# TNG Limited

## Mount Peake Project

## Draft Environmental Impact Statement

## Volume I

February 2016

# Volume I

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# Abbreviations

| Abbreviation | Definition |
|---|---|
| AAPA | Aboriginal Areas Protection Authority |
| ABS | Australian Bureau of Statistics |
| $Al_2O_3$ | Aluminium oxide |
| AMD | Acidic and/or Metalliferous Drainage |
| ANC | Acid Neutralising Capacity |
| ANCOLD | Australian National Committee on Large Dams |
| ANZECC | Australian and New Zealand Environment and Conservation Council |
| AS | Australian Standard |
| AWS | Automatic weather station |
| BOM | Bureau of Meteorology |
| BS | British Standard |
| BWRO | Brackish water reverse osmosis |
| CBP | Community Benefits Plan |
| CDRC | Central Desert Regional Council |
| CEMP | Construction environmental management plan |
| CEO | Chief Executive Officer |
| $CH_4$ | Methane |
| CLC | Central Land Council |
| $CO_2$ | Carbon dioxide |
| CO | Carbon monoxide |
| CMS | Cleaner Magnetic Separators |
| CTD | Central Thickened Discharge |
| dBA | Decibel A-weighting |
| DECC | New South Wales Department of Environment and Climate Change |
| DLRM | Northern Territory Department of Land Resource Management |
| DotE | Commonwealth Department of the Environment |
| DME | Northern Territory Department of Mines and Energy |
| DMP | Western Australian Department of Mines and Petroleum |
| EA Act | Northern Territory *Environmental Assessment Act 1982* |
| EIL | Ecological investigation levels |

| Abbreviation | Definition |
|---|---|
| EIS | Environmental Impact Statement |
| EL | Exploration Lease |
| EMP | Environmental Management Plan |
| EMR | Environmental Mining Report |
| EPA | Environment(al) Protection Authority |
| EPBC Act | Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* |
| ESIA | Economic and Social Impact Assessment |
| ESCP | Erosion and Sediment Control Plan |
| Fe | Iron |
| $FeS_2$ | Sulphide pyrite |
| FIFO | Fly-in fly-out |
| GDE | Groundwater dependant ecosystem |
| GWh | Gigawatt Hours |
| h | Hour |
| $H_2SO_4$ | Sulphuric Acid |
| ha | Hectares |
| HFC | Hydrofluorocarbons |
| HPGR | High Pressure Grinding Rolls |
| IAIA | International Principles for Social Impact Assessment |
| IAP2 | International Association for Public Participation |
| ICNG | NSW Interim Construction Noise Guidelines |
| ILOC | Indigenous Location |
| INP | New South Wales Industrial Noise Policy |
| ISP | International Organization for Standardization |
| IUCN | International Union for Conservation of Nature |
| JORC | Joint Ore Reserves Committee |
| kg | Kilogram |
| km | Kilometre |
| kt | Kilotonne |
| kVA | Kilo volt amps |
| kWh | Kilowatt-hour |
| L | Litres |

| Abbreviation | Definition |
| --- | --- |
| LAeq | A-weighted equivalent sound pressure level in dB |
| LGA | Local government authority |
| L/s | Litres per second |
| m | Metres |
| $m^2$ | Square metre |
| $M^3$ | Cubic metre |
| Ma | Million years |
| MCP | Mine Closure Plan |
| $Mm^3$ | Millions of cubic metres |
| mm | Millimetre |
| MMF | Multi-media filter |
| MMP | Mining Management Plan |
| ML | Million litres |
| MLA | Mineral Lease Application |
| MLpa | Million litres per annum |
| MNES | Matter of National Environmental Significance |
| MPA | Maximum Potential Acidity |
| Mt | Million tonnes |
| Mtpa | Million tonnes per annum |
| MW | Mega watts |
| $N_2O$ | Nitrous oxide |
| NAF | Non-acid Forming |
| NAPP | Net Acid Producing Potential |
| NEPC | National Environment Protection Council |
| NEPM | National Environment Protection Measure |
| NGER Act | *National Greenhouse and Energy Reporting Act* |
| $NO_2$ | Nitrogen dioxide |
| $NO_X$ | Oxides of nitrogen |
| NPI | National Pollutant Inventory |
| NRETAS | Northern Territory Department of Natural Resources, Environment, the Arts and Sport |
| NSW | New South Wales |
| NT | Northern Territory |

| Abbreviation | Definition |
|---|---|
| NZS | New Zealand Standard |
| OEMP | Operations environmental management plan |
| PAF | Potentially acid forming |
| PEM | Protocol for Environmental Management |
| PFC | Perfluorocarbon |
| PJpa | Petajoules |
| $PM_{2.5}$ | Particulate Matter up to 2.5 micrometres in size |
| $PM_{10}$ | Particulate Matter up to 10 micrometres in size |
| PMST | Protected matters search tool |
| PPL | Perpetual Pastoral Lease |
| ppm | Parts per million |
| PPV | Peak particle velocity |
| RJCP | Remote Jobs and Communities Program |
| RNP | Road Noise Policy |
| ROM | Run of mine |
| S | Sulphur |
| s | Second |
| SEPP-AQM | Victorian State Environment Protection Policy (Air Quality Management) |
| $SF_6$ | Sulphur hexafluoride |
| $SiO_2$ | Silicon dioxide |
| SOCS | Sites of Conservation Significance |
| SSC | State suburb |
| t | Tonnes |
| TAPM | The Air Pollution Model |
| Ti | Titanium |
| $TiO_2$ | Titanium dioxide |
| TJ | Terajoules |
| TNG | TNG Limited |
| tpa | Tonnes per annum |
| TPWC Act | *Territory Parks and Wildlife Conservation Act 2009* |
| TSF | Tailings storage facility |
| TSP | Total suspended particulates |

| Abbreviation | Definition |
|---|---|
| $V_2O_5$ | Vanadium pentoxide |
| V | Vanadium |
| VDV | Vibration dose value |
| VOC | Volatile organic compounds |
| WDL | Waste Discharge Licence |
| WMP | Weed Management Plan/ Workforce Management Plan |
| WMPC Act | Northern Territory *Waste Management and Pollution Control Act* |
| WONS | Weeds of national environmental significance |
| WRD | Waste rock dump |
| wt% | Weight percent |
| w/w | Weight for weight |
| XRF | X-ray fluorescence |
| µm | Micrometre |
| % | Percent |
| %ile | Percentile |
| > | Greater than |
| °C | Celsius |

# Glossary

| Term | Definition |
|---|---|
| Dewatering | Removal of water by pumping to allow mining below the water table |
| Drawdown | A lowering of groundwater level caused by pumping or the action of a pit void |
| Environmental pollutants | A substance or energy introduced into the environment that has undesired effects, or adversely affects the usefulness of a resource |
| Ephemeral | Flora with a short life cycle that germinate as a result of favourable conditions (e.g. fire, rainfall) |
| Evapotranspiration | The process by which water is transferred from the land to atmosphere by evaporation from the soil and other surfaces and by transpiration from plants |
| Flocculant | A substance which promotes the clumping of particles |
| Floodout | Alluvial floodplains that separate river/creek channels |
| Gabbro sill | A tabular sheet intrusion between older layers of sedimentary rock comprised of a course grained, dark-coloured, intrusive igneous rock |

| Term | Definition |
| --- | --- |
| Grizzly | A grating, usually constructed of steel rails, placed over the top of a chute or ore pass for the purpose of stopping large pieces of rock or ore that may hang up in the pass |
| Groundwater dependent ecosystem | Ecosystems which have their species composition and natural ecological processes wholly or partially determined by groundwater |
| Hydrocarbon | A compound of hydrogen and carbon, such as any of those which are the chief components of petroleum and natural gas |
| Hydrometallurgical processing | Extraction of metal from ore by preparing an aqueous solution of a salt of the metal and recovering the metal from the solution |
| Hydrothermal fluids | Fluids that pass through igneous rock fractures or porous spaces within the rock, altering the chemical composition |
| Phreatophytic | A plant, often with deep roots, that is mostly or entirely dependent on groundwater |
| Polymetallic ore body | An orebody of metallic minerals formed by the replacement of sedimentary, usually carbonate rock, by metal-bearing solutions in the vicinity of igneous intrusions |
| Magnetite | A grey-black magnetic mineral which consists of an oxide of iron and is an important form of iron ore |
| Mesic | Environment or habitat containing a moderate amount of moisture |
| Metalliferous Drainage | Refers to the outflow of acid water from metal mines |
| Metasediments | Sediment or sedimentary rock that has been subjected to metamorphism |
| Open-cut | A mine working in which excavation is performed from the surface to extract ore |
| Palaeovalley | Buried valley systems cut into bedrock |
| Peak Particle Velocity | The maximum instantaneous positive or negative peak of the vibration signal |
| Putrescible waste | Solid waste that contains organic matter capable of being decomposed by microorganisms and of such a character and proportion as to cause obnoxious odours and to be capable of attracting or providing food for birds or animals |
| Regolith | A layer of loose, unconsolidated solid material covering bedrock |
| Riparian | Situated on the bank of a river or other body of water |
| Tailings | Ground rock and process effluents that are generated due to mineral processing |
| Vibration Dose Value | Vibration parameter that combines the magnitude of the vibration and the time for which it occurs |
| Volatile Organic Compound | Carbon based chemicals that evaporate or can easily get into the air at room temperature |
| Wet Mess | Camp kitchen/recreation area for the provision of alcoholic beverages |

# Executive Summary

TNG Limited (TNG) is proposing to develop the Mount Peake Project (the Project), 235 km north-northwest of Alice Springs and 50 km west of the Stuart Highway in the Northern Territory.

This Draft Environmental Impact Statement (EIS) has been prepared to support key Commonwealth and Territory Government approvals under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Northern Territory *Environmental Assessment Act 1982* (EA Act).

### *Assessment Process*

TNG submitted a referral for the Project under the EPBC Act to the Department of the Environment (DotE) on 14 October 2013. The Project (action) was declared "a controlled action" as there is the potential for the Project to have a significant impact on listed threatened species and communities. The Project will be assessed by accredited assessment at the level of EIS under the NT EA Act.

In June 2013, a Notice of Intent for the Project was submitted to the NT Environment Protection Authority (NT EPA). On 13 November 2013 the NT EPA determined that the Project required assessment under the EA Act at the level of EIS. Terms of Reference for the Draft EIS were issued on 7 March 2014.

This Draft EIS will be advertised for public comment and circulated to relevant government advisory bodies for review for a minimum of 28 days. TNG will be required to prepare a Supplement to the Draft EIS addressing the comments received. The Supplement will be circulated to government advisory bodies for review and comment.

Assuming no further information is requested, an Assessment Report based on the Draft EIS and the Supplement is prepared by NT EPA for the Responsible Minister within 35 days of receiving the Supplement. The NT EPA also provides a copy of the Assessment Report to the Commonwealth Minister for the Environment for a decision under the EPBC Act on MNES.

### *Project Description*

The Mount Peake Project will comprise:

- the mining of a polymetallic ore body through an open-pit truck and shovel operation;
- processing of the ore to produce a magnetite concentrate;
- road haulage of the concentrate to a new railway siding and loadout facility on the Alice Springs to Darwin railway near Adnera; and
- rail transport of the concentrate to TNG's proposed Darwin Refinery located at Middle Arm, Darwin.

The Project will mine at a rate of up to 8.4 million tonnes per annum (Mtpa) and, following processing, will produce up to 1.8 Mtpa of magnetite concentrate. This concentrate will be processed at TNG's proposed Darwin Refinery to produce 19,700 tpa of vanadium pentoxide ($V_2O_5$) flake, 292,000 tpa of pigment grade titanium dioxide ($TiO_2$) and 856,000 tpa of pig iron ingots. Processing of the magnetite concentrate in Darwin does not form part of this assessment.

TNG proposes to commence construction in late 2016 with mining commencing in 2018. The life of the project is expected to be 19 years inclusive of construction (2 years), mining and production (15 years), and closure and rehabilitation (2 years).

Key characteristics of the Project are provided below.

## Key Characteristics of the Project

| Element | Characteristics |
|---|---|
| **Project Life** | |
| Construction period | 2 years. |
| Operations period | 15 years. |
| Closure and rehabilitation | 2 years. |
| **Production Estimates** | |
| Ore mined | Up to 8.4 Mtpa, 77.84 Mt over the mine life. |
| Concentrate produced | Up to 1.8 Mtpa, 23.4 Mt over the mine life. |
| **Mining** | |
| Pit | Completed pit will be 2,000 m long and up to 600 m wide covering an area of 120 ha and with a maximum depth of 125 m. |
| Mining | Conventional drill, blast, shovel and haul operation. |
| Waste | Up to 7.9 Mtpa, 61 Mt trucked to the waste rock dump (WRD) over the mine life. |
| Operations | 24 / 7, 365 days per annum. |
| **Ore Processing and Product Handling** | |
| Processing | Crushing, grinding and magnetic separation to produce a magnetite concentrate. |
| Haulage | Up to 50 concentrate loads per day hauled 100 km by truck to loadout facility. |
| Loadout | New train loadout facility at Adnera. Around one train load of concentrate per day. |
| **Infrastructure and Facilities** | |
| Waste rock dump | Maximum height of 40 m with a 90 ha footprint and capacity of 70 Mt. |
| Tailings storage facility | Maximum height of 32 m with a footprint of 457 ha and capacity of 38 Mt. Disposal by Central Thickened Discharge. Water recovery infrastructure installed. |
| Long-term stockpiles | Four long-term stockpiles with a 47 ha footprint and capacity of 16 Mt or ore. |
| Mine facilities | ROM pad, processing plant, Raw Water Dam, Process Water Dam, stockpiles, offices, workshops, water treatment plant, sewage treatment plant etc. |
| Water supply | Around 2,625 MLpa of make-up water will be required. 12 bores established in the Hanson River alluvial aquifer. Power supplied from diesel powered generators. Water delivery pipeline (49 km) connecting the borefield to the Raw Water Dam. |
| Power supply | 28 x 1,400 kVA gas fired generating sets with 3 emergency diesel backup sets. |
| Accommodation village | Located 5 km east of the mine site. |
| Hydrocarbon use / storage | Up to 15 MLpa of diesel stored in 85,500 L self-bunded tanks. Lubricating oil stored in bulk containers inside a bunded area with spill protection and recovery. Waste hydrocarbons stored in a tank within a bunded area to be held for collection by a contractor for reprocessing and recycling. Up to 1.8 PJpa of gas provided from the Amadeus Gas Pipeline via a hot tap and stored in intermodal containers. |
| Access road | Runs 100 km between the mine site and Adnera Loadout Facility. Unsealed. Underpass of Stuart Highway constructed. At-grade intersections of the highway to allow access to the mine. |

| Element | Characteristics |
|---|---|
| Adnera loadout facility | Concentrate stockpile, 1.8 km rail siding, site office, ablutions, diesel storage tank. |
| Ti Tree airstrip | Upgrade of the airstrip to support larger aircraft. Construction of a terminal. |
| Closure and Rehabilitation | |
| Open pit | Will remain as a void with access restrictions. |
| Waste rock dump and ROM pad | Infrastructure removed. Outer slopes battered, water run off directed to natural systems and surface covered in top soil and rehabilitated. |
| Tailings storage facility | Capped with waste rock once dry. Progressive rehabilitation on the perimeter. |
| Processing plant and power station | All equipment removed from site. Hazardous materials confined to prevent off site environmental impact. Disturbed areas rehabilitated. Contaminated sites are remediated. |
| Rail siding | All infrastructures removed (unless the subject of a sequential use agreement) and disturbed areas rehabilitated. |
| Access road | Removed (unless the subject of a sequential use agreement), natural drainage lines re-instated and road areas stabilised and rehabilitated. |
| Borefield | All infrastructure removed and reused if possible (unless the subject of a sequential use agreement). Disturbed areas rehabilitated. |
| Pipelines and power lines | Above ground lines removed and reused if possible. Below ground lines buried at least 600 mm below the surface. |
| Ancillary structures, hard stand areas, site roads etc. | All infrastructure removed (unless the subject of a sequential use agreement). Mobile plant removed. |
| Workforce | |
| Construction | Early-stage construction workers housed in a temporary “fly camp”. Peak of 225 housed in an accommodation village. |
| Operations | Peak of 170 housed in the accommodation village. |
| Decommissioning | Peak of 40 housed in the accommodation village. |

### *Stakeholder Engagement*

Consultation with stakeholders and the community occurred through a variety of methods during development of this Draft EIS. Consultation provided TNG with a forum to disseminate Project information and to allow stakeholders and the public to communicate their opinions to TNG. The consultation approach included meetings with the Traditional Owners, Central Land Council, Northern Territory Government, and public information sessions at Alice Springs, Stirling Station and Ti Tree.

### *Potential Impacts and their Management*

The following table provides a summary of the potential impacts associated with the Project and the proposed management measures.

| Existing Environment | Potential Impacts | Impact Assessment / Proposed Management |
|---|---|---|
| **Socio-Economic** | | |
| The Project is predominantly located on Stirling Station with a small portion of the access road potentially located on the adjacent Anningie Station. Stirling Station and Anningie Station are both cattle stations.<br><br>Anningie Station has organic certification and Stirling Station is considering certification.<br><br>Ti Tree is a small community located on Stuart Highway, 52 km from the mine site. It is identified as a service delivery centre. The estimated population is 143.<br><br>Wilora is an aboriginal community located 47 km east of the mine site. The estimated population is 129. | Potential draw of existing workers into better paying resource jobs.<br><br>Increased demand for accommodation.<br><br>Increased demand for community infrastructure and services.<br><br>Impacts on community values.<br><br>Potential business development and employment opportunities.<br><br>Upgrade of Ti Tree airport.<br><br>Risk to organic certification. | TNG will target 15% of its workforce being indigenous.<br><br>The Project could attract some existing workers from the local communities. Most would come from further afield. Management measures include:<br>• prepare and implement an Industry Participation Plan;<br>• work with local training providers to develop local training programs to provide unskilled people with opportunities to gain employment in the Project;<br>• adoption of recruitment policies that allow for appropriate notice periods to be served for new employees.<br><br>The workforces will be largely fly-in fly-out due to low population numbers in the area. Workers will fly to Ti Tree and then bus to a self-contained accommodation village. No demand on local accommodation or infrastructure and services is expected.<br><br>Potential management measures for impact to community values include:<br>• establish a complaints and feedback register as part of a Grievance Management Procedure for tracking and appropriately responding to any community issues raised;<br>• develop an overall Workforce Management Strategy including workforce sources, management, health and wellbeing and appropriate behavior.<br><br>The Project will bring a number of economic benefits to the local area including local employment, opportunities for local businesses and training. Upgrade of Ti Tree airport will generate some employment during construction with ongoing employment associated with running a small terminal. This will result in positive outcomes.<br><br>Potential risk to organic certification is unlikely due to Project design features such as physical separation, the choice of chemicals to be used and the management measures proposed to handle hazardous materials. |

| Existing Environment | Potential Impacts | Impact Assessment / Proposed Management |
|---|---|---|
| **Human Health and Safety** | | |
| <u>Human exposure to hazardous materials</u><br>The Project will be located on pastoral lease. Use of diesel is primarily limited to fuel for station vehicles. Stirling Station has its own bulk diesel supply.<br>Stuart Highway runs through the Project area with hydrocarbons regularly transported to remote towns and communities.<br>The Amadeus Gas Pipeline runs adjacent to the Stuart Highway. | Release of hydrocarbons due to a vehicle to vehicle accident or rollover.<br>Release of hydrocarbons due to a spill at the mine site.<br>Explosion from the gas storage vessel at the mine site.<br>Fire, formation of toxic gases or explosion of ammonium nitrate. | Potential impacts from human exposure to hazardous materials will be managed through the following:<br>• hydrocarbon transport in compliance with the Dangerous Goods Code. Vehicles will be registered and carry appropriate equipment to respond to a spill, including PPE;<br>• personnel trained in the handling of hazardous materials and spill clean-up procedures;<br>• design, storage and handling of hazardous materials to Australian standards;<br>• diesel stored in self-bunded tanks;<br>• lubricating oil stored in bulk containers inside a bunded area with spill protection and recovery;<br>• waste hydrocarbons stored in a tank within a bunded area and held for reprocessing and recycling;<br>• gas stored in intermodal containers in compliance with AS 4332-2004, The storage and handling of gases in cylinders. Personnel handling gas facilities will be trained;<br>• ammonium nitrate stored in a dedicated standalone building consistent with Code of Practice for the safe storage of solid ammonium nitrate. Handling by trained personnel. |
| <u>Traffic</u><br>The main public road is the Stuart Highway. It is a rural highway with a design capacity of 8,000 one-way vehicle movements per day.<br>A 2014 traffic count indicated that the highway carried 190 one-way (380 two-way) vehicle movements per day. | Interaction of concentrate trucks with vehicles using Stuart Highway.<br>Increased vehicle movements to and from the mine site.<br>Potential for vehicle collisions resulting in death or injury. | Up to 100 two-way concentrate truck movements per day between the mine site and the loadout facility. An underpass of Stuart Highway will be constructed to separate these trucks from highway traffic.<br>The Project is expected to generate 66 and 30 one-way vehicle movements per day during construction and operation respectively. Vehicle movements on Stuart Highway will increase to around 3% of the highway's design capacity. A new intersection will be constructed to allow site access from the highway.<br>Management measures include:<br>• design the intersection of the access road with Stuart Highway in consultation with the NT Department of Transport;<br>• prepare Road Transport Management Plan;<br>• use of pooled vehicles such as buses where practical;<br>• develop Emergency Response Plan. |
| <u>Sunburn, environmental exposure and heat exhaustion</u><br>The climate is arid to semi-arid. Mean monthly maximum temperatures range from 22°C to 37°C, with the mean monthly minimum temperature from 8°C to 24°C. | Workers exposed to increased levels of ultra-violet radiation and risk of heat induced medical conditions. | Management measures include:<br>• all employees provided with appropriate clothing;<br>• sunscreen made available for employee use;<br>• staff training and awareness;<br>• drinking water made available for employees.<br>It is anticipated that the health risks associated with heat exposure can be managed. |

| Existing Environment | Potential Impacts | Impact Assessment / Proposed Management |
|---|---|---|
| <u>Aquifer contamination (potable water)</u><br>All bores in the Project area are used for stock use.<br>Within the broader region, a number of bores provide permanent public water supply. These include Wilora (the closest potable bore to the borefield, approximately 50 km to the east), Barrow Creek service station and Stirling Station homestead. | Groundwater drawdown at the mine or borefield affecting bores supplying potable water.<br>Contamination of groundwater supply at the borefield from leaks or spills of hazardous materials. | No potable water supplies will be impacted from groundwater drawdown.<br>The Project will install diesel generators to power the borefield. Management measures for potential groundwater contamination include:<br>• constructing bores and installing generators on raised hardstands with the height of the hardstand sufficient to protect infrastructure from a 100 year flood event of the Hanson River;<br>• each generator and its associated diesel tank being located within a bunded area of the hardstand;<br>• installation of groundwater monitoring bores to monitor groundwater quality;<br>• implementing clean-up of any spills consistent with the Emergency Response Plan. |
| <u>Mosquito breeding</u><br>No specific assessment of mosquito occurrence in the Project area has been undertaken. Due to the absence to large areas of standing water, mosquito numbers are expected to be low.<br>Habitat suitable for mosquito breeding would be provided following rainfall (wheel ruts, topographic lows underlain by impervious soils and tree or rock hollows). Damp areas around bores also have the potential to act as breeding sites. | Nuisance levels of mosquitoes for the workforce.<br>Transmission of disease by mosquitoes infecting workers. | Management measures include:<br>• rectifying artificially created breeding sites;<br>• improving drainage of floodways;<br>• preventing potential mosquito breeding in artificial receptacles;<br>• screening rainwater tank inlets and outlets;<br>• avoid creating areas of temporary water;<br>• treating artificial ponding with an undiluted bleach solution or a residual insecticide;<br>• ensuring personnel wear long sleeved shirts, trousers and mosquito repellent;<br>• following “Guidelines for preventing mosquito breeding sites associated with mining sites” (Medical Entomology Centre for Disease Control 2005).<br>It is not expected that mosquito’s numbers will be a significant issue at the mine site. |
| <u>Animal attacks / bites</u><br>Several species of animal in the Project area are capable of human attack and inflicting bites (snakes, spiders, dingoes and wild dogs). | Injury or death of a worker. | Management measures include:<br>• staff training and awareness;<br>• on-site medical facilities and medical personnel;<br>• all employees provided with appropriate clothing (boots etc).<br>It is anticipated that the risk to workers can be managed. |

| Existing Environment | Potential Impacts | Impact Assessment / Proposed Management |
|---|---|---|
| Water Resources | | |
| <u>Groundwater</u><br><br>The Project is located within the Western Davenport Water Control District. It is estimated that a total of 50 MLpa is currently used, with 10 MLpa for Public Water Supply (licenced) and 40 MLpa for rural and domestic use (unlicensed).<br><br>The only use of groundwater in the Project area is for stock watering.<br><br>Groundwater levels at the mine site and borefield are around 22 m and 10 m below ground level respectively. | Groundwater contamination from the WRD, TSF, concentrate storage areas, liquid and solid waste disposal and hazardous materials.<br><br>Groundwater drawdown impacts current users.<br><br>Groundwater drawdown impacts phreatophytic vegetation or groundwater dependent ecosystems. | Tailings will comprise sand and silt and are benign.<br><br>Waste rock does not contain material with significant acid forming potential.<br><br>Concentrate is inert and benign.<br><br>Management measures for waste management include:<br>• manage disposal of wastes;<br>• waste hydrocarbons removed from site for recycling;<br>• organic waste buried in an on-site landfill;<br>• brine from the WTP used in the process plant;<br>• sewage treated via onsite packaged treatment plants.<br><br>Management measures for hazardous materials include:<br>• design, storage and handling of hazardous materials to Australian standards;<br>• maintain an inventory of chemicals, MSDS, spill kits and spill response procedures;<br>• lubricating oil stored in bulk containers inside a bunded area with spill protection and recovery;<br>• waste hydrocarbons stored in tank within bunded area and held for reprocessing and recycling;<br>• diesel stored in self-bunded tanks;<br>• regular inspections of storages, tanks and bulk containers and their bunding;<br>• transport of dangerous goods in accordance with relevant legislation;<br>• prepare Emergency Response Plan.<br><br>At the end of mining, groundwater drawdown reaches 100 m near the pit. The 1 m drawdown contour occurs around 1 km from the pit edge. Groundwater drawdown from the pit will not impact any groundwater users.<br><br>Maximum drawdown at the borefield is up to 12 m in the centre of the borefield. The 1 m drawdown contour occurs around 6 km from the borefield. Drawdown is predicted at several stock bores with groundwater levels expected drop more than 3.0 m, which may lead to water supply problems. Management measures include:<br>• base line assessment of potentially impacted bores;<br>• make good agreement developed with the owners prior to the development of the borefield (e.g. deepening the affected bores).<br><br>Groundwater drawdown impacts on Mud Hutt and Stirling Swamps, the Anmatyerr North Site of Conservation Significance and phreatophytic vegetation is discussed under vegetation and flora below.<br><br>The Project is not expected to have a significant impact on groundwater. |

<table>
<tr><th>Existing Environment</th><th>Potential Impacts</th><th>Impact Assessment / Proposed Management</th></tr>
<tr><td><u>Surface water</u><br><br>The Project is located within the Wiso Surface Management Basin. Key water courses near the site are Murray Creek, Bloodwood Creek and the Hanson River.<br><br>Mud Hut Swamp and Stirling Swamp are floodout areas of the Bloodwood Creek and Hanson River, respectively.<br><br>Surface water in the Wiso Basin is used primarily for stock watering and domestic supply to rural communities.</td><td>Contamination of surface waters from sediment runoff, overflow from retention ponds, erosion of the WRD, spills of hazardous materials, failure of the waste water treatment plant and failure of the TSF.<br><br>Flooding of the mine pit.<br><br>Construction of the access road across Murray Creek and the Hanson River resulting in upstream flooding.</td><td>Tailings will comprise sand and silt and are benign.<br><br>Waste rock does not contain material with significant acid forming potential.<br><br>Concentrate is inert and benign.<br><br>Thickened tailings will be pumped to the TSF. A low perimeter embankment will control the lateral extent of the tailings so there is no significant TSF wall to fail.<br><br>Management measures for contamination include:<br>• construction of retention ponds consistent with an Erosion and Sediment Control Plan;<br>• rehabilitation of disturbed areas;<br>• water retention ponds sized to capture an ARI Wet Season rainfall appropriate to their hazard category;<br>• reuse of water around the mine site and for processing;<br>• monitor and manage water levels in the retention ponds to maximise available storage capacity prior to the Wet Season;<br>• drain design to recognise 1 in 100 year flow events and to keep velocities within acceptable design criteria;<br>• regular checks and maintenance on all drains;<br>• use of rip-rap protection on earthwork embankments adjacent to drainage channels;<br>• regular inspections and maintenance;<br>• monitoring in accordance with Surface Water Monitoring Plan;<br>• management of hazardous materials as outlined above for groundwater;<br>• regular checks and maintenance of the waste water treatment plant.<br><br>A preliminary flood risk assessment indicates that the mine site is not expected to experience any significant flooding for events up to the 50-year ARI. However, a bench of lower lying topography in the vicinity of the proposed pit may be prone to flooding during more extreme events. Management measures include:<br>• further surface water modelling adjacent to the pit;<br>• bund constructed adjacent to the pit to prevent any ingress of flood waters, if necessary;<br>• regular inspections of bunds and maintenance as necessary.<br><br>The access road will be provided with at-grade floodways across the Hanson River and Murray Creek. These will prevent backwater effects but will wash out in a major flood event and require reconstruction.<br><br>Culverts will be installed where the access road crosses small defined drainages.<br><br>The Project is not expected to have a significant impact on surface water</td></tr>
</table>

| Existing Environment | Potential Impacts | Impact Assessment / Proposed Management |
|---|---|---|
| Biodiversity | | |
| <u>Vegetation and flora</u><br>The Project is located in the Burt Plain Bioregion. Eight vegetation types occur in the study area:<br>• Mulga shrubland on sandy red earths;<br>• Riparian woodland along watercourses and drainage channels;<br>• Triodia grassland on sandy plains;<br>• Floodplains dominated by *Eucalyptus victrix*;<br>• Open Corymbia woodland on loamy alluvial plains;<br>• Low Acacia shrubland on rocky slopes;<br>• Tall Acacia shrubland on stony quartz;<br>• Low open Eucalyptus woodland on limestone.<br>233 native and 5 introduced species were identified within the study area. One threatened species (dwarf desert spike rush), listed as vulnerable under the TPWC Act and EPBC Act, may occur. The total number of species known from the area is 571.<br>A number of weed species occur in the Project area. | Clearing of flora and vegetation and associated loss of habitat during construction.<br>Alteration of hydrological regimes associated with earthworks and construction activities and associated changes to land surface areas, and / or impediments to surface flows.<br>Groundwater drawdown and / or changes to groundwater flows impacting groundwater dependent ecosystems.<br>Contamination of surface and / or groundwater.<br>Introduction and / or spread of invasive exotic flora species.<br>Changes to fire regimes. | The Project will clear 1038 ha of vegetation of which 97% is mulga shrubland and triodia grassland. No communities are listed as threatened and none have regional significance. All vegetation types are well represented within the bioregion.<br>The Dwarf Desert Spike-rush is known from a location in Stirling Swamp, approximately 12 km north of the access road. There is potential habitat within the study area to support this species, although none were identified.<br>Clearing will remove a moderately diverse range of non-threatened native plants.<br>Management measures include:<br>• minimise and stage vegetation clearing where practical;<br>• use already-disturbed areas wherever possible;<br>• develop and implement a Weed Management Plan;<br>• develop and implement a Vegetation Clearing sub plan;<br>• development and implement a Fire Management Plan;<br>• conduct a preclearance survey to assist in the location of infrastructure in areas not previously surveyed (e.g. borefield, delivery pipeline and borrow pit areas);<br>• adhere to buffer widths recommended by the Northern Territory Land Clearing Guidelines where possible, with regard to riparian vegetation in drainage lines.<br>Construction of roads has the potential to interfere with natural surface water flows by blocking or disrupting water movement. Management will include incorporating floodways and culverts to maintain surface water flows.<br>Modelling indicates that Mud Hutt Swamp, Stirling Swamp and the broader Anmatyerr North Site of Conservation Significance will not be impacted by groundwater drawdown.<br>Groundwater extraction from the borefield will lower existing water table levels by approximately 12 m. Management measures include:<br>• flora survey to identify presence and distribution of phreatophytic vegetation;<br>• establish monitoring network for groundwater drawdown;<br>• monitor health of phreatophytic vegetation during operations;<br>• consider modifying extraction (the rate of extraction and distribution of operating bores) if significant impacts to vegetation occur.<br>The Project is not expected to significantly impact vegetation or flora in the area. |

| Existing Environment | Potential Impacts | Impact Assessment / Proposed Management |
|---|---|---|
| <u>Fauna</u><br>The Project is located in the Burt Plain Bioregion.<br>In total, 280 fauna species have been identified for the Project area. The Project area has the potential to support 10 threatened fauna species, including eight listed as vulnerable or endangered under the EPBC Act. These species are:<br>• fauna in rocky habitat - black-footed rock-wallaby;<br>• ground-dwelling sandplain fauna with limited mobility - greater bilby, brush-tailed mulgara, great desert skink, southern marsupial mole;<br>• arid-zone avifauna with high mobility - night parrot, red goshawk, princess parrot, grey falcon;<br>• fauna in riparian habitat - common brushtail possum. | Clearing of vegetation and associated loss of habitat, and habitat fragmentation during construction.<br>Alteration of hydrological regimes associated with earthworks and construction activities, and associated changes to land surface areas, and / or impediments to surface flows.<br>Groundwater drawdown and / or changes to groundwater flows impacting groundwater dependent ecosystems.<br>Contamination of surface and / or groundwater.<br>Introduction and / or spread of weeds and animal pests.<br>Changes to fire regimes.<br>Dust emissions from construction, mining and processing activities.<br>Light spill.<br>Noise emissions.<br>Fauna road-kill. | Adjusting for survey effort the mean number of fauna species by habitat type was:<br>• Riparian woodland – 34.0 species;<br>• Rocky rises – 25.7 species;<br>• Mulga woodland – 21.4 species;<br>• Corymbia woodland – 19.5 species;<br>• Spinifex grassland – 18.0 species.<br>The proposal would result in the removal of approximately 1038 ha of native vegetation. The clearing of the most species rich areas (riparian and rocky rises) amount to less than 2% of the Project area (~ 11 ha). These fauna habitats are well represented at the local and regional scale.<br>A number of management measures are proposed to manage potential impacts to fauna. These include:<br>• Weed Management Plan to prevent the introduction and spread of weeds;<br>• Erosion and Sediment Control Plan to prevent sediment mobilisation into aquatic areas;<br>• Construction Environmental Management Plan incorporating a pre-clearance fauna survey to ensure no threatened species are present and to assist in fauna translocation, avoidance of sensitive seasons for fauna, hydrological engineering controls, clearance minimisation strategies, staged clearing, clearing demarcations, fire prevention controls and vehicle hygiene;<br>• Operation Environmental Management Plan incorporating pest animal control and the management of water, weeds, fire, waste, noise, dust, light and traffic.<br>No aquatic fauna survey was undertaken due to the absence of surface water flows. Impacts to aquatic habitats will be managed by ensuring that there is no potential for the release of hazardous materials to aquatic environments.<br>The Project is not expected to significantly impact fauna in the area. |

| Existing Environment | Potential Impacts | Impact Assessment / Proposed Management |
|---|---|---|
| **Conservation Estate** | | |
| Three Sites of Conservation Significance occur in the study area:<br>• Mud Hut Swamp is located 7.7 km to the north of the pit. It is a large, isolated, gum-barked coolabah (*Eucalyptus vitrix*) swamp fed by Bloodwood and Murray Creeks;<br>• Anmatyerr North includes Stirling Swamp, a large wetland complex comprised of claypans, lignum swamp, semi-saline samphire and temporary open water as well as parts of the Hanson River. It encompasses the known extent of the near threatened Giant Sweet Potato (*Ipomoea polpha subsp. latzii*) as well as a population of the threatened Dwarf Desert Spike Rush (*Eleocharis papillosa*). The access road will cross Anmatyerr North 12 km to the south of Stirling Swamp;<br>• Wood Duck Swamp is located approximately 10 km south of the access road, outside of the study area. Wood Duck Swamp is an ephemeral swamp that may hold water for many months in an otherwise dry landscape. | Disturbance to significant vegetation and flora within Mud Hut or Stirling Swamp.<br>Disturbance to significant vegetation and flora within Anmatyerr North SOCS.<br>Introduction or spread of weeds within Anmatyerr North SOCS.<br>Increased risk of fire within Anmatyerr North SOCS. | Modelling indicates that Mud Hutt Swamp, Stirling Swamp and the broader Anmatyerr North SOCS will not be impacted by groundwater drawdown.<br>The access road will disturb up to 21 ha of vegetation within the Anmatyerr North SOCS. All vegetation types are well represented at the local scale within the bioregion. Vegetation clearing will involve removal of a moderately diverse range of non-threatened native plants. No impact to threatened flora species will occur.<br>Management measures include:<br>• minimise and stage vegetation clearing where practical;<br>• use already-disturbed areas wherever possible;<br>• develop and implement a Weed Management Plan;<br>• develop and implement a Vegetation Clearing sub plan;<br>• development and implement a Fire Management Plan;<br>• weed removal prior to vegetation clearing so that vegetative material is clean and able to be mulched and reused directly on site;<br>• adhere to buffer widths recommended by the Northern Territory Land Clearing Guidelines where possible, with regard to riparian vegetation in drainage lines.<br>Management of fire risk will be via the following management measures:<br>• firefighting equipment available during construction and operations;<br>• maintain fire breaks around high-risk areas / activities;<br>• active fire management and the use of small-scale, cool-season control burns;<br>• all site personnel required to undertake fire control training;<br>• all vehicles required to carry a fire extinguisher and two-way radio.<br>The Project is not expected to have a significant impact on any Site of Conservation Significance. |

| Existing Environment | Potential Impacts | Impact Assessment / Proposed Management |
|---|---|---|
| Heritage | | |
| A site survey did not identify the presence of historic heritage structures, places or archaeological sites.<br><br>An archaeological survey identified 16 previously unrecorded Aboriginal sites.<br><br>A Sacred Site Clearance Certificate (SSCC) has been issued by the Central Land Council which identifies Sacred Site Exclusion Zones and Restricted Work Areas. | Aboriginal archaeological sites adversely impacted.<br><br>Sacred sites are adversely impacted by mine site construction and / or operations.<br><br>One sacred site is located close to the pit and there is potential for damage to the site if the pit wall fails. | Targeted surveys identified that there is no potential for impacts to Aboriginal archaeological sites or areas of archaeological sensitivity associated with construction of the mine site, accommodation village and rail loadout facilities.<br><br>Construction of the access road will potentially directly impact two artefact scatters, and may indirectly impact one additional scatter and one isolated find. The access road has been realigned to avoid these sites.<br><br>Construction of the pipeline and borefield may impact two artefact scatters and may impact any subsurface *in situ* artefact deposits along the Hanson River bank. The pipeline has been realigned to avoid these sites.<br><br>Where impacts are unavoidable, artefact recording and relocation, and archaeological excavations will be undertaken to fully record the condition, extent and significance of the sites.<br><br>A Works Approval Application Form will be lodged with the Heritage Branch to allow further archaeological works within the Project area including artefact recording and relocation, and archaeological excavations, in accordance with section 72 of the Heritage Act.<br><br>TNG will comply with the conditions set in the SSCC and make all staff aware of the statutory obligations relating to Aboriginal cultural heritage. A section of the access road has been realigned to avoid impacting one of the Sacred Sites.<br><br>A geotechnical stability monitoring program will be established for the sacred site situated near to the north eastern boundary of the pit.<br><br>The Project is not expected to have a significant impact on any heritage values. |

