in the north Galilee Basin approximately 160 kilometres (km) north-west of the town of Clermont, Central Queensland. All coal will be railed via a privately owned rail line connecting to the existing QR National rail infrastructure, and shipped through coal terminal facilities at the Port of Abbot Point and the Port of Hay Point (Dudgeon Point expansion). The Carmichael Coal Mine and Rail Project (the Project) will have an operating life of approximately 90 years. The Project comprises of two major components:

- The Project (Mine): a greenfield coal mine over EPC1690 and the eastern portion of EPC1080, which includes both open cut and underground mining, on mine infrastructure and associated coal processing facilities (the Mine) and the Mine (offsite) infrastructure including:
  - A workers accommodation village and associated facilities
  - A permanent airport site
  - Water supply infrastructure
- The Project (Rail): greenfield rail lines connecting the Mine to the existing Goonyella and Newlands rail systems; including:
  - Rail (west): a 120 km dual gauge portion from the Mine site running west to east to a junction with proposed lines running south-east to the Goonyella rail system and north-east to the Newlands rail system
  - Rail (east): a 69 km narrow gauge portion connecting to the Goonyella rail system south of Moranbah to provide for export of coal via the Port of Hay Point (Dudgeon Point expansion)

The objectives of the Project (Mine) are to:

- Produce 100 per cent thermal coal product
- Achieve a maximum production of 60 Mtpa of product coal, on an as received basis, sourced from open cut and underground mining
- Produce coal with a target ash of 25 per cent ash requiring minimal washing

The open cut mine has a capacity of 40 Mtpa (product) and will be located along the eastern portion of EPC1690. The open cut mine will be predominantly a truck/shovel/excavator operation, supplemented by draglines and dozers for primary waste removal. The proposed dragline method is standard in many Central Queensland coal mines. The method involves an extended key and bench operation that can be easily optimised. Sixteen open cut pits will be mined over the life of the Project (Mine), designated pits A to P. Pits A to K are located to the north of the Carmichael River and Pits L to P are located to the south.

During the early stage of development of each pit, overburden will be transported to out-of-pit dumps on EPC 1080, which will be profiled and rehabilitated as operations progress. Thereafter, backfilling of the pit will be maximised during operations and eventually a proportion of the waste will be used to re-profile the high-wall of the final voids.

Three underground longwall coal mines will be developed, designated as the north underground mine, central underground mine and south underground mine. The north and central underground mines are located to the north of the Carmichael River, with the south underground mine to the south of the river. The underground mines will produce up to approximately 20 Mtpa (product) of lower ash coal over the first 45 years of the overall mine life. The lower ash coal will be blended with higher ash coal from the open cut mines, to minimise the overall need for coal processing and washing to meet the target ash content of 25 per cent.

The potential impacts of the Project (Mine) as they relate to the following values have been investigated and assessed as part of Volume 2.

- Climate, natural hazards and climate change
- Land, incorporating
  - Scenic amenity and lighting
  - Topography, geology and soils
  - Land contamination
  - Land use and tenure
- Nature conservation, incorporating
  - Terrestrial ecology
  - Aquatic ecology
- Water resources, incorporating
  - Surface water resources
  - Groundwater resources
- Air quality
- Greenhouse gas emissions
- Noise and vibration
- Waste
- Transport
- Hazard and risk

A Draft Environmental Management Plan for the Project (Mine) is presented in Volume 2 Section 13, and a Draft Environmental Management Plan for the Project (Offsite Infrastructure) is presented in Volume 2 Section 14. The potential impacts of the Project (Mine) as they relate to indigenous and non-indigenous cultural heritage, social values, economic values and matters of national environmental significant have been investigated and assessed in as part of Volume 1.

**Climate, Natural Hazards and Climate Change**

Natural hazards with the potential to impact or be impacted by the Project (Mine) include flooding, severe rainfall, tropical cyclone, earthquake and bushfire. Furthermore, the frequency or severity of natural hazard interaction with the Project (Mine) may increase as a result of climate change.

Management and mitigation measures have been identified as part of this EIS for the Project (Mine) to safeguard against risks associated with natural hazards and climate change. These include design

requirements for mine affected water dams and sediment basins, development of a conceptual drainage scheme and the development of a fire management system to prevent and control fire.