| Existing Environment | Potential Impacts | Impact Assessment / Proposed Management |
|---|---|---|
| Air Quality | | |
| The Project is situated in a relatively isolated location. The closest receptor will be the mine village, 5 km from the mine. The nearest non-mining sensitive receptor is Anningie Station homestead, 30 km south-west. The access road lies 20 km to the south of the Wilora Aboriginal community.<br><br>There are no industrial air emissions in the area. The main sources of particulate matter are smoke from seasonal bushfires and wind erosion over exposed ground.<br><br>Australia's total greenhouse gas emissions for 2013 were estimated at 548.6 Mt $CO_2$-e and the NT's emissions for the same period were estimated at 13.8 Mt $CO_2$-e. Global greenhouse gas emissions for 2012 were 15.1 gigatonnes of $CO_2$-e. | Dust levels at sensitive receptors exceed air quality criteria.<br><br>Reduced air quality at sensitive receptors from power station emissions.<br><br>Contribution to Northern Territory and Australian greenhouse gas levels. | Predicted dust levels at receptors are all lower than assessment criteria. Highest predicted concentrations at the accommodation village range between 2.5% and 44% of assessment criteria and at non-mining receptors between 0.005% and 5% of criteria. Dust deposition levels will be undetectable.<br>Standard dust minimisation measures will be applied including:<br>• maintenance of moisture levels in ore and concentrate;<br>• application of water to unsealed roads;<br>• application of water to WRD and ore stockpiles as required;<br>• covering of loads during concentrate haulage;<br>• hooded crushers and enclosed HPGRs;<br>• visual monitoring of emissions.<br><br>Predicted concentrations of power station emissions at all receptors are below the assessment criteria for all assessed pollutants.<br><br>Total greenhouse emissions for the life of mine are estimated at 3,212,358 t $CO_2$-e. Average annual emissions are estimated at 178,000 t $CO_2$-e. This is approximately 1%, 0.03% and 0.001% of annual NT, Australia and global emissions respectively.<br><br>Greenhouse gas emissions will be managed and minimised through:<br>• maintenance of fuel-powered plant and equipment to the manufacturers specifications;<br>• considering the potential use of biodiesel blends;<br>• considering the potential use of solar power and storage battery systems;<br>• energy auditing and review;<br>• monitoring of emissions.<br><br>The Project is not expected to result in a significant air quality impacts. |

| Existing Environment | Potential Impacts | Impact Assessment / Proposed Management |
|---|---|---|
| Noise and Vibration | | |
| The Project area is situated in a relatively isolated location, with noise sources and sensitive receptors distributed sparsely. Noise sources in the area include:<br>• machinery noise from Anningie and Stirling stations;<br>• traffic noise from the Stuart Highway;<br>• rail noise from the Adelaide – Darwin rail line;<br>• natural noise from wind, insects and other animals.<br><br>The closest receptor will be the mine village, 5 km from the mine. The nearest non-mining sensitive receptor is Anningie Station homestead, 30 km south-west. The access road lies 20 km to the south of the Wilora Aboriginal community. | Noise levels at sensitive receptors exceed noise criteria.<br><br>Vibration impacts from blasting at sensitive receptors. | Predicted noise impacts at receptors are all lower than assessment criteria. Predicted noise levels under worst case conditions at the nearest noise sensitive receptor (the accommodation village) is 34 dBA, which is below the noise criterion of 35 dBA.<br><br>Traffic noise levels due to the Project are not expected to be noticeable.<br><br>The nature and levels of vibration emitted by the mine will vary with the activities being undertaken, however, due to the distances between the sources and receptors, vibration is unlikely to have a significant impact.<br><br>The Project is not expected to result in significant noise and vibration impacts. |

| Existing Environment | Potential Impacts | Impact Assessment / Proposed Management |
|---|---|---|
| Waste | | |
| The Project will be developed on a Pastoral lease that has not been exposed to previous industrial and mining activities. No industrial waste currently occurs on the Project site.<br><br>Existing waste disposal facilities in the region are limited to local landfills servicing small communities such as Ti Tree. Alice Springs has a number of operators that can recycle tyres, batteries, waste hydrocarbons, scrap metal, bottles and cans. | Release of AMD via seepage and / or run-off from WRD and TSF.<br><br>Release of putrescible wastes to the environment and an increase in introduced pest species.<br><br>Release of sewage to the environment.<br><br>Soil or water contamination from the release of hazardous wastes to the environment including waste oil, waste lubricants and batteries.<br><br>Failure of the waste rock dump resulting in environmental damage.<br><br>Failure of the tailings storage facility resulting in release of tailings to the environment and smothering of habitat. | No significant potentially acid forming materials have been identified within the ore body. Management measures will include:<br>• ongoing waste characterisation;<br>• develop AMD Management Plan if required;<br>• WRD Management Plan will be modified to include the selective handling and storage of any potentially acid forming materials if needed.<br><br>The management of general site waste will include:<br>• separation of waste for recycling and recovery;<br>• removal of residual waste to landfill;<br>• landfill fenced and waste buried on a daily basis;<br>• recording waste types and volumes generated on-site and transported off-site.<br><br>Sewage will be treated in a sewage treatment plant. Treated water will be used for landscape purposes. Untreatable solids will be collected and disposed of offsite by a licensed waste transporter.<br><br>The following management measures will be applied to hazardous wastes:<br>• all hydrocarbons will be stored and handled in accordance with the bunding requirements of AS 1940:2004: The Storage and handling of combustible and flammable liquids;<br>• all hazardous materials will be transported in compliance with Dangerous Goods legislation;<br>• spill clean-up procedures developed and implemented;<br>• appropriate training for relevant employees;<br>• regular inspections of storages, tanks and bulk containers and the integrity of bunded areas and containment systems;<br>• all hazardous wastes transported off-site by a licensed carrier for disposal / treatment at an appropriate facility.<br>The WRD will be designed to ensure a stable landform. The dump height will be limited to 40m.<br><br>Tailings will be deposited as a slurry with around 65% solids content. Water recovery from the facility will recover a further 10%. Tailings will be non-mobile and comprise non-toxic silts and sands. The design of the tailings facility will be consistent with ANCOLD guidelines and a perimeter bund will be constructed to limit the extent of tailings spread.<br><br>Overall it is expected that waste can be effectively managed. |

| Existing Environment | Potential Impacts | Impact Assessment / Proposed Management |
|---|---|---|
| **Closure and Rehabilitation** | | |
| No mining operations have occurred near the Project area. | Rehabilitation occurs at a slower rate than planned resulting in;<br>• increased rehabilitation costs;<br>• loss of rehabilitated vegetation;<br>• erosion of exposed surfaces;<br>• potential sedimentation into waterways.<br>Ineffective mine closure resulting in:<br>• closure plan being ineffective;<br>• closure costs greater than calculated;<br>• financial impact (unplanned) to company;<br>• third party financial impacts;<br>• inability to achieve lease relinquishment in a timely manner.<br>Temporary closure of the Project.<br>Insufficient topsoil / growth medium available.<br>Rehabilitation not reaching target species diversity values.<br>Inadequate infrastructure decommissioning provisions. | A Conceptual Mine Closure Plan has been prepared. This plan will be updated and refined throughout mining operations including life of mine closure planning, contingency planning, tailings management plan, waste rock management plan and a care and maintenance plan.<br>Revegetation trials will be undertaken to determine best practice for revegetation of the site.<br>Progressively rehabilitating the mine will reduce the environmental and financial risk of closure.<br>The security bond will be regularly reviewed to ensure that closure liability is accurately accounted for.<br>A contingency plan has prepared as a component of the Mine Closure Plan to cover early closure of the Project.<br>An audit of rehabilitation materials will be regularly conducted. The Project will seek to maximise the recovery of topsoil during construction activities.<br>Rehabilitation trials will be conducted to assess the viability and practicality of different rehabilitation techniques. Indices will be developed to evaluate successful establishment of keystone species. The progressive success of rehabilitation will be monitored.<br>All mine infrastructure that does not have a sequential use agreement in place at the time of closure will be demolished and removed. |

# 1. Introduction

## 1.1 Overview

TNG Limited (TNG) is proposing to develop the Mount Peake Project (the Project), 235 km north-northwest of Alice Springs and 50 km west of the Stuart Highway in the Northern Territory.

The primary objective of the Project is to produce an intermediate feedstock (concentrate) for further processing to extract high value products.

The Mount Peake Project will comprise:

- the mining of a polymetallic ore body through an open-pit truck and shovel operation;
- processing of the ore to produce a magnetite concentrate;
- road haulage of the concentrate to a new railway siding and loadout facility on the Alice Springs to Darwin railway near Adnera; and
- rail transport of the concentrate to TNG's proposed Darwin Refinery located at Middle Arm, Darwin.

The Project will mine at a rate of up to 8.4 million tonnes per annum (Mtpa) and, following processing, will produce up to 1.8 Mtpa of magnetite concentrate.

This concentrate will be processed at TNG's proposed Darwin Refinery to produce vanadium pentoxide flake, pigment grade titanium dioxide and pig iron ingots. Processing of the magnetite concentrate in Darwin does not form part of this assessment.

This Draft Environmental Impact Statement (EIS) has been prepared to support key Commonwealth and Territory Government approvals under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Northern Territory *Environmental Assessment Act 1982* (EA Act). The Draft EIS has been written to address the following broad criteria:

- address issues raised by government and community stakeholders;
- provide decision makers, stakeholders and the public with information on the Project;
- discuss the need for, and alternatives to, the Project;
- describe and assesses potential environmental, social and economic impacts of the Project;
- identify performance criteria, legislation and standards to be met; and
- provide management, monitoring and control measures to be implemented to mitigate potential adverse impacts of the Project.

The content of the Draft EIS reflects the Terms of Reference issued in March 2014 by the Northern Territory Environment Protection Authority.

## 1.2 Objectives

The objectives of this Draft EIS are to allow TNG the opportunity to:

- anticipate the range of environmental and social impacts and issues that may arise in relation to the Project;
- plan, from the earliest stages of the Project, to incorporate appropriate mechanisms to avoid and minimise adverse impacts and maximise benefits for stakeholders;
- identify environmental and social issues associated with the Project, and discuss how these will be managed throughout the currently anticipated 19 year project life inclusive of construction, operation and closure;
- provide adequate information in a transparent and easily understood manner so that the full range of stakeholders have access to the information and can make submissions to decision makers in relation to the Project; and
- provide adequate information to allow a decision to be made on whether environmental and development approvals should be granted that would allow the Project to proceed.

## 1.3 The Proponent

The proponent for the Project is TNG Limited, an Australian resource company focussed on evaluation and development of its Mount Peake Project. Contact details for TNG are provided in Table 1-1.

**Table 1-1 Proponent contact details**

| Company | TNG Limited |
|---|---|
| Contact | Paul Burton<br>Managing Director |
| Street address | Level 1, 282 Rokeby Road, Subiaco, WA 6008 |
| Postal address | PO Box 1126, Subiaco, WA 6904 |
| Phone<br>Fax<br>Email | +61 8 9327 0900<br>+61 8 9327 0901<br>peb@tngltd.com.au |
| ABN | 12 000 817 023 |
| ASX code | TNG |
| Web | www.tngltd.com.au |

### Environmental record

TNG has been actively exploring in the Mount Peake area since 2006, and discovered the Mount Peake V-Ti-Fe mineralisation in 2007/8. Exploration activities take place on Exploration Licences approved by the NT DME. Environmental conditions are set and monitored by the NT DME through the Mining Management Plan (MMP) authorisation process, where prior to any ground disturbing work TNG submits and receives approval for programs (drilling, clearing etc). Current authorisation 0477-03 covers activities to 2016.

During June 2015 Mining Compliance officers of the NT DME audited the exploration and rehabilitation activities undertaken over the previous several years. The minor concerns raised in this audit were addressed in late 2015 and form part of the 2016 MMP which will be submitted to the DME Mining Compliance Division shortly.

Since drilling began in 2009 TNG has completed seven years of exploration having met all environmental and rehabilitation conditions across the Mount Peake tenure. There are currently no outstanding or non-compliant environment issues relating to the Mount Peake Project.

There are no environmental proceedings against TNG under any jurisdiction.

#### Other proposals / actions in the region

The nearest potential development in the region is Arafura Resources proposed Nolans Rare Earths Project, approximately 100 km to the south of Mount Peake.

## 1.4 Environmental Impact Assessment

### 1.4.1 Overview of the Impact Assessment Process

An overview of the Impact Assessment Process is provided in Figure 1-1.

The Mount Peake Project (the action) was referred to the Department of the Environment (DotE) on 14 October 2013 due to the potential for the action to have a significant impact on a Matter of National Environmental Significance (MNES). On 13 November 2013, DotE determined that the proposed action was a controlled action and required assessment under the EPBC Act before it could proceed (Appendix B). The controlling provision was listed threatened species and communities (sections 18 and 18A).

The DotE also determined that the Project will be assessed by accredited assessment at the level of Environmental Impact Statement under the Northern Territory EA Act.

In June 2013, a Notice of Intent for the Mount Peake Project was submitted to the NT Environment Protection Authority (NT EPA). On 13 November 2013 the NT EPA determined that the Mount Peake Project required assessment under the EA Act at the level of an Environmental Impact Statement (Appendix B). Terms of Reference for the Draft EIS were issued on 7 March 2014 (Appendix C).

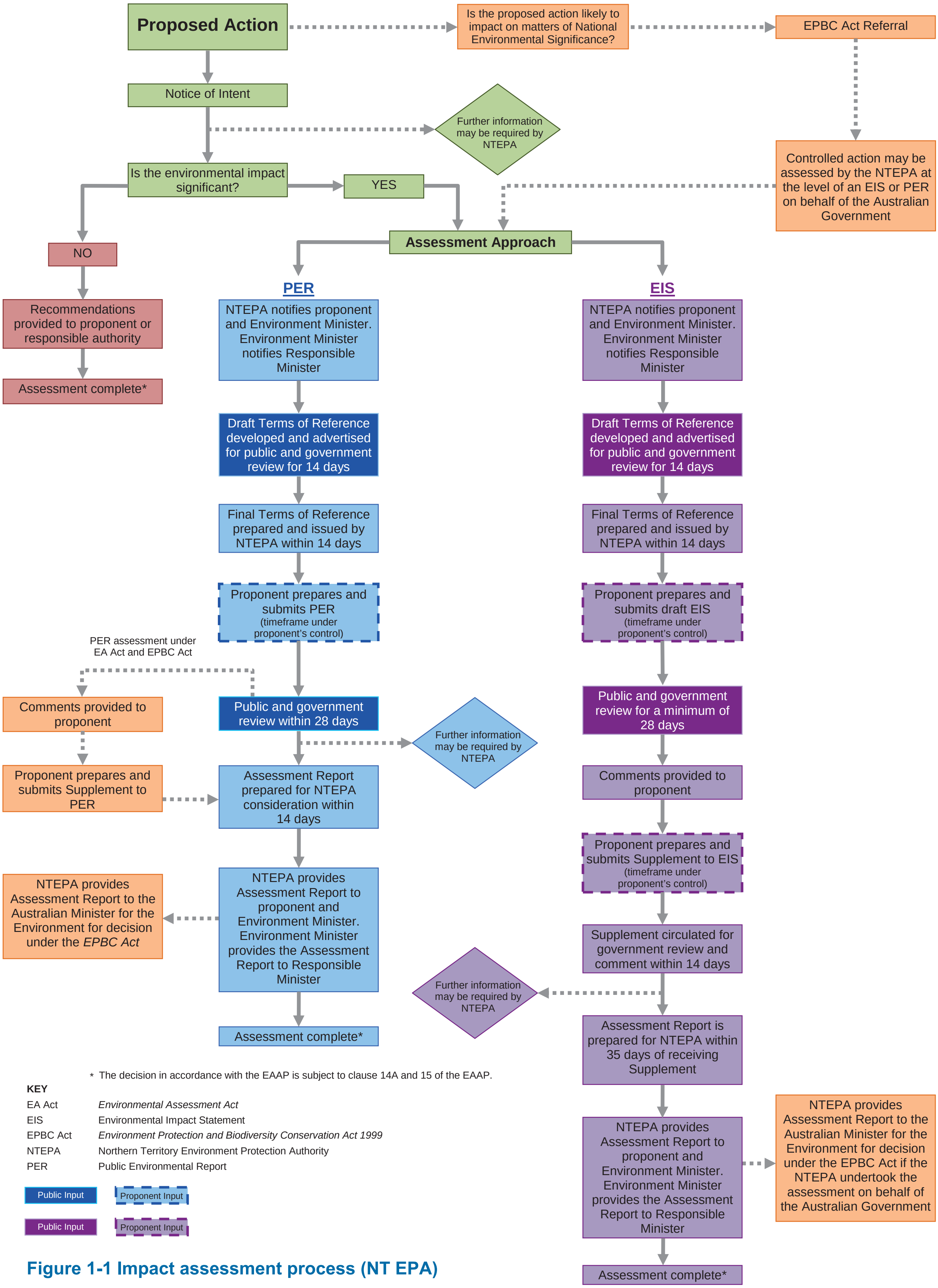
On 9 March 2015 the NT EPA was notified that changes had been made to the Mount Peake Project. The changes removed the hydrometallurgical processing plant and a gas / slurry pipeline infrastructure corridor linking the mine site with a rail siding at Adnera, and confirm that trucking will be used to transport magnetite concentrate to the rail head and that any gas pipeline will be located within the transport corridor. In accordance with clause 14A of the Environmental Assessment Administrative Procedures, the NT EPA decided that the changes do not alter the environmental significance of the Project, that the Project will continue to be assessed at the level of an EIS, and that the Terms of Reference issued on 7 March 2014 will not be amended (Appendix B).

On 11 March 2015 a request to vary the action under section 156B of the EPBC Act was submitted to the DotE. The variation was consistent with the notification of change to the NT EPA described above. On 8 April the DotE confirmed acceptance of the variation and that the originally identified controlling provisions would still apply (Appendix B).

Magnetite concentrate will now to be supplied to TNGs proposed Darwin Refinery for processing and therefore the Mount Peake Project will not result in any port related impacts. The port aspects of the assessment have been removed.

# NORTHERN TERRITORY
# ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

Pursuant to the *NT Environmental Assessment Act* & Environmental Assessment Administrative Procedures




* The decision in accordance with the EAAP is subject to clause 14A and 15 of the EAAP.

**KEY**

| | |
|---|---|
| EA Act | *Environmental Assessment Act* |
| EIS | Environmental Impact Statement |
| EPBC Act | *Environment Protection and Biodiversity Conservation Act 1999* |
| NTEPA | Northern Territory Environment Protection Authority |
| PER | Public Environmental Report |

**Figure 1-1 Impact assessment process (NT EPA)**

Once submitted to the NT EPA, the Draft EIS will be advertised for public comment and circulated to relevant government advisory bodies for review for a minimum of 28 days. Submitted comments will be forwarded by the NT EPA to the proponent. The proponent will be required to prepare a Supplement to the Draft EIS addressing these comments. The Supplement will be submitted to the NT EPA and then circulated to government advisory bodies for review and comment within 14 days. During the first 21 days from the receipt of the Supplement, the NT EPA may call for further information from the proponent.

Assuming no further information is requested, an Assessment Report based on the Draft EIS and the Supplement is prepared by NT EPA for the Responsible Minister within 35 days of receiving the Supplement.

The NT EPA also provides a copy of the Assessment Report to the Commonwealth Minister for the Environment for a decision under the EPBC Act on MNES.

### 1.4.2 Key Issues Identified by the NT EPA

The key risks identified by the NT EPA as part of the Terms of Reference for the Mount Peake Project (Appendix C), and reflecting the Project changes in Section 1.4.1, were:

#### Ground and surface water resources

- potential for Acidic and/or Metalliferous Drainage (AMD) from the waste rock dump, tailings storage facility and other mine infrastructure, to contaminate shared water resources;
- surface water quality may be impacted by spills to surface water and runoff containing hazardous substances or elevated sediment concentrations;
- contamination of groundwater could occur through leaks from storages or pipelines and spills during handling of contaminants, chemicals and toxicants; and
- practically available water sources will not be sufficient to supply the needs of the proposed Project configuration; or will not be sufficient without causing environmental or social impacts.

#### Biodiversity

- biodiversity values, conservation status, diversity, geographic distribution or productivity of local native flora or fauna species or ecosystems may be degraded by Project actions;
- the Project may result in one or more of the following significant impacts to species or communities listed as threatened under the EPBC Act and / or Territory Parks and Wildlife Conservation Act:
    - long-term decrease in the size of an important population of a listed threatened species or community;
    - adverse effects on habitat critical to the survival of a species or community;
    - fragmentation of an existing important population into two or more populations;
    - reduced area of occupancy of an important population or community; and / or
    - modification, destruction, removal or isolation of the availability or quality of habitat, to the extent that a threatened species or community is likely to decline.
- degradation of the environment may occur through the introduction and spread of weeds and / or pest fauna species within and adjacent to the Project area;

- Project inputs of environmental pollutants may result in reduced water quality (offsite) and impacts on sensitive ecosystems supporting higher biodiversity values, such as aquatic, riparian or wetland habitats; and
- wildlife may be exposed to metals and / or pollutants from the Project that will result in ongoing impacts, especially to long-lived species that accumulate toxicants and metals.

### Historic or cultural heritage

- construction of the Project has the potential to damage areas or degrade values of sites or items which have historic and / or cultural heritage significance;
- operations associated with the life of the Project and increased human activities in the vicinity have the potential to disturb or damage areas of historic and / or cultural heritage; and
- the Project has potential to disturb sites of Aboriginal heritage significance.

### Socio-economic

- operations associated with the life of the Project and increased human activities in the Project area have the potential to change the social demographic, culture and economies; and
- potential economic and social benefits may not be optimised and costs may not be fully understood and taken into consideration.

### Rehabilitation and mine closure

- following closure and rehabilitation, potential for the mine to negatively impact the environment and / or associated communities; and
- risk that the Project will create an ongoing environmental, social and / or economic legacy if operations are required to cease ahead of schedule due to unforeseen circumstances, prior to the planned closure and rehabilitation of the site.

### Human health and safety

- risks of health impacts to workers from exposure to hazardous, toxic or radioactive substances, associated with the Project;
- traffic or rail accidents;
- contamination of a shared potable aquifer accessed by workers or a local community;
- spread of mosquito-borne disease due to creation of mosquito breeding sites;
- sunburn, environmental exposure, heat exhaustion etc; and
- risks to workers from animal attacks / bites.

### Air emissions

Potential risks to air quality for sensitive receptors from:

- drilling, blasting and materials handling;
- crushing and beneficiation plant;
- general site movements over unsealed surfaces; and
- wind erosion mobilising dust from exposed surfaces, such as from waste dumps, laydown areas, stockpiles, and sites of vegetation clearing.

# 2. Project Description

## 2.1 Project Overview

### 2.1.1 Introduction

The mine site is located approximately 235 km north-northwest of Alice Springs and approximately 50 km west of the Stuart Highway (Figure 2-1).

The Mount Peake Project will comprise:

- the mining of a polymetallic ore body through an open-pit truck and shovel operation;
- processing of the ore to produce a magnetite concentrate;
- road haulage of the concentrate to a new railway siding and loadout facility on the Alice Springs to Darwin railway near Adnera; and
- rail transport of the concentrate to TNG's proposed Darwin Refinery located at Middle Arm, Darwin.

### 2.1.2 Product

The Project will mine at a rate of up to 8.4 million tonnes per annum (Mtpa) and, following processing, will produce up to 1.8 Mtpa of magnetite concentrate.

Concentrate will be processed at TNG's proposed Darwin Refinery to produce 19,700 tpa of vanadium pentoxide ($V_2O_5$) flake, 292,000 tpa of pigment grade titanium dioxide ($TiO_2$) and 856,000 tpa of pig iron ingots. Processing of the magnetite concentrate in Darwin does not form part of this assessment.

### 2.1.3 Key Project Components

New facilities associated with the Mount Peake Project include (Figure 2-2):

- open cut mine;
- waste rock dump (WRD) with up to 70 Mt capacity;
- run of mine (ROM) pad;
- four long term stockpiles of up to 4 Mt capacity each;
- process plant;
- tailings storage facility (TSF) with up to 63.41 Mt capacity;
- access road between the mine site and Adnera Loadout Facility including an underpass of Stuart Highway (for concentrate trucks) and intersections with Stuart Highway (for mine site access);
- borefield and associated water pipeline;
- concentrate stockpiles;
- water and sewage treatment plants;
- gas fired power station;
- explosives and detonator magazines;
- accommodation village;

- administrative buildings, laboratory, workshops and warehouses;
- gatehouse and weighbridge;
- fuel farm; and
- concentrate loadout facility and rail siding at Adnera (Figure 2-1).

### 2.1.4 Timing

TNG proposes to commence construction in the late 2016 with mining commencing in 2018. The life of the Project is expected to be 19 years inclusive of construction (2 years), mining and production (15 years), and closure and rehabilitation (2 years).

### 2.1.5 Tenure

Mining and processing will occur within Mineral Lease Application (MLA) 28341 for the mine pit and MLA 29855 for all mining facilities (Figure 2-1).  The accommodation facilities will be located within MLA 29856, 5 km to the east of the mine site.

The access road between the mine site and Adnera passes from MLA 29855, through Exploration Lease (EL) 29578, EL 27069, Perpetual Pastoral Lease (PPL) 1057, EL 27941, PPL 1103 and PPL 1138. The access road is covered by an Access Authority application, administered by the NT DME.

The proposed borefield is located 20 – 35 km NNE to NE of the mine site. TNG has applied to the NT DME for an Access Authority licence covering the route of the pipeline to the borefield.

Grant of the Access Authorities will likely coincide with the Mining Lease approvals after the environmental approvals are secured.

All tenements lie within the Stirling and Anningie PPLs aside from a portion of crown land adjacent to the Stuart Highway.

## 2.2 Geology

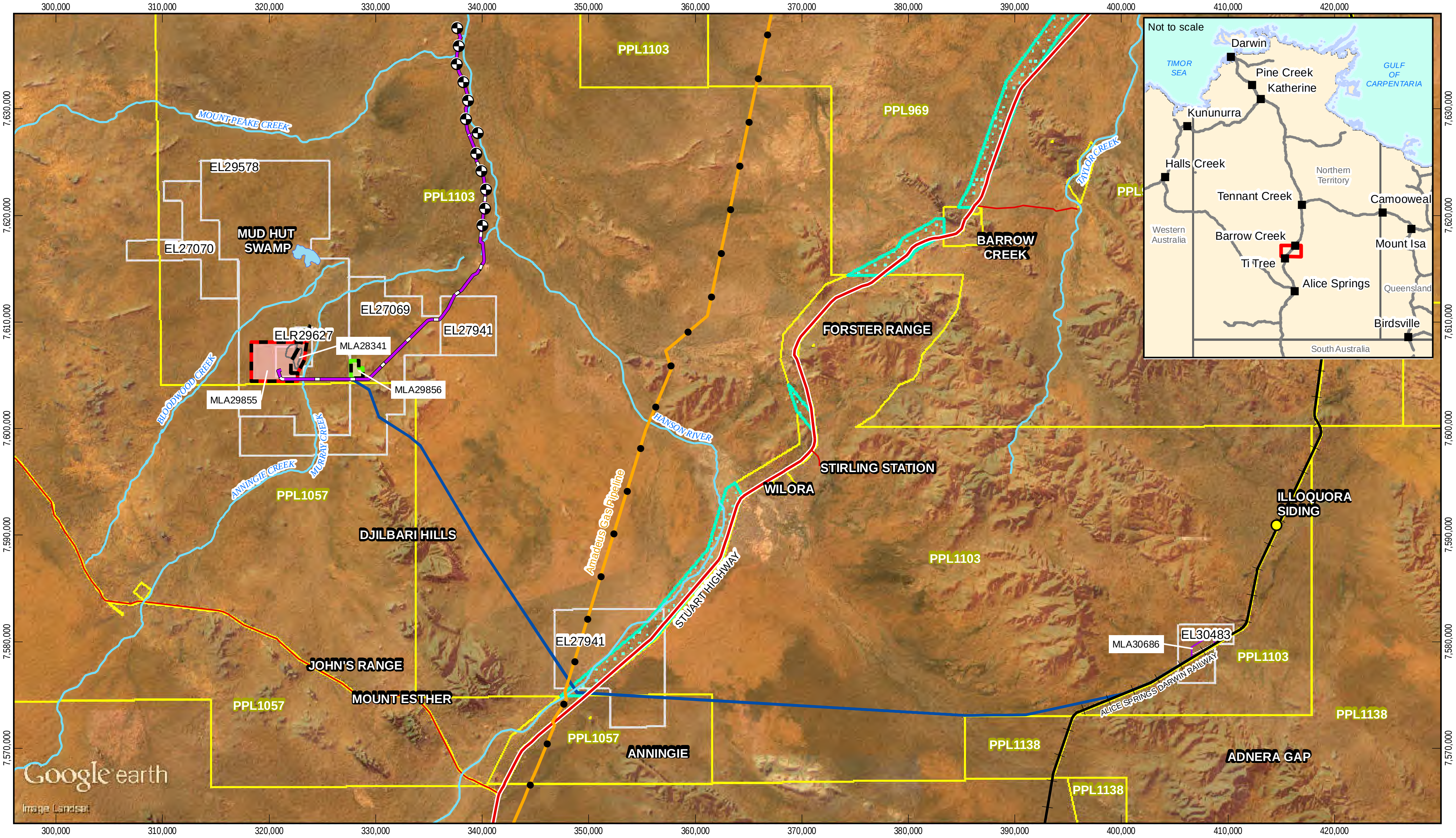
### 2.2.1 Regional Geology

The Mount Peake Resource lies in the north-central portion of the Paleoproterozoic Arunta region Aileron Province (Figure 2-3). The deposit lies on the boundary between the older Aileron Province schists, gneisses and granites to the west and south, and the Georgina Basin sediments to the east and north.

The near flat-lying and unmetamorphosed shales, siltstones and sandstones of the lowermost Georgina Basin range from 800 to 500 Ma (Million years old) and are exposed to the east of the Mount Peake deposit, and form the range from the Djilbari Hills to Central Mount Stuart (10 to 40 km to the SSE) as well as the distinctive flat topped hills around Barrow Creek (20 to 50 km ENE). They unconformably overlie the metamorphosed Aileron schist basement, which is Proterozoic (1700 to 1880 Ma) in age.

In the vicinity of the Mount Peake deposit the basement includes schists and gneisses of the Lander Rock Formation, together with relatively undeformed granitic and porphyritic felsic intrusives. To the west of the deposit is a potassium feldspar megacrystic granite porphyry.

The resource is hosted in an intrusive gabbro sill intruding the lowermost Georgina basin sediments. The gabbro sill complex is quite extensive (based on magnetic interpretation and scattered outcrops) covering an area of up to 20 x 40 km. It outcrops poorly and has not been mapped at surface as more than 50 m thick, however in the shallow sub-surface it can reach 250 m thick and may exceed 300 m.




Paper Size A4

0 2.5 5 7.5 10 12.5 15

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

- Illoquora Siding
- Potential Borefield
- Borefield Delivery Pipeline
- Principal Road
- Minor Road
- Major Watercourses
- Railway
- Amadeus Gas Pipeline
- Mine Site Facilities
- Mud Hut Swamp
- Rail Siding Loading Facility
- Mount Peake Mining Area
- Crown Land
- Mount Peake Granted Tenements
- Mount Peake Mineral Leases
- Cadastral Boundaries
- Access Road
- Camp Facilities

GHD

TNG Ltd
Mount Peake EIS

Job Number 61-29057
Revision A
Date 29 Oct 2015

Project Location
Mount Peake Project Area

Figure 2-1

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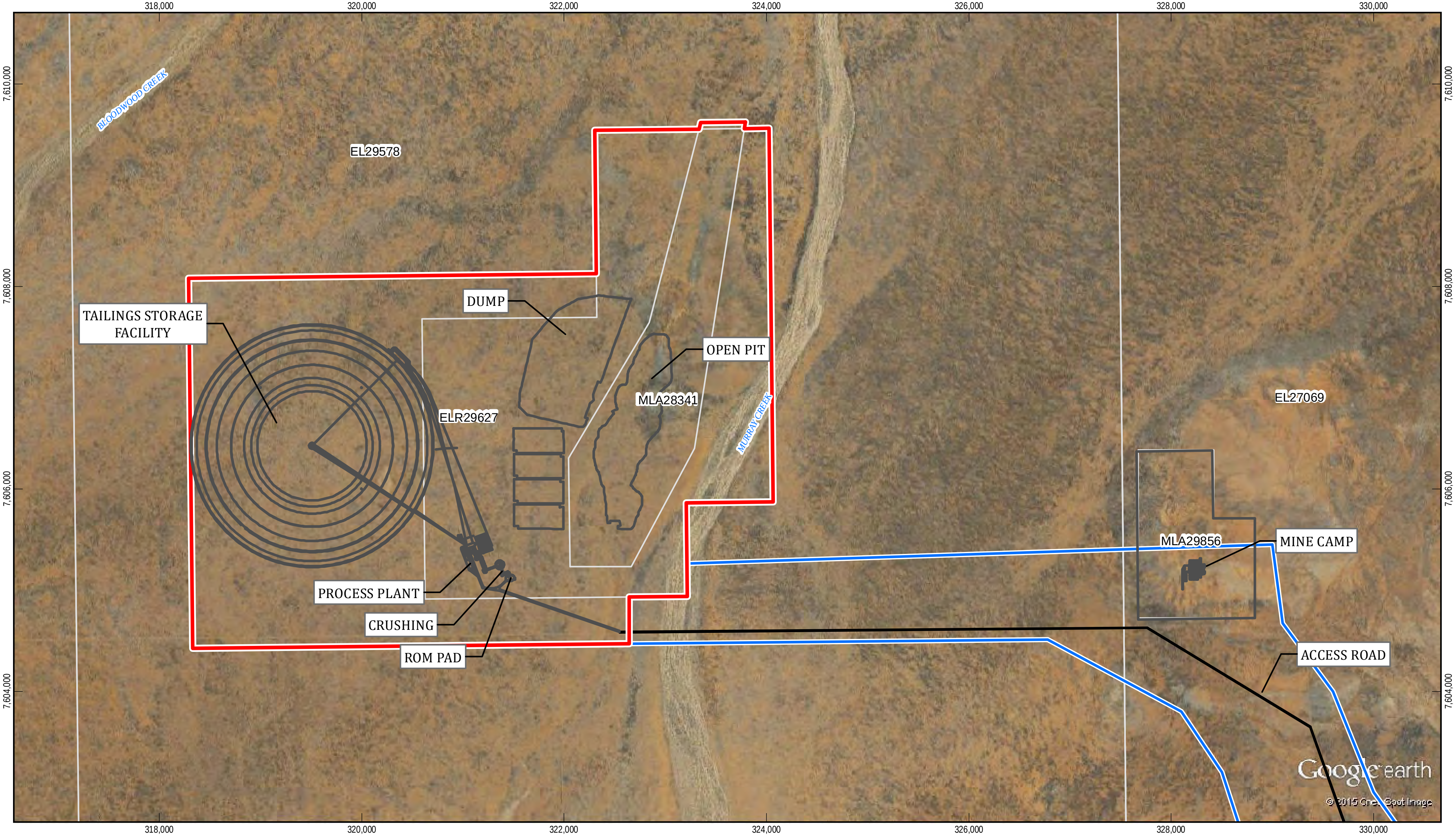
239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au



Data source: TNG - Gas / Slurry Pipeline Study Corridor, Camp Facilities, Borefield Infrastructure,Transport Study Corridor, Mount Peake Mining Area, Mount Peake Granted Tenements (2015). Geoscience Australia - Waterways, mainland, placename, road (2008). Google Earth Pro - Imagery (Date extracted: 13/02/2014). Created by: RB

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0 0.5 1 1.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

## LEGEND

- Mine Site Facilities
- Mount Peake Granted Tenements
- Mount Peake Mining Area
- Access Road
- Transport Study Corridor

TNG Ltd
Mount Peake EIS

Job Number | 61-29057
Revision | A
Date | 29 Oct 2015

Mine Site Detail
Mount Peake Project Area

Figure 2-2

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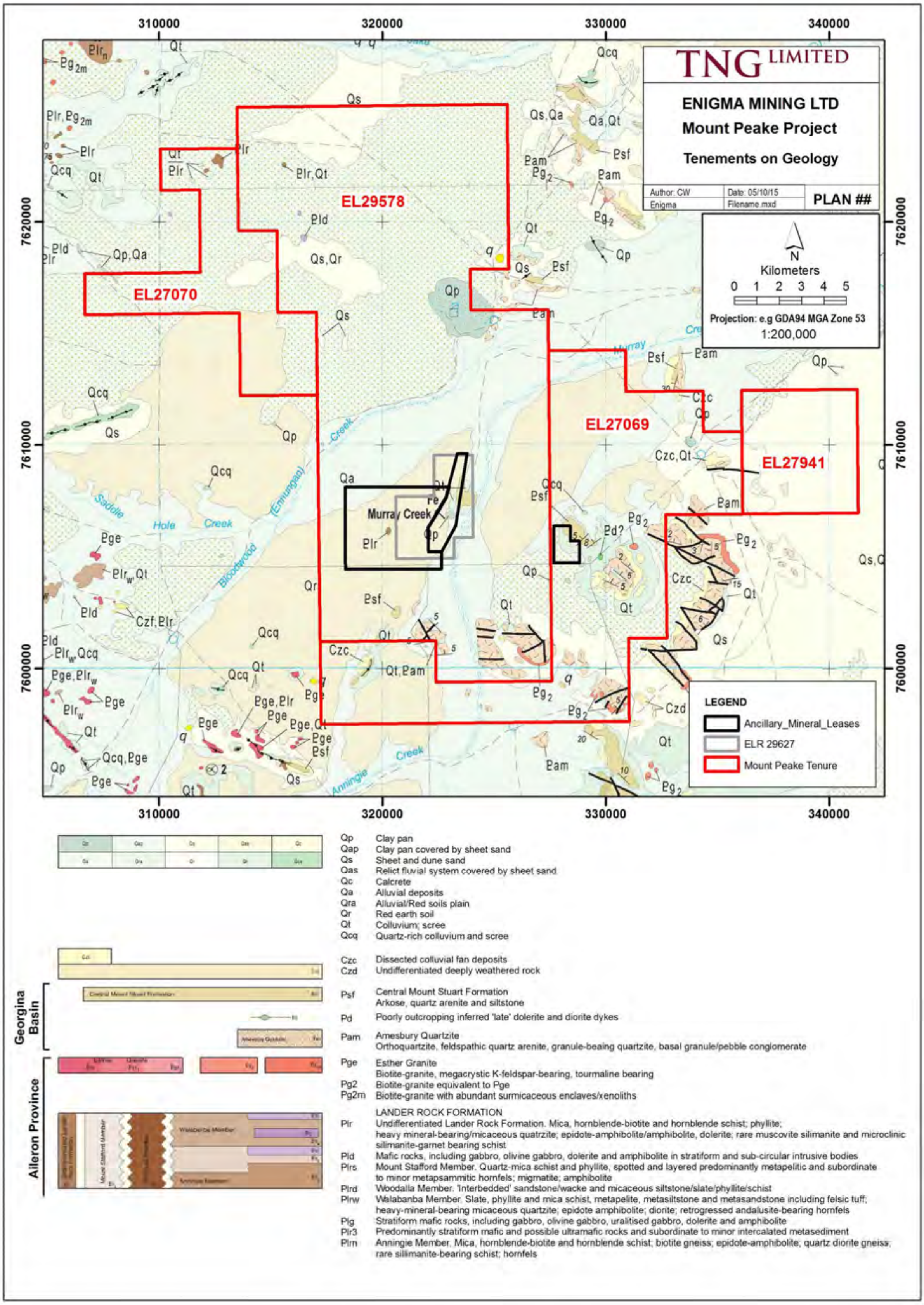
239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au



Google: Imagery - 20150910; TNG Ltd: Mine site facilities, access road, mining area,Tenure - 20151021




## Figure 2-3 Regional geology

### 2.2.2 Geology of the Mount Peake Deposit

The Mount Peake deposit is hosted within a layered gabbro sill, with the orebody comprising a particularly magnetite-rich portion in the middle.