An estimated 35 per cent increase in runoff over the Project (Mine) was modelled for the 1 in 1000 year ARI event under a climate change scenario defined by the Queensland Government Scientific Advisory Group. This potential impact would be further investigated during detailed design of the Project (Mine).

**Land**

The Project (Mine) will unavoidably result in a change to the character of the landscape. The visual sensitivity of all identified sensitive receptors was assessed to be low, given their distance from the Project (Mine). In the first instance, preliminary evaluation of site works and facilities have been guided by the need to avoid or reduce potential adverse impacts of the Project (Mine) on visual receptors. Additional measures such as retention of vegetation and minimisation of light spill were also proposed.

The main impacts in relation to topography, geology and soils associated with the Project (Mine) will be in relation to the disturbance of land. Mining operations will allow for progressive rehabilitation over the life of the Project (Mine), minimising the area of land disturbed at a given time. Progressive rehabilitation is scheduled to commence in 2018, at completion of mining in Pit I.

Pits will be remediated by pushing the highwalls to a stable angle. The low wall will likewise be profiled to a stable angle that can be revegetated and rehabilitated along with the main body of the backfill. The final voids will be left in an internally draining condition, to minimise potential discharge of accumulating groundwater and surface precipitation.

A subsidence study for the Project (Mine) was undertaken by Mine Subsidence Engineering Consultants (MSEC). The report predicted an average of 7.5 m of subsidence at the surface over the shallow longwalls with the total subsidence decreasing with depth. A range of design factors may act to modify the level of subsidence that actually occurs. The final arrangement of overlying panels and pillars will act to locally modify strata response and result in potentially lower values of vertical subsidence than noted here, while strains and tilts associated with panel edges and remnant chain pillars may be locally elevated.

No lots within the Project (Mine) area are listed on the Contaminated Land Register (CLR) or the Environmental Management Register (EMR) for contaminated land. As such, the potential for mobilisation of contaminants as a result of the Project (Mine) was restricted to contact with pre-existing and unregistered contaminated land. It is intended that the Project (Mine) will not lead to land contamination requiring registration. It was considered that any potential impacts that do eventuate would be managed through design, construction, operation and decommissioning in line Project (Mine) and regulatory requirements.

The Project (Mine) will have a direct impact upon the current land use and tenure of the Project area. A progressive shift from the current cattle grazing land use to a mining related land use will occur throughout the life time of the Project (Mine). These Project (Mine) impacts are unavoidable due to the location of the coal deposit, however progressive rehabilitation and ultimate decommissioning of the Project (Mine) are planned.

Soil surveys conducted over EPC 1690 found that soils had generally poor physical properties and agricultural suitability. Given these poor physical properties, post mining land use is likely to be

restricted to cattle breeding country. Topsoil management planning and soil quality amelioration measures were identified to improve the physical properties of the soil for rehabilitation.

The Project (Mine) has the potential to impact upon the existing road network and stock route network. Road closure of the Moray Carmichael Road is not proposed and the utility of Moray Carmichael Road as a public road link will be maintained at all times. Adani have and will continue to consult with the IRC and DNRM in order to avoid causing undue disruption to the use of stock routes.

**Nature Conservation**

The Project Area occurs in an agricultural landscape, where historic and current land use practices associated with cattle grazing have altered the extent, connectivity and ecological integrity of vegetation communities and the fauna habitat they provide. Remnant vegetation occurs over approximately 60 per cent of the Project Area and a total of 36 field verified REs were identified within the Project Area, 22 from the Desert Uplands and 14 from the Brigalow Belt bioregions. The Project Area contains a range of fauna habitat types that share broadly similar habitat values (based on habitat structure), but vary in their value for wildlife based on the specific forage and shelter resources they provide. Ironbark-box woodland was the most widespread fauna habitat type at the Project Area.

The DEHP Biodiversity Planning Assessment (BPA) mapping indicated that some remnant vegetation within and surrounding the Project Area is of ecosystem value at a regional level, while much of this remnant vegetation is ranked as having very high or high ecosystem diversity and (ecosystem) context and connection. Approximately 1,060 ha of Category B ESAs (endangered Biodiversity Status REs), recorded from the occurrence of seven RE types (10.4.3, 10.9.3, 11.3.1, 11.4.5, 11.4.6, 11.4.8 and 11.4.9), were identified from the Project Area (based on field verified RE mapping). No DNRM mapped essential habitat occurs at the Project Area, although a number of patches (for a variety of species) occur in the landscape around the Project Area.

The EPBC Act listed TEC, Brigalow (Acacia harpophylla dominant and co-dominant), was identified as present at the Project Area during field surveys. The presence of this TEC was recorded from the occurrence of REs 11.3.1, 11.4.8 and 11.4.9 within the Project Area. Approximately 267 ha of these REs are present, predominantly south of the Carmichael River at the east of the Project Area.

One threatened flora species, listed under both the EPBC Act and the NC Act, was recorded within the Project Area from field surveys – waxy cabbage palm (*Livistona lanuginosa*). Two individuals of this species were observed in the Carmichael River channel, and it is not expected to occur elsewhere within the Project Area. One EPBC Act listed threatened flora species, *Acacia ramiflora* and two flora species listed under the Queensland NC Act, *Nesaea robertsii* and *Peripleura scabra*, may occur at the Project Area (based on suitability of habitat, previous records from region, current known distribution).

The vast majority of fauna species recorded from the Project Area were common, widely distributed species. A limited number of introduced fauna species were recorded. Notwithstanding the cane toad, introduced animals were observed to occur at relatively low densities. Two threatened birds and one mammal listed under the EPBC Act were recorded – the endangered black-throated finch (southern) (*Poephila cincta cincta*), the vulnerable squatter pigeon (southern) (*Geophaps scripta scripta*) and the vulnerable koala (*Phascolarctos cinereus*). Both bird species appeared to be locally common where suitable habitat was present at the Project Area. Potential habitat occurring within and beyond the Project Area for these species was identified. Two additional EPBC Act listed

threatened fauna species, yakka skink (*Egernia rugosa*) and ornamental snake (*Denisonia maculata*), were not recorded from field studies, but are considered likely to occur at the Project Area (based on suitability of habitat, previous records from region, current known distribution).

Three common EPBC Act listed migratory bird species, eastern great egret (*Ardea alba*), rainbow bee-eater (*Merops ornatus*) and satin flycatcher (*Myiagra cyanoleuca*) were recorded at the Project Area. In addition to these, 15 EPBC Act listed migratory bird species not recorded during field studies have the potential to occur at the Project Area. However, habitats at the Project Area are not considered likely to support important assemblages of migratory species.

Three threatened fauna species listed under the NC Act (in addition to the two bird species also listed under the EPBC Act (black-throated finch (southern) and squatter pigeon (southern)) were recorded – the near threatened black-necked stork (*Ephippiorhynchus asiaticus*), cotton pygmy-goose (*Nettapus coromandelianus*) and little pied bat (*Chalinolobus picatus*). Potential habitat occurring within the Project Area for these species was identified. An additional two threatened fauna species listed under the NC Act (in addition to those also listed under the EPBC Act) are considered likely to occur at the Project Area (based on suitability of habitat, previous records from region, current known distribution).

Five NC Act-listed special least concern fauna species were recorded at the Project Area (the three EPBC Act listed migratory birds mentioned above, echidna (*Tachyglossus aculeatus*) and koala).

One protected area occurs within the Project Area. Bygana West Nature Refuge, at the southern part of the Project Area, is dominated by ironbark-box woodland, although smaller patches of three other fauna habitat types were recorded within its boundary. The land use of the nature refuge is cattle grazing. Two threatened species were recorded along its southern boundary - black-throated finch (southern) and squatter pigeon (southern). Both (sub) species are likely to utilise habitats within the Nature Refuge.

Construction phase impacts are associated with the mine infrastructure area and offsite infrastructure. These facilities will be constructed within predominantly cleared land within and to the east of eastern portion of EPC 1080. Potential impacts associated with the construction phase include:

- Vegetation clearing
- Disturbance of surface watercourses and water bodies
- Introduction of pests and feral species
- Altered exposure to disturbance

Operation phase impacts are associated with open cut mining, out of pit waste dumping, water management dams, underground mining (and potential for subsidence) and operation of offsite infrastructure. Potential impacts associated with the operation phase include:

- Vegetation clearing
- Disturbance of surface water courses and water bodies
- Alteration of groundwater regime
- Introduction of pests and feral species
- Altered exposure to disturbance