The sill is overlain with between 2 to 16 m of Cenozoic desert sand aeolian/alluvial sediment cover and does not outcrop. Cover thickens to the east, towards Murray Creek, and south. The nearest outcrop is a hill a few hundred metres northeast of the deposit exposing basal Georgina Basin sediments.

The deposit was discovered by interpretation of aeromagnetic geophysical data, as the magnetite ore produces a strong magnetic anomaly.

The sill is bound to the west by a moderate west dipping and NNE/SSW striking fault, with porphyritic granite to the west. The sill continues under sand cover to the east, north and south, but it and the magnetite-rich unit thins dramatically. Magnetite bearing gabbro has been intersected in exploration drill holes immediately below thin transported cover both 1 km and 5 km to the east of the resource.

In the vicinity of the orebody the sill is at least 250 m thick and has three broad layers. The upper unit forms the hanging wall over the southern and northern parts of the orebody while it is eroded away in the central area. It is equigranular and coarse grained with less than 3% magnetite content. The footwall gabbro has very coarse plagioclase crystals and only trace magnetite content.

The Mount Peake deposit comprises all of the central gabbro intrusive unit (MOG – magnetite-rich olivine gabbro), which is characterised by magnetite contents from 5 to 45%, cumulate magnetite and olivine grains (to 5 mm glassy green), and is up to 150 m thick. The magnetite grains are 1 to 4 mm in size and contain almost all of the vanadium, titanium and iron content of the ore. The MOG unit is quite homogeneous, showing only a gradual decrease in magnetite content from top to bottom.

Vanadium and titanium are both found within the magnetite – vandiferous titanomagnetite. A minor amount of the iron is tied up in silicates (pyroxene and olivine) that is not recovered, a smaller portion of the titanium hosted in ilmenite, which is still recoverable, and a very small proportion of the vanadium locked up in pyroxene.

### 2.2.3 Mount Peake Exploration History

Because the orebody does not outcrop, the exploration program was initially guided by the aeromagnetic interpretation and then essentially was driven by drilling to outline and then measure the Resource.

Work from early 2009 through 2011 defined the extent of the resource, and resulted in the predominantly Inferred and Indicated Mineral Resource that was used to underpin the Pre-Feasibility Study conducted in 2011 - 2012. Six drilling programs were completed to the end of 2011:

- March 2009 reverse circulation, 6 holes, 928 m;
- November 2009 reverse circulation, 141 holes, 2172 m;
- November 2009 diamond, 2 holes, 225 m;
- November 2009 reverse circulation, 2 holes, 692 m;
- June 2011 diamond, 8 holes, 1,081 m; and
- July 2011 reverse circulation, 23 holes, 2,748 m.

Essentially the orebody was drilled on north / south lines 100 m apart and with holes 50 to 100 m apart along the drill lines. This pattern was sufficient to define Inferred and Indicated Mineral Resource status.

In late 2012 additional resource drilling was conducted:

- December 2012 reverse circulation, 59 holes, 2,748 m; and
- December 2012 diamond, 14 holes, 1,892 m.

Hole depths ranged from 65 m to 405.8 m, with most being between 100 and 180 m deep. Most holes intersected mineralisation and towards the centre of the orebody it was up to 166 m thick.

Drilling in 2012 was to upgrade the resource to predominantly Indicated and Measured Resource status, which would allow the publishing of a Measured Resource that could, in the Feasibility Study, be in part converted to Mineral Reserves, once mining and financial considerations had been taken into consideration. The program also generated over 20 tonnes of sample for metallurgical testwork.

Other than infill drilling of the current deposit, there are no plans to expand the mine outside of its currently delineated extent.

### 2.2.4 Mount Peake Resources Estimates

Deposit mineralisation has been categorised as Measured, Indicated or Inferred, in accordance with the 2012 guidelines of the JORC Code (Table 2-1).

**Table 2-1 Mount Peake resource estimates**

| Resource | Million tonnes | $V_2O_5$ (%) | $TiO_2$ (%) | Fe (%) | $Al_2O_3$ (%) | $SiO_2$ (%) |
|---|---|---|---|---|---|---|
| Measured Resources[1] | 117 | 0.29 | 5.5 | 24 | 8.2 | 33 |
| Indicated Resources[2] | 20 | 0.29 | 5.3 | 22 | 9.1 | 34 |
| Inferred Resources[3] | 22 | 0.22 | 4.4 | 19 | 10.0 | 38 |
| Total | 160 | 0.25 | 5.3 | 23 | 8.6 | 34 |

Mineral Resources are inclusive of Mineral Reserves. Tonnes and grade have been rounded and this may have resulted in minor discrepancies.

## 2.3 Construction Activities

### 2.3.1 Construction Staging

Subject to statutory approvals construction activities will commence in the second half of 2016.

Construction works will take place largely between 6 am and 6 pm.

1 Measured Resources – resources that have undergone enough further sampling that a 'competent person' (defined by the norms of the relevant mining code; usually a geologist) has declared them to be an acceptable estimate, at a high degree of confidence, of the grade, tonnage, shape, densities, physical characteristics and mineral content of the mineral occurrence.
2 Indicated Resources – economic mineral occurrences that have been sampled (from locations such as outcrops, trenches, pits and drill holes) to a point where an estimate has been made, at a reasonable level of confidence, of their contained metal, grade, tonnage, shape, densities, physical characteristics.
3 Inferred Resources – that part of a mineral resource for which tonnage, grade and mineral content can be estimated with a low level of confidence. It is inferred from geological evidence and assumed but not verified geological / or grade continuity. It is based on information gathered through appropriate techniques from location such as outcrops, trenches, pits, workings and drill holes which may be of limited or uncertain quality and reliability.

Construction activities will occur over a 24 month period and include the following:

- an initial 40 person fly camp to support an initial construction workforce. This workforce will be responsible for establishing temporary power and water supplies, and temporary access to site;
- expansion of the fly camp to support a construction workforce of 225 personnel. This will be converted to house the operations workforce of initially 125 personnel expanding to 170 personnel in year 5;
- approximately four bores to support construction of the access road;
- approximately eight production bores and pump testing to confirm yield. Borefield access road, power supply and delivery pipeline. Early commissioning of two bores to provide construction water supply with the remaining bores brought on line prior to commissioning of the process plant
- installation of self-bunded diesel storage tanks;
- temporary construction phase power and communications;
- a fenced access road between the mine site and Adnera Loadout Facility including an underpass of Stuart Highway (for concentrate trucks) and intersections with Stuart Highway (for mine site access). Road construction will occur within the first four months of the construction program;
- flood ways across the Hanson River, Murray Creek and minor creeks;
- a concrete batch plant;
- ROM pad;
- process plant, including crushing and grinding plants, crushed-ore pad, concentrator, thickener, conveyor tunnels, magnetite concentrate pad, and process water and raw water ponds;
- TSF;
- workshop and stores;
- offices and administration area buildings;
- gas fired power station;
- water treatment plant and potable water supply;
- explosives and detonator magazines;
- weighbridge;
- sewage treatment plant;
- a stock fence around the mine site and loadout facility;
- rail siding;
- site office at Adnera; and
- hardstand at Adnera for concentrate storage.

Potable water will be trucked to site during the early stages of construction until supply is established from the borefield.

Pre-production mine preparation works will also commence during this stage. Selected materials from the pit area will be stockpiled and placed to build bases for the HPGR, ROM ramp and pad, TSF perimeter bund and central access ramp, access road and other site roads. Excess material will be trucked to the WRD.

### 2.3.2 General Site Works

Earthworks will involve clearing, grubbing, cut and fill, preparation of unsealed roads and hardstands and basic drainage works. Areas will be levelled and compacted prior to construction of infrastructure.

Toward the end of the construction program a second phase of earthworks will be initiated. This work will involve trimming to final level, constructing final drainage profiles and installing culverts.

The Project will disturb an estimated 1060 ha (Table 2-2). Figures showing disturbance areas in relation to vegetation associations are provided as Figure 4-3 in Appendix G – Flora and Vegetation Assessment Report

A clearing width of up to 25 m has been allowed for to accommodate construction of the access road. The road, including shoulders and drains will have a final width of 13 m.

**Table 2-2 Disturbance areas**

| Item | Disturbance Area (ha) |
|---|---|
| Pit | 77 |
| Waste Rock Dump | 90 |
| Long-term stockpiles | 47 |
| Mine facilities including ROM pad, process plant and associated stockpiles and ponds, mine offices and workshops, fuel storage facility, water treatment plant, power station and site roads | 71 |
| Tailings Storage Facility | 475 |
| Accommodation village | 6 |
| Access road | 234 |
| Borefield, delivery line and access road | 50 |
| Road base borrow areas | To be determined |
| Adnera Loadout Facility | 10 |
| **Total** | **1060** |

Areas to be cleared for construction will be grubbed of trees and larger vegetation with material collected and stored for reuse in rehabilitation.

Topsoil, where present, will be removed and stored for future use in rehabilitation. Where necessary stockpiles will be protected with erosion and sediment control structures and stabilised to prevent excessive wind erosion.

Vegetation clearing and topsoil removal will be carried out shortly before the area is required for construction.

### 2.3.3 Construction Materials

It is proposed to use up to 5 Mt of non-acid forming waste from pre-production for Project construction requirements (ROM Pad, construction pads, site roads, sedimentation ponds etc).

It is not expected that clay will be required at site.

Construction materials (steel, plate work, piping, cable, timber, cement, aggregate etc) will be trucked to site from Stuart Highway via the access road. Materials will be sourced locally where available

Transportation vehicles will be a combination of standard and oversize loads. It is estimated that up to 30 heavy vehicle deliveries will occur per day. Final trucking numbers will be established by contractors involved in the construction phase.

Larger plant and equipment that cannot be assembled on-site will be transported under appropriate permits.

Once the Adnera rail siding is established, some construction materials may be imported by rail.

Concrete will be supplied from an onsite batch plant.

Borrow pits will be established along the alignment of the access road to provide road base course and maintenance materials. The location and size of these borrow pits still needs to be determined. Alternatively road base could be imported to site.

### 2.3.4 Construction Equipment

Construction activities will use standard construction machinery, general trade equipment and specialised equipment including excavators, scrapers, front-end loaders, graders, cranes, water tankers, concrete trucks / pumps, dozers, dump trucks, forklifts, busses and light vehicles.

Fuel consumption during construction is estimated to be 3.5 megalitres (ML). Fuel will be delivered to site by tanker on a weekly basis and stored in self-bunded storage tanks.

### 2.3.5 Access Road

The access road connecting the mine site with the Adnera Loadout Facility will be approximately 100 km long and constructed with two 5 m traffic lanes with two 0.5 m shoulders. Table drains will be constructed adjacent to the road. The key steps in construction are:

- establish borrow pits;
- clear and grub vegetation and stockpile as required (to be used for remediation works);
- cut to fill where necessary;
- rip and scarify subgrade;
- condition and compact subgrade material;
- compaction testing;
- place and compact 300 mm layer of 75 mm base course material;
- final grade and trim of road surface and batters including cutting of drainage swale; and
- installation of road furniture (signs, guide posts, etc.).

Several bores will be established along the access road to provide construction water.

An underpass of Stuart Highway will be constructed to remove road trains from the highway. An artistic impression of the underpass is shown in Figure 2-4 with design details shown in Figure 2-5.

A Super-Cor™ arch is the major structural element for the underpass. An example of the use of Super-Cor™ arches is shown in Figure 2-6.

To allow for construction of the underpass Stuart Highway will be temporarily diverted. All works will be undertaken in compliance with NT Department of Transport requirements.

**Figure 2-4 Artistic impression of Stuart Highway underpass**

At grade connections from the highway to the access road will be provided for vehicles accessing the mine site and Adnera (Figure 2-7).

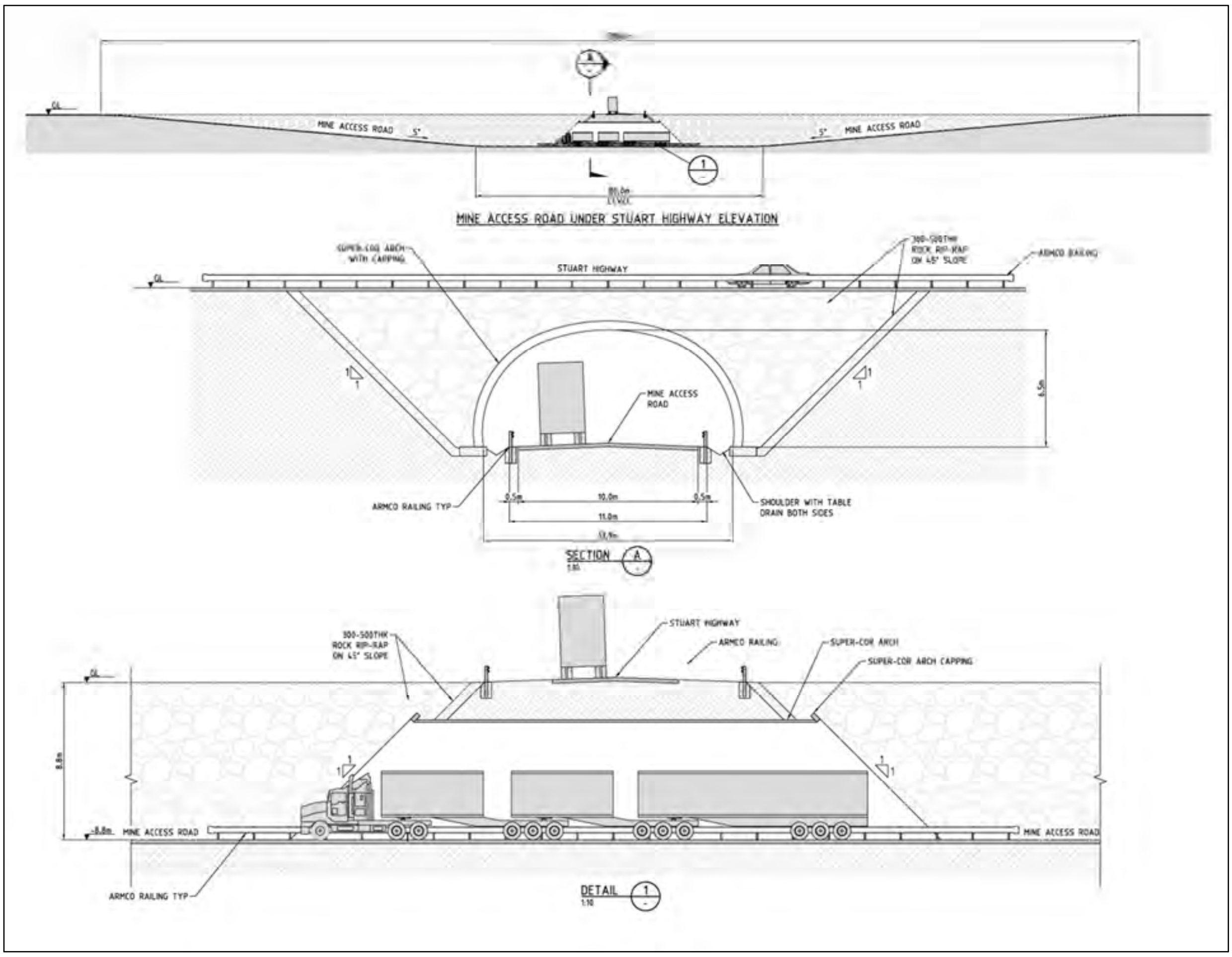



**Figure 2-5 Access road under Stuart Highway**

The Amadeus Gas Pipeline runs north / south crossing the proposed access road approximately 2 km west of the Stuart Highway. Sufficient protection, in the form of a concrete slab, will be installed prior to any heavy vehicles using the access road. Design and installation of this structure will be undertaken in consultation with the pipeline operator, APA Group.

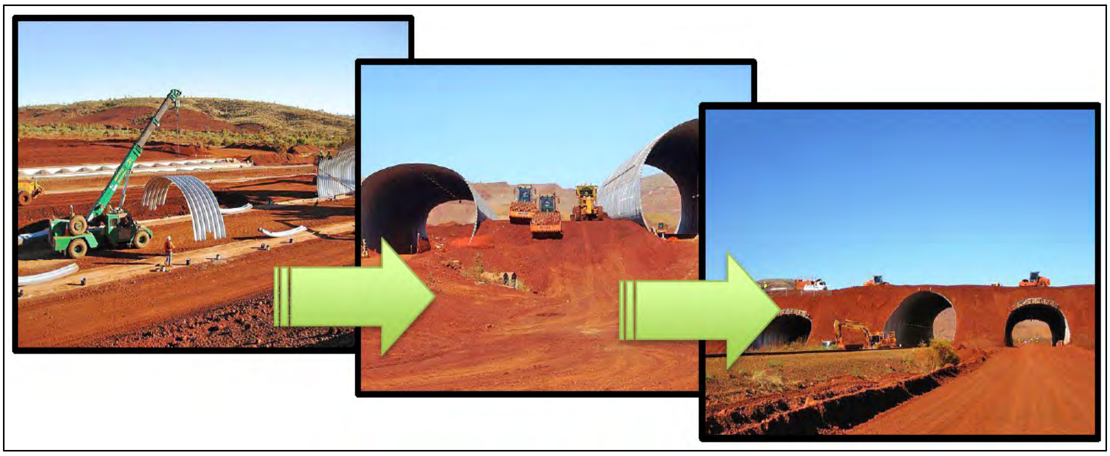


**Figure 2-6 Use of Super-Cor™ arches on the Nammuldi haul road**

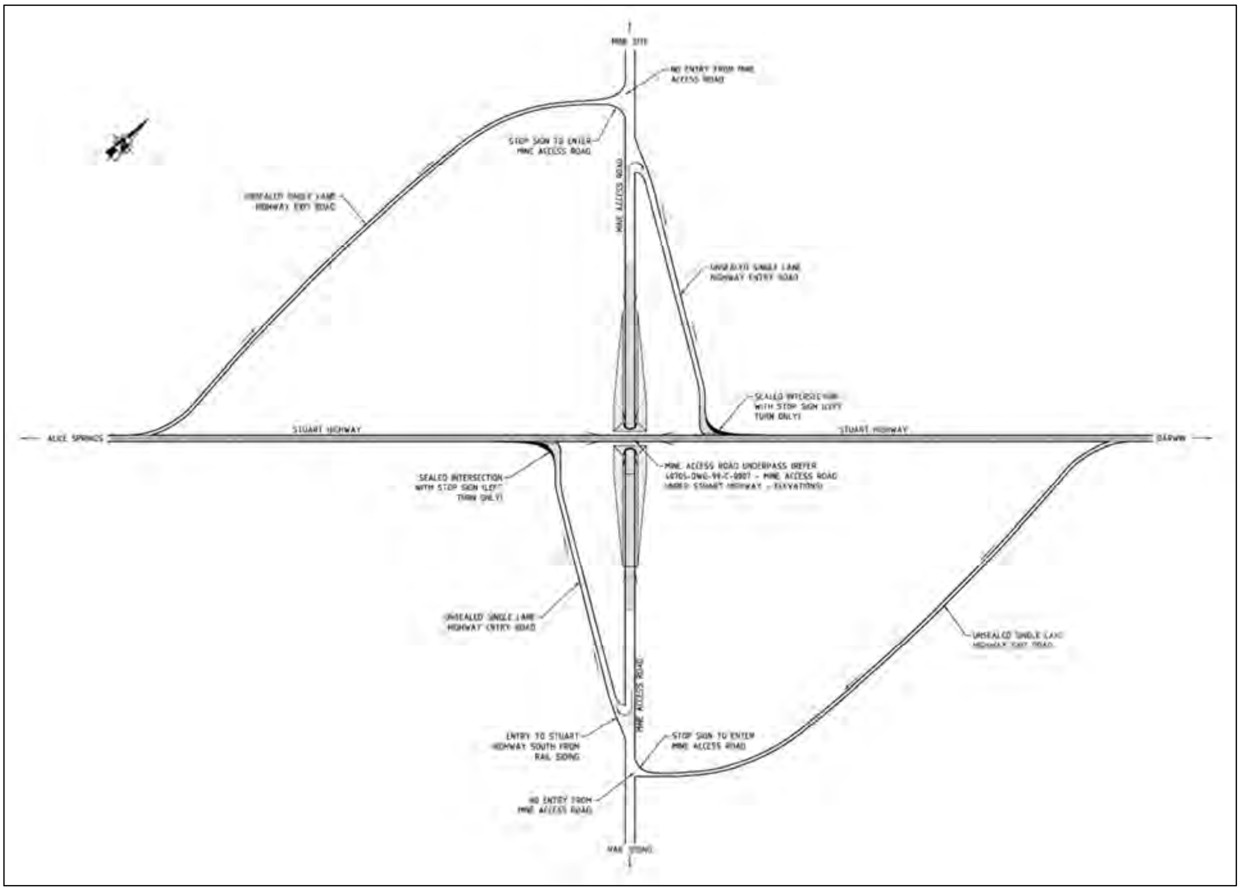



**Figure 2-7 Stuart Highway road connections**

Floodways will be constructed across the Hanson River, Murray Creek and some minor watercourses that bisect the access road. Crossing design incorporates a 300 mm thick stabilised fill road boarded with rock filled gabion baskets to sit at grade (Figure 2-8). The crossing has been designed to tolerate small river flows and to wash out during significant flood events to eliminate the potential for backup of flood waters. Typical crossing locations for the Hanson River and Murray Creek are shown in Plate 2-1.

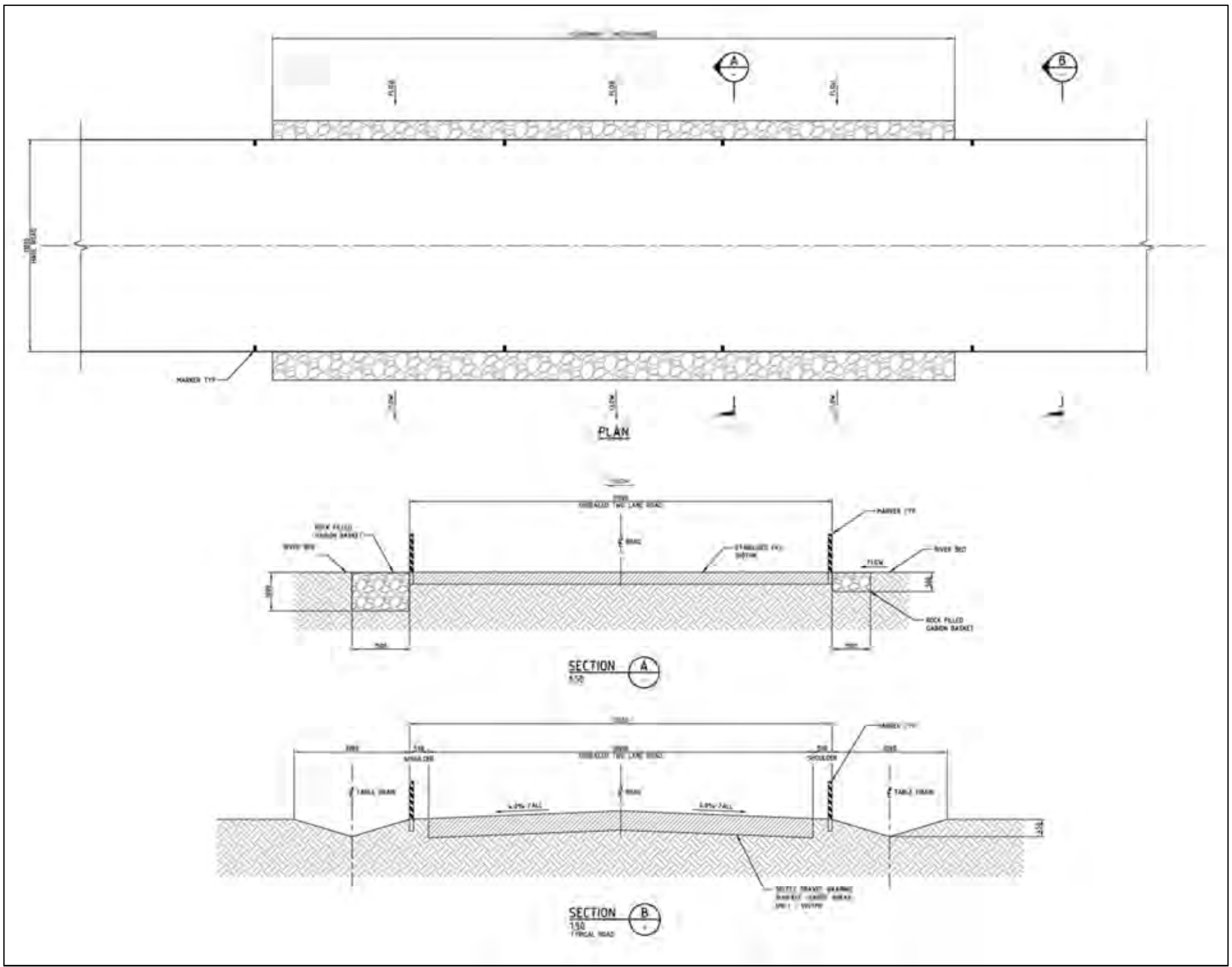



**Figure 2-8 Floodway detail**

| | |
|---|---|
|  |  |
| **Hanson River** | **Murray Creek** |

**Plate 2-1 Typical waterway crossing locations**

## 2.4 Mining, Processing and Product Export

### 2.4.1 Mine Plan and Pit Development

The ultimate pit shell will be reached through five intermediate but overlapping stages. These stages have been developed to minimise waste movement and haulage distances (Figure 2-9). Once mining is complete the pit will be approximately 2,000 m long and 600 m wide with a maximum depth of 125 m.

Pit design and construction follows standard industry design techniques.

The production schedule over the 15 year mine life is provided in Table 2-3. There is a pre-production year that will occur during the second year of construction and will involve pre-stripping of waste material. Some 138.84 Mt of material is expected to be extracted over the life of the mine, comprising around 77.84 Mt of ore and 61 Mt of waste. The largest amount of material mined occurs during mining years 7 and 8 (11.85 Mt).

### 2.4.2 Mining

Mining will occur in two 12 hour shifts.

Mining will commence with a "starter pit" accessing high grade and low strip ratio ore. Drilling and blasting, to loosen rock ahead of mining, will be undertaken to produce rock sizes that conform to processing requirements.

Extracted high grade ore will be transported by haul truck from the pit to the ROM pad and directly fed into the process plant.

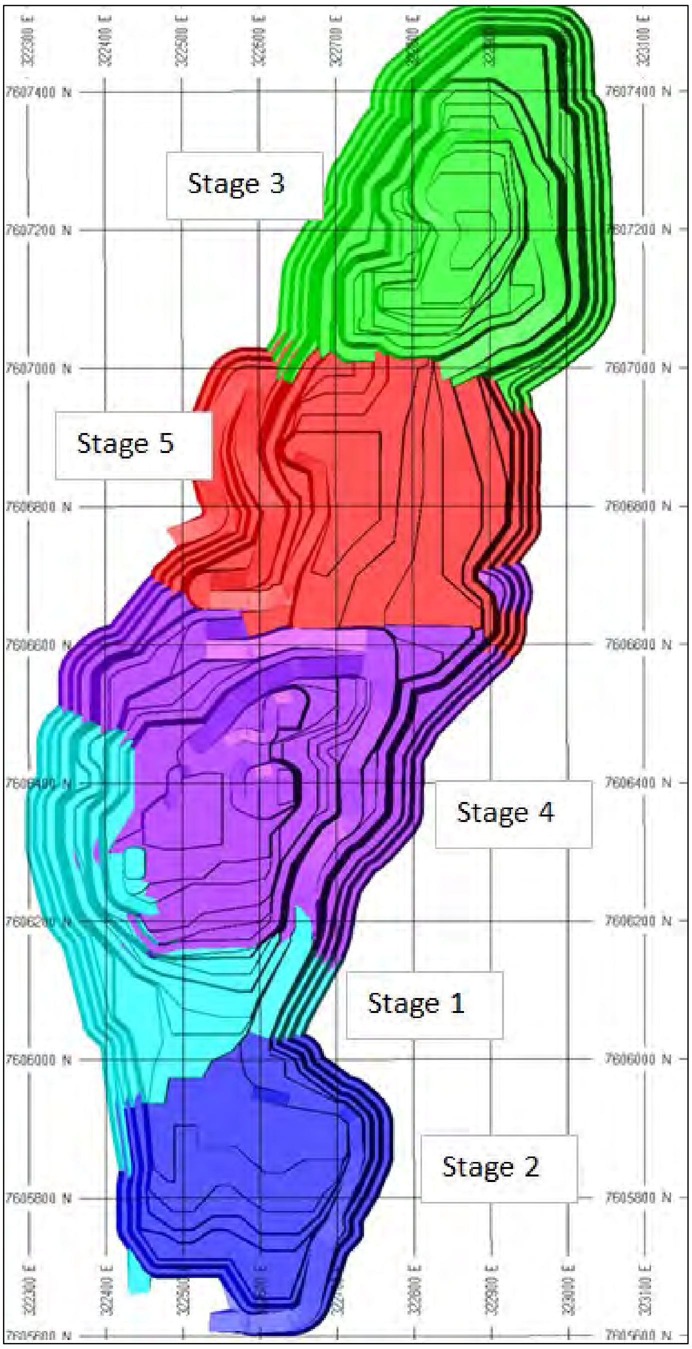



Figure 2-9 Staged pit development

**Table 2-3 Annual mine production schedule**

| Mining year | Total ore mined | Total waste mined | Total tonnes mined | Strip ratio (waste to ore) |
|---|---|---|---|---|
| | Million tonnes (rounded) | | | |
| Pre-production | 0.06 | 4.82 | 4.88 | 82.20 |
| 1 | 5.80 | 5.84 | 11.64 | 1.01 |
| 2 | 4.62 | 7.02 | 11.64 | 1.52 |
| 3 | 3.79 | 7.85 | 11.64 | 2.07 |
| 4 | 5.31 | 6.26 | 11.57 | 1.18 |
| 5 | 6.12 | 5.37 | 11.49 | 0.88 |
| 6 | 5.65 | 5.93 | 11.58 | 1.05 |
| 7 | 5.87 | 5.98 | 11.85 | 1.02 |
| 8 | 6.23 | 5.62 | 11.85 | 0.90 |
| 9 | 6.57 | 5.27 | 11.84 | 0.80 |
| 10 | 8.39 | 0.55 | 8.94 | 0.07 |
| 11 | 6.83 | 0.26 | 7.09 | 0.04 |
| 12 | 4.30 | 0.18 | 4.48 | 0.04 |
| 13 | 4.44 | 0.05 | 4.49 | 0.01 |
| 14 | 2.26 | 0.00 | 2.26 | 0.01 |
| 15 | 1.60 | 0.00 | 1.60 | 0.00 |
| **Total** | **77.84** | **61.00** | **138.84** | **0.78** |

Four long-term stockpiles will be established according to grade (Figure 2-10). The higher grade stockpile will be used to balance the mining and processing rates and will be of similar quality to the direct feed material. Medium and low grade stockpiles will be depleted towards the end of the mine life with the higher grade material used first.

Waste material will be trucked to the WRD that will progressively develop to the west of the pit (Figure 2-10).

Testing of the orebody produced limited volumes of groundwater. It is proposed to use in-pit sump pumps to remove any water accumulating in the pit due to seepage and direct rainfall.

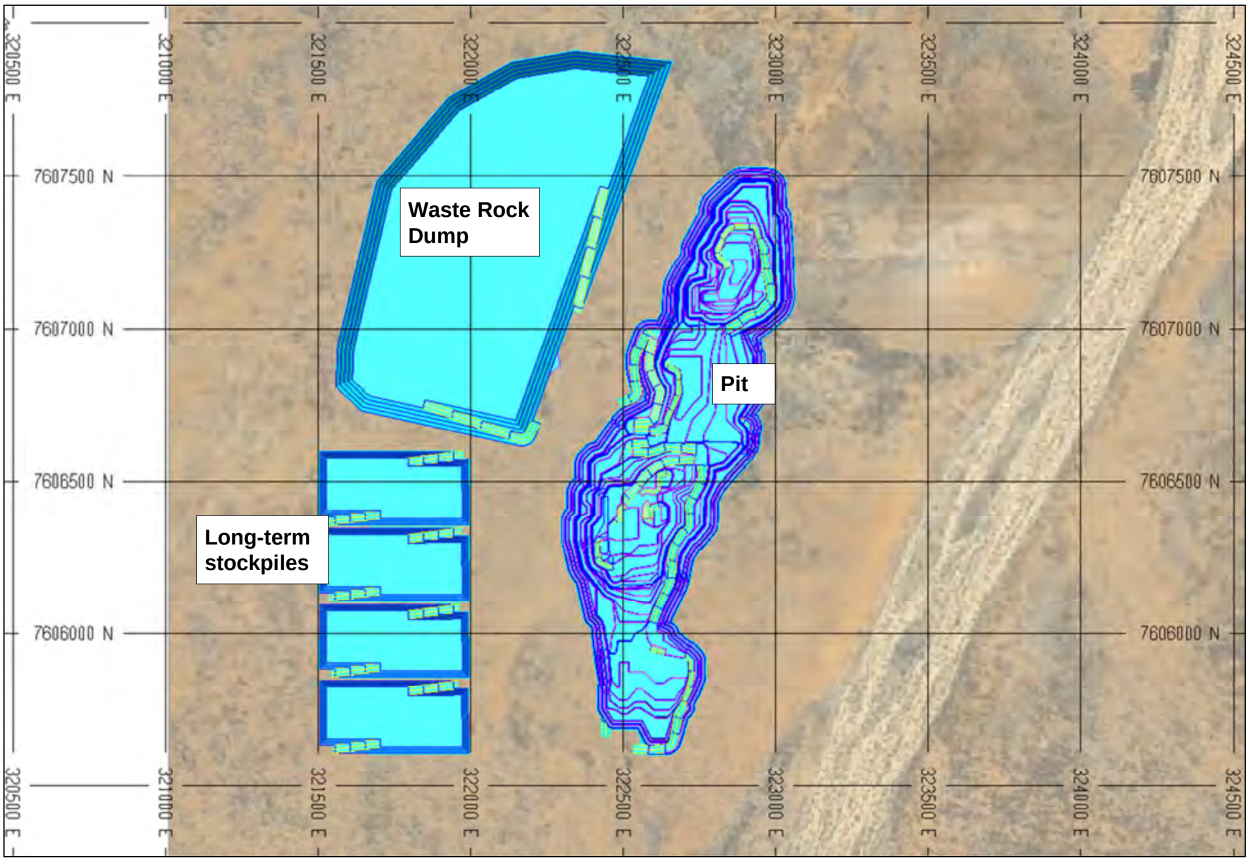



**Figure 2-10 Mine site layout**

Figure 2-11 shows the progression of mining over the Project life:

- end of year 2: initial mining focuses on the southern portion of the mine (Stage 1) where the overburden is shallowest and the highest grades exist. Mined ore is fed directly to the process plant;
- end of year 4: mining of ore is taking place in the southern area (Stage 1 and 2) with waste stripping to the northern (Stage 3). The full footprint of the waste dump has been opened. The low grade stockpiles are being filled (to approximately 5 Mt at this stage) as material is mined to uncover higher grade material;
- end of year 6: mining of ore continues in Stage 2 and 3. Material is added to the stockpiles with the total size reaching about 9 Mt at this stage. The higher grade stockpile (southern) is regularly depleted to manage variations in ore delivery;
- end of year 8: stripping of Stage 4 commences as ore mining in Stage 2 and 3 continues;
- end of year 10: stripping of Stage 5 commences as ore mining in Stage 3 and 4 continues;
- end of year 12: waste mining ceases, and all stages are being depleted to final depth. The stockpiles peak at just over 12 Mt;
- end of year 14: Final ore mining from the pit is virtually complete, while the stockpiles start to be depleted;
- end of mine life: mining has been completed. Final stockpile depletion occurs to meet concentrator requirements.

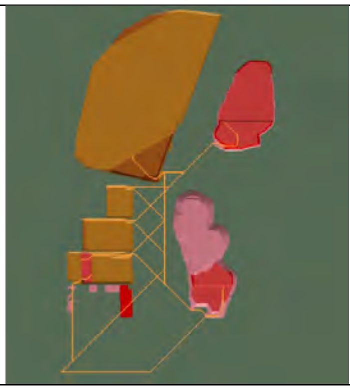
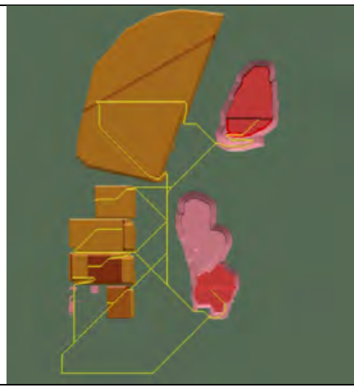
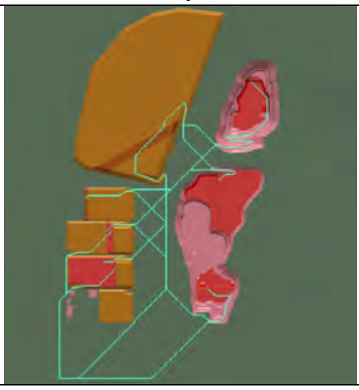
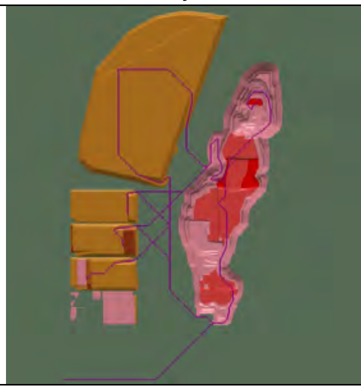
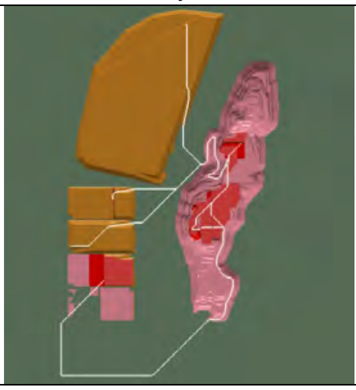
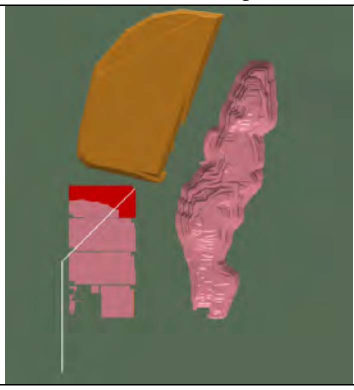
| End of pre-production year | End of year 4 | End of year 6 |
|---|---|---|
|  |  |  |
| End of year 8 | End of year 10 | End of year 12 |
|  |  |  |
| End of year 14 | End of mining | Legend |
|  |  | Red – areas being actively mined and stockpiled material being used.<br>Pink – inactive areas of the mine and depleted stockpile areas.<br>Brown – waste material stored in the waste rock dump and ore in stockpiles. |

**Figure 2-11 Progression of mining through the project life**

### 2.4.3 Processing

Processing involves crushing, grinding and magnetic separation to produce a magnetite concentrate. A layout of the processing facilities is shown in Figure 2-12 and a simplified process diagram is shown in Figure 2-13.

Throughput of the plant will be 3 Mtpa initially, doubling to 6 Mtpa in year 5. The plant will operate 24/7.

#### Crushing

A front end loader will feed ore onto a static grizzly above the ROM bin. Screened oversize material (+500 mm) will be broken by a mobile rock crusher and re-fed into the grizzly.

ROM bin material will be fed to a vibrating grizzly. Screened oversize material (+150 mm) will be crushed in a primary jaw crusher with crushed product mixed with -150 mm material and conveyed to a primary screen bin feed. The +30 mm material will be conveyed to a secondary cone crusher, then recombined with screened undersize (-30 mm) material and conveyed to a High Pressure Grinding Rolls (HPGR) stockpile.

### Grinding

The HPGR stockpile will have a live capacity of 20,000 tonnes. Material will be reclaimed from beneath the stockpile and sent to the HPGR feed bin.

Tertiary crushing will be achieved using an HPGR. The grinding elements of the HPGR are two counter-rotating rolls, between which the material is crushed.

The HPGR product will be conveyed to the HPGR screen feed bin. Screening of the HPGR product will be a wet process. Screen oversize (+2.8 mm) will be returned to the HPGR feed bin with undersize either sent to a secondary ball mill for further milling or fed directly to cyclones.

Cyclone overflow (<90 µm) gravitates to the magnetic separation circuit with underflow returned to the ball mill for further grinding.

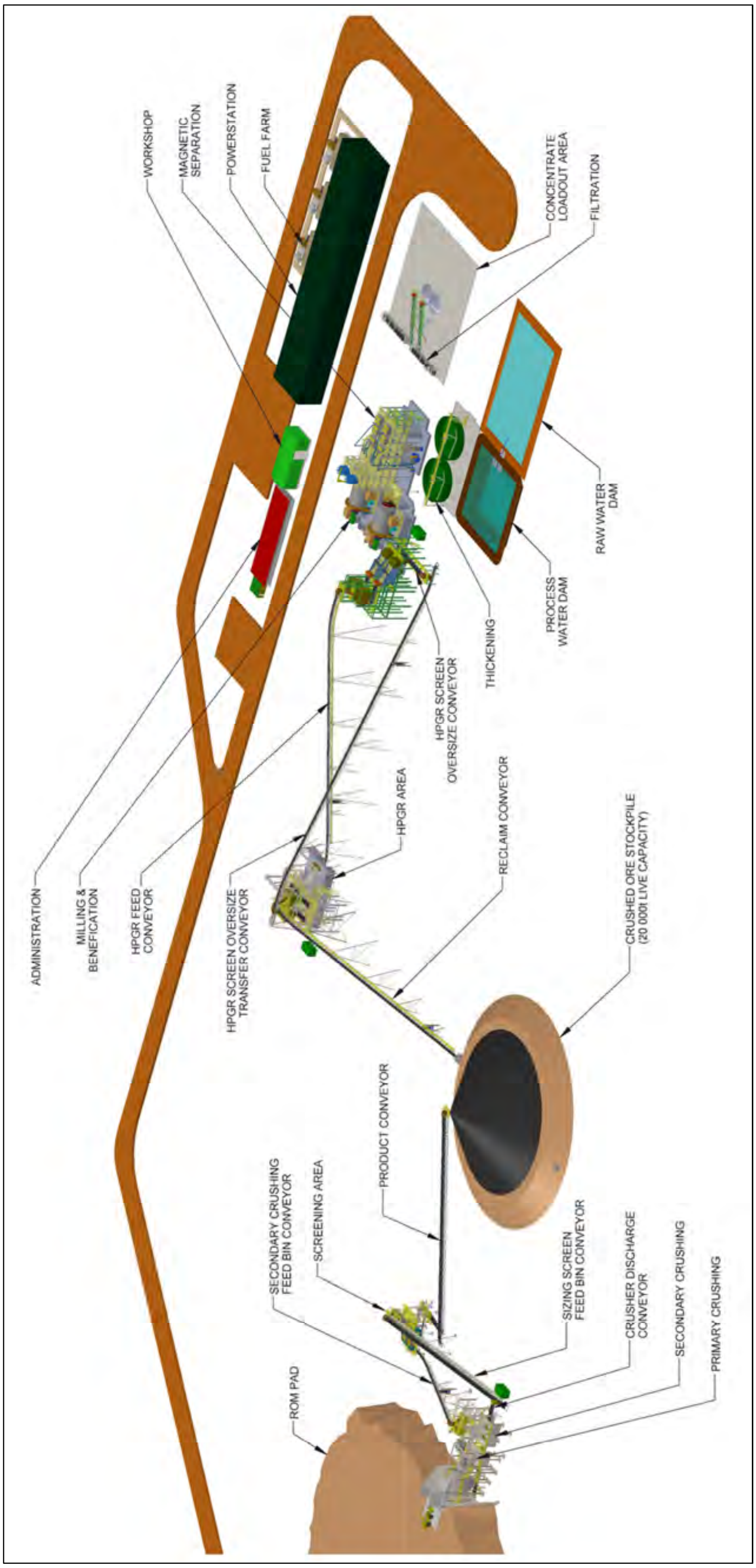



**Figure 2-12 Layout of the processing facilities**

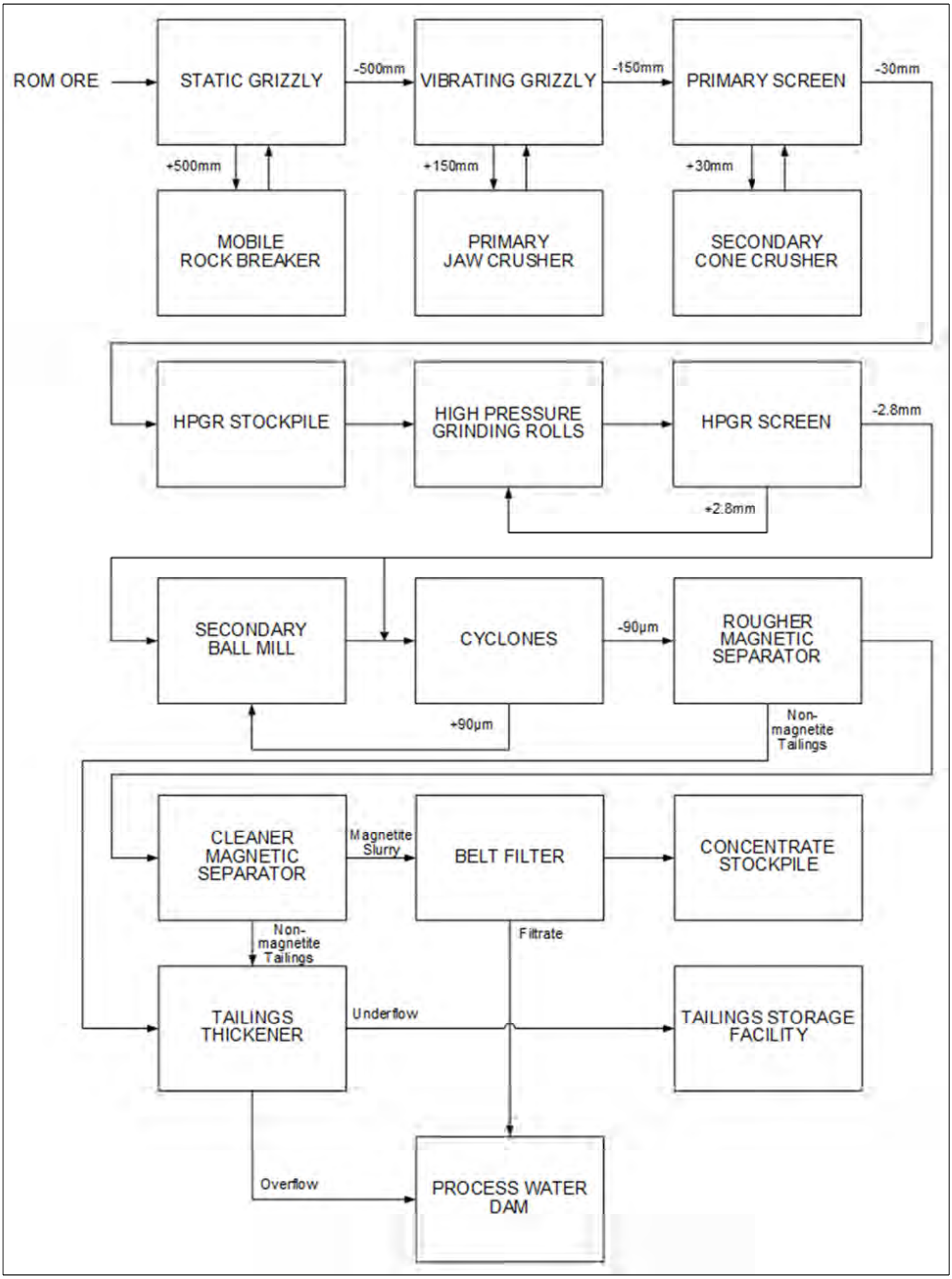



**Figure 2-13 Simplified process diagram**

### Magnetic separation

Cyclone overflow gravitates to a bank of Rougher Magnetic Separators (RMS) to remove entrained highly magnetic material (magnetite).

RMS concentrate then gravitates to bank of Cleaner Magnetic Separators (CMS) to increase the final concentrate grade. The CMS concentrate gravitates into the Magnetite stock feed tank.

Non-magnetic tailings streams will be pumped to a tailings thickener where the solids density is increased to approximately 65%. Overflow from the thickener will gravitate to the process water dam whilst underflow will be pumped to the TSF.

### Magnetite concentration

The magnetite slurry is filtered to achieve a moisture content of 10% w/w which is required to minimise transport costs. Filter cake is then stockpiled in a concentrate storage area.

## 2.4.4 Product Transfer

Concentrate will be loaded into trucks using a front end loader. A concentrate weighbridge will record the tonnage that is trucked off site.

The concentrate will be trucked via the access road to a new rail siding and loadout facility at Adnera. Trucks will be triple side tippers with 140 tonne capacity. Loads will be covered to prevent dust generation and product loss. Up to 50 loads of concentrate will be delivered to Adnera per day (up to 100 return truck movements or four per hour).

## 2.4.5 Adnera Loadout Facility

The proposed layout for the Adnera Loadout Facility is shown in Figure 2-14.

Road trains will side dump concentrate to a stockpile adjacent to the rail siding. The stockpile will have a capacity of up to 150,000 tonnes, sufficient for four weeks.

Train loading will occur directly by up to four front-end loaders. The train will have a length of 1.5 km and consist of 60 hopper wagons with a total capacity of around 5,500 tonnes. Around one train movement per day is expected.

Infrastructure located at Adnera will include:

- 1.8 km rail siding with signalling;
- site office with potable water tank, toilet, washroom and shower connected to a septic tank;
- generator and lighting;
- bunded diesel storage tank; and
- hardstand.

Potable water and diesel will be trucked from the mine site as required.

Adnera is expected to have a workforce of four, accommodated at the camp adjacent to the mine site.

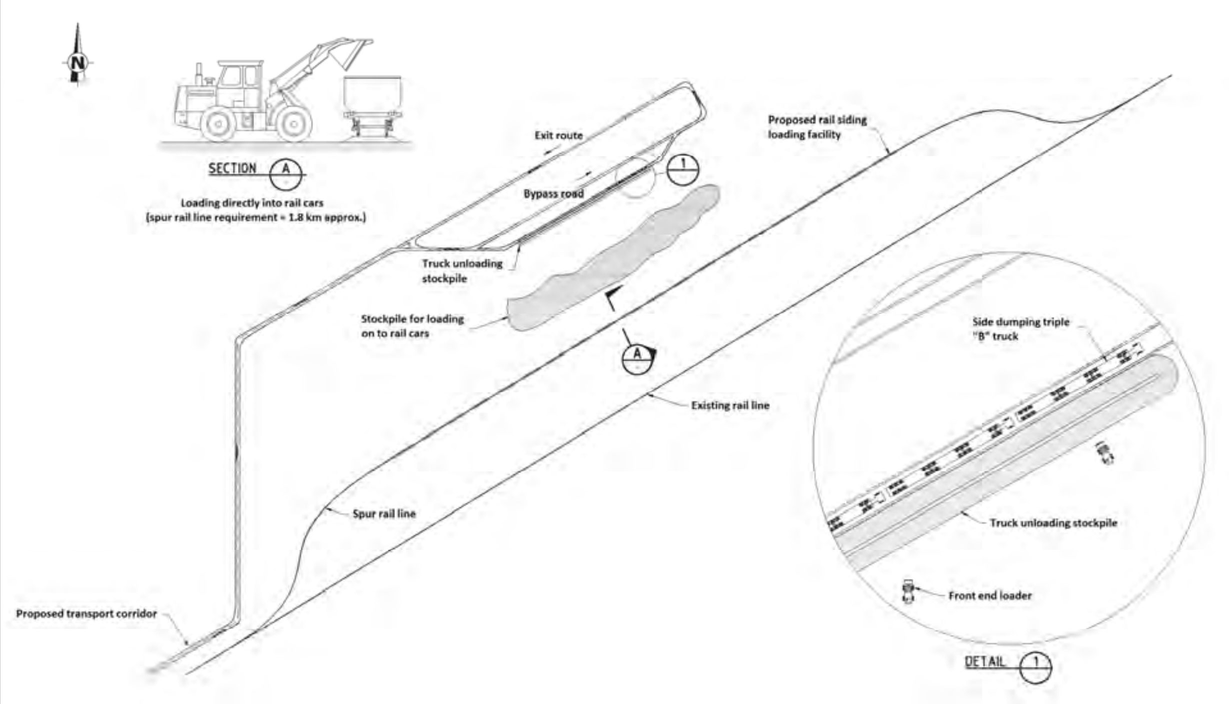



**Figure 2-14 Adnera loadout facility**

### 2.4.6 Reagents and Consumables

Reagents and consumables expected to be used at Mount Peake include:

- Nalco 83372 (or similar) as a flocculant in the process plant – 300 tpa;
- sodium hypochlorite (or similar) for disinfection in the water treatment plant – 5 tpa;
- antiscalent for use in the water treatment plant – 1 tpa;
- primary and secondary mill balls – 15,000 units; and
- operating consumables associated with wear in the apron feeders, vibrating grizzly, crushing circuit, crusher screens, HPGR screens and HPGR liners.

Reagents and consumables will be delivered by truck. It is estimated that up to four deliveries per day will occur.

### 2.4.7 Site Vehicle

Vehicles at Mount Peake will undertake a variety of functions including mining, stockpile management, plant feeding, road maintenance, dust suppression, general personnel movement etc. The expected vehicle fleet is provided in Table 2-4.

**Table 2-4 Indicative vehicle fleet**

| Equipment | Indicative Number |
|---|---|
| Dump truck (Cat 777F) | 7 |
| Drill rig (Cat MD5125) | 2 |
| Track dozer (Cat D9T) | 2 |
| Wheel dozer (834) | 1 |
| Shovel (Cat 6018) | 2 |
| Shovel (Cat 6015) | 1 |
| Grader (Cat 16M) | 1 |
| Water truck (Cat 777D WT) | 2 |
| Wheel loader (Cat 980H) | 6 |
| Wheel loader (Cat 966H) | 1 |
| Roller (Cat CS74) | 1 |
| Fuel truck (Cat 777G FT) | 1 |
| Road train | 5 |
| Light vehicles (Land cruisers, utes, sedans) | 10 |
| Busses | 4 |

## 2.5 Infrastructure

### 2.5.1 Access Road

A private access road between the mine site and Adnera Loadout Facility will serve the dual purpose of providing general vehicle access from Stuart Highway to both the mine site and loadout facility, and as the haulage route for concentrate product.

Road trains used to transport concentrate will be highway compliant and will operate under shared usage conditions with other highway compliant vehicles such as delivery trucks, busses and light vehicles.

### 2.5.2 Power Supply

At full production the power draw for the mine and process plant is estimated at 24 MW. Power during the first four years will be supplied by 16 x 1,400 kVA gas fired generating sets with an additional 12 generating sets added from year five. Emergency backup will be provided by 3 x 1,250 kVA diesel generators. Key specifications of the proposed power plant are provided in Table 2-5.

Gas will be provided from the Amadeus Gas Pipeline via a hot tap. Road train tankers will commute between the pipeline and the mine site along the access road. Storage of gas at the mine site will be in intermodal containers in accordance with AS 4332-2004: The storage and handling of gases in cylinders.

Diesel generators will be used to power the borefield.

Power for construction will be provided by diesel powered generators until the power station is operable.

### Table 2-5 Power plant specifications

| Specification | Measurement |
|---|---|
| Gas Consumption | 1.2 Petajoules per annum (PJpa) – years 1 to 4<br>1.8 PJpa – years 5 to 15 |
| Electricity produced | 2,500 Gigawatt Hours (GWh) over project life |
| Estimated Emissions (kg per year) | |
| $NO_X$ | 117,944 |
| CO | 9,145 |
| VOC | 3,468 |

### 2.5.3 Water Supply and Storage

A new borefield will be established within the alluvial aquifer of the Hanson River (Figure 2-1). Six supply bores with two standby bores will provide water for the first four years of the Project with an additional four bores installed from year 5. Bores will be spaced approximately 1,800 m apart and will pump at around 8.5 L/s each.

The bores and their associated diesel generators will be constructed on raised pads to provide flood immunity from the Hanson River.

A water supply pipeline will be constructed between the borefield and the Raw Water Dam predominantly along existing tracks, a distance of approximately 49 km. The pipeline will have a diameter of up to 450 mm. Access to the borefield will be via a graded dirt road following the pipeline. The clearing width will be approximately 10 m.

Power to each bore will be supplied via a 50 kVA generator with a 4,670 L diesel tank, sufficient for around 20 days continuous operation. Generators will be located on bunded hardstand pads. Diesel will be delivered by tanker.

A water balance for Mount Peake is provided in Figure 2-15. Around 2,625 MLpa of make-up water will be required for mining, processing, dust suppression and potable use once the mine reaches full production. Water for use at the Adnera Loadout Facility will be trucked from the mine site.

A 1.5 ha Raw Water Dam will be constructed adjacent to the process plant to manage Project water supply (Figure 2-12). Total storage will be around 21 ML, sufficient for three days supply. A 0.9 ha Process Water Dam will be constructed adjacent to the process plant to provide process water and to receive recovered water from the plant and tailings storage facility. Total storage will be around 7 ML, sufficient for 2 days supply. Both dams will be lined with a synthetic membrane to prevent seepage.

A water treatment plant will be constructed. The plant will treat 35.6 $m^3/h$ for potable use, irrigation and process plant gland water. Water treatment will comprise filtration using multi-media filters (MMF), desalination using brackish water reverse osmosis (BWRO) and disinfection using sodium hypochlorite or similar.

The brine reject will be discharged to the Process Water Dam where it will be recirculated.

Water supply to the camp will be from the water treatment plant via a 100 mm pipeline constructed along the access road.

### 2.5.4 Buildings

The administration building will be single storeyed containing offices, work area, meeting room, archives, crib room, training facilities, emergency response facilities, change room and store.

The mill office will house the main control room, process plant office area, changing room, crib room and a general covered area.

A mine workshop will service major equipment used on the mine. A plant workshop and warehouse will deal with equipment used on the plant and light vehicles. The workshop will be divided into a general mechanical workshop, an electrical/instrument workshop and a boilermaker's workshop. The warehouse section will be a double storeyed and include some space for offices, crib room, etc.

A separate reagent storage warehouse will be provided for solid reagents that require protection from the elements.

A metallurgical laboratory will be provided to allow monitoring for grade control of incoming ore and to allow process and product monitoring.

Buildings will be of a modular transportable style requiring minimum on-site construction labour.

A site office will be established at Adnera and include toilet, washroom and shower.

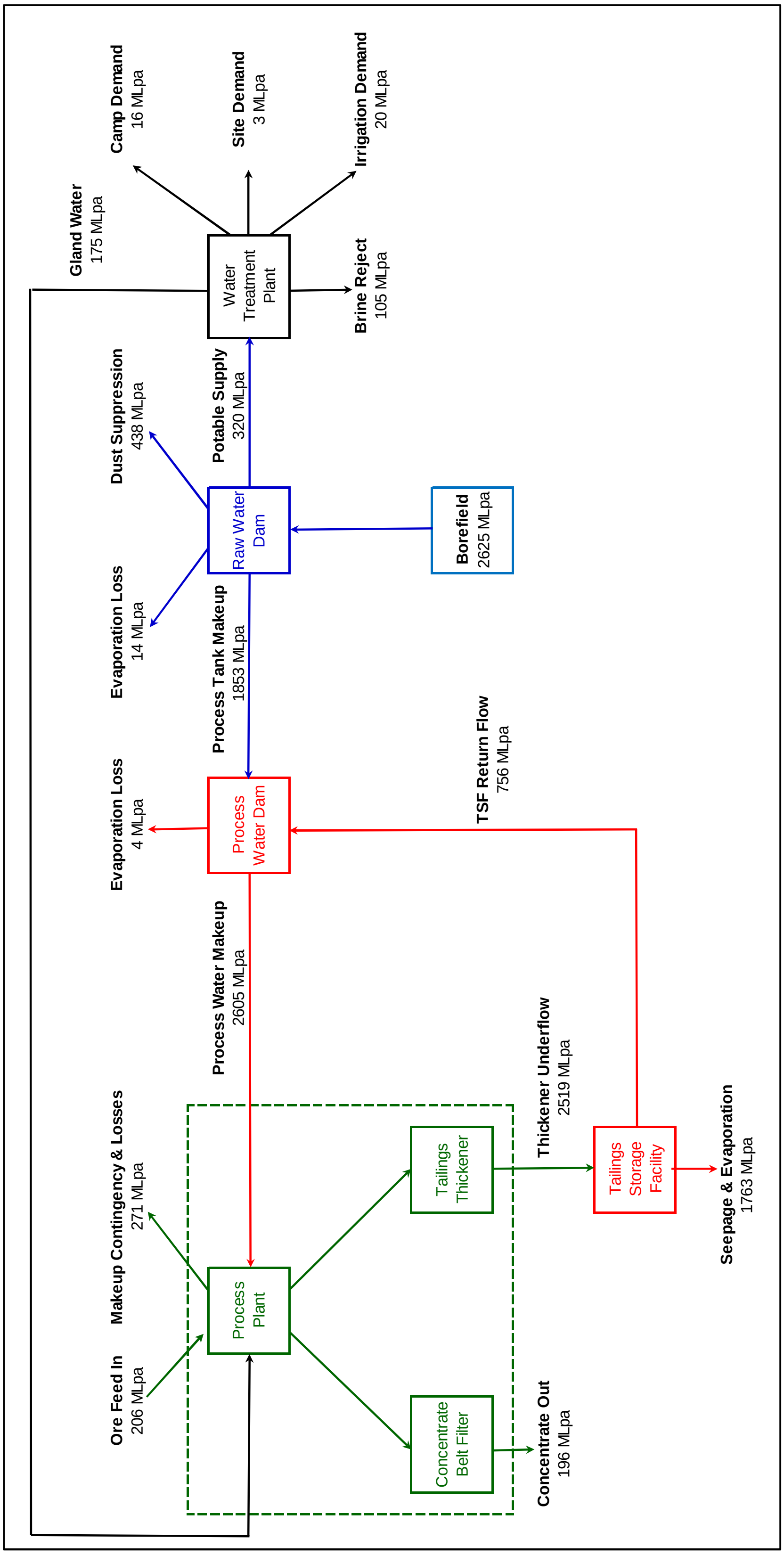



**Figure 2-15 Mount Peake water balance at full production**

### 2.5.5 Sewage

Two pump stations will be installed to collect sewage and wastewater for treatment in a Sewage Treatment Plant. One station will service the mine site with a second station servicing the accommodation village.

Treated waste water will be used around the site for landscaping purposes.

The untreatable solids will be collected and disposed of offsite by a licensed waste transporter.

Sewage at the Adnera Loadout Facility will be treated by septic tank and leach drains.

### 2.5.6 Communications

A line of microwave repeater stations runs between Alice Springs and Tennant Creek, approximately 50 km from the mine site. It is planned to establish a repeater station on-site to tie into this network in combination with a two way satellite system to meet all site communications demands.

A two way radio network will be used for operational communications on site.

### 2.5.7 Chemical and Hydrocarbon Storage

Diesel will be required to fuel the mining and vehicle fleet, and generators at the borefield. At a mining rate of 6 Mtpa the estimated diesel requirement is 15 MLpa. To achieve this there will be three 100,000 L deliveries per week by triple carriage semitrailer.

Diesel at the mine site will be stored in 85,500 L self-bunded tanks with a total storage capacity of around 850,000 L (Plate 2-2). The tanks are effective storage solutions for type 1 or 2 combustible fluids. The tanks are manufactured to comply with Australian Standard AS1692 and when installed in compliance with AS1940 for Storage of Combustible Fluids easily meet regulatory requirements.


**Plate 2-2 Example of 85,000 L self-bunded tank**

Lubricating oil will be stored in bulk containers inside a bunded area with spill protection and recovery.

Waste hydrocarbons will be stored in a tank within a bunded area to be held for collection by a contractor for reprocessing and recycling.

The Project will not use any hazardous chemicals that require special storage and handling.

### 2.5.8 Explosives Magazine

A total of 24,000 tonnes of explosives is estimated to be required over the life of mine peaking at 2,200 tpa. Around 55% of the explosive required is emulsion for use in fresh material with the balance being ammonium nitrate / fuel oil.

Explosives will be stored in a dedicated magazine.

### 2.5.9 Ti Tree Airstrip

The Project is expected to use the existing Ti Tree airstrip, 70 km from the mine site. This airstrip is available, and able to accommodate aircraft such as the Fokker F100 or BAE146. Negotiations with the Northern Territory Government on this facility are in progress and the upgrade of the current airstrip is anticipated to be covered by the Federal Government's Development Fund for Northern Australia.

The runway is 1,320 m long and 30 m wide. There is an 18 m wide strip of sealed pavement with the remaining 12 m width (6 m on both sides) being unsealed.

The runway will be upgraded by increasing the width and length of seal. A concept for a small terminal has also been prepared (Figure 2-16) which would include check-in desks, baggage collection, amenities, car parking facilities, undercover seated areas and baggage collection area.

The upgrade is expected to be undertaken by TNG in consultation with the NT Government.

**Figure 2-16 Concept schematic for the new Ti Tree terminal**

## 2.6 Workforce and Accommodation

### 2.6.1 Workforce

The construction and operations workforces are estimated to peak at 225 and 170 personnel respectively.

The workforces will be largely fly-in fly-out due to low population numbers in the local area.

Workers will fly to Ti Tree and then bus to the accommodation village for the duration of their roster. Peak workforce transport will occur in the morning and evenings at the beginning and end of the rosters.

Construction workforce traffic is expected to peak at six return bus trips and 30 light vehicle trips per day with operation workforce traffic expected to peak at five return bus trips and 20 light vehicle trips per day.

The workforce will comprise personnel typical of this type of mine and include mine manager, pit supervisor, site administration officers, plant operators (excavators, trucks, dozers, graders, water carts, front-end loaders), drillers, environmental staff and maintenance personnel. Environmental staff will comprise a tertiary qualified environmental manager and 2 to 3 support personnel including aboriginal rangers.

### 2.6.2 Accommodation

The accommodation village will be established within the new camp Ancillary Lease to the east of the mine site (Figure 2-2) to facilitate ease of access to the operation and crew rotations to and from the site. An adequate distance between the village and operations has been allowed for to minimise the exposure to site noise, vibration and dust emissions.

An initial 40 person “fly camp“ will be established to allow for early construction works. This will consist of separate 4 room en-suited accommodation units together with kitchen / diner, laundry units, wet mess, and office / administration building.

Following early site works a permanent village will be constructed to provide housing for the main construction workforce prior to hand over for operations personnel. The village will comprise (Figure 2-17 and Figure 2-18):

- dry mess, wet mess, kitchen and cold room;
- ablutions;
- games room complete with internet and telephone connection;
- swimming pool, tennis court and gymnasium;
- laundry facilities;
- fire water protection with diesel backup;
- sewage treatment plant;
- village administration offices; and
- car parking.

Village buildings will be of a modular transportable style requiring minimum on-site construction labour.


**Figure 2-17 Concept layout for the accommodation village**

**Figure 2-18 Concept schematic for the accommodation village**

## 2.7 Waste Management

### 2.7.1 Waste Rock Dump

#### Ore and Waste Rock Characterisation

The Mineral Resource is hosted by a mafic intrusive rock, a gabbro sill, up to 250 m thick with gabbro rocks both below and above the ore zones. The orebody comprises the magnetite-rich portion of the sill, which forms a flat-lying body oriented north/south. All of the intrusive is oxidised so there is no magmatic sulphide within this material. What sulphide is seen in the ore/intrusive was introduced by hydrothermal fluids within structural zones. The intrusive has only minor alteration and structural disruption and very little sulphides. Other rock types that will contribute to the waste dump also have a low sulphide content.

Mining will involve movement of a moderate amount of waste, both from above (surface overburden “pre-strip”) and adjacent to the ore material. A significant component (ca. 30%) of the overburden material is aeolian sand and colluvial/alluvial sediment. All of this material is weathered, as it formed at surface under strongly oxidising conditions, and so will not contain significant sulphides. Un-mineralised gabbro comprises a significant component (>30%) of the waste rock, which is either weathered or fresh. All of this material contains some magnetite indicating oxidising conditions for the intrusive magma and hence no significant sulphide is present. Adjacent to the orebody some of the waste material to be removed comprises granite (10 - 20%) from along the western wall of the pit, which has a low sulphide content.

Geological logging of all drilling on the resource has only rarely encountered visible sulphides. Rarely do they comprise more than a few percent of the sample over a few metres. Generally the sulphides seen are associated with structural zones and faults/fractures. The majority of fracture zones are less than one metre thick, irregularly developed, and not able to be correlated between holes. The only significant fault (both width and extent) follows the western side of the gabbro body and will dip into the western pit wall.

An Acid Mine Drainage (AMD) assessment was undertaken on a comprehensive dataset of XRF data obtained during various drilling and targeted waste sampling programs (Appendix O). The combined dataset included over 6000 samples within and immediately surrounding the pit shell. Geochemical relationships were formulated from the data to build an understanding of the AMD risk at Mount Peake. The approach was based on industry guidelines (DITR 2007, INAP 2009).

The assessment confirmed that sulfur concentrations are generally low and not widespread. 99.35% of the samples analysed for sulfur returned values of below 0.3% total sulfur. This equates to 99.35% of the samples having a Maximum Potential Acidity (MPA) of less than 10 kg of $H_2SO_4$ per tonne. This assumes that all sulfur is present as reactive pyrite and it is therefore an inherently conservative assessment as it discounts non-acid forming sulfur species or any inherent neutralising capacity.

The Acid Neutralising Capacity (ANC) was found to be relatively high indicating that any acid forming waste would likely to be neutralised. From the Maximum Potential Acidity and the Acid Neutralising Capacity, the Net Acid Producing Potential (NAPP) was calculated for each lithological unit. This indicated that approximately 99.7% of the samples had a NAPP value of less than 10 kg of $H_2SO_4$ per tonne indicating the material is largely Non-acid Forming (NAF).

Although the geochemistry indicates a low risk of AMD, a management plan was developed to take into consideration the highest AMD risk material observed. The key aspect of the management plan is early identification of Potentially Acid Forming (PAF) material through additional analyses and ongoing monitoring. The results of these tests will be reviewed to develop a revised potential acidity assessment of the ore and waste. In addition to pre-production testing, a program of regular testing as part of ongoing grade control and regular updating of the AMD model will be undertaken.

No sources of radiation have been identified from the ore body or waste material.

### Waste Rock Dump

A WRD will be constructed to contain waste rock from mining operations. The dump will have an ultimate height of 40 m and a footprint of 90 ha with capacity to store up to 70 Mt of waste (Figure 2-10). It is proposed to use up to 5 Mt of non-acid forming waste from pre-production for Project construction requirements.

The parameters used for waste dump design are:

- batter height: 10 m;
- ramp width: 27 m; and
- ramp gradient: 1 in 10.

There are no specific strategies to manage waste placement in the dump as the waste rock is benign.

Stormwater drainage, erosion and sediment controls will be designed and constructed to minimise erosion and channel scour. A concept is presented in the Drainage, Erosion and Sediment Control Plan (Appendix N). Stormwater collected on dump benches will be conveyed to a sedimentation basin on the toe of the WRD through engineered channels located on the benches. After settling of any sediment load, water will be either used around the site, for example in dust suppression, or allowed to discharge to natural drainage lines.

## 2.7.2 Tailings Storage Facility

The TSF will be located west of the process plant (Figure 2-2).

Tailings will be produced following the magnetic separation of the crushed and screened ore and will consist of non-magnetic silts and sands. Geochemical characterisation of ore and waste samples show a very low percentage of sulphur within the ore body and AMD is not expected to be an issue. No chemical process is required in the beneficiation plant. Therefore, the tailings solids are considered to be chemically stable and will not contain any contaminants.

Central Thickened Discharge (CTD) was selected as the preferred method for tailings disposal based on balancing water recovery, environmental risk, the relatively flat nature of the site, ease of closure, and construction and operating costs.

The tailings disposal system comprises:

- cone tailings thickener;
- tailings pumps;
- tailings delivery pipeline;
- access ramp to a central discharge area;
- perimeter earth-filled embankment;
- surface water drainage and seepage recovery systems;
- recovery water pond;
- emergency spillway; and
- monitoring wells.

The initial processing rate of 3 Mtpa will be doubled to 6 Mtpa from year five. The tailings thickener and the tailings discharge system will be duplicated in line with the duplication of the process plant.

The key parameters of the TSF are:

- height of the CTD cone: 32 m;
- CTD cone slope: 3%;
- diameter of the CTD cone: 2,134 m;
- active TSF footprint area: 357 ha; and
- TSF storage capacity: 63.41 Mt (38.13 $Mm^3$).

The various components of the tailings disposal system are described below.

### Tailings thickening

The tailings streams from the process plant will be combined in a tailings thickener where flocculant will be added to settle the fine solids. Thickener underflow, with a solids content of 65%, will be pumped to the TSF with overflow reused within the process plant.

### Tailings deposition

Thickened tailings will be pumped from the thickener to a central discharge area along the access ramp through an approximately 1.5 km long main delivery pipeline.

The access ramp is an earth fill structure constructed initially using mine pre-strip and overburden material and later on using mine waste.

The ramp embankment connects the perimeter wall with the central deposition area and will be constructed in stages. The first section of the ramp will be horizontal and it will change to a 3% slope to reach the Stage 1 deposition platform, 14 m above natural ground level. In later stages, the sloping section of the access ramp will be progressively raised by centreline construction according to the staged development schedule (Table 2-6).

**Table 2-6 Staged development of TSF**

| Stage | Cone height (m) | Cone radius (m) | Cumulative cone volume ($Mm^3$) |
|---|---|---|---|
| 1 | 14 | 467 | 3.19 |
| 2 | 18 | 600 | 6.79 |
| 3 | 22 | 733 | 12.39 |
| 4 | 25 | 833 | 18.18 |
| 5 | 28 | 933 | 25.54 |
| 6 | 30 | 1,000 | 31.42 |
| 7 | 32 | 1,067 | 38.13 |

Tailings deposition will be via outlet spigots placed around the perimeter of the central discharge area. The spigots will open and close progressively to form an even beach that will allow effective draining and drying of the tailings. Discharged tailings will form a cone shape tailings beach creating a roughly circular storage area.

In addition to the main delivery pipeline, an emergency pipeline will be installed with a single discharge point. This pipeline will run from the thickener to a discharge point close to the perimeter embankment.

### TSF staging

The TSF will develop in stages related to the incremental raising of the central access ramp. This will reduce the volume of construction materials required as access ramp raises will be constructed partly on the tailings itself. The proposed TSF staging is provided in Table 2-6. Staged development is presented in plan in Figure 2-19 and profile in Figure 2-20.

The rate of raise of the TSF gradually decreases, reducing to less than 1 m per year in the final stages of the design life. This slow rate of raise also allows for drying and densification of the tailing surface which is important for tailings to achieve a high density.

Given that the tailings do not contain contaminants, the TSF will not be lined.

**Perimeter embankment**

The perimeter embankment will be constructed in stages to nominal height of 2 m. It is expected that due to minor slope change across the site, the height of the embankment will vary between 1 m and 4 m across the site. The final shape, size and capacity of the facility will depend on the beach slope. The 2 m high perimeter embankment is sufficient for a beach angle of 3% and this will be confirmed during the initial years of tailings deposition after the beach slope is well understood.

The perimeter embankment will have a 6 m wide crest with side slopes at 1V:2H. The crest will be covered by road base material and will be used as a maintenance road.

The perimeter embankment will be constructed using selected material from the mine pre-strip or from materials borrowed from within the storage facility.

**Drainage management**

Implementation of a drainage system is important to maximise functionality for the TSF and to maximise water recovery from the tailings.

The drainage system will comprise drains placed at radii of 600 m, 850 m and 1100 m from the central discharge area. These drains will collect water from the entire area and flow to the central main collector drain connected to the recovery water pond. The drains will be constructed using free draining rockfill materials with flow areas of 3 $m^2$ and 5 $m^2$, for radial drains and the main collector drain, respectively.