The approach to mitigating and managing operation phase impacts will include a combination of prevention or reduction of all avoidable impacts to the greatest extent possible, active management to maintain and where possible enhance habitats that will not be impacted during staged operations, and active management of areas that will be disturbed during staged mining operations such that they retain their existing values until such time that they are disturbed. Research and monitoring will be a fundamental component of the impact management approach, with a dual objective of informing management of environmental impacts at and near the Project Area, as well as contributing to the understanding and protection of ecological values in the Galilee Basin. As unavoidable impacts are an inherent aspect of this Project, given that its operations are entirely related to the locality of the coal resource within the mining lease, offsets will form a substantial component of the impact management approach. Whilst all reasonable efforts will be made to minimise impacts to flora and fauna values within the operation phase footprint, vegetation loss, fauna habitat loss and fauna mortality will occur. The overarching objective of managing impacts during the operation phase will be to maintain and where at all possible enhance the ecological values that characterise the Project Area and the surrounding landscape, with a view to achieving no-net-loss of regional biodiversity values.

**Water Resources**

The Project (Mine) has the potential to impact on surrounding water resources. Many of these potential impacts are insignificant as a result of the implementation of the water management system. This system involves the development of a drain diversion system designed to redirect surface water away from MAW, to both provide flood immunity to the site and to minimise the volume of mine-affected water requiring treatment before discharge. Levees will run parallel to the northern and southern sides of the Carmichael River to prevent MAW entering the river, thereby protecting water quality and environmental flows downstream. Sediment basins will be constructed as the mine develops to treat stormwater runoff from spoil areas and rehabilitation areas.

The proposed open cut mining areas are located towards the east of the EPC 1690 lease area. None of the Triassic-age strata which form part of the GAB (i.e. the strata overlying the Rewan Group) are present within the proposed open cut mining areas. Triassic-age strata including the Dunda Beds are present in the underground mining area towards the west of the lease but only the older underlying Permian units will be actively dewatered in this area. The area to the west of Study Area is mapped as representing part of the Eastern Recharge area of the GAB. Hence, any impacts on groundwater levels in outcropping relatively permeable sandstone units such as the Dunda Beds and Clematis Sandstone has the potential to reduce the volume of recharge to the GAB. However, it should be noted that the topography, groundwater modelling results and the limited available groundwater level data all suggest that current groundwater flow in Triassic-age units to the west of the site may be towards the east i.e. away from the GAB rather than towards it. No direct impact to the GAB is anticipated and where this eastward groundwater flow direction is confirmed by further monitoring then no indirect impacts on the GAB groundwater resources would occur as a result of dewatering.

Groundwater model predictions suggest maximum groundwater table drawdowns of up to 10 m during the operation phase along the western boundary of the Study Area where Triassic-age Dunda Beds, Clematis Sandstone and/or the Moolayember Formation are mapped at outcrop. Predicted impacts decline relatively rapidly towards the west, away from Study Area, and hence maximum water table impacts of less than one metre at 10 km from the lease boundary are typically predicted.

For the most part the predicted cone of influence of mine dewatering does not extend beneath the GAB Doongmabulla Spring complex to the west of the Project (Mine) site and hence less than 0.05 m of drawdown is predicted at 9 of the 11 mapped spring sites. However, minor impacts of up to around 0.12 m drawdown are predicted at the two springs closest to the lease, Little Moses (1034) and Doongmabulla or Joshua Spring (1041). There is the potential, therefore, for some minor impact on groundwater levels at two springs which in turn has the potential to reduce the rate of flow from the springs and to reduce the amount of water available for the ecological communities dependent on and associated with the springs. Any reduction in the flow from the springs will also impact flows in the Carmichael River downstream.

Based on recent assessments of the potential for impacts on GAB springs in response to Coal Seam Gas (CSG) extractions carried out by DNRM and the Queensland Water Commission, drawdowns of over 0.2 m at GAB spring locations are considered to be potentially significant. Predicted drawdowns at all of the mapped Doongmabulla Springs are below this threshold and are therefore considered to be insignificant.