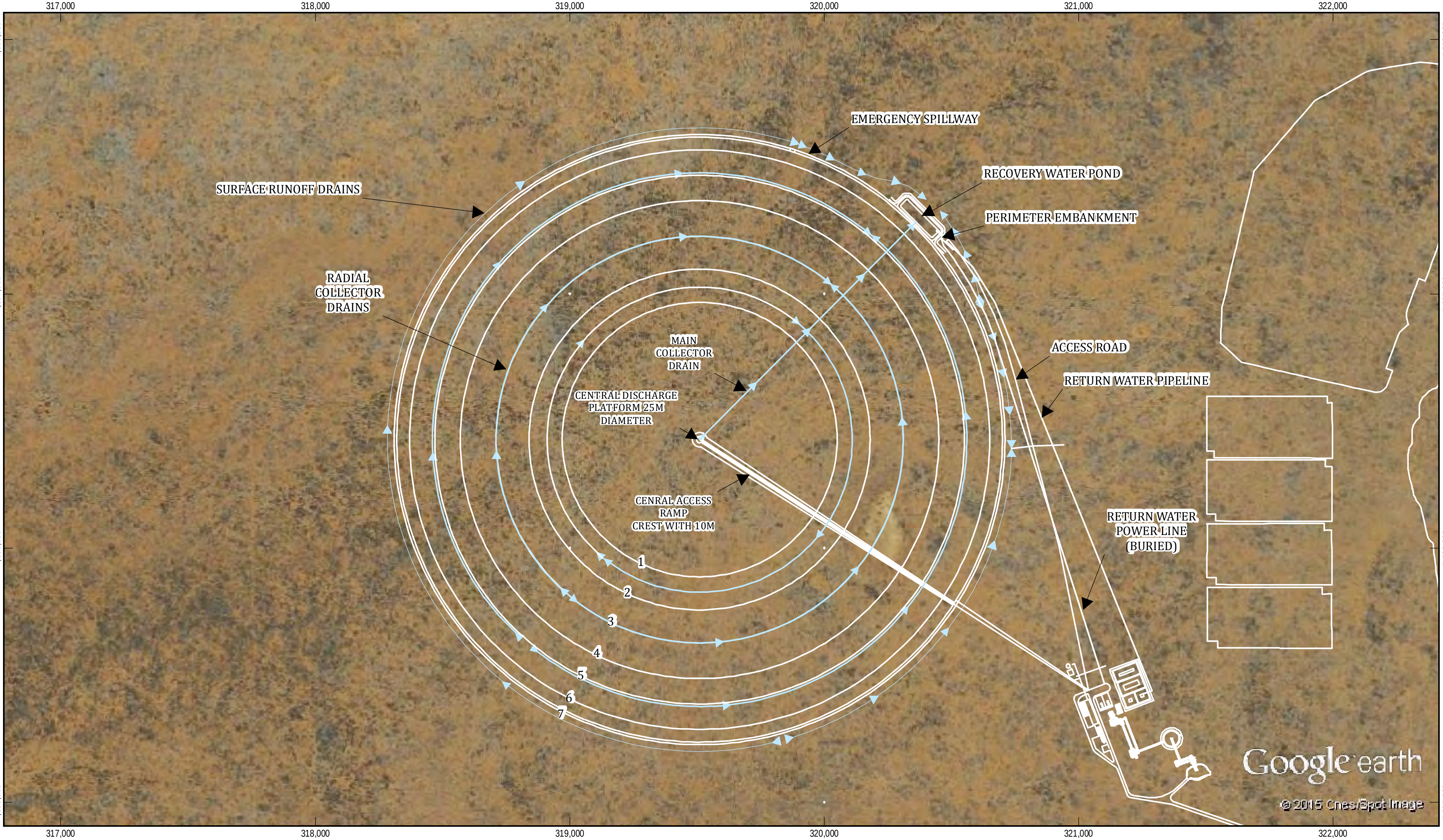
A seepage recovery trench will be constructed along the upstream toe of the perimeter embankment to recover seepage that would otherwise pass under the embankment.

To control surface runoff and avoid erosion of the perimeter embankment, surface runoff collector drains will be constructed along the downstream toe of the perimeter embankment. These drains will collect clean surface runoff and direct the flow away from the TSF.

**Recovery water pond**

Excess water from the deposited tailings will be collected in a recovery water pond located at the north-east part of the TSF.

Shortly after discharge, the tailings will settle and release excess water. The expected initial settlement of the 65% solid content of the slurry to a 75% solid content at the beach, will result in the release of about 70 $m^3$ of water per hour. This water, together with rainfall collected within the TSF, will flow to a lined 20,000 $m^3$ recovery water pond and returned to the process water dam for use in the process plant.

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

Mine Layout

Drams

1 - 7 : TSF Stages

TNG Ltd
Mount Peake EIS

Tailings Storage Facility
Mount Peake

| | |
|---|---|
| Job Number | 61-29057 |
| Revision | A |
| Date | 29 Oct 2015 |

Figure 2-19

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239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au



Google: Imagery - 20151021; TNG Ltd: Drams, Mine Layout - 20151021

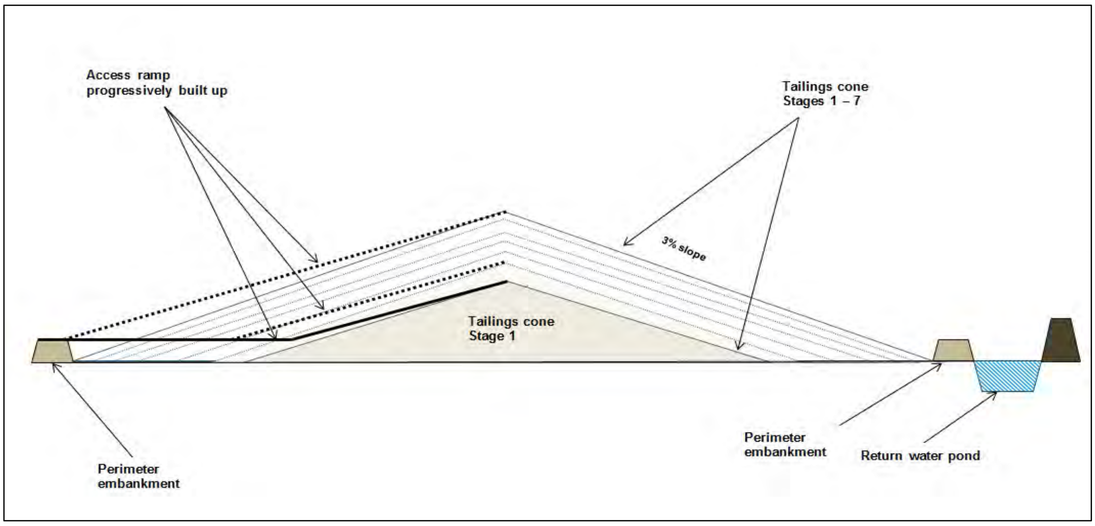


Figure 2-20 Staged development of TSF - profile

**Emergency spillway**

The emergency spillway will be constructed at the lowest part of the perimeter area. The emergency spillway will discharge into Bloodwood Creek. No infrastructure will be constructed within in the flood plain of this creek. The spillway will be around 14 m wide to safely convey the 100 year storm event.

**Monitoring boreholes**

To monitor behaviour of the TSF and its influence on the environment, a seepage monitoring system will be installed. The proposed monitoring system comprises 14 monitoring bores designed primary to monitor groundwater level and allow for sampling to carry out water quality checks.

### 2.7.3 Waste Hydrocarbons

Waste hydrocarbons will be stored in a tank within a bunded area to be held for collection by a contractor for reprocessing and recycling.

### 2.7.4 Sewage

Treated effluent from the Sewage Treatment Plant will be used around the site for landscaping purposes.

The untreatable solids will be collected and disposed of offsite by a licensed waste transporter.

Sewage at the Adnera Loadout Facility will be treated by septic tank and leach drains.

### 2.7.5 Brine

The brine reject from the Water Treatment Plant will be discharged to the Process Water Dam for reuse.

### 2.7.6 Drainage, Erosion and Sediment Control

An outline drainage, erosion and sediment control strategy has been prepared to inform development of the Project design (Appendix K of Appendix N). The strategy outlines drainage control measures for the waste rock dump, tailings storage facility and plant site and provides recommendations on flood immunity for the pit. The strategy will be updated following further topographic survey of the site and confirmation of the final layout of key Project elements.

## 2.8 Closure and Rehabilitation

A conceptual Mine Closure Plan has been prepared for the Project (Appendix M) consistent with Western Australian Department of Mines and Petroleum and Environmental Protection Authority Guidelines for Preparing Mine Closure Plans (2015).

The principal domains for closure and rehabilitation are:

- open pit;
- waste rock dump and run of mine pad;
- tailings storage facility;
- processing plant and power station;
- rail siding;
- access road;
- bore field;
- pipelines and power lines; and
- ancillary infrastructure, hardstand areas, site roads etc.

The following sections provide a brief overview of how each of these domains will be managed with a more detailed description provided in Chapter 16.

### 2.8.1 Open Pit

The pit will cover approximately 77 ha and be approximately 2,000 m long, 600 m wide and 125 m deep. The pit will remain at the conclusion of mining. The following objectives have been developed:

- entry into the pit is restricted by the presence of landforms and abandonment bunds; and
- clean water catchments are excluded from the pit.

### 2.8.2 Waste Rock Dump and Run of Mine Pad

This domain includes the WRD and the ROM pad. The latter has been included in this domain as the structure itself is usually made from mine waste. At closure, rehabilitation principles of the WRD are similar to those of the ROM pad. The WRD will have an ultimate height of 40 m and a footprint of 90 ha with capacity to store up to 70 Mt of mine waste. The following objectives have been developed:

- final landform is geotechnically stable and safe;
- surface and outer slopes of the waste rock dumps resist erosion;
- drainage from the WRD and ROM pad does not cause significant contamination of local surface waters or harm to local vegetation;
- there are no mass vegetation deaths caused by AMD or salt in the vicinity of the landform.
- landform is safe, stable and rehabilitated; and
- rehabilitation monitoring results trending upwards or above minimum analogue values.

### 2.8.3 Tailings Storage Facility

Tailings will be produced from the magnetic separation of the crushed and screened ore and will consist of non-magnetic silt and sand. Central Thickened Discharge was selected for tailings disposal based on balancing water recovery, environmental risk, the relatively flat nature of the site, ease of closure, and construction and operating costs. Beach slopes have shallow slope angles (about 3%). The storage area is bounded with a low perimeter embankment (nominal height of 2 m) which reduces the likelihood of any instability and failure. The TSF will have a diameter of approximately 2.1 kilometres, a maximum height at the central cone of 32 m and total area inclusive of drainage works and a perimeter bund of approximately 475 ha. The following objectives have been developed:

- final landform is stable and safe;
- surface of the TSF resists erosion;
- drainage or seepage from the TSF does not cause significant contamination of local surface waters or harm to local vegetation;
- erosion of any waste rock cap does not liberate tailings material;
- water quality parameters in groundwater monitoring bores do not exceed values representative of analogue sites or baseline data;
- there are no mass vegetation deaths in the vicinity of the landform; and
- rehabilitation monitoring results trending upward or above minimum analogue values.

### 2.8.4 Processing Plant and Power Station

This domain includes the main power generation and ore processing infrastructure on site. The processing plant includes the plant site, water storage dams, power station, product stockpile storage and load-out area. The following objectives have been developed:

- all infrastructure that is not subject to a sequential use agreement is removed from site;
- hazardous material is remediated, encapsulated or contained to prevent off-site environmental impact;
- contaminated sites are appropriately remediated. Contaminated sites not able to be remediated or removed are properly defined and registered;
- no rubbish remains onsite; and
- disturbed areas rehabilitated.

### 2.8.5 Rail Siding

A 1.8 km rail siding will be constructed at the Adnera Loadout Facility. The following objectives have been developed:

- all infrastructure not subject to a sequential use agreement is removed; and
- disturbed areas rehabilitated.

### 2.8.6 Access Road

The 100 km access road connects the mine site with the Adnera Loadout Facility. The following objectives have been developed:

- the access road, unless the subject of a sequential use agreement, will be removed;
- natural drainage lines re-instated;
- vehicular access required for monitoring purposes is maintained; and
- rehabilitated road areas are stable and non-eroding.

### 2.8.7 Bore Field

This domain includes the bore field with around 12 production and standby bores, diesel generators and fuel storage tanks. The following objectives have been developed:

- all pumps, pump stations and pipeline control infrastructure are removed (unless the subject of a sequential use agreement) and recycled if feasible or disposed of to an appropriate landfill; and
- disturbed areas rehabilitated.

### 2.8.8 Pipelines and Power Lines

Like haul roads and access roads, pipelines and power lines are linear infrastructure. However, due to the specific nature of their infrastructure, they have been placed in a separate domain rather than include them with access roads. The following objectives have been developed:

- above ground pipelines are removed, recycled if feasible, or disposed of to an appropriate landfill;
- below ground pipelines are grouted at openings and any surface obtrusions are buried more than 600 mm below the surface;
- all power infrastructure and power controls are recycled if feasible or disposed of to an appropriate landfill; and
- underground services are left in situ and any surface obtrusions are removed or buried at least 600 mm below the surface.

### 2.8.9 Ancillary infrastructure, hardstand areas, site roads etc

The following objectives have been developed:

- infrastructure that is beneficial to sequential land users will be transferred to the new owner via a sequential use agreement;
- all mobile plant, transportable structures and consumables are reused, recycled, removed or disposed of appropriately;
- permanent structures are demolished and recycled if economically feasible, disposed of to an onsite landfill, or removed from site and disposed of appropriately; and
- all concrete pads and footings are broken up and buried at least 1 m below the surface or disposed of to landfill.

## 2.9 Environmental Offsets

The Terms of Reference (NT EPA 2014) require the consideration of offsets where there is a significant residual impact to a Matter of National Environmental Significance (MNES).

Chapter 8 Biodiversity and Chapter 15 Matters of National Environmental Significance identify the presence or possible presence in the Project area of one flora species and 20 fauna species listed as MNES under the EPBC Act. The assessment concluded that there was no significant residual impact to any of these species.

No offsets are proposed.

# 3. Project Alternatives

This chapter describes various alternatives to the Project, or to components of the Project, that were considered during Project planning and design.

Project alternatives were considered for:

- not proceeding with the Project;
- the preferred approach to mining;
- the transport of concentrate from the mine site to the Adnera Loadout Facility;
- rail loadout;
- site selection for mine site Project components;
- power supply;
- water supply;
- access road crossing of Stuart Highway;
- waste rock dump;
- tailings storage facility; and
- management of the final pit void.

## 3.1 Not Proceeding with the Project

Not proceeding with the Project would result in the following:

- up to 1.8 Mtpa of magnetite concentrate would not be produced. When processed the concentrate would produce 19,700 tpa of vanadium pentoxide flake (12% of world demand), 292,000 tpa of pigment grade titanium dioxide (3.5% of world demand) and 856,000 tpa of pig iron ingots;
- loss of capital expenditure during construction of the mine of approximately $310 million;
- loss of expenditure during operation of the mine of approximately $2 billion;
- loss of up to 225 direct construction jobs and 170 jobs direct operation jobs;
- the loss of business opportunities from sourcing of goods and services, with some coming from local suppliers in nearby communities; and
- loss of royalties over the life of the Project to the Commonwealth and Territory Governments.

In addition, if the Project did not proceed the proposed Darwin Refinery would not be built with the loss of capital expenditure of approximately $1.5 billion and total revenue in excess of $27 billion.

## 3.2 Mining

The mine is essentially an iron ore mine. A traditional approach to mining was selected which included:

- the mine being open-cut. The uniform nature of the orebody does not lend itself to underground mining methods and underground mining would be cost prohibitive;
- a truck and shovel operation as typically used in the iron ore industry; and
- out of pit dumping of waste rock.

## 3.3 Product Transport and Export

### 3.3.1 Product Transfer from the Mine Site to the Adnera Loadout Facility

Two options were considered for the transfer of concentrated from the mine site to the loadout facility:

- Option 1 – slurry of the concentrate to the loadout facility. This would require construction or establishment of the following:
  - a mixing tank at the process plant to slurry the concentrate;
  - slurry pumps;
  - a 90 km pipeline to allow the concentrate to be slurried to the loadout facility;
  - a duplicate backup pipeline in the event that the primary pipeline failed;
  - a number of pump stations along the pipelines;
  - facilities (e.g. filter press) to dewater the slurry at the loadout facility;
  - water dam to contain slurry dewater at the loadout facility;
  - pumps and a return water pipeline (with possibly a duplicate backup line) to convey dewater back to the process plant for reuse; and
  - an easement to accommodate the pipelines, an access track and a power supply.
- Option 2 – truck transport of the concentrate to the loadout facility. This would involve the movement of concentrate 24/7 from the mine site to the loadout facility by triple road train. Trucking would be via the site assess road with the only new piece of infrastructure needed being an underpass at Stuart Highway to allow concentrate trucks to be kept separate from highway road users.

Option 2 was selected as the preferred option for the following reasons:

- the capital cost is approximately $50 million less than Option 1;
- operation costs are similar for both options. The primary operation costs associated with truck transport are diesel consumption, wear and tear on vehicles and an increased cost of road maintenance. Operation costs associated with slurry transport include pipeline maintenance and replacement costs due to abrasion by the concentrate, maintenance and parts for the filter press, power cost (pumps, filter press), and the cost of additional water supply. Labour costs for the two options would be similar;
- Option 1 carries significantly higher risk due to the potential for the slurry pipeline to block;
- for Option1 the easement carrying the pipelines, access track and power supply crosses large areas subject to flooding from the Hanson River. Flood immunity would need to be provided for the pipelines with sections either buried or supported above the level of inundation;
- Option 1 also has greater potential to impact species of National Environmental Significance; and
- Option 2 has lower power and water use.

### 3.3.2 Rail Loadout

Magnetite concentrate delivered to the Adnera Loadout Facility by truck will be loaded into rail wagons for transport to Darwin. Two options were considered for loading the rail cars (Figure 3-1):

- Option 1 – loading of a static train set by front-end loaders. This would require a spur line of approximately 1.8 km in length to accommodate a train length of 1.5 km; and
- Option 2 – loading a shunted train set from a static loadout bin. This would require a spur line of approximately 3.24 km in length to accommodate a train length of 1.5 km on either side of the loadout bin without impacting through traffic on the main line.

Option 1 was selected as the preferred option for the following reasons:

- the capital cost is approximately $3 million less than Option 2;
- it has a smaller development footprint; and
- it provides a shorter turnaround time for train loading through the use of several front-end loaders compared to the single point loading of Option 2.

At a national, territory, regional and local level there are no significant differences between the options.

There are no significant differences between the options over the short, medium and long term.

There are no differences between the options on Matters of National Environmental Significance.

## 3.4 New Infrastructure and Facilities

### 3.4.1 Site Selection for Mine Site Project Components

The location of Project components is dictated by the location of the orebody and the surrounding general topography. The orebody is fixed and, to minimise costs associated with haulage of materials, infrastructure and facilities need to be located as close as possible to the orebody. The location of the waste rock dump, processing plant and tailings storage facility recognise the topographic and environmental characteristics of the area. In particular:

- the mine site lies between Murray Creek and Bloodwood Creek and there is a need to ensure that infrastructure is located above the flood extent of these creeks. Surface water modelling has demonstrated that all key Project components will not encroach into these creeks;
- the location of infrastructure avoids any vegetation of conservation significance. A flora and vegetation survey did not identify the presence of conservation significant species or associations. A fauna survey also identified that the mine site has less value to conservation significant fauna;
- key infrastructure is located remote from any Sites of Conservation Significance (SOCS). The closest SOCS is Mud Hut Swamp, approximately 7.7 km from the mine site;
- the mine and associated infrastructure is located near the boundary of Stirling Station, avoiding any significant impact to station operations. There are also no stock watering points in this area so its value to the Station is less than in areas where a water supply is provided;
- the location of the waste rock dump and processing plant close to the mine minimises material haul distances, minimises haul costs and minimises emissions associated with consumption of diesel fuel. The location of the tailings storage facility adjacent to the processing plant minimises tailings pumping distances and reduces energy costs.

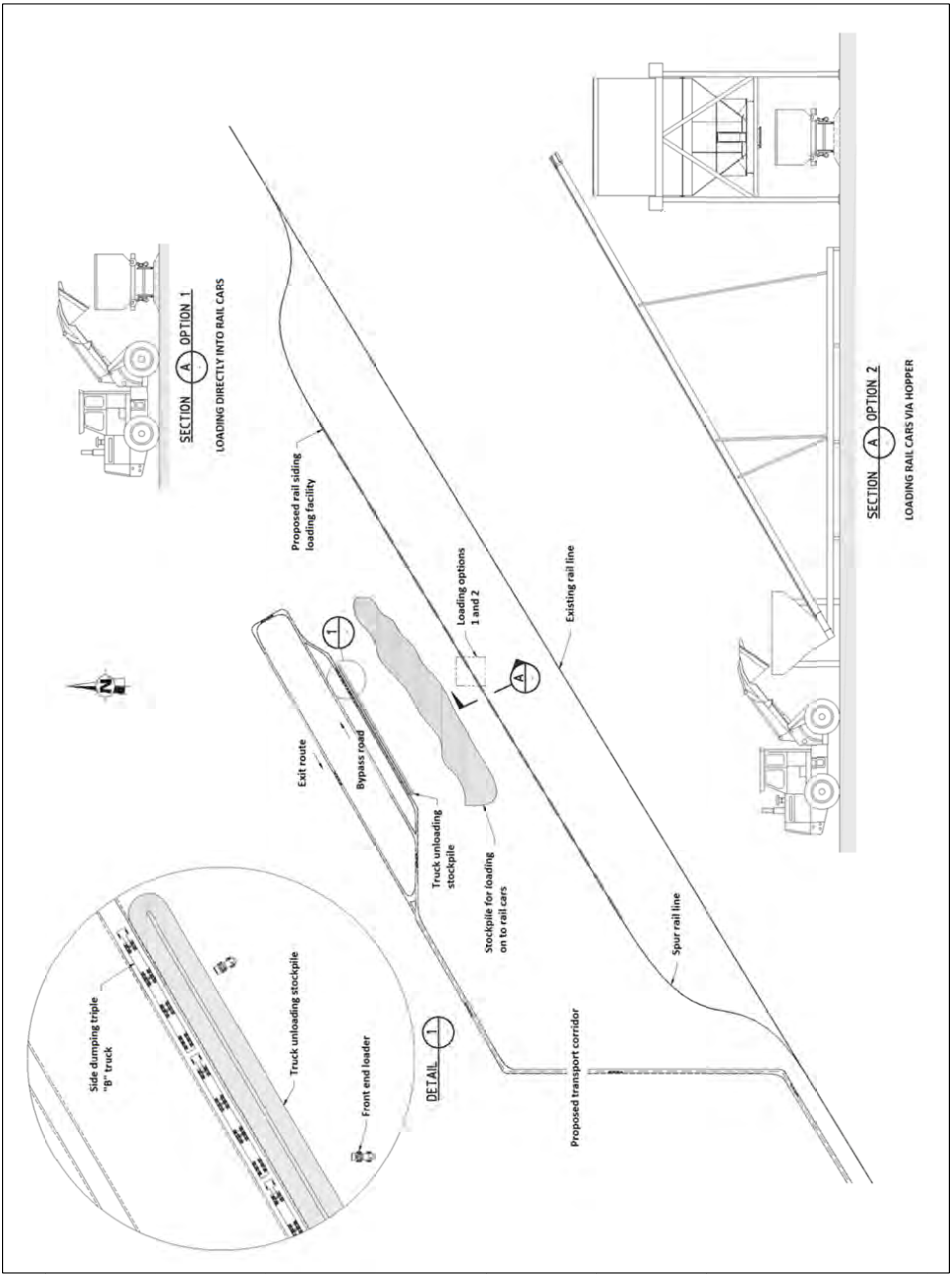


**Figure 3-1 Train loading facility**

Alternatives considered included locating infrastructure to the north of Bloodwood Creek or to the east of Murray Creek. The disadvantages of these sites include:

- infrastructure would be located in areas subject to sheet flow;
- infrastructure would encroach into areas of mulga woodland.  Soils in this area are also deeper providing greater value to fauna of conservation significance;
- infrastructure would be located closer to Mud Hutt Swamp;
- infrastructure would encroach into areas that are of greater value to Stirling Station due to the presence of stock watering points; and
- energy costs would increase due to greater haul and pumping distances.

At a national, territory, regional and local level there are no significant differences between the locations considered.

The short, medium and long term advantages of the preferred location is that it is adjacent to a boundary of Stirling Station in an area with less grazing value due to the absence of permanent water.

The preferred location also has less potential value for species of National Environmental Significance.

### 3.4.2 Power Supply

The two options considered for the supply of power to the mine site were diesel and gas. At full production the power draw for the mine and process plant is estimated at 24 MW.

Due to the volume of diesel needed to generate this amount of power, the option of using diesel was quickly discounted.  Use of diesel would treble the cost of fuel. Diesel would also need to be delivered by tanker and diesel has significantly more greenhouse gas emissions than gas.

The Amadeus Gas Pipeline runs approximately 40 km to the east of the mine and a sufficient supply of gas for the Project is available.  Gas is more cost effective than diesel and has environmental benefits associated with reduced emissions.

### 3.4.3 Water Supply

Three options were considered for the supply of water to the Project:

- use of dewatering water from the pit;
- groundwater extraction from the alluvials of Murray Creek adjacent to the mine site; and
- groundwater extraction from the Hanson River palaeovalley, 25 km to the north of the mine site.

From a cost perspective, the closer the supply is to the mine site, the lower the cost.

Test pumping of bores on the orebody and bores constructed in Murray Creek provided very low to zero groundwater yield. The low yield would be insufficient to supply Project water needs of 2,625 MLpa.

Drilling was then undertaken in the Hanson River palaeovalley with results suggesting that sufficient water is sustainably available to supply the Project. A concept design for the borefield was developed with 10 active and two standby bores spaced 1.8 km apart pumping at 8.5 L/s.  The borefield was located so that it did not impact groundwater outfall from the Ti Tree Basin but was still close to the mine site.

### 3.4.4 Access Road Crossing of Stuart Highway

An access road between the mine site and Adnera Loadout Facility will serve the dual purpose of providing general vehicle access from Stuart Highway to both the mine site and loadout facility, and as the haulage route for concentrate product. At the location of the preferred crossing, Stuart Highway is flat, straight and has no speed restriction on public traffic.

During construction and operation the Project is expected to generate 66 and 30 one-way (132 and 60 return) vehicle movements per day that will require access from / to Stuart Highway. In addition, up to 50 loads of concentrate will be delivered to Adnera from the mine site per day (up to 100 return truck movements or four per hour).

Whilst recognising that an at grade intersection of Stuart Highway will be required to facilitate vehicle access to the Project, consideration was given as to how concentrate trucks were to cross the highway in a way that ensured the safety of all road users.

Community consultation identified safety concerns around haul trucks crossing Stuart Highway at-grade. In addition, discussions with the NT Transport Infrastructure Planning Division and the Department of Mine and Energy indicated that any proposal for an at-grade intersection would be rejected.

Concepts were prepared for more expensive grade-separated crossings with three options considered:

- Option 1 – mine access road over Stuart Highway (Figure 3-2).

  A diversion road with the appropriate speed restrictions and traffic management will be required while the Super-Cor™ arch (Figure 2-6) is assembled over the existing Stuart Highway. Once assembly is completed, traffic on the Stuart Highway would recommence, as backfill forming the access road and approach ramps is placed and compacted.

  While this option reduces the time required for traffic to bypass the Stuart Highway, it has the ongoing drawback of dust and debris from the access road potentially falling onto Stuart Highway.

  This method will not require any rework to be performed on the existing Stuart Highway, with its current alignment maintained.

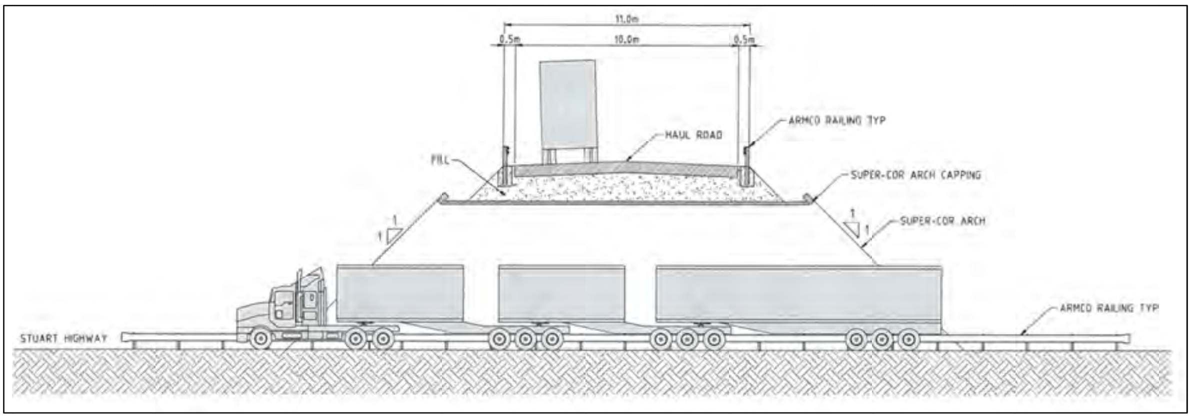


**Figure 3-2 Option 1 – Mine access road over Stuart Highway**

- Option 2 – mine access road under the Stuart Highway (Figure 3-3).

  A diversion road will be required while the existing road is demolished and excavation is completed for the construction of the Super-Cor™ arch (Figure 2-6).

  This option will require traffic to be diverted for longer than Option 1.

This option eliminates issues associated with product dust and debris from the haulage trucks impacting on the Stuart Highway. This option also has considerably less earthworks since approach ramps will not be required.

This is the least expensive option.

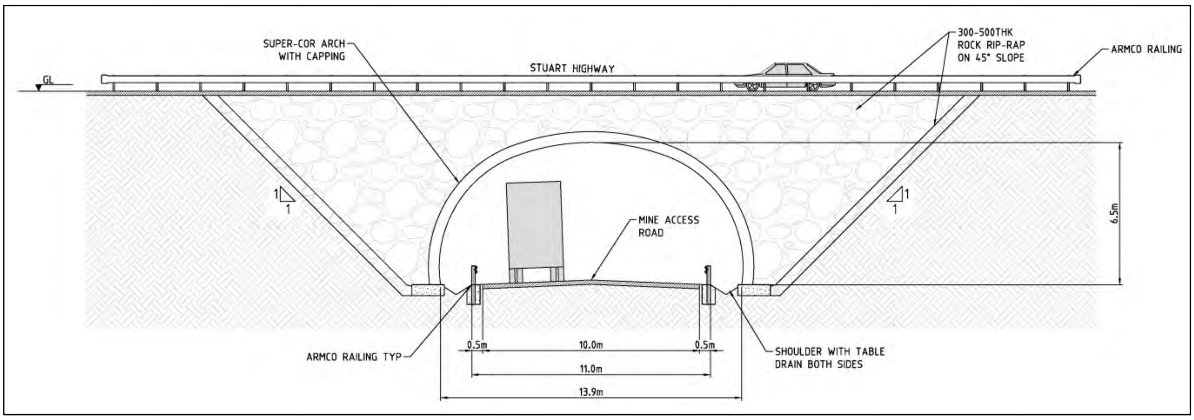


**Figure 3-3 Option 2 – Mine access road beneath Stuart Highway**

- Option 3 – Stuart Highway passing over the mine access road.

  This option is similar to Option1 but with Stuart Highway passing over the access road.

  This option will require the diversion of Stuart Highway to be in place for the longest period of time. The option will also require significant earthworks to provide long and shallow approach ramps to maintain appropriate levels of safety for highway users.

  This is the highest cost option.

Option 2 was selected as the preferred option for the following reasons:

- the current grade of Stuart Highway is maintained;
- less earthworks are required;
- minimal disruption to the Stuart Highway throughout construction works;
- more control related to safety in design and construction;
- it has the shortest overall construction period;
- it has the smallest disturbance footprint;
- there is no visual intrusion in the landscape; and
- it has the lowest cost.

### 3.4.5 Waste Rock Dump

Approximately 70 Mt of waste will be generated over the life of the Project. Some of this waste will be used for construction purposes (building pads, ROM pad, road construction etc) during the two years of construction. The waste rock dump will reach an ultimate height of 40 m with a footprint of around 90 ha.

The location of the waste rock dump was selected to minimise the distance needed to haul waste rock from the pit. The location avoids any vegetation of conservation significance and does not encroach into any significant drainage lines.

The height of the dump was kept low to minimise visual impact and reduce costs associated with haulage of waste up a higher landform.

A single dump was selected as it has a smaller surface area to volume ratio than several smaller dumps, resulting in lower rehabilitation costs.

Due to the benign nature of the waste material it is not expected that specific handling of waste will be required. Geochemical testing identified that the waste does not contain significant quantities of AMD material. Two samples (out of 6000) were identified as having low acid forming potential. The Acid Neutralising Capacity of the orebody was found to be high and it is expected that any minor quantities of potentially acid forming material will be co-disposed with non-acid forming material to take advantage of this neutralising capacity.

### 3.4.6 Tailings Storage Facility

The processing plant will produce around 63 Mt of tailings over its 15 year life. An options study considered three options for tailings disposal:

- Option 1 – dry stacking of tailings. Dry stacking would involve tailings filtration by either vacuum belt filter or pressure filter to produce a filtrate with a solids content of around 90%. Filtrate would be trucked from the filter plant to the dry staking area, where it would be deposited and spread;
- Option 2 – wet deposition in a convention tailings dam. Wet deposition is a conventional tailings deposition method in which the tailings are thickened to 40% – 55% solids and then discharged into a TSF. Given that the natural ground at the TSF site is generally flat, the TSF would be constructed as a paddock style facility. The tailings would be discharged from the TSF perimeter walls forming a concave beach with the lowest point in the centre of the TSF. The excess water would be collected in the central decant pond and then returned to the process plant. The final height of the TSF would be 24 m and it would be constructed and operated as two adjacent cells (950 m x 950 m); and
- Option 3 – slurry deposition to a tailings dam. Slurry deposition would involve tailings thickening at the process plant to produce a slurry with a solids content of 65%, with the slurry then pumped into the TSF (paste disposal, with paste having a solids content of 75%, was also considered, however the absence of clayey fines does not allow the tailings to bind and achieve this higher solids content). As the TSF area is generally flat, a Central Thickened Discharge (CTD) was considered to be the most suitable. CTD would result in the tailings being discharged from the centre of the TSF to form a cone shape of the tailings beach. A drainage system would be installed in the floor of the TSF to recover around 30% of the water entrained in the slurry and return it for use in the process plant. The area of the TSF is typically delineated by a perimeter bund to collect drainage and rainwater, and to prevent uncontrolled spreading of the tailings. The maximum final height of the TSF would be 32 m at its centre and 2 m at the perimeter bund, and it would have a deposition area of around 357 ha.

The options study concluded that dry stacking of tailings was the most effective disposal system in terms of water recovery, which was estimated to exceed 90%. However, the filter performance is very sensitive to variations in the ore feed and the beneficiation process. Dry stacking was found to be the most capital intensive tailings disposal option by a considerable margin (45% and 100% more expensive that slurry and wet deposition respectively). Dry stacking poses very low residual risk.

The benefits of wet tailings deposition are that it has the lowest capital cost, is technologically simple and thus poses low design risk, and has low sensitivity to the performance of the tailings deposition system. However, this option would result in much lower water recovery, estimated to be less than 50%. The major disadvantages of this option are that it has comparatively higher operational risks, along with potential difficulties and risks for closure. It also has the highest operating costs (45% more expensive that dry stacking and slurry deposition respectively).

Slurry deposition was estimated to return approximately 74% of tailings water (through thickening and drainage capture) to the process. Capital expenditure for this option was found to be considerably lower than for dry stacking. When compared with dry stacking, tailings thickening and slurry deposition was considered less sensitive to potential changes in feed properties and ore beneficiation. Rehabilitation of a CTD tailings facility would be easier than a conventional wet TSF.

On balance slurry deposition was selected as the preferred tailings disposal method. Slurry deposition has a high rate of water recovery, poses no technology challenges, is not susceptible to changes in ore feed properties or beneficiation, has a low operational and residual (closure) risk and is cost effective.

For the three options considered, lining of the tailings facility will not be necessary given the nature of the material to be deposited – non-magnetic silts and sands.

There are no significant differences between the options on Matters of National Environmental Significance.

## 3.5 Pit Void

A the completion of mining the pit will cover approximately 77 ha and be approximately 2,000 m long, 600 m wide and 125 m deep. The pit will remain as a void at the end of mining.

The option of partially filling the pit with waste rock was considered but rejected for the following reasons:

- the cost of double handling the waste is cost prohibitive;
- the placement of waste material back into the pit would sterilise any remaining ore; and
- direct in-pit dumping is not feasible due to the operation of a single pit (although there may be an opportunity to dispose of small volumes of waste towards the end of mining once an area of the pit has been mined out).

# 4. Legislative Framework

## 4.1 Overview

This chapter provides a legislative overview for the Project including relevant Commonwealth and Northern Territory legislation and guidelines.

Chapter 1 provides an overview of the environmental assessment process.

## 4.2 Commonwealth Legislation

### *Environment Protection and Biodiversity Conservation Act* (EPBC Act)

Assessment under the EPBC Act is required for actions that are likely to have a significant impact on a Matter of National Environmental Significance (MNES). The MNES include:

- world heritage properties;
- national heritage places;
- wetlands of international importance (listed under the Ramsar Convention);
- listed threatened species and ecological communities;
- migratory species (protected under international agreements);
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- nuclear actions (including uranium mines); and
- a water resource, in relation to coal seam gas development and large coal mining development.

The environment under the EPBC Act includes:

a) ecosystems and their constituents;

b) natural and physical resources;

c) qualities and characteristics of locations, places and areas;

d) heritage values of places; and

e) social, economic and cultural aspects.

The Mount Peake Project (the action) was referred to the Department of the Environment (DotE) on 14 October 2013. On 13 November 2013, DotE determined the proposed action was a controlled action and required assessment under the EPBC Act before it could proceed (Appendix B). The controlling provision was listed threatened species and communities (sections 18 and 18A). The DotE also determined that accredited assessment at the level of Environmental Impact Statement under the Northern Territory *Environmental Assessment Act* was applicable.

On 11 March 2015 a request to vary the action under section 156B of the EPBC Act was submitted to the DotE. The variation removed the hydrometallurgical processing plant and a gas / slurry pipeline infrastructure corridor linking the mine site with a rail siding at Adnera, and confirms that trucking will be used to transport magnetite concentrate to the rail head and that the gas pipeline (if required) will be located within the transport corridor. On 8 April the DotE confirmed acceptance of the variation and that the originally identified controlling provisions would still apply (Appendix B).

### Native Title Act

The *Native Title Act* provides for the recognition and protection of native title and contains processes for effecting native title claims. The Act sets out processes by which native title rights are established, protected and compensation determined, in addition to facilitating Indigenous Land Use Agreements (ILUA's) between native title parties and other interest holders.

The objectives of the *Native Title Act* are to:

- provide for the recognition and protection of native title;
- establish ways in which future dealings affecting native title may proceed and to set standards for those dealings;
- establish a mechanism for determining claims to native title; and
- provide for, or permit, the validation of past acts, and intermediate period acts, invalidated because of the existence of native title.

The Mount Peake Project tenements are covered by a native title application. Registration of Native Title Determination Application – DC11/12 Stirling and Neutral Junction NTD17/2011 was registered with the National Native Title Tribunal on 17 August 2011 under section 190A of the *Native Title Act*. The application was accepted for registration and entered onto the Register of Native Title Claims on 19 August 2011.

The Native Title Claimant Group comprises members of the Akalpere, Amakweng, Alapanp, Alhalker Anangker, Arlwekarr, Arnerre, Arnmanapwenty, Errene/Warlukurlangu, Jarra Jarra, Kwerrkepentye, Twerrpe, Wake and Wurrulju landholding groups.

TNG and the Native Title Claimant Group are discussing development of an ILUA.

### Aboriginal Land Rights (Northern Territory) Act

This Act provides for the granting of freehold title to traditional Aboriginal owners of land in the Northern Territory, the establishment of Land Councils, and the establishment and management of Land Trusts to hold the Aboriginal land for the benefit of traditional owners of the land. The Act also regulates exploration and mining on Aboriginal land and sets out the processes to be followed when negotiating with Traditional Owners for access to, and leases over, Aboriginal land. An exploration licence cannot be granted in relation to Aboriginal land without the consent of the relevant Land Council (for the traditional owners) and the Minister. A mineral lease cannot be granted unless an agreement has been entered into under the Act.

### Aboriginal and Torres Strait Islander Heritage Protection Act

This Act makes provision for the preservation and protection from injury or desecration of areas and objects in Australia and in Australian waters, being areas and objects that are of particular significance to Aboriginal people in accordance with Aboriginal tradition. TNG will comply with relevant provisions of this Act.

### *National Environment Protection Council Act* (NEPC Act)

The National Environment Protection Council (NEPC) comprises environment ministers from the Australian Government and each state and territory and was established under the NEPC Act and corresponding legislation in the other jurisdictions (e.g. *National Environment Protection Council (Northern Territory) Act*). The purpose of NEPC is to ensure that:

- Australians enjoy the benefit of equivalent protection from air, water or soil pollution and from noise wherever they live; and
- business decisions are not distorted and markets are not fragmented by variations in major environment protection initiatives between member governments.

NEPC has powers to make National Environment Protection Measures (NEPMs) on:

- ambient air quality;
- ambient marine, estuarine and fresh water quality;
- the protection of amenity in relation to noise (but only if differences in environmental requirements relating to noise would have an adverse effect on national markets for goods and services);
- general guidelines for the assessment of site contamination;
- environmental impacts associated with hazardous wastes;
- the re-use and recycling of used materials; and
- motor vehicle noise and emissions (in consultation with the National Transport Commission).

The Air NEPM sets national standards for the six key air pollutants to which most Australians are exposed: carbon monoxide, ozone, sulfur dioxide, nitrogen dioxide, lead and particles.

Ambient Air Quality NEPM standards have been adopted for the Project. TNG will also comply with compulsory annual reporting if Project emissions exceed thresholds outlined in the Act.

### *National Greenhouse and Energy Reporting Act* (NGER Act)

The NGER Act introduced a single national framework for reporting and disseminating company information about greenhouse gas emissions, energy production, energy consumption and other information specified under NGER legislation.

The objectives of the NGER Act are to:

- inform government policy;
- inform the Australian public;
- help meet Australia's international reporting obligations;
- assist Commonwealth, state and territory government programs and activities; and
- avoid duplication of similar reporting requirements in the states and territories.

Facility and corporate group thresholds define which corporations are affected by the NGER Act. Both the facility and corporate group thresholds have three components:

- a greenhouse gas emissions threshold;
- an energy production threshold; and
- an energy consumption threshold.

If a corporation meets or exceeds one or more of the thresholds for a reporting year, they must register and report for the first year the threshold is reached and for each year thereafter that the corporation remains registered. The facility thresholds are:

- 25,000 t or more of greenhouse gases - carbon dioxide equivalence ($CO_2$-e);
- production of 100 terajoules (TJ) or more of energy; or
- consumption of 100 TJ or more of energy.

Corporate group thresholds are:

- 50,000 t or more of greenhouse gases ($CO_2$-e);
- production of 200 TJ or more of energy; or
- consumption of 200 TJ or more of energy.

The Project will trigger both the facility and corporation reporting thresholds.

### *Leading Practice Sustainable Development Program for the Mining Industry*

This program promotes sustainable development and industry self-regulation through proactive adoption of leading practice principles. The Department of Industry and Science administers the program.

The program provides practical guidance to the mining industry through handbooks and workshops. Resources assist with the implementation of leading practice, and offer the mining industry and other stakeholders the opportunity to improve their social and environmental performance.

TNG proposes to undertake its activities, where possible, in line with the leading practice standards set out by the program. Handbooks applicable to the Mount Peake Project include:

- A Guide to Leading Practice Sustainable Development in Mining;
- Airborne Contaminants, Noise and Vibration;
- Biodiversity Management;
- Community Engagement and Development;
- Evaluating Performance: Monitoring and Auditing;
- Hazardous Materials Management;
- Managing Acid and Metalliferous Drainage;
- Mine Closure and Completion;
- Mine Rehabilitation;
- Risk Management;
- Stewardship;
- Tailings Management;
- Water Management; and
- Working with Indigenous Communities.

## 4.3 Northern Territory Legislation

### *Mineral Titles Act*

The *Mineral Titles Act* establishes the framework to explore for, and mine, mineral resources. The Act sets out the administrative processes for authorising these activities through the granting of a title. The objects of the *Mineral Titles Act* are to:

- establish a framework for granting and regulating mineral titles that authorise exploration for, and extraction and processing of, minerals and extractive minerals;
- facilitate the commercialisation of activities conducted under mineral titles by authorising the creation and transfer of interests in the titles; and
- authorise other activities relating to minerals or extractive minerals to be conducted without mineral titles.

### *Mining Management Act*

The *Mining Management Act* provides for authorisation of mining activities, management of mining sites, protection of the environment on mining sites and related purposes. The Act is administered by the Department of Mines and Energy (DME). The objectives of the Act are to:

- ensure the development of the NT's mineral resources in accordance with environmental standards consistent with best practice in the mining industry;
- protect the environment by:
  - requiring authorisation for and monitoring of mining activities;
  - requiring appropriate management of mining sites through implementation of management systems;
  - facilitating consultation and cooperation between management and workers in implementing environment protection management systems;
  - implementing audits, inspections, investigations, monitoring and reporting to ensure compliance with agreed standards and criteria; and
  - specifying the obligations of all persons on mining sites with respect to protection of the environment.
- assist the mining industry to introduce programs of continuous improvement to achieve best practice environmental management;
- enable persons connected with the mining industry to participate in the implementation of this Act through the establishment of a Mining Board to advise the Minister on:
  - guidelines for the industry;
  - specification of competencies required by persons involved in the industry;
  - best practice in mining activities; and
  - minimising the liability of the Territory by requiring the payment of security to provide for the rehabilitation of mining sites or to rectify environmental harm caused by mining activities.

The Mining Management Amendment Bill 2011 came into force on 1 July 2012. Key changes include:

- enabling the Chief Executive Officer (CEO) of DME to require investigations of less-serious environmental incidents that do not result in material environmental harm (in addition to the current requirements for incidents causing material environmental harm);
- allowing the publication of reports by operators or mining officers following environmental incidents;
- obligation for mining operations on mineral leases to publically report environmental performance in the form of a Environmental Mining Report (EMR) which forms part of the annually submitted Mining Management Plan (MMP);
- introducing new environmental offences and confirming the application of Part IIAA of the Criminal Code Act (NT) (the Criminal Code) to offences under the Act; and
- Community Benefits Plan (CBP) required for mining authorisation of a new mine.

Approval for the Project is required from the Minister for Mines and Energy. The environmental assessment process will allow the Minister to be informed of potential environmental impacts and proposed management to assist in the decision making process.

An approved MMP will be required prior to commencement of proposed works if the Project is approved. The Minster will require security for potential costs of rectifying environmental harm and rehabilitating the site.

### *Environmental Assessment Act* (EA Act)

The environmental assessment process is administered under the EA Act taking into account the Environmental Assessment Administrative Procedures. The EA Act ensures that each matter affecting the environment is examined and taken into account in in relation to:

- formulation of proposals;
- carrying out of works and other projects;
- negotiation, operation and enforcement of agreements and arrangements (including agreements and arrangements with authorities of the Commonwealth, the states and other territories);
- making of, or the participation in the making of, decisions and recommendations; and
- incurring of expenditure.

In June 2013, TNG submitted a Notice of Intent for the Mount Peake Project to the NT Environment Protection Authority (NT EPA). On 13 November 2013 the NT EPA determined that the Mount Peake Project required assessment under the EA Act at the level of an Environmental Impact Statement (Appendix B). Terms of Reference for the EIS were issued on 7 March 2014 (Appendix C).

On 9 March 2015 the NT EPA was notified that changes had been made to the Mount Peake Project. The changes remove the hydrometallurgical processing plant and a gas/slurry pipeline infrastructure corridor linking the mine site with a rail siding at Adnera, and confirm that trucking will be used to transport magnetite concentrate to the rail head and that a gas pipeline, if required, will be located within the transport corridor. In accordance with clause 14A of the Environmental Assessment Administrative Procedures, the NT EPA decided that the changes do not alter the environmental significance of the Project, that the Project will continue to be assessed at the level of an EIS, and that the Terms of Reference issued on 7 March 2014 will not be amended (Appendix B).

### *Northern Territory Environmental Protection Authority Act*

This Act came into force on 1 January 2013 and established the new Northern Territory Environment Protection Authority (NT EPA) as an independent regulatory authority and makes consequential amendments to the *Waste Management and Pollution Control Act* (WMPC Act) and the EA Act.

Amendments to the WMPC Act identify the NT EPA as the entity responsible for administration of the regulatory functions of that Act.

Amendments to the EA Act also identify the NT EPA as the entity responsible for administration of the assessment functions and impose additional transparency and reporting responsibilities on the Environment Minister and the responsible Minister for specific projects.

### *Northern Territory Aboriginal Sacred Sites Act*

This Act is administered by the Aboriginal Areas Protection Authority (AAPA). The Act provides for the location, recognition, description and protection of sites sacred under Aboriginal tradition. All sacred sites (even if not registered) are protected under the Act and it is an offence to enter or carry out work on a sacred site without permission or an Authority Certificate. The certificate sets out conditions under which the work may be carried out.

Consultation with the CLC has been undertaken by TNG as part of Project development activities.

A number of sacred sites are present in proximity to the mining area and access road. CLC has provided TNG with Sacred Site Clearance Certificate for the Project. Data provided by the CLC has informed TNG of no-go areas for the location of Project elements and has resulted in TNG modifying the alignment of the access road to avoid a known site.

### *Heritage Act*

The *Heritage Act* provides a system for the identification, assessment, protection and conservation of the NT's natural and cultural heritage. Heritage includes fossils, buildings, gardens, ruins, archaeological sites, landscapes, ecosystems, coastlines, plant and animal communities.

Chapter two of the Act allows for the establishment of the NT Heritage Register. Members of the community can nominate areas, places, sites, buildings, shipwrecks and heritage objects to the register. If the Minister agrees that those features are of special significance to the heritage of the NT, the place is added to the register. The place will then be protected from accidental and deliberate damage or harm. The Act allows for processes to approve works and maintenance for a heritage place. There are no nominated or declared heritage places in the Mount Peake Project area.

Sections 17 and 18 of the Act declare all Aboriginal and Macassan archaeological places and objects heritage places, providing the same level of protection as places on the Heritage Register. Part 3.2 of the Act allows for applications to work on heritage places, including work on, or salvage of, Aboriginal archaeological sites. In practice, permits to salvage Aboriginal Archaeological places will be issued under conditions which include the approval of the appropriate Traditional Owner or Site Custodian for a site. Permits under the Act will also require reasonable study of each site disturbed, and appropriate curation of any artefacts salvaged.

The Act includes a provision for the declaration of classes of places or objects that are known to be of significance in the NT but where not all locations are currently mapped and recorded.

An archaeological survey of the Project area has been undertaken 16 new archaeological sites have been recorded. Recommendations are made in relation to protection of sites and some changes to the Project have been made to avoid the sites.

### *Water Act*

The *Water Act* covers allocation, use, control, protection and management of NT water resources. Pollution under the Act includes directly or indirectly altering the physical, thermal, chemical, biological or radioactive properties of the water so as to render it less fit for a prescribed beneficial use for which it is or may reasonably be used, or to cause a condition which is hazardous or potentially hazardous to:

- public health, safety or welfare;
- animals, birds, fish or aquatic life or other organisms; and
- plants.

A Waste Discharge Licence (WDL) for the Project will be required under the Act if water is to be discharged off site.

Under section 7 of the *Water Act*, permits and licenses for groundwater extraction are not required for the Mount Peake Project as groundwater will be used for a mining activity or for a purpose ancillary to a mining activity, including the use of water as drinking water. The *Water Act* also does not apply to the taking of water for the purpose of roadwork's (Government Gazette, No S60, 28 November 2008).

### *Waste Management and Pollution Control Act*

The purpose of this Act is to protect the environment through objectives and approvals, encouraging effective and responsible waste management and reduction and response to pollution. This Act facilitates the implementation of national environment protection measures made under the *National Environment Protection Council (Northern Territory) Act*, and incorporates environmental compliance plans and audits.

Section 14 of the Act establishes a process for notifying the NT EPA (the administrating agency for the Act) about incidents causing, or threatening to cause pollution. Schedule 2 of the Act requires environment protection/licensing for certain activities.

### *Territory Parks and Wildlife Conservation Act* (TPWC Act)

The TPWC Act lists species of plants and animals that are protected within the Northern Territory. Under this Act, permits will be required to take or interfere with protected plants or animals. This may apply if protected plants or animals are encountered during the project's life.

TNG will seek all appropriate permits and approvals required under this Act. No species of plants or animals protected under the Act are proposed to be significantly impacted by the Project.

### *Weeds Management Act*

The purpose of the Act is to:

- prevent the spread of weeds in, into and out of the NT and to ensure that the management of weeds is an integral component of land management in accordance with the NT Weeds Management Strategy 1996 – 2005 or any other strategy adopted to control weeds in the NT;
- ensure there is community consultation in the creation of weed management plans; and
- ensure that there is community responsibility in implementing weed management plans.

The Alice Springs Regional Weed Management Plan 2013 - 2018 supports landholders in their obligations to manage weeds on their land.

The NT Government uses the 'NT Weed Risk Management System' to identify and prioritise plants to be considered for declaration as weeds in accordance with the Act and to determine the appropriate management response for those plants. Declared species are assessed on the severity of impact and likelihood of its control using a number of parameters including:

- invasiveness: mode of reproduction, and potential to disperse;
- impacts: capacity to modify the environmental, social or economic values; and
- distribution: current distribution and potential distribution based on favoured habitat.

Also considered are:

- costs and ease of control: ease of detection, accessibility of the site, cost of control methods and effectiveness, time to reproduction from a new plant, reproductive capacity (e.g. duration the weed may reproduce and the amount of reproductive parts) and factors contributing to the spread or establishment of the weed; and
- persistence: how long propagules may remain viable in the environment and the probability of re-invasion.

The Weeds Management Act states that the owner and occupier of land must:

- take all reasonable measures to prevent the land being infested with a declared weed;
- take all reasonable measures to prevent a declared weed or potential weed on the land spreading to other land; and
- within 14 days after first becoming aware of a declared weed that has not previously been known to be present on the land, notify an officer of the weeds location.

#### *Other Northern Territory legislation*

Other legislation that may be applicable to the project includes:

- *Biological Control Act*;
- *Bushfires Act*;
- *Civil Aviation Act*;
- *Control of Roads Act*;
- *Crown Lands Act*;
- *Dangerous Goods Act*;
- *Environmental Offences and Penalties Act*;
- *Fire and Emergency Act*;
- *Liquor Act*;
- *Mining Royalty Act*;
- *Motor Vehicles Act* and Motor Vehicles (Standards) Regulations;
- *National Environment Protection Council (Northern Territory) Act*;
- *Planning Act*;
- *Poisons and Dangerous Drugs Act*;

- *Public and Environmental Health Act*;
- *Road Traffic Act*;
- *Soil Conservation and Land Utilisation Act*;
- *Transport of Dangerous Goods by Road and Rail (National Uniform Legislation) Act*;
- *Traffic Act*;
- *Work Health and Safety Act*; and
- *Work Health and Safety (National Uniform Legislation) Act*.

### *Northern Territory Guidelines*

NT EPA draft and current Guidelines relevant to the Project include:

- Environmental Assessment Guidelines on Acid and Metalliferous Drainage (AMD);
- Guidelines for Assessment of Impacts on Terrestrial Biodiversity;
- Guidelines for the Preparation of an Economic and Social Impact Assessment;
- Guidelines on Conceptual Site Models;
- Guidelines on Environmental Offsets and Associated Approval Conditions; and
- Draft Guideline for the Preparation of an Environmental Management Plan.

# 5. Environmental Risk Assessment

## 5.1 Introduction

A risk assessment was completed to assist in identifying the key environmental, social and economic issues and potential impacts associated with the Mount Peake Project, in the context of the EIS scope. The risk assessment was initially conducted early in the study process to identify key risks for focus and to guide (through enabling informed choices and prioritisation of actions / works) site specific technical and specialist studies being undertaken. Updates to the risk assessment were made to reflect an improved understanding of the associated issues resulting from completion of specialist studies.

The process provided an understanding of residual risks and potential impacts during all phases of the Project and reinforces the importance of effective control measures for risk reduction and management.

The key risks identified by the NT EPA as part of the Terms of Reference for the Mount Peake Project (Appendix C) are presented in Section 1.4.2.

## 5.2 Risk Assessment Process and Methodology

Risk relates to the effect of uncertainty on objectives. These objectives relate in this case primarily to environmental goals within the Draft EIS. Risk is expressed and assessed in terms of a combination of the consequence of an event and the associated likelihood of occurrence.

Identification of the source and consequence of a risk, mitigation measures to reduce or remove the risk and determination of residual risk to environmental components (aspects) have been determined using standard qualitative risk assessment procedures with a matrix form (Table 5-5). The process is consistent with AS / NZS ISO 31000:2009 ‘Risk Management – Principles and guidelines’.

Assessment of risk has been conducted through consideration of the circumstances around risks, identifying necessary controls to address potential impacts and assuming effective implementation of planned and committed mitigation of potential impacts. Mitigation is proposed, where possible, to reduce residual risk (risk after mitigation) to below “Extreme” or “High” risk outcomes to the extent reasonably practicable as part of reducing the overall Project risk profile.

Table 5-1 provides a summary of the qualitative risk matrix adopted and the levels of risk for the various consequence and likelihood combinations.

**Table 5-1 Qualitative Risk Analysis Matrix**

| | | Severity of Consequence | | | | |
|---|---|---|---|---|---|---|
| | | **Critical (5)** | **Major (4)** | **Significant (3)** | **Moderate (2)** | **Minor (1)** |
| Likelihood of Consequence | **Almost Certain (5)** | Extreme | Extreme | High | High | Medium |
| | **Likely (4)** | Extreme | High | High | Medium | Medium |
| | **Possible (3)** | Extreme | High | Medium | Medium | Low |
| | **Unlikely (2)** | High | Medium | Medium | Low | Very Low |
| | **Rare (1)** | Medium | Medium | Low | Low | Very Low |

A brief description of each risk classification and the likely responses is provided below.

### Extreme

Unacceptable risks primarily critical in nature in terms of consequences (e.g. extensive and long term environmental harm, permanent sacred site damage, fatality, massive economic impacts) that are considered a possibility through to almost certain to occur. Such risks significantly exceed the risk acceptance threshold and require comprehensive control measures, and additional urgent and immediate attention towards the identification and implementation of measures to reduce the level of risk.

### High

Typically relate to significant to critical consequences (e.g. a major amount of environmental or heritage damage, and considerable safety, social or economic impacts) that are inclined to cut across the possible to almost certain likelihood ratings. These are also likely to exceed the risk acceptance threshold and although proactive control measures have been planned or implemented, a very close monitoring regime and additional actions towards achieving further risk reduction is required.

### Medium

As suggested by the classification, medium level risks span a group of risk combinations varying from relatively low consequence / high likelihood to mid-level consequence / mid-level likelihood, to relatively high consequence / low likelihood scenarios across environmental, social and economic areas. These risks are likely to require active monitoring as they are positioned on the risk acceptance threshold.

### Low

These risks are below the risk acceptance threshold and although they may require additional monitoring in certain cases are not considered to require active management. In general such risks represent relatively low likelihood and low to mid-level consequence scenarios.

### Very Low

Such risks are below the risk acceptance threshold and in many cases would not require active management. These risks can include unlikely to rare events with minor consequences and in essence relate to situations around very low probabilities of relatively minor impacts occurring.

Definitions of likelihood are provided in Table 5-2. Likelihoods are categorised around the probability of occurrence, within the context of reasonable timeframes and frequencies given the Project life.

**Table 5-2 Definition of Likelihood Ratings**

| Rating | Likelihood | Definitions |
|---|---|---|
| 5 | Almost certain | The event is expected to occur in most circumstances (the event is likely to occur once per year). |
| 4 | Likely | The event will probably occur in most circumstances (the event is likely to occur once every 1 – 2 years). |
| 3 | Possible | The event might occur at some time (the event is likely to occur once every 2 – 5 years). |
| 2 | Unlikely | The event could occur at some time (the event is likely to occur once every 5 – 10 years). |
| 1 | Rare | The event may occur only in exceptional circumstances (the event is unlikely to occur in any 10 year period). |

Table 5-3 describes the types of consequences that have been identified and assessed as part of the risk assessment process. These are grouped into environment which also includes heritage considerations, and socio-economic and regulatory including health and safety.

## Table 5-3 Definition of Consequence Ratings

| Rating | Consequence | Environment (including heritage) | Socio-economic and regulatory (including health and safety) |
|---|---|---|---|
| 5 | Critical | Extensive long term environmental harm or harm that is very widespread. Could include extensive pollutant discharges. Impacts permanent or unlikely to be reversible within 10 years.<br>Unsalvageable and permanent damage to sensitive historic structures or sites of cultural significance.<br>Substantial regional habitat modification and / or lifecycle disruption for a listed species. Moderate or substantial regional decrease in size of population(s) of listed species.<br>Irreversible and / or extensive impact to soils. Chemical concentrations >10 times the ecological investigation levels (EILs).<br>Widespread, permanent exceedance of background and applicable Water Quality guidelines. | Loss of life / fatality or long term or permanent disabling effects on human health (> one person).<br>Increase of >10 annual non-fatal vehicle accidents. Fatal vehicle accident.<br>Community condemnation and irreconcilable community loss of confidence. Public or media attention of national to international scale.<br>Continuous exceedance of air quality or noise standards leading to respiratory or health impacts, or permanent loss of hearing.<br>Irreversible changes to social characteristics and values of the communities of interest or community has no capacity to adapt and cope with change.<br>Extensive flooding of critical mining infrastructure or third party property. Recovery unlikely.<br>Severe action / prosecution by agencies such as NT EPA, DME, AAPA and NT WorkSafe. Major litigation or prosecution.<br>>$10m impact on company or stakeholders. |
| 4 | Major | Major or widespread, unplanned environmental impact on or off-site. Could include substantial pollutant discharges. Significant resources required to respond and rehabilitate.<br>Major damage or infringement to sensitive historic structures or sites of cultural significance.<br>Moderate regional habitat modification and / or lifecycle disruption for a listed species. Substantial local decrease in size of population(s) of listed species.<br>Widespread and / or long term impact to soils. Chemical concentrations 5-10 times EILs.<br>Local, permanent or widespread, long-term exceedance of background and applicable Water Quality guidelines. | Injuries requiring hospitalisation. Serious long term or permanent disabling effects on human health (one person).<br>Increase of 5-10 annual nonfatal vehicle accidents.<br>Prolonged community condemnation or annoyance and / or loss of confidence and local media attention.<br>Regular exceedance of air quality or noise standards leading to regular complaints and / or temporary and reversible health complaints.<br>A long-term recoverable change to social characteristics and values of the communities of interest or community has limited capacity to adapt and cope with change.<br>Long-term opportunities emanating from the project.<br>Extensive flooding of mining infrastructure or third party property. Repairs take more than 6 months.<br>Major regulatory restrictions or orders – substantial prosecution.<br>$5m-$10m impact on company or stakeholders. |

| Rating | Consequence | Environment (including heritage) | Socio-economic and regulatory (including health and safety) |
|---|---|---|---|
| 3 | Significant | Significant, unplanned environmental impact contained on-site or minor impact that is off-site.<br>Considerable damage or infringement to sensitive historic structures or sites of cultural significance.<br>Substantial local habitat modification and / or lifecycle disruption for a listed species. Moderate local decrease in size of population(s) of listed species.<br>Localised long term or widespread short term soil impact. Chemical concentrations 2-5 times EILs.<br>Local long-term or widespread short-term exceedance of background and applicable Water Quality guidelines. | Injury or illness requiring medical treatment. Short term or reversible disabling effect (impairment) to human health.<br>Increase of 2-5 annual nonfatal vehicle accidents.<br>Limited and localised loss of confidence by the community.<br>Occasional exceedance of air quality or noise standards leading to nuisance impacts.<br>Medium-term recoverable changes to social characteristics and values of the communities of interest or community has some capacity to adapt and cope with change.<br>Medium term opportunities emanating from the project.<br>Long term flooding of mining infrastructure or third party property. Repairs take 1-6 months.<br>Significant breach of regulations. Direction to operate under limited regulatory restrictions or orders.<br>$2m-$5m impact on company or stakeholders. |
| 2 | Moderate | Moderate, unplanned localised environmental impact (may be of a temporary nature) or discharge contained on-site or with negligible off-site impact.<br>Moderate but repairable damage to important historic structures or sites of cultural importance.<br>Moderate local habitat modification and / or lifecycle disruption for a listed species. Minor local decrease in size of population(s) of listed species.<br>Localised soil impact. Low level <2 times exceedance of EILs.<br>Local short-term minor exceedance of background and applicable Water Quality guidelines. | Injuries requiring first aid treatment. Minor short term inconvenience or symptoms to human health.<br>Increase of <2 annual nonfatal vehicle accidents.<br>Localised community impacts and concerns.<br>No exceedance of air quality or noise standards but some amenity impacts / complaints.<br>A short-term recoverable change to social characteristics and values of the communities of interest or community has substantial capacity to adapt and cope with change.<br>Short-term opportunities emanating from the project.<br>Short term flooding of mining infrastructure or third party property. Repairs, if needed, take 1 week to 1 month.<br>Some regulatory restrictions, associated with breach of regulation with investigation or report to authority necessary.<br>$100k-$2m impact on company or stakeholders. |

| Rating | Consequence | Environment (including heritage) | Socio-economic and regulatory (including health and safety) |
|---|---|---|---|
| 1 | Minor | Minor environmental impact. Impacts are contained on-site and short term in nature. No detrimental effect on the environment.<br>Minor repairable damage to common historic structures or sites. No disturbance of cultural heritage sites.<br>Minor local habitat modification and / or lifecycle disruption for a listed species. No loss of individuals of listed species.<br>Negligible soil impact. Chemical concentrations are above background but below EILs.<br>No detectable change to background water quality. No exceedance of background and applicable Water Quality guidelines. | Incident with or without minor injury. No impact on human health or very minor short term inconvenience or symptoms.<br>No increase in vehicle accidents.<br>Isolated community or individual issue-based concern and complaints.<br>No exceedance of air quality or noise standards.<br>Local, small-scale, easily reversible change on social characteristics or values of the communities of interest or communities can easily adapt or cope with change.<br>Local small-scale opportunities emanating from the project that the community can readily pursue and capitalise on.<br>Minor flooding of mining infrastructure or third party property. Repairs, if needed, take <1 week.<br>Minor issues around non-compliance.<br><$100k impact on company or stakeholders. |

## 5.3 Discussion of Key Outcomes

### 5.3.1 Classification of Risks

The risk assessment provides a good understanding of the Project risk profile and has enabled priority risks to be highlighted in order to minimise the likelihood of occurrence and / or the consequence severity. Risk assessments were based on the outcomes of planned mitigation and monitoring to detect incipient or actual failure of management systems. In total 153 different environmental, social and economic aspects were evaluated.

The major areas of interest in terms of the number of different risk scenarios identified and assessed include the following, which represents 117 risks or just over 75% of the total number of aspects:

- fauna (38);
- vegetation and flora (33);
- human health and safety (13);
- surface water (12);
- groundwater (11); and
- socio-economic (10).

### 5.3.2 Risk Assessment Results

Table 5-4 summarises the outcomes of the risk assessment process.

The specific consequence and likelihood scenarios are detailed in Table 5-5, along with the residual risk rating, based on a reasonable assumption of effective implementation of the control measures described.

Ongoing monitoring and management will be required to test the effectiveness of these controls, audit their implementation and identify other measures or different approaches that may be required to achieve and maintain acceptable risk levels.

In terms of table layout and structure (Table 5-5), risks are grouped according to their environmental aspect. Comments are also included in the table in order to provide additional context, assumptions and/or logic in assessing the risks.

**Table 5-4 Summary of Risks**

| Risk Level | No. Risks | Reference No's (refer Table 5-5) |
|---|---|---|
| Extreme | nil | NA |
| High | 4 | SE06, SE07, GW03, VF30 |
| Medium | 64 | (see Table 5-5) |
| Low | 50 | (see Table 5-5) |
| Very Low | 35 | (see Table 5-5) |
| Total | 153 | |

The High and Medium risks flagged above (68 in total) will have inspection, reporting and / or monitoring programs, and many will have specific management programs associated with them. All management, mitigation and monitoring measures will be subject to continuous review and updates / improvement depending on circumstances and performance.

Two socio-economic risks were identified with having high positive local community outcomes. The rating of “high” is driven primarily by the “almost certain” likelihood of the activity occurring:

- SE06 relates to potential business development opportunities, employment opportunities and flow on benefits experienced in the area as a result of the Project; and
- SE07 relates to local expenditure and employment during upgrade of Ti Tree airport, local employment during operations (check in, baggage handlers, cleaners etc) and an increase in opportunities for travel.

Two high risks were identified as a result of the potential for groundwater drawdown from the borefield to impact phreatophytic vegetation (GW03, VF30). The rating of “high” is driven primarily by the “almost certain” likelihood of groundwater drawdown occurring. The critical controls to address potential impacts include:

- an additional flora survey to identify presence and distribution of phreatophytic vegetation;
- establishing a monitoring network for groundwater drawdown;
- monitoring the health of phreatophytic vegetation within the area of groundwater drawdown during operations; and
- considering options to modify groundwater extraction (the rate of extraction and distribution of operating bores) if significant impacts to vegetation occur.