The maximum predicted cone of influence of mine dewatering extends beneath the Carmichael River within, upstream and downstream of the Project (Mine) site. Given that groundwater discharge to the Carmichael River upstream of the site is thought to help maintain flow in the river during dry periods (along with discharge from Doongmabulla Springs), surface water flows in the river are likely to decline as a result of the predicted reduction in groundwater levels along the river. Groundwater modelling results suggest that groundwater discharges to local water courses, predominantly the Carmichael River, will be reduced by up to 1,000 $m^3$/d or 7 per cent of pre-development discharge during the operational phase. Where groundwater discharge is reduced by 7 per cent as predicted then this may have some impact on the duration of zero flow and/or low flow periods in the Carmichael River and also possibly the Belyando River downstream. Ongoing monitoring and measurement of flows in the Carmichael River and of discharges from the Doongmabulla Springs is required to quantify the magnitude of these impacts.

The Carmichael River also receives a proportion of its water from Doongmabulla Springs; hence any reduction in the rate of flow from the springs as a result of the minor predicted impacts on groundwater levels at two of the springs may also contribute to a reduction of flow in the river.

No significant impacts on flows in the various ephemeral minor creeks which drain the Project area are anticipated since these water courses are not thought to currently receive any substantial discharges from groundwater.

**Air Quality**

Emissions from the Project (Mine) were determined using industry recognised emission calculation and dispersion modelling techniques. Particulate matter concentrations were assessed as TSP, $PM_{10}$, $PM_{2.5}$ at proposed offsite infrastructure locations and sensitive receptors identified around the Project (Mine).

The assessment of impacts to humans at existing sensitive receptors found that, with the inclusion of background levels, there are no exceedences of the air quality objectives predicted at sensitive receptor locations for $PM_{10}$ (24-hour average), $PM_{2.5}$ (24-hour average and annual average), TSP (annual average) and deposited dust (monthly average) during the start-up, full operations and maximum emissions scenarios. However results indicated that the $PM_{10}$ (24-hour average) criterion is equalled at receptor 32 (Lignum) in the maximum emissions scenario and the $PM_{2.5}$ (annual average)

criterion is equalled at receptor 6 (Doongmabulla) in the full operations scenario. The assessment of future sensitive receptors found that the industrial zone exceeded the $PM_{10}$ (24-hour average) criterion in the start-up scenario. Both the industrial zone and airport terminal exceeded the $PM_{2.5}$ (24-hour average) criterion and $PM_{10}$ (24-hour average) criterion in the full operations and maximum emissions scenarios. The $PM_{2.5}$ (annual average) criterion, the TSP annual objective and the deposited dust objective were not exceeded at any future sensitive receptor in any scenario.

Adani have commissioned the installation of ambient dust monitoring equipment at four regional receptor locations in order to obtain air quality data to assist in ongoing monitoring requirements. Additional dust mitigation measures prescribed in the event that dust monitoring records any potential exceedance included:

- Consideration of the use of conveyors to haul a proportion of overburden
- Increase dust management of haul roads and stockpiles
- Implementation of a dust management plan including the use of a meteorological forecasting system coupled with a dust impact index for the management and control of significant dust sources during adverse conditions

**Greenhouse Gas Emissions**

The Project (Mine) has the potential to contribute to the greenhouse effect through emissions produced by various chemicals and fuels used to undertake underground and open cut mining activities. The Scope 1 emissions of the Project (Mine) are estimated at 781,891 t $CO_2$-e per annum and the Scope 2 emissions of the Project (Mine) are estimated at 1,503,687 t $CO_2$-e per annum, totalling 2,285,578 t $CO_2$-e per annum. Electricity use has been identified as the largest emission source, accounting for 65.8 per cent of emissions. As electricity is a Scope 2 emission source, the largest Scope 1 emission source is diesel, accounting for 30 per cent of emissions.

A number of GHG mitigation and management measures were identified for the construction phase of the Project (Mine), including use of efficient plant and vehicle types and the implementation of a traffic management plan that will reduce unnecessary or excessive use of vehicles for transport.

The Draft Mine and Offsite EMPs (Volume 2, Section 13 and 14) includes commitments aimed at avoiding and reducing greenhouse gas emissions, energy costs and energy consumption for the Project (Mine). In line with the Draft Mine and Offsite EMPs, a detailed energy efficiency assessment will be conducted for the Project (Mine) on a regular basis. This review will aim to identify initiatives and available technologies, leading to implementation of processes to ensure energy efficiency opportunities are integrated into operations.

**Noise and Vibration**

Baseline noise monitoring was conducted at two locations (A and B) in the vicinity of the proposed Project Area. Locations were selected as they were considered representative of the acoustic environment for the nearest sensitive receptors located in the vicinity of the Mine. While noise levels at monitoring Location A were generally higher due to the influence of birdlife and cattle, both locations were dominated by natural noise sources including insects and birds.

Construction noise during normal hours is not expected to cause adverse impacts at noise receptors. However, in order to reduce the risk of noise impact, the mitigation measures outlined will be taken into consideration during construction of all infrastructures associated with the Project (Mine). Results

indicate that predicted construction noise levels outside of normal hours are expected to be well under the 55 dB(A) WHO criteria at all sensitive receptors.

Operational noise modelling results indicate that received noise levels are expected to comply with the project specific criteria at all receptors under assessed adverse weather conditions. Although not expected to cause adverse noise impacts, the mitigation measures for operation of the Project (Mine) will be reviewed in order to reduce risk of noise impact.

Noise model results indicate the predicted low frequency noise levels are expected to be under the low frequency noise criteria of 50 dB(linear) at all assessed surrounding sensitive receptors. Given the relatively low volumes projected on the Moray Carmichael Road and the large distances involved from the road to sensitive receptors, traffic noise levels are expected to be satisfactory.

Based on available literature, it is concluded unlikely that potential noise associated with the Project (Mine) will adversely impact livestock and native fauna. As such, no specific management measures are required.

Vibration levels produced during the construction and operation of the Project (Mine), including blasting, were expected to be below the most stringent structural damage criteria of 3 mm/s at receptors located at all identified sensitive receptors, and indeed at distances greater than 50 m from the vibration source. Monitoring will be conducted during the initial blasts to confirm predictions.

**Waste**

The characterisation of waste streams for the Project (Mine) is based on its concept design during the construction and operational phases and are generally defined as either construction or demolition waste, or commercial and industrial waste under the *Waste Reduction and Recycling Act 2011* (WRR Act). The waste management measures for the Project (Mine) adhere to the waste management hierarchy of the WRR Act. With the application of waste management measures it is unlikely that the waste generated during the construction and operational phases of the Project (Mine) will have a significant impact. The proposed waste management measures are as follows.

- Vegetation removal will be carefully managed to minimise green waste, and where suitable will be reused for rehabilitation and habitat.
- Spoil will be reduced through the design of earthworks to maximise a balance of cut to fill, thereby minimising excess spoil. Where excess spoil is generated, it will be utilised within the Project (Mine) area as general fill, and fill for the construction of road and bund areas. Bund areas may include that required for water management and works required to protect the Carmichael River.
- Overburden will be managed through the implementation of a policy of in-pit disposal of overburden materials and/or use in rehabilitation, bund construction or other onsite management activities. Where in-pit disposal cannot be achieved out-of-pit disposal will be required.
- Domestic waste will be recycled or composted where possible, with as little waste going to land fill as possible.
- Commercial materials will be purchased through a considered procurement process, reducing excess material and associated waste. Materials such as paper, computer and printer waste and equipment will be recycled where possible.
- Plant and equipment waste will be recycled where possible, and stored and disposed of in accordance with regulatory requirements.

- Wastewater will be treated and reused where possible, or disposed of in accordance with regulatory requirements.

There will be three key mine waste streams generated at Carmichael; being:

- Over / interburden from the open cut pits
- Coarse rejects from initial screening and the CHPP
- Fine tailings from the CHPP

Based on the available results the majority of the overburden and interburden materials (not immediately adjacent to the coal seams) and roof and floor wastes are not likely to be a source of acid immediately after mining. Nor would most of these materials be expected to an immediate source of salinity; however, some portion could be a source of salinity. The clay materials of the overburden and interburden could have a markedly higher potential to release salts and metals to contact water even though the pH may remain alkaline. Typically however, the concentrations of metals in water contacting the waste would be expected to be low while waters remain circum-neutral.

A portion of the carbonaceous mudstone, claystone and sandstone roof and floor and coal materials could be expected to be potentially acid forming in the longer term. The majority of the overburden and interburden waste from all lithological groups is likely to be non-acid forming in the longer term. Some clay, claystone, mudstone and sandstone components of the overburden and interburden may be acid forming in the long term and there may be a requirement to manage these materials prevent or limit the longer-term development of AMD.