**Table 5-5 Project Risk Assessment (by Aspect)**

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| **Socio-economic** | | | | | | | | |
| SE01 | Development and operation of the mine including the requirement for a construction workforce of up to 225 persons (peak) during the 2 year construction period and an operational workforce of up to 170 full-time positions. | Potential draw of existing workers from other industries into better paying resource jobs leading to shortfalls in other industries. | The Project could attract some workers from the local communities. Most would come from further afield. | Prepare and implement an Industry Participation Plan.<br>Work with local training providers to develop local training programs to provide unskilled people with opportunities to gain employment in the Project.<br>Adoption of recruitment policies that allow for appropriate notice periods to be served for new employees. | 2 | 3 | M | 12.3.1 |
| SE02 | | Increase in demand for accommodation, and reduction in affordability of rental housing leading to rent escalation and housing price inflation. | Most of the construction and operation workforce will be accommodated in an onsite accommodation village. Personnel drawn from the surrounding district will continue to live in their own homes. | No specific mitigation. | 3 | 1 | L | 12.3.3 |
| SE03 | | Increased demand for community infrastructure and utilities leading to local / regional shortfalls including increased demand on health facilities. | Due to the remote location of the mine, the medical facilities available on site, and with the workforce housed at the mine accommodation village, no impacts on local housing and social infrastructure services are expected. | No specific mitigation. | 3 | 1 | L | 12.3.3 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| SE04 | | Impacts on community values and conditions including:<br>• decline in community, health, safety and wellbeing<br>• increase in incidence of anti-social behavior.<br>• impacts on vulnerable groups such as women and Indigenous groups. | Most of the construction and operation workforce will be accommodated in an onsite accommodation village. Personnel drawn from the surrounding district will continue to live in their own homes. No impacts on local community values, lifestyle and amenity are expected. | Establish a complaints and feedback register as part of a Grievance Management Procedure for tracking and appropriately responding to any community issues raised.<br>Develop an overall Workforce Management Strategy including workforce sources, management, health and wellbeing and appropriate behavior. | 3 | 1 | L | 12.3.2 |
| SE05 | | Indigenous resources, values and aspirational impacts including:<br>• potential for community conflict<br>• traditional Owner cultural heritage and resources. | Sacred site clearance surveys and archaeological surveys have been conducted over the Project area to understand indigenous values.<br>TNG will have a target 15% of its workforce being indigenous. | Establish clear mechanisms for ongoing consultation and communication with local Indigenous groups.<br>Implement and monitor a Cultural Heritage Management Plan.<br>Prepare and implement an Industry Participation Plan for the Project, including indigenous participation. | 3 | 1 | L | 12.3.1<br>11.6 |
| SE06 | | Potential business development opportunities, employment opportunities and flow on benefits experienced in the area. | This is certain to happen and will result in positive outcomes. | Develop opportunities for local communities to benefit from employment and business prospects with the Project. | 3 | 5 | H | 12.3.1 |
| SE07 | Upgrade of Ti Tree airport. | Local expenditure and employment during upgrade. Local employment during operations (check in, baggage handlers, cleaners). Increase in traffic through the airport. Increased opportunities for travel. | This is certain to happen and will result in positive outcomes. | No specific mitigation. | 2 | 5 | H | 12.1.1<br>12.3.1 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| SE08 | Use of hazardous materials on site such as use of ammonium nitrate for blasting, transport of magnetite concentrate across properties with the potential for spills of concentrate and diesel, use of chemical suppressants for dust management, potential leaks of waste and sewage from the accommodation village. | Potential risk to the organic certification of Anningie Station and future certification of Stirling Station. | Potential risk to the organic certification is unlikely due to project design features such as physical separation and the choice of chemicals to be used. | Fencing and drainage containment along roads and around the mine and accommodation village to provide appropriate separation from the Project activities and the remainder of Stirling Station and Anningie Station.<br>No hazardous chemicals are proposed for use on the Project. | 3 | 2 | M | 12.3.4 |
| SE09 | Existing road access to Stirling Station on the eastern side of railway line may be impacted by the access road. | Restricted access to parts of Stirling Station. | | Discussions will be held with station owner during detailed design of the road to ensure that access can be maintained to the property. | 3 | 2 | M | 12.3.4 |
| SE10 | Access to strategic areas of the stations, such as bores and gates, may be impacted by the access road and rail siding. | Restricted access to parts of the stations. | | Discussions will be held with station owner during detailed design to ensure that access can be maintained to the property. The intent is that access to these areas of the stations will be maintained or replaced to allow a similar level of access. | 3 | 2 | M | 12.3.4 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| **Human Health and Safety** | | | | | | | | |
| HS01 | Release of hydrocarbons due to a vehicle to vehicle accident or rollover. | Impact to human health through contact with hydrocarbons. | | Hydrocarbon transport will be in compliance with the Dangerous Goods Code. All vehicles will be registered. A component of this registration is that vehicles carry appropriate equipment to respond to a spill, including personal protective equipment (PPE).<br>Personnel will be trained in the appropriate handling of hazardous materials and in clean-up procedures in the event of a spill. | 3 | 3 | M | 13.1.4 |
| HS02 | Release of hydrocarbons due to a spill at the mine site. | | | Hazardous materials will be stored and handled in compliance with industry standards.<br>Diesel will be stored in self-bunded tanks.<br>Lubricating oil will be stored in bulk containers inside a bunded area with spill protection and recovery.<br>Waste hydrocarbons will be stored in a tank within a bunded area to be held for collection by a contractor for reprocessing and recycling.<br>Personnel will be trained in the appropriate handling of hazardous materials and in clean-up procedures in the event of a spill. PPE will be provided. | 3 | 3 | M | 13.1.4 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| HS03 | Explosion from the gas storage vessel at the mine site. | Human fatality. | | Gas will be stored in intermodal containers.<br>Gas storage will be in compliance with AS 4332-2004, The storage and handling of gases in cylinders.<br>Personnel handling gas facilities will be appropriately trained. | 5 | 1 | M | 13.1.4 |
| HS04 | Fire, formation of toxic gases or explosion of ammonium nitrate. | Poisoning or fatality. | | Ammonium nitrate will be stored in a dedicated standalone building consistent with Code of Practice for the safe storage of solid ammonium nitrate.<br>Handling of ammonium nitrate will be by appropriately trained personnel. | 5 | 1 | M | 13.1.4 |
| HS05 | Interaction of concentrate trucks with vehicles using Stuart Highway. | Vehicle collision resulting in injury or death. | Up to 100 concentrate truck movements per day between the mine site and rail loadout facility. An underpass of Stuart Highway will be constructed to separate concentrate trucks from highway traffic. | Construction of underpass of Stuart Highway. | 5 | 1 | M | 13.2.1<br>13.2.3 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| HS06 | Increased vehicle movements to and from the mine site | Major single vehicle or vehicle to vehicle accident leading to a fatality. | The Project is expected to generate 66 and 30 one-way vehicle movements per day during construction and operation respectively. Vehicle movements on Stuart Highway will increase to around 3% of the highway's design capacity.<br>A new intersection will be constructed to allow access from the highway to the access road. | Design the intersection of the access road with Stuart Highway in consultation with the NT Department of Transport.<br>Prepare Road Transport Management Plan.<br>Use of pooled vehicles such as buses where practical to minimise exposure.<br>Develop Emergency Response Plan. | 5 | 1 | M | 13.2.1<br>13.2.3 |
| HS07 | | Major vehicle to pedestrian fatality. | There is very limited pedestrian traffic in the Project area. | | 5 | 1 | M | 13.2.3 |
| HS08 | Vehicles travelling between the mine site and loadout facility collide with cattle. | Vehicle collision resulting in injury or death to the driver. | | The access road will be fenced to exclude cattle. | 5 | 1 | M | 12.3.4 |
| HS09 | Mine dewatering or groundwater abstraction to provide Project water supply. | Groundwater drawdown at the mine or borefield affecting bores supplying potable water. | There are no potable water supplies near to the Project.<br>The closest potable water supply is 50 km up groundwater gradient from the borefield and no impact to a potable supply is expected from borefield abstraction. | Monitor groundwater level drawdown at the mine and borefield.<br>No specific mitigation required. | 3 | 1 | L | 13.3.3<br>13.3.4 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| HS10 | Storage and use of diesel at the borefield to power generators. | Contamination of groundwater supply at the borefield from leaks or spills of diesel. | | Constructing bores and installing generators on raised hardstands with the height of the hardstand sufficient to protect infrastructure from a 100 year flood event of the Hanson River.<br>Each generator and its associated diesel tank will be located within a bunded area of the hardstand;<br>Installation of groundwater monitoring bores to monitor groundwater quality.<br>Clean-up of any spills consistent with the Emergency Response Plan. | 3 | 3 | M | 13.3.4 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| HS11 | Increase in potential breeding sites for mosquitoes due to water ponding. | Nuisance levels of mosquitoes for the workforce. | | Rectify any artificially created mosquito breeding sites. | 1 | 3 | L | 13.4.4 |
| | | Transmission of disease by mosquitoes infecting workers. | | Improve drainage of grassy floodways and poorly draining areas.<br>Prevent potential mosquito breeding in artificial receptacles.<br>Screen any rainwater tanks at the inlet and outlet.<br>Ensure construction avoids establishment of areas of temporary water.<br>Treat artificial ponding with an undiluted bleach solution or a residual larvacide if breeding is detected.<br>Ensure personnel wear long sleeved shirts, long trousers and mosquito repellent.<br>Monthly inspections during the Wet Season, to identify areas of potential mosquito breeding.<br>Follow the "Guidelines for preventing mosquito breeding sites associated with mining sites" (Medical Entomology Centre for Disease Control 2005). | 3 | 2 | M | 13.4.3<br>13.4.4 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| HS12 | Workers working outdoors. | Sunburn and heat exhaustion. | | All employees and contractors required to wear long-sleeve shirts, trousers and hats to help reduce sun exposure.<br>Sunscreen will be made available to all employees.<br>All personnel will be made aware during staff induction training of the signs and symptoms of overexposure to heat and its effects, including dehydration.<br>Drinking water will be readily available to all staff. | 3 | 2 | M | 13.5.2 |
| HS13 | Animal attacks of bites. | Injury or death to a worker. | Several animals in the Project area are capable of human attack and inflicting bites. These include snakes and dingoes / wild dogs.<br>Bites from some species of snake (Mulga, Western Brown, Easter Brown, Desert Death Adder) are potentially fatal if not treated. Attack by a dingo / wild dog is unlikely unless the animal is injured or cornered. | During staff inductions personnel will be made aware of the potential wildlife hazards and the best methods to avoid negative encounters.<br>All staff will be provided with appropriate training for the treatment of snake bite will be provided to all staff.<br>First-aid facilities will be equipped to respond to incidents and provide appropriate treatment.<br>PPE such as boots, trousers and long sleeves will be required on the mine site. Gloves will also be provided for use during relevant tasks. | 5 | 1 | M | 13.6.2 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| **Groundwater** | | | | | | | | |
| GW01 | Groundwater abstraction. | Volume not sufficient to supply Project needs. | Groundwater assessment indicates that there should be sufficient water available from the Hanson River palaeovalley to supply project needs.<br>The assessment is based on limited drilling. | Additional drilling of bores to confirm aquifer properties across the proposed borefield.<br>Model re-runs to confirm yield and drawdown extent.<br>Modify borefield configuration if necessary | 3 | 3 | M | 7.4.4<br>7.6.2 |
| GW02 | | Impact on water supply for human or livestock consumption. | Groundwater from the area of the borefield is not used for human consumption.<br>Drawdown is predicted at several stock bores with groundwater levels expected to experience a drop in water level of greater than 3.0 m, which may lead to water supply problems. | Base line assessment of potentially impacted bores.<br>Make good agreement developed with the owners prior to the development of the borefield. This could involve deepening of the existing bore, lowering the pump setting, drilling another bore next to the existing bore, or supplying the required water demand from external sources (e.g. pipeline offtake). | 2 | 4 | M | 7.6.3 |
| GW03 | | Impact on phreatophytic vegetation in the area of borefield groundwater drawdown. | Groundwater extraction from the borefield will lower existing water table levels by approximately 12 m. | Flora survey to identify presence and distribution of phreatophytic vegetation.<br>Establish monitoring network for groundwater drawdown.<br>Monitor health of phreatophytic vegetation within the area of groundwater drawdown during operations.<br>Consider modifying extraction (the rate of extraction and distribution of operating bores) if significant impacts to vegetation occur. | 2 | 5 | H | 7.4.3<br>7.6.2<br>8.1.4 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| GW04 | Pit development. | Reduction in groundwater flow from the Mineral Lease to local creeks, rivers and / or groundwater dependent ecosystems. | Groundwater drawdown impact would be limited to the Mineral Lease and unlikely to affect any potentially groundwater dependent ecosystems. | Monitoring of bores surrounding the pit that are potentially influenced by groundwater drawdown.<br>Data to be assessed and summarised within the Water Management Plan.<br>Exploration drill holes that may act as conduits interacting with mine features will be rehabilitated. | 3 | 1 | L | 7.4.4<br>7.6.2 |
| GW05 | | Groundwater drawdown affects Mud Hut Swamp. | Modelling indicates that drawdown contours from the pit do not encroach on Mud Hutt Swamp. | Establish monitoring network for groundwater drawdown. | 3 | 1 | L | 7.4.3<br>7.6.2 |
| GW06 | | Reduction in local water supply. | Modelling indicates that drawdown contours from the pit do not encroach on any stock bores. | | 2 | 1 | L | 7.6.2 |
| GW07 | Seepage from the TSF. | Localised increase in groundwater levels.<br>Seepage of AMD causing contamination.<br>Increased long term risk to groundwater. | Tailings will comprise sand and silt and are benign.<br>The orebody does not contain material with significant acid forming potential.<br>The TSF will be constructed with an underdrainage system to recover as much water as possible for reuse as process water. Not all water will be recovered and a localised rising of groundwater level is likely. | Perimeter monitoring bores will be installed and monitored for depth and quality to assess potential interaction between TSF and the surrounding environment.<br>Tailings will be managed in accordance with the Tailings Management Plan.<br>The TSF will be designed to ANCOLD guidelines. | 1 | 5 | M | 7.5 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| GW08 | Seepage from the WRD. | Release of AMD causing contamination. | Waste rock does not contain material with significant acid forming potential. | Periodic testing of waste rock to confirm the absence of Potentially Acid Forming (PAF) material.<br>Selective handling / treatment of waste if PAF material identified (e.g. encapsulation and / or neutralisation).<br>Managed in accordance with the WRD Management Plan. | 1 | 5 | M | 7.5 |
| GW09 | Concentrate storage at the mine site and Adnera. | Groundwater contamination. | Concentrate is inert and benign. | No specific mitigation. | 1 | 2 | VL | 7.5 |
| GW10 | Liquid and solid waste disposal. | Production of leachate leading to groundwater contamination. | | Manage disposal of wastes in accordance with the Waste Management and Pollution Control Act and waste management hierarchy.<br>Waste hydrocarbons removed from site for recycling.<br>Organic waste buried in an on-site landfill.<br>Brine from the WTP used in the process plant.<br>Sewage treated via onsite packaged treatment plants. | 3 | 3 | M | 14.5.3 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| GW11 | Storage, handling and transport of hazardous materials. | Groundwater contamination from leaks and spills. | Diesel, oil and lubricants will be the principle dangerous goods transported.<br>At full production the Project is estimated to use 15 MLpa of diesel. To achieve there will be three 100,000 L deliveries per week by triple carriage semitrailer. | Design, storage and handling of hazardous materials to Australian standards and regulations.<br>Maintain an inventory of chemicals onsite, material safety data sheets, spill kits and spill response procedures.<br>Lubricating oil stored in tank with bunded area with spill protection.<br>Waste oil stored in tank within bunded area and held for collection by contractor for reprocessing and recycling.<br>Diesel stored in self-bunded tanks.<br>Regular inspections of storages, tanks and bulk containers and the integrity of bunded areas and containment systems.<br>Transport of dangerous goods in accordance with relevant legislation.<br>Prepare Emergency Response Plan. | 3 | 2 | M | 13.1.4 |
| **Surface Water** | | | | | | | | |
| SW01 | Sediment runoff from disturbed areas. | Adverse impacts on downstream water quality, aquatic environment, and downstream users. | There are no downstream users from the Project area. | Construction of retention ponds consistent with an Erosion and Sediment Control Plan.<br>Rehabilitation of disturbed areas. | 2 | 3 | M | 7.5 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| SW02 | Overflow from retention ponds due to extreme rainfall event. | Adverse impacts on downstream water quality, aquatic environment, and downstream users.<br>Impact on structural integrity of engineered embankments. | | Water retention ponds sized to capture an ARI Wet Season rainfall appropriate to their hazard category plus an appropriate freeboard allowance for sedimentation.<br>Reuse of water around the mine site and for processing.<br>Monitor and manage water levels in the retention ponds to maximise available storage capacity prior to the Wet Season. | 2 | 3 | M | App K of App N |
| SW03 | Insufficient capacity of site drains. | Release of sediments and contaminants into the environment.<br>Erosion in drains. | | Drain design to recognise 1 in 100 year flow events and to keep velocities within acceptable design criteria.<br>Regular checks and maintenance on all drains.<br>Erosion and Sediment Control Plan.<br>Use of rip-rap protection on earthwork embankments adjacent to drainage channels. | 2 | 3 | M | App K of App N |
| SW04 | Erosion of the WRD and TSF due to significant rainfall events. | Capacity of sedimentation basins exceeded, reducing their efficiency and leading to sediments and contaminants entering waterways. | | Ongoing stabilisation and rehabilitation of embankments.<br>Regular inspections and maintenance.<br>Monitoring in accordance with Surface Water Monitoring Plan. | 2 | 3 | M | 7.5 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| SW05 | Flooding of the mine pit. | Loss of production.<br>Loss of life. | A preliminary flood risk assessment indicates that the mine site is not expected to experience any significant flooding for events up to the 50-year ARI. However, the bench of lower lying topography in the vicinity of the proposed pit may be prone to flooding during more extreme events. | Further surface water modelling adjacent to the pit.<br>Bund constructed adjacent to the pit to prevent any ingress of flood waters, if necessary.<br>Regular inspections of bunds and maintenance as necessary. | 5 | 1 | M | 7.6.1 |
| SW06 | Construction of the access road across the Hanson River, Murray Creek and smaller drainage lines. | Upstream flooding due to retention of flood waters. | The access road will be provided with at-grade floodways across the Hanson River and Murray Creek. These will prevent backwater effects but will wash out in a major flood event and require reconstruction.<br>Culverts installed where the access road crosses small defined drainages. | No specific mitigation. | 2 | 3 | M | 16.4.5 |
| SW07 | Concentrate storage at the mine site and Adnera. | Contamination of surface waters from stockpile erosion. | Concentrate is inert and benign.<br>Stockpiles are not located near to any significant watercourses. | Drains installed around the base of stockpiles. | 1 | 3 | L | 7.5 |
| SW08 | | Contamination of surface waters from dust liftoff. | | Maintenance of concentrate moisture levels.<br>Application of additional water if needed in dry / windy conditions. | 1 | 3 | L | 7.5 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| SW09 | Spills of hazardous materials from storage areas. | Surface water contamination from leaks and spills. | Diesel, oil and lubricants will be the principle dangerous goods transported.<br>At full production the Project is estimated to use 15 MLpa of diesel. To achieve there will be three 100,000 L deliveries per week by triple carriage semitrailer. | Design, storage and handling of hazardous materials to Australian standards and regulations.<br>Maintain an inventory of chemicals onsite, material safety data sheets, spill kits and spill response procedures.<br>Lubricating oil stored in tank with bunded area with spill protection.<br>Waste oil stored in tank within bunded area and held for collection by contractor for reprocessing and recycling.<br>Diesel stored in self-bunded tanks.<br>Regular inspections of storages, tanks and bulk containers and the integrity of bunded areas and containment systems.<br>Transport of dangerous goods in accordance with relevant legislation.<br>Prepare Emergency Response Plan. | 3 | 2 | M | 13.1.4 |
| SW10 | Use of mine waste for construction purposes around the site. | Release of AMD causing contamination. | Waste rock does not contain significant Potentially Acid Forming material. | Collection of runoff from disturbed areas in detention ponds. | 3 | 3 | M | 7.5 |
| SW11 | Failure of the WWTP. | Release of untreated waste water to the environment. | | Regular checks and maintenance.<br>Operations generating waste shut down as much as possible.<br>Provide alternative temporary supply of potable water. | 1 | 2 | VL | |

<table>
<tr><th>Ref.</th><th>Source of Impact</th><th>Consequence</th><th>Discussion</th><th>Mitigation</th><th>Consequence</th><th>Likelihood</th><th>Residual Risk</th><th>EIS reference</th></tr>
<tr><td>SW12</td><td>Failure of TSF.</td><td>Uncontrolled release of tailings to the surrounding environment.</td><td>Thickened tailings will be pumped to the TSF. A low perimeter embankment will control the lateral extent of the tailings so there is no significant TSF wall to fail.</td><td>Design to ANCOLD guidelines.<br>Protection of toe of TSF through construction of diversion drains and installation of rock armour.<br>Regular structural checks and maintenance.<br>Develop a robust and fully implemented mine closure plan.<br>Prepare TSF Management Plan as part of MMP.</td><td>3</td><td>1</td><td>L</td><td>7.5<br>16.3.4</td></tr>
<tr><td colspan="9">Vegetation and Flora</td></tr>
<tr><td>VF01</td><td rowspan="3">Clearing of 1008 ha of native vegetation (mapped) comprising approximately:<br>• 558 ha of Triodia grassland on sandy plains<br>• 420 ha of Mulga shrubland on sandy red earths<br>• 10 ha of Tall Acacia shrubland on stony quartz<br>• 8 ha of Low open Eucalyptus woodland on limestone<br>• 3 ha of Riparian woodland along</td><td>Reduction of terrestrial flora and habitat locally and/or regionally.</td><td rowspan="3">Approximately 1038 ha of native vegetation will be cleared. None of the vegetation communities to be cleared are listed as threatened under the EPBC or TSC Act and none have regional significance. All of these vegetation types are well represented at the local scale within the bioregion.<br>The current survey identified 238 flora species (233 native and 5 introduced) within the Study area.<br>Vegetation clearing will involve removal of a moderately diverse range of non-threatened native plants.<br>No threatened flora species were</td><td rowspan="3">Minimise vegetation clearing where practical.<br>Use already-disturbed areas (rather than undisturbed areas) wherever possible (e.g. lay down areas for construction).<br>Stage clearing of vegetation to minimise areas of bare ground and clear land only as required and in accordance with ESCP.<br>Avoid land clearing for construction during the Wet Season.<br>Develop and implement Vegetation Clearing sub plans which include areas not to be cleared (no-go areas).<br>Conduct a preclearance survey to assist in the location of infrastructure in areas that have not been previously surveyed (e.g.</td><td>3</td><td>1</td><td>L</td><td>8.1.3<br>8.1.4<br>8.1.5<br>8.1.6</td></tr>
<tr><td>VF02</td><td>Adverse impact on habitat critical to the survival of a species or community.</td><td>4</td><td>1</td><td>M</td><td>8.1.3<br>8.1.4<br>8.1.5<br>8.1.6</td></tr>
<tr><td>VF03</td><td>Fragment or damage habitat important for the conservation of biological diversity.</td><td>4</td><td>1</td><td>M</td><td>8.1.3<br>8.1.4<br>8.1.5<br>8.1.6</td></tr>
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| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| VF04 | watercourses and drainage channels<br>• 5 ha of Low Corymbia woodland on loamy alluvial plains<br>• 4 ha of Low Acacia shrubland on rocky slopes.<br>Additional clearing of 30 ha (unmapped) associated with the borefield and pipeline. | Cause a long term reduction in rare, endemic or unique plant populations or species. | recorded, although there is potential habitat within the Study area for one threatened species (*Eleocharis papillosa* Dwarf Desert Spike-rush). This species is listed as vulnerable under both the TPWC Act and EPBC Act. | borefield, delivery pipeline and borrow pit areas).<br>Weed removal prior to vegetation clearing so that vegetative material would be clean and able to be mulched and reused directly on site. | 4 | 1 | M | 8.1.3<br>8.1.4<br>8.1.5<br>8.1.6 |
| VF05 | | Modification, destruction, removal or isolation of habitat availability or quality such that a threatened species or community is likely to decline. | | Adhere to buffer widths recommended by the Northern Territory Land Clearing Guidelines where possible, with regard to riparian vegetation in drainage lines. | 4 | 1 | M | 8.1.3<br>8.1.4<br>8.1.5<br>8.1.6 |
| VF06 | | Increased likelihood of weed establishment in cleared areas. | A number of weed species occur in the Project area. One species (*Tribulus terrestris*) is listed as a declared weed under the *Weeds Management Act 2001* and one species (*Cenchrus ciliaris,* Buffel Grass) has been identified as high threat environmental weeds in the Burt Plain Bioregion. | Development and implementation of a Weed Management sub-plan as part of the Project CEMP.<br>Weed removal prior to vegetation clearing so that vegetative material would be clean and able to be mulched and reused directly on site. | 3 | 2 | M | 8.1.3<br>8.1.4<br>8.1.5 |
| VF07 | Transport of materials, vehicle movements and inappropriate waste management allows for introduction of new weeds and spread of existing weeds during construction and operation phases. | Modify or inhibit ecological processes. | A number of weed species occur in the Project area. One species (*Tribulus terrestris*) is listed as a declared weed under the *Weeds Management Act 2001* and one species (*Cenchrus ciliaris,* Buffel Grass) has been identified as high threat environmental weeds in the Burt Plain Bioregion. | Development and implementation of a Weed Management sub plan as part of the project CEMP.<br>Environmental inductions for workforce.<br>Minimise exposure of bare soils.<br>Vehicle and equipment wash-down procedures on site. | 3 | 1 | L | 8.1.3<br>8.1.4<br>8.1.5 |
| VF08 | | Reduce the diversity or modify the composition of plant species. | | | 3 | 1 | L | 8.1.3<br>8.1.4<br>8.1.5 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| VF09 | | Fragment or damage habitat important for the conservation of biological diversity. | | | 3 | 1 | L | 8.1.3<br>8.1.4<br>8.1.5 |
| VF10 | | Cause a long term reduction in rare, endemic or unique plant populations or species. | | | 3 | 1 | L | 8.1.3<br>8.1.4<br>8.1.5 |
| VF11 | | Fragment, isolate or substantially damage habitat for rare, endemic or unique plant species. | | | 3 | 1 | L | 8.1.3<br>8.1.4<br>8.1.5 |
| VF12 | Wind erosion mobilising dust from exposed surfaces, such as pits, waste dumps, tailings storage facility, laydown areas, stockpiles, roads and sites of vegetation clearing.<br>Drilling, blasting, excavation and materials handling at the mine site during operations results in dispersion of particulates and dust. | Dust deposition leading to disturbance / loss of general terrestrial flora species and vegetation communities. | Modelling indicates that the project will generate only low levels of dust with offsite impacts confined to areas adjacent to the mine. | Development and implementation of a Dust Management Sub-Plan as part of the Project CEMP.<br>Use water carts on roads, wet ore before crushing, use hooded crushers and enclosed HPGR's.<br>Use of dust suppression techniques (i.e. spray trucks).<br>Minimise exposure of bare soils. | 2 | 2 | L | 8.1.4<br>8.1.5<br>8.1.6 |
| VF13 | | Modify or inhibit ecological processes | | | 2 | 2 | L | 8.1.4<br>8.1.5<br>8.1.6 |
| VF14 | | Reduce the diversity or modify the composition of plant species. | | | 2 | 2 | L | 8.1.4<br>8.1.5<br>8.1.6 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| VF15 | | Cause a long term reduction in rare, endemic or unique plant populations or species. | | | 4 | 1 | M | 8.1.4<br>8.1.5<br>8.1.6 |
| VF16 | Removal of individuals or habitat for the threatened flora species *Eleocharis papillosa* (Dwarf Desert Spike Rush). | Decrease in the population size of a listed threatened species. | The Dwarf Desert Spike-rush is known from a location in Stirling Swamp, approximately 12 km north of the proposed access road. There is potential habitat within the Study area to support this species, although none were identified. | Conduct targeted threatened species searches in areas of suitable habitat.<br>Modify Project elements to avoid impact. | 4 | 1 | M | 8.1.3<br>8.1.4<br>8.1.5<br>8.1.6 |
| VF17 | Unplanned wildfire. | Modify or inhibit ecological processes. | Construction and operational activities, particularly hot works, are potential ignition sources, and could result in a bushfire. In addition, it may be necessary to conduct controlled burns to minimise fuel loads in the vicinity of the mine site. | Firefighting equipment available during construction and operations.<br>All welding, cutting and grinding works undertaken require prior approval of an internal hot works permit.<br>All site personnel will be required to undertake fire control training.<br>All vehicles are required to carry a fire extinguisher and two-way radio. | 2 | 2 | L | 8.1.4<br>8.1.5 |
| VF18 | | Reduce the species diversity or modify the composition of plant communities. | | | 2 | 2 | L | 8.1.4<br>8.1.5 |
| VF19 | | Fragment or damage habitat important for the conservation of biological diversity. | | | 2 | 2 | L | 8.1.4<br>8.1.5 |
| VF20 | | Cause a long term reduction in rare, endemic or unique plant populations or species. | | | 4 | 1 | M | 8.1.4<br>8.1.5 |
| VF21 | Alteration to surface water flows from roads, hard stands or embankments. | Modify or inhibit ecological processes. | Construction of linear infrastructure such as access roads and pipelines has the potential to interfere with natural surface water flows by | Incorporate engineering controls into road that act to maintain surface water flows (e.g. floodways and culverts). | 2 | 3 | M | 8.1.3<br>8.1.4<br>8.1.6 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| VF22 | | Reduce the species diversity or modify the composition of plant communities. | blocking or disrupting the movement of water. These potential impacts are likely to be most significant where the proposed access road crosses the Hanson River and within the borefield area adjacent to the Hanson River.<br>Additionally operations may impact surface water flows through changes to areas of inundation, concentration of flows and/or disruption to sheet flow regimes.<br>Approximately 37% of the Project area is comprised of floodplains and plains that would be subject to seasonal inundation or surface water flows. A reduction in surface water flows has the potential to result in the death of understorey species and also overstorey mulga shrubs during low rainfall periods and may in the long term lead to alterations to community composition. | To control surface runoff and avoid erosion of the perimeter embankment of the TSF, surface runoff collector drains will be constructed along the downstream toe of the perimeter embankment. | 2 | 3 | M | 8.1.3<br>8.1.4<br>8.1.6 |
| VF23 | | Fragment or damage habitat important for the conservation of biological diversity. | | | 2 | 3 | M | 8.1.3<br>8.1.4<br>8.1.6 |
| VF24 | | Cause a long term reduction in rare, endemic or unique plant populations or species. | | | 4 | 1 | M | 8.1.3<br>8.1.4<br>8.1.6 |
| VF25 | Lowering of the water table caused by groundwater extraction. | Disturbance to significant vegetation and flora within Mud Hut or Stirling Swamp. | Modelling indicates that Mud Hutt Swamp, Stirling Swamp and the broader Anmatyerr North SOCS will not be impacted by groundwater | No specific mitigation. | 3 | 1 | L | 8.1.3<br>8.1.4 |
| VF26 | | | | | | | | |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| VF27 | | Reduce the species diversity or modify the composition of plant communities (i.e. Riparian communities or Swamp Vegetation within Anmatyerr North SOCS). | drawdown. | | 3 | 1 | L | 8.1.3 |
| VF28 | | Cause a reduction in the population of *Eleocharis papillosa* (Dwarf Spike Rush) at Stirling Swamp. | | | 4 | 1 | M | 8.1.3<br>8.1.4<br>8.1.5<br>8.1.6 |
| VF29 | | Fragment or damage habitat important for the conservation of biological diversity. | No habitat important for conservation of biological diversity will be significantly impacted. | | 2 | 2 | L | 8.1.3 |
| VF30 | | Impact on phreatophytic vegetation in the area of borefield groundwater drawdown. | Groundwater extraction from the borefield will lower existing water table levels by approximately 12 m. | Flora survey to identify presence and distribution of phreatophytic vegetation.<br>Establish monitoring network for groundwater drawdown.<br>Monitor health of phreatophytic vegetation within the area of groundwater drawdown during operations.<br>Consider modifying extraction (the rate of extraction and distribution of operating bores) if significant impacts to vegetation occur. | 2 | 5 | H | 7.4.3<br>7.6.2<br>8.1.3<br>8.1.4 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| VF31 | Contamination of surface and/or groundwater caused by erosion and sedimentation, hydrocarbon or chemical spills. | Disturbance to significant vegetation and flora within Anmatyerr North SOCS. | Risks include contamination of waterways or the groundwater table caused by embankment failure or overtopping and subsequent uncontrolled release from storage ponds, the processing site and the TSF. Inappropriate storage and handling of hazardous substances may also result in uncontrolled release, spills or passive discharge into drainage lines. | Preparation and implementation of an Erosion and Sediment Control Plan as part of the Project CEMP.<br>Regular inspection of erosion and sediment control measures, particularly following rainfall events.<br>Siting of stockpiles away from natural drainage channels.<br>Stage clearing of vegetation to minimise areas of bare ground and clear land only as required and in accordance with ESCP.<br>Avoid land clearing for construction during the Wet Season.<br>Minimise surface water infiltration, water runoff and groundwater seepage.<br>Preparation of a Water Management Plan for construction and operational activities.<br>Runoff from ROM pad, stockpiles and workshops directed to sediment basins.<br>All mining equipment refuelled, serviced and repaired within designated areas outlined for such activity.<br>Constructing adequate bunds around sources of potential contamination, to contain contaminated water in the event of heavy rainfall.<br>Spill clean-up procedures developed and implemented.<br>Personnel trained in the use of spill kits and emergency response procedures. | 3 | 1 | L | 8.1.3<br>8.1.4 |
| VF32 | | Disturbance of vegetation along Hanson River. | | | 3 | 3 | M | 8.1.4<br>14.5.3 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| VF33 | Failure of TSF. | Destruction of flora and vegetation. | The TSF has been designed as a low structure with tailings deposition by central thickened discharge. There is a limited requirement for the surrounding bund to actively retain the tailings. | Design according to ANCOLD guidelines including storm water drainage, erosion and sediment controls.<br>Immediate reconstruction of affected area. | 3 | 1 | L | 8.1.4<br>8.1.5 |
| **Fauna** | | | | | | | | |
| FA1 | Clearing of habitat. | Reduction of fauna habitat.<br>Adverse impact on habitat critical to the survival of a species.<br>A long term reduction in rare, endemic or unique fauna populations or species.<br>Modification, destruction, removal or isolation of habitat availability or quality such that a threatened species is likely to decline. | **Black-footed Rock-wallaby**<br>Loss of 8.35 ha of potentially suitable (low quality) rocky habitat, and additional loss of habitats that may be used rarely by dispersing individuals to access other rocky areas. The loss of rocky habitat equates to 0.83% of the vegetation proposed to be cleared. Removal of habitat is unlikely to result in impacts on the local population. | Subtle realignment and siting of all infrastructure to minimise habitat loss.<br>Use already-disturbed areas where possible.<br>Clearly mark out areas of land to be cleared and areas to be retained.<br>Monitor habitat clearing to ensure compliance with areas marked for clearing and no intrusion outside the clearing zone.<br>Progressive incremental clearing of land as needed. | 1 | 2 | VL | 8.2.3<br>8.2.4<br>8.2.5<br>15.2.2 |
| FA2 | | | **Greater Bilby, Brush-tailed Mulgara, Great Desert Skink, Southern Marsupial Mole**<br>Loss of approximately 978.8 ha of potential breeding, foraging and dispersal habitat, 97.1% of the vegetation proposed to be cleared. With mitigation impacts can be reduced to minor. | Minimise the clearing width associated with the access road.<br>Limit construction and clearing to times of the year when fauna are least vulnerable (e.g. avoiding breeding period).<br>Undertake pre-clearing fauna surveys prior to construction.<br>Progressive reinstatement of cleared land as activities are completed. | 2 | 2 | L | 8.2.3<br>8.2.4<br>8.2.5<br>15.2.2 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| FA3 | | | **Night Parrot, Red Goshawk, Princess Parrot, Grey Falcon**<br>All habitats cleared as a result of the Project incorporate potential breeding, foraging and dispersal habitat. These species tend to forage over broad areas, relying less on any particular patch. Habitat clearing is unlikely to have a measurable impact on these highly-mobile bird species. | | 1 | 2 | VL | 8.2.3<br>8.2.4<br>8.2.5<br>15.2.2 |
| FA4 | | | **Common Brushtail Possum**<br>Loss of 2.9 ha of potentially suitable riparian habitat, 0.29% of the vegetation proposed to be cleared. Removal of habitat is unlikely to result in impacts. | | 1 | 2 | VL | 8.2.3<br>8.2.4<br>8.2.5 |
| FA5 | | Fragment or damage habitat important for the conservation of biological diversity. | The Project is not expected to result in isolation of any population. | | 1 | 2 | VL | 8.2.6 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| FA6 | Alteration to surface water flows caused by construction of roads, hard stands or embankments.<br>Contamination of surface water bodies.<br>Erosion and sedimentation. | Modify or inhibit ecological processes.<br>Reduce the species diversity.<br>Fragment or damage habitat important for the conservation of biological diversity.<br>Cause a long term reduction in rare, endemic or unique population or species. | **Black-footed Rock-wallaby, Greater Bilby, Brush-tailed Mulgara, Great Desert Skink, Southern Marsupial Mole Night Parrot, Red Goshawk, Princess Parrot, Grey Falcon**<br>Altered hydrology is not expected to impact on any population.<br>Potential impact if species come into contact with contaminated water. | Incorporate engineered controls into design of all roads to maintain existing surface water flows.<br>Implement standard management controls and protocols to minimise the risks of hydrocarbon spills.<br>Avoid spills or leaks of contaminated water or other substances.<br>Implement standard management controls and engineering specifications for drainage from on-site facilities.<br>Prepare and implement a Hazardous Materials Management Plan.<br>Prepare and implement a Drainage, Sediment and Erosion Control Plan. | 1 | 2 | VL | 8.1.5<br>8.2.4<br>8.2.5<br>15.2.2 |
| FA7 | | | **Common Brushtail Possum**<br>Impacts are possible if altered hydrology results in broadscale death of large hollow-bearing trees along watercourses, and that tree death results in loss or fragmentation of habitat. Management and mitigation efforts can reduce the risk to very low.<br>Potential impact if species come into contact with contaminated water. | | 1 | 2 | VL | 8.1.5<br>8.2.4<br>8.2.5 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| FA8 | Lowering or contamination of water table. | Reduce species diversity.<br>Cause a reduction in a population.<br>Fragment or damage habitat important for the conservation of biological diversity. | **Black-footed Rock-wallaby**<br>This species occupies rocky hills and slopes, and does not rely on groundwater dependent ecosystems or habitats. | Avoid where possible, or minimise, draw-down of the water table in areas where Groundwater Dependent Ecosystems exist, such as along waterways where River Red Gums occupy the riparian zone.<br>Implement standard management controls and protocols to minimise the risks of hydrocarbon spills.<br>Avoid of spills or leaks of contaminated water or other substances.<br>Monitor hydrogeological changes, and adapt the mitigation as necessary. | 1 | 1 | VL | 8.2.3<br>8.2.4<br>8.2.6<br>15.2.2 |
| FA9 | | | **Greater Bilby, Brush-tailed Mulgara, Great Desert Skink, Southern Marsupial Mole**<br>No impact expected to sandplain ground-dwelling fauna. | | 1 | 2 | VL | 8.2.4<br>8.2.6<br>15.2.2 |
| FA10 | | | **Night Parrot, Red Goshawk, Princess Parrot, Grey Falcon**<br>No impact on this group of highly mobile avifauna is expected. | | 1 | 1 | VL | 8.2.4<br>8.2.6<br>15.2.2 |
| FA11 | | | **Common Brushtail Possum**<br>Lowering or contamination of the water table is most likely to impact on watercourses and riparian habitat. Impacts have the potential to be significant if broadscale death of large hollow-bearing trees along watercourses occurs, and tree death results in loss or fragmentation of habitat. Management and mitigation efforts can reduce the risk to very low. | | 1 | 2 | VL | 8.2.4<br>8.2.6 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| FA12 | Production, transport and storage of mine waste. | Injury and death of fauna as a result of increase in waste-carrying transport and resulting collisions with wildlife.<br>Clearing of breeding and/or foraging habitat to create space to store/pile waste products.<br>Dust as a result of increased traffic and specifically due to haulage of waste rock. | **Black-footed Rock-wallaby**<br>This species is unlikely to encounter waste materials as it occupies rocky hills and slopes. | Keep the proposed road network to a minimum.<br>Upgrade high-use areas to be safer for vehicles and fauna (e.g. no blind curves, wider shrub-free verges).<br>Monitor and document roadkill (location and time of day) of threatened species to determine high-risk periods or locations.<br>Subtle realignment and siting of all infrastructure to minimise habitat loss.<br>Use already-disturbed areas wherever possible.<br>Clearly mark out areas of land to be cleared and areas to be retained.<br>Monitor habitat clearing to ensure compliance with areas marked for clearing and no intrusion outside the clearing zone.<br>Progressive incremental clearing of land as needed.<br>Limit construction and clearing to times of the year when fauna are least vulnerable (e.g. avoiding breeding period).<br>Undertake pre-clearing fauna surveys prior to construction.<br>Progressive reinstatement of cleared land as activities are completed. | 2 | 1 | VL | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |
| FA13 | | | **Greater Bilby, Brush-tailed Mulgara, Great Desert Skink, Southern Marsupial Mole**<br>Industrial waste on its own is not expected to result in direct impacts to sandplain fauna. However, the need to transport and dump waste materials has the potential to impact these species through injury and death through vehicle collisions and clearing of breeding and/or foraging habitat to create space to store waste products. | | 1 | 3 | L | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |
| FA14 | | | **Night Parrot, Red Goshawk, Princess Parrot, Grey Falcon**<br>No impact expected on this group of highly mobile avifauna. | | 1 | 1 | VL | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |
| FA15 | | | **Common Brushtail Possum**<br>No impacts expected as waste will not be disposed of in riparian habitat. | | 2 | 1 | VL | 8.2.4<br>8.2.5<br>8.2.6 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| FA16 | Production of domestic waste. | Increase in vermin (rats and mice).<br>Increase in predators (cats, foxes and dingoes).<br>Cause a reduction in a population. | **Black-footed Rock-wallaby**<br>No direct impact but a risk of indirect impact from predation.<br>**Common Brushtail Possum**<br>No direct impact but a risk of indirect impact from predation However, this species is partially arboreal and seeks refuge in trees, thereby reducing the risk. | On-site garbage/waste held in a securely fenced compound (i.e. the fence will need to prevent the entry of cats, foxes and dingos) to prevent the scavenging of waste material and potential population increases in both feral and native predators.<br>Cover putrescible waste daily.<br>Baiting / control if feral populations are seen to increase. | 2 | 1 | VL | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |
| FA17 | | | **Greater Bilby, Brush-tailed Mulgara, Great Desert Skink, Southern Marsupial Mole**<br>No direct impact but an increased risk of predation on ground-dwelling sandplain fauna. | | 2 | 2 | L | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |
| FA18 | | | **Night Parrot, Red Goshawk, Princess Parrot, Grey Falcon**<br>No impact expected on this group of highly mobile avifauna. | | 1 | 1 | VL | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| FA19 | Noise from Project activities. | Modify or inhibit ecological processes.<br>Reduce the diversity or modify the composition of fauna species.<br>Cause a long term reduction in rare, endemic or unique fauna species. | **Black-footed Rock-wallaby**<br>Noise is likely to preclude rock-wallaby movements through the Mine Site. Particularly noisy activities would likely occur during daylight hours when rock-wallabies (generally nocturnal) tend to be sheltering, and noise would be somewhat buffered and deflected by their rocky, elevated habitat. | Implement standard noise minimisation measures to reduce noise wherever possible.<br>Avoid or minimise high-impact noises to daylight hours only (i.e. avoid excessively loud noises at night, when the majority of relevant threatened species are likely to be active). | 1 | 2 | VL | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |
| FA20 | | | **Greater Bilby, Brush-tailed Mulgara, Great Desert Skink, Southern Marsupial Mole, Common Brushtail Possum**<br>Noise is likely to preclude fauna movements through the Mine Site. Particularly noisy activities would likely occur during daylight hours when most of the fauna (mostly nocturnal) tend to be sheltering. Most fauna can habitualise to predictable noises with time. | | 1 | 2 | VL | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |
| FA21 | | | **Night Parrot, Red Goshawk, Princess Parrot, Grey Falcon**<br>Impacts from noise are possible but the severity for mobile avifauna is expected to be minor. Most fauna can habitualise to predictable noises with time. | | 1 | 1 | VL | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| FA22 | Dust from Project activities. | Modify or inhibit ecological processes.<br>Reduce the diversity or modify the composition of fauna species.<br>Cause a long term reduction in rare, endemic or unique fauna species. | **Black-footed Rock-wallaby**<br>There is habitat for this species within 2 km of the Mine Site, and this species may be exposed to higher levels of dust. | Defined haul routes to be used wherever it is necessary for vehicles to traverse unsealed surfaces or unformed roads.<br>Vehicular speeds would be limited to 25 km/h on areas of unconsolidated or unsealed soil associated with the project.<br>Prompt mitigation of excessive visible dust emissions, which may be a combination of.<br>Use sediment traps near waterways along roads, to trap accumulated dust before it enters waterways.<br>Progressively reinstate cleared land as activities are completed to minimise dust-generating areas.<br>Cover concentrate loads to prevent dust generation and product loss. | 1 | 2 | VL | 8.2.4<br>8.2.6<br>15.2.2 |
| FA23 | | | **Greater Bilby, Brush-tailed Mulgara, Great Desert Skink, Southern Marsupial Mole**<br>Sandplain fauna live in dusty habitats, and many of them dig burrows in dusty ground. Consequently, these species are likely to be adapted to coping with dusty conditions. | | 1 | 2 | VL | 8.2.4<br>8.2.6<br>15.2.2 |
| FA24 | | | **Night Parrot, Red Goshawk, Princess Parrot, Grey Falcon**<br>These species of highly mobile and any high dust levels are likely to drive these species out of local areas at least for the short term. | | 1 | 2 | VL | 8.2.4<br>8.2.6<br>15.2.2 |
| FA25 | | | **Common Brushtail Possum**<br>Most desert fauna are likely to be adapted to coping with dusty conditions. Activities that generate large quantities of dust may drive small numbers of individuals out of local areas at least for the short term. | | 1 | 2 | VL | 8.2.4<br>8.2.6 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| FA26 | Light from Project activities. | Reduce the diversity or modify the composition of fauna species.<br>Cause a long term reduction in rare, endemic or unique fauna species. | **Black-footed Rock-wallaby**<br>Light emitted from the mine could have a small effect on any transitory rock-wallabies moving through the mine site footprint. Light emissions are unlikely to impact populations >2 km from the site. | Limit artificial light to areas where it is essential.<br>Turn off lights when not required.<br>Avoid the flood of light into natural habitats and limit the escape of light into surrounding areas of fauna habitat (i.e. using shields/deflectors).<br>Ensure that artificial lighting is not directed upwards or laterally (i.e. should be directed towards the ground).<br>Use lower (i.e. closer to the ground) rather than higher lighting installations.<br>Use lower wavelengths of light wherever possible i.e. red/yellow lights.<br>Use light intensities that are as low as possible without reducing safety or efficiency.<br>Avoid painting large structures bright or reflective colours and minimise use of bright or reflective construction materials and finishes for large structures. | 1 | 2 | VL | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |
| FA27 | | | **Greater Bilby, Brush-tailed Mulgara, Great Desert Skink, Southern Marsupial Mole, Night Parrot, Red Goshawk, Princess Parrot, Grey Falcon**<br>Light emitted from the mine could have a small and localised effect on nocturnal sandplain fauna (e.g. Mulgara, Greater Bilby) and the Night Parrot. | | 1 | 2 | VL | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |
| FA28 | | | **Common Brushtail Possum**<br>Light emitted from the mine could have a small effect on Common Brushtail Possums that use riparian habitats near the mine site footprint. | | 1 | 2 | VL | 8.2.4<br>8.2.5<br>8.2.6 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| FA29 | Unplanned Wildfire. | Long-term decrease in the size of a population.<br>Reduce the area of occupancy of the species.<br>Adversely affect habitat critical to the survival of the species.<br>Fragment an existing population into two or more populations.<br>Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.<br>Interfere with recovery of the species. | **Black-footed Rock-wallaby**<br>Wildfire within this species habitat can have an impact as it burns food plants rendering habitats unsuitable for periods of time. Continued persistence of the species in the area will depend on prevention of wildfire in the surrounding rocky habitats. | Develop and implement a Fire Management Plan.<br>Careful planning of where high-risk activities can take place.<br>Maintain fire breaks around high-risk areas/activities.<br>Active fire management and the use of small-scale, cool-season control burns. | 4 | 2 | M | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |
| FA30 | | | **Greater Bilby, Brush-tailed Mulgara, Great Desert Skink, Southern Marsupial Mole**<br>Wildfire can have an impact on sandplain fauna, particularly those that are less mobile or that are territorial or tend to remain within discrete areas. | | 4 | 2 | M | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| FA31 | | | **Night Parrot, Red Goshawk, Princess Parrot, Grey Falcon**<br>Wildfire can impact fauna that rely on the habitats that burn, and/or that cannot escape the fire. Grey Falcon, Red Goshawk and Princess Parrot are likely to be able to escape the fire and seek alternative non-burned habitats, but there is a small chance of impact to these species if the fire occurs during the nesting season and any species has a nest near the ground. The likelihood of impact from fire on the Night Parrot is higher. This species appears to spend most of its time on or near the ground, sheltering in spinifex habitat by day and foraging in spinifex habitat by night, and nesting in large clumps of spinifex. | | 3 | 2 | L | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |
| FA32 | | | **Common Brushtail Possum**<br>It is possible that extensive unplanned wildfire as a result of mine activities could have a significant impact on the Common Brushtail Possum, particularly if it burns large hollow-bearing trees in riparian habitat. | | 4 | 2 | M | 8.2.4<br>8.2.5<br>8.2.6 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| FA33 | Impacts from vehicles/transport. | Long-term decrease in the size of a population.<br>Interfere with recovery of the species.<br>Cause a long term reduction in rare, endemic or unique fauna species. | **Black-footed Rock-wallaby**<br>This species occupies rocky hills and slopes, and occasionally disperses across lower ground to reach other rocky slopes. It would be rarely encountered on roads or tracks. | Keep the proposed road network to a minimum.<br>Develop and implement a Traffic Management Plan.<br>Upgrade high-use areas to be safer for vehicles and fauna (e.g. no blind curves, wider shrub-free verges).<br>Fencing of the access road.<br>Provide road safety and awareness training to all staff and contractors with respect to safe driving in areas where native wildlife is prevalent.<br>Apply reduced speed limits for vehicles travelling at night.<br>Limit vehicle speeds in all locations where roads cross waterways.<br>Monitor and document roadkill (location and time of day) of threatened species within the Project Area, to determine high-risk periods or locations. | 1 | 1 | VL | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |
| FA34 | | | **Greater Bilby, Brush-tailed Mulgara, Great Desert Skink, Southern Marsupial Mole**<br>Impacts on sandplain fauna from vehicle collision, particularly along the access road, are likely. Vehicle movements during dawn, dusk and nighttime would result in the highest risk to fauna. | | 1 | 2 | VL | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |
| FA35 | | | **Night Parrot, Red Goshawk, Princess Parrot, Grey Falcon**<br>This group of highly-mobile avifauna comprises species that are generally sparse / rare and that occur in small numbers. Collisions with vehicles are unlikely. | | 2 | 1 | VL | 8.2.4<br>8.2.5<br>8.2.6<br>15.2.2 |
| FA36 | | | **Common Brushtail Possum**<br>This species occupies large trees in riparian habitats and would be rarely encountered on roads or tracks. Collisions with vehicles are unlikely. | | 1 | 1 | VL | 8.2.4<br>8.2.5<br>8.2.6 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| FA37 | Introduction of weed species to site and / or spread of existing weeds into new areas. | Modify or inhibit ecological processes.<br>Reduce the diversity or modify the composition of fauna species.<br>Fragment or damage habitat important for the conservation of biological diversity.<br>Cause a long term reduction in rare, endemic or unique fauna species.<br>Fragment, isolate or substantially damage habitat for rare, endemic or unique fauna species. | An increase in the incidence of weeds has the potential to modify habit for all threatened species. | Vehicle and equipment wash-down procedures on site.<br>Develop a Weed Management Plan to document mitigation measures to control existing exotic plants, and to stem the spread of others.<br>Clean vehicles (washdown) that are new to the site, to prevent the introduction of new weeds.<br>Keep vehicles to established tracks and roads, and limiting their use off-road.<br>Annual weed monitoring and mapping, particularly along transport routes.<br>Weed control activities as required and in consultation/partnership with local landowners as necessary. | 2 | 3 | L | 8.2.4<br>8.2.5<br>8.2.6 |
| FA38 | Poisoning of fauna from drinking contaminated water. | Long-term decrease in the size of a population.<br>Interfere with recovery of the species.<br>Cause a long term reduction in rare, endemic or unique fauna species. | No contaminated water storages are proposed on-site. | No specific mitigation. | 1 | 1 | VL | 8.2.4<br>8.2.6 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| **Conservation Estate** | | | | | | | | |
| CE01 | Lowering of the water table caused by groundwater extraction. | Disturbance to significant vegetation and flora within Mud Hut or Stirling Swamp. | Modelling indicates that Mud Hutt Swamp, Stirling Swamp and the broader Anmatyerr North SOCS will not be impacted by groundwater drawdown. | No specific mitigation. | 3 | 1 | L | 8.1.3<br>8.1.4 |
| CE02 | Road construction. | Disturbance to significant vegetation and flora within Anmatyerr North SOCS. | The access road will disturb up to 21 ha of vegetation within the Anmatyerr North SOCS.<br>All vegetation types are well represented at the local scale within the bioregion. Vegetation clearing will involve removal of a moderately diverse range of non-threatened native plants. | Minimise vegetation clearing where practical.<br>Use already-disturbed areas (rather than undisturbed areas) wherever possible (e.g. lay down areas for construction).<br>Stage clearing of vegetation to minimise areas of bare ground and clear land only as required and in accordance with ESCP.<br>Avoid land clearing for construction during the Wet Season.<br>Develop and implement Vegetation Clearing sub plans which include areas not to be cleared (no-go areas).<br>Weed removal prior to vegetation clearing so that vegetative material would be clean and able to be mulched and reused directly on site.<br>Adhere to buffer widths recommended by the Northern Territory Land Clearing Guidelines where possible, with regard to riparian vegetation in drainage lines. | 4 | 1 | M | 8.1.3<br>8.1.4<br>8.1.5 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| CE03 | | Introduction or spread of weeds within Anmatyerr North SOCS. | A number of weed species occur in the Project area. One species (*Tribulus terrestris*) is listed as a declared weed under the *Weeds Management Act 2001* and one species (*Cenchrus ciliaris*, Buffel Grass) has been identified as high threat environmental weeds in the Burt Plain Bioregion. | Development and implementation of a Weed Management sub-plan as part of the Project CEMP. | 3 | 2 | M | 8.1.3<br>8.1.4<br>8.1.5 |
| CE04 | | Increased risk of fire within Anmatyerr North SOCS. | Construction and operational activities are potential ignition sources, and could result in a bushfire. | Firefighting equipment available during construction and operations.<br>Maintain fire breaks around high-risk areas/activities.<br>Active fire management and the use of small-scale, cool-season control burns.<br>All site personnel will be required to undertake fire control training.<br>All vehicles are required to carry a fire extinguisher and two-way radio. | 2 | 2 | L | 8.1.3<br>8.1.4<br>8.1.5 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| **Heritage** | | | | | | | | |
| HE01 | Ground disturbance and land clearing. | Aboriginal archaeological sites adversely impacted. | Targeted surveys identified that there is no potential for impacts to Aboriginal archaeological sites or areas of archaeological sensitivity associated with construction of the mine site, accommodation village and rail loadout facilities.<br>Construction of the access road will potentially directly impact two artefact scatters, and may indirectly impact one additional scatter and one isolated find.<br>Construction of the pipeline and borefield may impact two artefact scatters and may impact any subsurface in situ artefact deposits along the Hanson River bank. | The access road and water pipeline have been refinement to avoid impact to known archaeological sites.<br>Where impacts are unavoidable, artefact recording and relocation, and archaeological excavations will be undertaken to fully record the condition, extent and significance of the sites.<br>Works Approval Application lodged with the Heritage Branch to allow r archaeological works within the project area including artefact recording and relocation, and archaeological excavations, in accordance with section 72 of the Heritage Act.<br>Clearly demarcate (including additional buffer zone) in field, areas of significance. | 3 | 3 | M | 11.5<br>11.6 |
| HE02 | | Historic cultural material adversely impacted. | Targeted surveys did not identify the presence of historical cultural material in the Project Area. | No specific mitigation. | 2 | 1 | L | 11.5<br>11.6 |
| HE03 | Ground disturbance and / or access. | Sacred sites are adversely impacted by mine site construction and / or operations. | Sacred site have been recorded from the Project area.<br>Sacred Sites Clearance Certificates (SSCCs) has been issued for the Project. | Modify the location of project infrastructure to avoid impacts to sacred sites. This is reflected in realignment of the access road.<br>Create no go areas where necessary.<br>Undertake inductions and provide all personnel with an understanding of the need to understand and comply with the conditions of the SSCCs. | 4 | 1 | M | 11.6 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| HE04 | Major open pit slope failure. | Major damage to any adjacent sacred or archaeological site. | One sacred site is located close to the pit. | Establish a geotechnical stability monitoring program for the sacred site situated near to the north eastern boundary of the pit. | 4 | 1 | M | 11.5<br>11.6 |
| **Air Quality** | | | | | | | | |
| AQ01 | Dust from mine construction activities. | Dust levels at closest sensitive receptor exceed air quality criteria. | The nearest non-mining sensitive receptor to the mine site is Anningie Station homestead approximately 30 km to the south-west. The access road lies approximately 20 km to the south of the Wilora Aboriginal community. The accommodation village will be located 5 km to the east of the mine.<br>Predicted dust levels at receptors are all lower than assessment criteria. Highest predicted concentrations at the accommodation village range between 2.5% and 44% of assessment criteria and at non-mining receptors between 0.005% and 5% of criteria. Dust deposition levels will be undetectable. | Standard dust minimisation measures will be applied including:<br>• maintenance of moisture levels in ore and concentrate;<br>• application of water to unsealed roads;<br>• application of water to WRD and ore stockpiles as required;<br>• covering of loads during concentrate haulage;<br>• hooded crushers and enclosed HPGRs;<br>• visual monitoring of emissions. | 3 | 1 | L | 9.3.1<br>9.4.1<br>9.5.1 |
| AQ02 | Dust from mine operations including mining, processing, WRD, TSF and ore stockpiled. | | | | 3 | 1 | L | 9.3.1<br>9.4.1<br>9.5.1 |
| AQ03 | Dust generation by traffic using the access road. | | | | 2 | 1 | L | 9.3.1<br>9.4.1<br>9.5.1 |
| AQ04 | Air emissions from the power station. | Reduced air quality at closest sensitive receptor. | The closest sensitive receptor is the accommodation village located 5 km to the east of the power station.<br>Predicted concentrations at all receptors are below the assessment criteria for all assessed pollutants. | Operation and maintenance of power station in accordance with the design and emission criteria. | 3 | 1 | L | 9.5.2 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| AQ05 | Greenhouse gas emissions from Project activities. | Contribution to Northern Territory and Australian emission levels. | Total emissions for the life of mine are estimated at 3,212,358 t $CO_2$-e.<br>Average annual emissions are estimated at 178,000 t $CO_2$-e. This is approximately 1%, 0.03% and 0.001% of annual NT, Australia and global emissions respectively. | Greenhouse gas emissions managed and minimised through:<br>• maintenance of fuel-powered plant and equipment to the manufacturers specifications;<br>• considering the potential use of biodiesel blends;<br>• considering the potential use of solar power and storage battery systems;<br>• energy auditing and review; and<br>• emissions reporting. | 1 | 5 | M | 9.3.2<br>9.4.2<br>9.5.2<br>9.6.2 |
| **Noise and Vibration** | | | | | | | | |
| NV01 | Noise from mine construction activities. | Noise levels at closest sensitive receptor exceed noise criteria. | The nearest non-mining sensitive receptor to the mine is Anningie Station homestead, 30 km to the south-west. The access road lies 20 km to the south of the Wilora Aboriginal community. The accommodation village will be located 5 km to the east of the mine.<br>Predicted impacts at receptors are all lower than assessment criteria. Noise under worst case conditions at the nearest noise sensitive receptor (the accommodation village) is 34 dBA, which is below the noise criterion of 35 dBA.<br>Traffic noise levels are not expected to be noticeable. | Implement standard measures to minimise Project related noise.<br>Establish a complaints register for tracking and appropriately responding to any community issues raised. | 3 | 1 | L | 10.3.1<br>10.4.1<br>10.5 |
| NV02 | Noise from mine operations. | | | | 3 | 1 | L | 10.3.1<br>10.4.1<br>10.5 |
| NV03 | Noise generation by traffic using the access road. | | | | 2 | 1 | L | 10.3.1<br>10.4.1<br>10.5 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| NV04 | Blasting. | Vibration impacts at closest sensitive receptor. | The nature and levels of vibration emitted by the mine will vary with the activities being undertaken, however, due to the distances between the sources and receptors, vibration is unlikely to have a significant impact. | Blasting will only occur between 9am to 5pm (Monday to Saturday).<br>Plan to blast during the middle of the day when background noise levels are higher than at other times of day.<br>Where monitoring or complaints indicate airblast overpressure or ground vibration levels exceed the environmental protection objectives, the following mitigations measures should be considered:<br>• reducing the maximum instantaneous charge (MIC) by using delays, reduced hole diameter and/or deck loading;<br>• changing the burden and spacing by altering the drilling pattern and/or delay layout, or altering the hole inclination;<br>• ensuring stemming depth and type is adequate;<br>• restricting blasts to favourable weather conditions. | 3 | 1 | L | 10.3.2<br>10.4.2<br>10.5 |
| **Transport** | | | | | | | | |
| TR01 | Transportation of dangerous goods. | Spillage of dangerous goods and their release to the environment. | Diesel, oil and lubricants will be the principle dangerous goods transported.<br>At full production the Project is estimated to use 15 MLpa of diesel. To achieve there will be three 100,000 L deliveries per week by triple carriage semitrailer. | Transport of dangerous goods in accordance with relevant legislation with measures incorporated into the Transport Management Plan.<br>Prepare Emergency Response Plan.<br>Prepare and comply with Road Transport Management Plan and statutory approvals. | 3 | 2 | M | 13.1.1<br>13.1.4 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| TR02 | Increase in delivery truck numbers on Stuart Highway. | Traffic congestion. | Construction and operation will result in an estimated 30 and 5 one way (60 and 10 return) heavy vehicle movements per day respectively. Total vehicle movements on Stuart Highway are around 3% of the highways design capacity. | No specific mitigation. | 3 | 1 | L | 13.2.1<br>13.2.3<br>13.2.4 |
| TR03 | Interaction of concentrate trucks with vehicles using Stuart Highway. | Vehicle collision resulting in injury or death. | Up to 100 concentrate truck movements per day between the mine site and rail loadout facility. An underpass of Stuart Highway will be constructed to separate concentrate trucks from highway traffic. | Construction of underpass. | 5 | 1 | M | 13.2.1<br>13.2.3 |
| TR04 | Increase in train movements. | Train congestion. | All train movements will be scheduled by the rail operator to avoid congestion. Additional rail sidings may be constructed by the rail operator to ensure that traffic flow is maintained. | No specific mitigation. | 3 | 1 | L | |
| **Waste** | | | | | | | | |
| WA01 | AMD material from mining. | Release of AMD via seepage and / or run-off from WRD and TSF. | No significant Potentially Acid Forming (PAF) materials have been identified within the ore body. | Ongoing waste characterisation.<br>Develop AMD Management Plan if required.<br>WRD Management Plan will be modified to include the selective handling and storage of any PAF materials if needed. | 3 | 2 | M | 14.5.2 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| WA02 | Generation of putrescible and, general waste. | Release of wastes to the environment.<br>Increase in introduced pest species. | | Separation of waste for recycling and recovery.<br>Removal of residual waste to landfill.<br>Landfill fenced and waste buried on a daily basis.<br>Record waste types and volumes generated on-site and transported off-site. | 2 | 3 | M | 14.5.1<br>14.5.3 |
| WA03 | Generation of sewage. | Release of sewage to the environment. | | Treatment of sewage via the STP.<br>Use of treated water for landscaping.<br>Untreatable solids collected and disposed of offsite by a licensed waste transporter. | 2 | 2 | L | 14.5.3 |
| WA04 | Generation of hazardous wastes including waste oil, waste lubricants and batteries. | Soil or water contamination from the release of waste to the environment. | | Hydrocarbons stored and handled in accordance with the requirements of AS 1940:2004: The Storage and handling of combustible and flammable liquids.<br>Hazardous materials will be transported in compliance with Dangerous Goods legislation.<br>Spill clean-up procedures developed and implemented.<br>Appropriate training for relevant employees.<br>Regular inspections of storages, tanks and bulk containers and the integrity of bunded areas and containment systems.<br>All hazardous wastes transported off-site by a licensed carrier for disposal / treatment at an appropriate facility. | 3 | 3 | M | 13.1.4<br>14.5.3 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| WA05 | Storage of waste rock. | Failure of the waste rock dump resulting in environmental damage. | The waste rock dump will be located to the west of the pit. | Design of the dump to ensure a stable landform.<br>Limit the dump height to 40m. | 3 | 1 | L | 2.7.1 |
| WA06 | Storage of tailings. | Failure of the tailings storage facility resulting in release of tailings to the environment and smothering of habitat. | Tailings will be deposited as a slurry with around 65% solids content. Water recovery from the facility will recover a further 10%. Tailings will be non-mobile. Tailings will be comprised of non-toxic silts and sands. | Design of the tailings facility consistent with ANCOLD guidelines.<br>Construction of a perimeter bund to limit the extent of tailings spread. | 3 | 1 | L | 2.7.2 |
| **Closure and Rehabilitation** | | | | | | | | |
| CL01 | Rehabilitation occurs at a slower rate than planned. | Increased rehabilitation costs.<br>Loss of rehabilitated vegetation.<br>Erosion of exposed surfaces.<br>Potential sedimentation into waterways. | Conceptual Mine Closure Plan has been prepared. | Closure Plan updated and refined throughout mining operations including life of mine closure planning, contingency planning, tailings management plan, waste rock management plan and a care and maintenance plan.<br>Revegetation trials to determine best practice for revegetation of the site.<br>Progressively rehabilitating the mine reducing the environmental and financial risk of closure. | 3 | 3 | M | 8.1.5<br>16.3.1<br>16.3.3 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| CL02 | Ineffective mine closure. | Closure plan is ineffective.<br>Closure costs greater than calculated.<br>Financial impact (unplanned) late in process to company.<br>Third party financial impacts.<br>Inability to achieve lease relinquishment in a timely manner. | | The security bond will be regularly reviewed to ensure that closure liability is accurately accounted for.<br>Closure Plan updated and refined throughout mining operations including life of mine closure planning, contingency planning, tailings management planning, waste rock management planning and care and maintenance planning.<br>Revegetation trials to determine best practice for revegetation of the site.<br>Progressively rehabilitating the mine reducing the environmental and financial risk of closure. | 3 | 3 | M | 8.1.5<br>16.3.1<br>16.3.3 |
| CL03 | Temporary closure of the Project. | Inability to meet environmental obligations in relation to landform stability, water quality management and contaminant management.<br>Inadequate closure provisions. | Conceptual Mine Closure Plan incorporates measures for unexpected or temporary closure. | Contingency Plan has prepared as a component of the Mine Closure Plan.<br>Regular review of closure provisions.<br>Third party audits. | 3 | 3 | M | App M |
| CL04 | Limited topsoil for sufficient cover on all disturbed surfaces. | Insufficient topsoil/growth medium available. | | Clearing and Topsoil Procedures.<br>Reconciliation of topsoil stockpile quantity. | 3 | 3 | M | 16.3.2 |