All siltstone overburden and interburden samples were classed non-acid forming (NAF). There was variability in dispersion results within each lithological group. The fresh rocks were typically non-dispersive, however, there was a very low potential for dispersion for some lithological groups.

The clays, weathered mudstone, claystone, carbonaceous mudstone and siltstone generally may exhibit dispersive behaviour. Slightly weathered siltstone and fresh mudstones may show a very slight potential for dispersivity. The weathered sandstone did not show any indication of dispersive behaviour.

Weathered rock (all lithological units), fresh siltstone and fresh sandstone showed potential for deterioration and breakdown after exposure to water. The fresh siltstone showed a moderate rate of deterioration, and the fresh sandstone showed slow deterioration. This may indicate that although the fresh rock units are not dispersive, they are not durable, and with time may degrade to sand, silt or clay. The degraded material may be more prone to physical erosion than the original fresh rock.

In addition to the over and interburden, the coarse rejects and CHPP tailings can pose environmental risks if incorrectly managed. The risks are similar to those of the over and interburden, in that, should any potentially acid generating material be incorrectly managed, there remains the potential to adversely impact receiving water quality. This would be realised through lowered (acidic) pH values, and elevated sulphate (salinity) and metal concentrations.

Coarse rejects are likely to comprise roof and floor material from the underground mine, identified in the chapter above as being potentially one of the higher risk geological units at Carmichael. The geochemical assessment indicated that salinities generally ranged between 100 and 1,000 µS/cm for roof and floor material, posing a risk for slightly saline drainage. Additionally, the carbonaceous

mudstone, claystone and a sandstone sample indicated that these geological units may be potentially acid forming.

**Transport**

The construction of the Project (Mine) is expected to occur over a period of approximately ten years between 2013 and 2022. The volume and intensity of truck movements will vary over the construction period. The worst-case construction period was identified to occur during 2013 and generate 25,000 trips or 68 daily trips on the external road network. The operation of the Project (Mine) is expected to commence in 2013. The volume and intensity of the operation vehicle movements would increases over the operation period, peaking three years after the target output production of the Mine is reached (60 Mtpa), which is planned to be by 2022. In 2025, the operation of the Mine is expected to generate approximately 52,000 trips on the external road network, which is equal to 142 daily trips.

The peak traffic generation occurs in 2025 which consists of traffic associated with the Mine operations only. The analysis of the road network during this period indicates that the expected increase in traffic associated with the both the construction and operation of the Mine can be adequately accommodated and does not impact the operating performance of the road network. However, the estimated worst case scenario for traffic generated by the Mine operations will exceed the threshold of a five per cent increase in AADT along Flinders Highway and Gregory Developmental Road a predicted increase that does not meet the GARID criteria. However, this outcome would not impact on midblock level of service (LOS) performance of either road, which is expected to operate with LOS A. Adani will continue to liaise with DTMR regarding management and mitigation measures if this worst case scenario should eventuate.

The delivery of materials and equipment will be managed in order to minimise impact on the local community. Traffic management issues would be addressed through the preparation and implementation of construction and operation Traffic Management Plans (TMPs), which will be developed during the detailed design phase. The TMPs would be developed in consultation with the relevant DTMR Regional offices, police and local authorities.

**Hazard and Risk**

The hazard and risk assessment for the Project (Mine) identified a range of hazards and risks that might 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. Dam failure for both MAW and sediment basins was undertaken separately and in accordance with DEHP guidelines.

There 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.

## 15.2 Recommendation

The Draft Environmental Management Plans (Offsite Infrastructure and Mine) present a range of management and mitigation measures to be implemented during construction and operation of the Mine. Based on the findings of the EIS and assuming implementation of the Draft EMPs (refer to Volume 2 Section 13 Draft Environmental Management Plan (Mine) and Volume 2 Section 14 Draft Environmental Management Plan (Offsite)) and Draft Offsets Strategy (refer to Volume 1 Section 8 Draft Offsets Strategy) it is considered that the Project (Mine) can be undertaken without unacceptable social, environmental or cultural impacts. The Project (Mine) also presents a range of opportunities and positive impacts to regional and State economies.