| Ref. | Source of Impact | Consequence | Discussion | Mitigation | Consequence | Likelihood | Residual Risk | EIS reference |
|---|---|---|---|---|---|---|---|---|
| CL05 | No return of keystone species, demonstrating no long term vegetative establishment with self-sustaining ability. | Perennial species not returning in rehabilitated areas.<br>Keystone species not returning in rehabilitated areas via returned topsoil.<br>Species either absent or not germinating. | | Further investigation of rehabilitation, to identify indices with which to evaluate successful establishment of keystone species.<br>Rehabilitation monitoring. | 3 | 3 | M | 8.1.5<br>16.3.2<br>16.3.3 |
| CL06 | Not being able to establish native vegetation by local provenance species with resultant cover comparable to nearby areas. | Rehabilitation not reaching target species diversity values due to insufficient quantities of restock seeds. | | Seed collection planned.<br>Seed storage and inventory procedures.<br>Rehabilitation monitoring. | 2 | 3 | M | 8.1.5<br>16.3.2 |
| CL07 | 'Created' soil profile and properties with no natural analogue. | Failure to relinquish.<br>Failure of vegetation to stabilise the site. | | Further investigation of rehabilitation, to identify indices with which to evaluate successful establishment of keystone species.<br>Rehabilitation monitoring. | 3 | 3 | M | 8.1.5<br>16.3.2 |
| CL08 | Geotechnical stability - Pit wall failure. | Land degradation.<br>Public injury. | | Geotechnical assessment.<br>Abandonment bunds to be installed. | 4 | 2 | M | 16.3.2<br>16.4 |
| CL09 | Closure Planning - Inadequate infrastructure decommissioning provisions. | Infrastructure remains post-closure.<br>Soil and water contamination.<br>Aesthetics. | | All mine infrastructure that does not have a sequential use agreement in place at the time of closure is to be demolished and removed. | 3 | 2 | M | 16.5 |

# 6. Stakeholder Engagement

TNG is committed to consulting with stakeholders during the planning and development of the Mount Peake Project, to identify and understand any potential issues and concerns, as well as possible management strategies that may be implemented for the Project.

This Chapter documents the stakeholder consultation program undertaken by TNG specifically during the environmental impact assessment process, with focus placed on seeking input and feedback from stakeholders on the potential environmental and social impacts to be considered during the assessment and addressed in the development of the Project.

## 6.1 Introduction

The Terms of Reference for Mount Peake Project (NT EPA 2014) state that it is “essential that the Proponent demonstrate how any public concerns were identified, and how those concerns will influence the design and delivery of the Project”.

The stakeholder consultation undertaken during the development of the EIS was designed to facilitate engagement with stakeholders to provide information about the Project and to gain feedback on potential environmental and social issues, allowing for these issues to be considered through the EIS process.

A Stakeholder Consultation Plan (SCP) was developed by GHD on behalf of TNG, to provide structure and rigour to communications and consultation. Planning was underpinned by the NT EPA’s requirements for consultation in the development of the EIS (NTEPA 2014). Whilst the stakeholder consultation is focussed on the development of the EIS, TNG is committed to continuing to engage and consult with stakeholders throughout the life of the Project, including through the future construction and operation of the mine, which is reflected in the approach developed in the SCP.

The approach to stakeholder consultation during the EIS process was developed with reference to the following documents, guidelines and industry standards:

- Guide to the Environmental Impact Assessment Process in the Northern Territory (NT EPA 2014a);
- Guidelines for the Preparation of an Economic and Social Impact Assessment (NT EPA 2013);
- Mount Peake Project Notice of Intent (TNG 2013);
- Terms of Reference for the Preparation of an Environmental Impact Statement: Mount Peake Project, TNG Limited (NT EPA 2014); and
- International Association for Public Participation (IAP2)[1].

This chapter summarises the implementation and outcomes of the stakeholder consultation program as part of the EIS process. A full report is provided in Appendix E.

[1] http://www.iap2.org.au/

## 6.2 Consultation Planning and Approach

### 6.2.1 Consultation Objectives

The following objectives were established for stakeholder consultation:

- ensure the relevant key stakeholders and the broader community are informed about the proposed Project, its current status and the EIS process;
- engage key stakeholders and the broader community through best practice processes, to discuss concerns, potential impacts and possible management measures, and demonstrate how stakeholder feedback will be considered in the EIS process; and
- develop and nurture stakeholder confidence and relationships for the life of TNG's Project, including throughout the future construction and operation of the mine.

These objectives were supported by:

- establishing an open and honest communication process;
- providing relevant, timely and factual information about the Project;
- demonstrating a willingness to answer any questions and address potential concerns directly with stakeholders in a timely manner; and
- providing concise information on the outcomes of engagement to be considered and integrated, as appropriate, into the EIS.

### 6.2.2 Participation Goal and Guiding Principles

The consultation approach was guided by the Core Values and Code of Ethics of the International Association for Public Participation (IAP2). The IAP2 Spectrum for Public Participation (Figure 6-1) is an Australian standard that aims to ensure public participation is given a place in the project planning, design and delivery phases.

Given the nature of the Project, the community and stakeholder consultation activities were conducted in accordance with the 'inform' and 'consult' level of the spectrum. In line with this level of participation, the goal for engagement was to provide stakeholders with clear information on the Project, its current status and its potential impacts, and to listen to any concerns and obtain feedback for consideration in the development of the Project and the EIS.

To achieve this goal, the following principles were established to guide the planning and delivery of the consultation program:

- involving stakeholders shows respect for them. It recognises them as recipients and 'hosts' of projects and allows them to have some ownership of the project outcomes;
- using engagement techniques that effectively and meaningfully engage the community and stakeholders;
- ensuring that all stakeholders have easy access to information about the Project;
- demonstrating that concerns and aspirations raised by the community and other stakeholders have been considered during the Project development; and
- ensuring that all information is provided in plain English.

| | INFORM | CONSULT | INVOLVE | COLLABORATE | EMPOWER |
|---|---|---|---|---|---|
| PUBLIC PARTICIPATION GOAL | To provide the public with balanced and objective information to assist them in understanding the problems, alternatives and/or solutions. | To obtain public feedback on analysis, alternatives and/or decision. | To work directly with the public throughout the process to ensure that public issues and concerns are consistently understood and considered. | To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution. | To place final decision-making in the hands of the public. |
| PROMISE TO THE PUBLIC | We will keep you informed. | We will keep you informed, listen to and acknowledge concerns and provide feedback on how public input influenced the decision. | We will work with you to ensure that your concerns and issues are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision. | We will look to you for direct advice and innovation in formulating solutions and incorporate your advise and recommendations into the decisions to the maximum extent possible. | We will implement what you decide. |
| EXAMPLE TOOLS | • Fact sheets<br>• Websites<br>• Open houses | • Public comment<br>• Focus groups<br>• Surveys<br>• Public meetings | • Workshops<br>• Deliberate polling | • Citizen Advisory committees<br>• Consensus-building<br>• Participatory decision-making | • Citizen juries<br>• Ballots<br>• Delegated decisions |

*Source: International Association for Public Participation (IAP2): http://www.iap2.org.au/*

**Figure 6-1 IAP2 Public Participation Spectrum**

## 6.3 Integration with other studies for the Environmental Impact Statement

Information relating to the technical studies undertaken as part of preparing the EIS was integrated into the consultation and communication materials as required. Of particular importance was the integration of the stakeholder consultation approach with the social impact assessment (SIA) to:

- avoid potential duplication and consultation fatigue amongst stakeholders involved in both the consultation on the broader EIS and social research as part of the SIA; and
- enable the effective and efficient sharing of information gathered from stakeholders for both the consultation and SIA processes.

Specific consultation with traditional owners has been undertaken separately by the Central Land Council on behalf of TNG to inform the assessment of potential impacts to sacred sites.

## 6.4 Stakeholder Identification

A stakeholder can be defined as any individual, group of individuals, organisation or political entity with an interest in the outcome of a decision. They may be, or perceive that they may be, affected directly or indirectly by the outcome of a decision.

The stakeholders likely to have an interest in the consultation undertaken during preparation of the EIS were initially identified based on a desktop analysis. As new stakeholders emerged or the interest of existing stakeholders changed over the course of the Project, processes were established to accommodate ongoing stakeholder identification and refinement.

Stakeholders identified are listed in Table 6-1. Input was sought from NT Government representatives, departments and agencies, local Government authorities, affected landowners including Traditional Aboriginal Landowners (via the Central Land Council), residents, service providers and businesses in the Ti Tree and Barrow Creek areas, conservation groups and the wider Alice Springs community.

**Table 6-1 Identified stakeholders**

| Stakeholder category | Stakeholder |
|---|---|
| Commonwealth Government | Department of the Environment |
| Northern Territory Government – Elected Representatives | Member for Stuart |
| | Member for Barkly |
| | Member for Namatjira |
| | Member for Fong Lim |
| Northern Territory Government – Departmental Ministers | Minister for Mines and Energy |
| | Minister for the Environment |
| | Minister for Indigenous Affairs |
| | Minister for Land Resource Management |
| | Minister for Transport |
| Northern Territory Government – Departments and Agencies | Northern Territory Environment Protection Authority |
| | Department of Mines and Energy |
| | Aboriginal Areas Protection Authority |
| | Department of Lands, Planning and the Environment |
| | Department of Land Resource Management |
| | Darwin Port Corporation |
| Local Government | Central Desert Regional Council |
| | MacDonnell Regional Council |
| | Alice Springs Town Council |
| | City of Darwin |
| Traditional Aboriginal Landowners | Central Land Council (representing the traditional owners) |

| Stakeholder category | Stakeholder |
|---|---|
| Pastoral lease holders | Stirling pastoral lease |
| | Anningie pastoral lease |
| Local residents / businesses / operators | Ti Tree and Barrow Creek residents |
| | Wilora, Ti Tree, Barrow Creek, Wauchope and Alice Springs Aboriginal communities |
| | Neighbouring pastoral stations |
| | Ti Tree Police Station |
| | Northern Territory Emergency Service – Ti Tree Volunteer Unit |
| | Ti Tree Health Clinic |
| | Ti Tree School |
| | Ti Tree Roadhouse and Caravan Park |
| | Ti Tree General Store |
| | Barrow Creek Hotel |
| Alice Springs residents / businesses / operators | Alice Springs residents and businesses |
| | Alice Springs Rural Fire Brigade |
| | Royal Flying Doctor Service – Alice Springs Base |
| Conservation groups | Territory Natural Resource Management |
| | Environment Centre NT |
| | Arid Lands Environment Centre |
| Industry / business representative groups | Chamber of Commerce Northern Territory – Alice Springs / Tennant Creek |
| | Regional Development Australia Northern Territory |
| | Tourism NT – Alice Springs |

It is important to note that a separate consultation process focussing on land negotiations with the traditional Aboriginal landowners was undertaken between TNG and the Central Land Council (representing the traditional owners). This process will continue to be undertaken separately and parallel to the development of the EIS.

## 6.5 Consultation Program

The consultation program, outlined in Figure 6-2, highlights the key communications and consultation activities during the development of the EIS, together with the anticipated timings.

| | Commence Draft EIS process | Prepare and submit Draft EIS | Public Exhibition of Draft EIS | Prepare and submit Supplement to EIS |
|---|---|---|---|---|
| | February 2015 – March 2015 | February 2015 – December 2015 | Early 2016 | Early 2016 |
| **Consultation objectives** | Provide stakeholders with information about the Project and the EIS process<br>Engage with stakeholders to discuss concerns, potential impacts and proposed management measures | Report on consultation outcomes for consideration in developing Draft EIS | Publish Draft EIS and promote Public Exhibition period | Analyse submissions received during public exhibition period and prepare responses for consideration in preparing Supplement to EIS |
| **Deliverables** | | Stakeholder Consultation Report for Draft EIS | | Summary report of Public Exhibition period for Supplement to EIS |
| **Communications and consultation activities** | Meetings and information sessions with key stakeholders and broader community<br>Introductory letter<br>Project information sheet<br>Public displays<br>Project website<br>Media release (if required)<br>Print advertisement (if required) | Thank you letter to stakeholders involved in consultation<br>Project information sheet (on progress of EIS)<br>Project website<br>Other direct courtesy communications as requested | Project information sheet (to promote public exhibition of Draft EIS)<br>Public displays<br>Project website<br>Media release (if required)<br>Print advertisement (if required) | Response to stakeholders involved in providing feedback<br>Project information sheet (on progress of EIS)<br>Project website<br>Media release (if required) |
| | **Project telephone number and email for enquiries**<br>**Issues and media monitoring** | | | |

### Figure 6-2 Stakeholder consultation program

Stakeholders were consulted using a combination of meetings, public information sessions and Project information sheets. These were supported by communication channels to provide a point of contact for Project queries, further feedback or complaints. The key activities included:

- an introductory letter sent to all identified stakeholders to provide details of the Project, the EIS process and the associated consultation process, and to extend an invitation to meetings or public information sessions;
- a Project information sheet providing details of the Project, the EIS and consultation process and the potential impacts to be included in the EIS as identified to date, with the letter made available at meetings and public information sessions, and with further copies provided for distribution at public buildings and businesses in Ti Tree and Barrow Creek;

- print advertisements in the NT News on 18 March 2015 and in the Centralian Advocate on 20 March 2015 to provide notice of the public information sessions;
- a series of meetings with Government agencies, Local Governments and the Central Land Council and members of the TNG and GHD Project team held in Alice Springs on 24 March 2015 and in Ti Tree on 25 March 2015, to provide a briefing on the Project, to discuss concerns, potential impacts and possible management measures and to seek specific information to assist in the assessments undertaken for the Draft EIS;
- three public information sessions held in Alice Springs on 24 March 2015, and at Stirling Station and Ti Tree on 25 March 2015, by members of the TNG and GHD Project team to provide a briefing on the Project and to discuss concerns, potential impacts and possible management measures;
- a Project telephone number and email featured in all Project information and communication materials to promote open communication and provide a point of contact for Project queries, to provide further feedback or discuss concerns, and to raise complaints; and
- a Stakeholder Database maintained to record the consultation undertaken and its outcomes, and the queries and feedback received and responses provided, as well as to assist in tracking issues, identifying trends and providing an early indication of concerns and issues that require management.

## 6.6 Consultation Outcomes Results

Table 6-2 presents the issues of high interest, which were raised by, and discussed with, stakeholders in the majority of the briefings and information sessions. The remaining issues are presented in Table 6-3.

### Table 6-2 High interest issues resulting from stakeholder consultation

| Potential impact or issue | Action |
|---|---|
| Safety, traffic and transport | |
| Concerns were raised regarding the potential safety impacts of the access road between the mine and the loadout facility at Adnera crossing the Stuart Highway at grade, with the potential conflict of trucks hauling magnetite concentrate and standard vehicle traffic.<br><br>These concerns were raised particularly with consideration to the high volume of truck movements and the size of the trucks, as well as a potential issue with the angle of the sun during the morning and afternoon trips (as haulage will occur 24 hours a day over 7 days a week) with the east-west orientation of the majority of the transport corridor. | Feedback was considered in the design of the transport corridor, with the outcome being the inclusion of an underpass of Stuart Highway for use by haul trucks and general traffic travelling between the mine site and loadout facility. An at-grade intersection will be constructed for general access to the Project area from Stuart Highway. |
| Potential safety and maintenance issues of having an unsealed access road were raised, given the high volume of return truck movements. | Unsealed roads are common in the mining industry. Recognising that a major use of the road will be for the transport of concentrate, the road will be regularly inspected and maintained. The road will also not be available for general use by the public. |
| Concern was raised regarding the potential degradation of the Stuart Highway with an at-grade crossing of the transport corridor, which would require haulage trucks to enter and exit the highway. | This has been resolved with the inclusion in the design of an underpass of Stuart Highway. |

| Potential impact or issue | Action |
|---|---|
| Potential safety issue of having a shared road between the mine site and loadout facility for use by both haulage trucks and light vehicles (for site personnel, contractors, supplies and deliveries, police and emergency response) was raised. | The road has been designed to accommodate shared use by both heavy and light vehicles. All vehicles using the road will be road compliant. It is anticipated that there will be up to 50 deliveries of concentrate per day resulting in 4 (return) truck movements per hour. |
| **Employment , training and economy** | |
| Overall support was expressed for the Project and the potential opportunities for increased local employment and training, contractors, suppliers and other businesses and services in Ti Tree and Alice Springs. | It is anticipated that the workforce will primarily comprise personnel on a fly-in / fly-out basis from Darwin, Alice Springs and potentially further afield, depending on where the necessary skills reside, with some employment from local communities.<br>The remote workforce will fly to Ti Tree and be transported to site by bus.<br>Opportunities for contractors, suppliers and other businesses could include road construction, plant / machinery operators, bus drivers, accommodation camp staff and suppliers, administration staff, Aboriginal rangers. |
| The potential employment opportunity for local Aboriginal communities was noted. | TNG's target is to employ 15% of the workforce from local Aboriginal communities. |
| Sacred Sites | |
| The assessment of potential impacts to sacred sites was discussed, which was assessed through a Sacred Sites Clearance managed by the Central Land Council with traditional owners.<br>The Sacred Sites Clearance included the mining lease and the transport corridor and provides the opportunity to protect sites and the areas wider cultural integrity. | A summary of outcomes of the Sacred Sites Clearance has been documented in the Draft EIS, however the full report by the CLC will be subject to a confidentiality agreement between the Traditional Owners, the CLC and TNG. |
| Concern was raised regarding compensation to traditional owners and custodians for impact to land. | This will be the subject of discussions between TNG and Traditional Owners. |
| Project timing | |
| The anticipated timing of construction works and commissioning of the mine for operation was raised and discussed. | The progress and anticipated timing of the Project is included in the Draft EIS and will be included in follow up communications. |
| The anticipated timing of the final investment decision as to whether the Project will proceed to construction was raised and discussed. | The progress and anticipated timing of the Project is included in the Draft EIS and will be included in follow up communications. |

**Table 6-3 Other issues resulting from stakeholder consultation**

| Potential impact or issue | Action |
|---|---|
| Employment, training and economy | |
| The cumulative loss of the skilled workforce to mining projects was raised as a concern for Local Government and local businesses.<br>It was noted that this may also contribute to rising salary costs. | This is an unavoidable consequence of development and impossible to mitigate. |
| The potential employment of local Aboriginal rangers was raised as an opportunity for monitoring of impacts to flora and fauna during the construction and operation of the mine and in providing recommendations for traditional species for rehabilitation (including food and non-food species), so that rehabilitation as closely as possible resembles the natural environment.<br>There is one ranger currently located in Ti Tree. | TNG's target is to employ 15% of the workforce from local Aboriginal communities. |
| The potential opportunity to support the Ti Tree School to develop an education program for the middle school years (years 7, 8 and 9) as a stepping stone to future employment at the Mount Peake site was raised. | This will be considered as a component of a community benefits package. |
| The potential local business opportunity for the Remote Jobs and Communities Program (RJCP) was raised, which could provide training services to the workforce and contractors. | This will be considered as a component of a community benefits package. |
| Potential business opportunities for contractors in Alice Springs and the Project area. | Opportunities for contractors, suppliers and other businesses could include road construction, plant / machinery operators, bus drivers, accommodation camp staff, administration staff and suppliers, Aboriginal rangers (for environmental monitoring and advice). |
| Potential economic opportunities for Alice Springs should some of the workforce fly in / fly out or drive in / drive out from Alice Springs. | It is anticipated that the workforce will primarily comprise personnel on a fly-in / fly-out basis from Darwin, Alice Springs and potentially further afield, depending on where the necessary skills reside, with some employment from local communities. Drive in / drive out of Alice Springs is unlikely due to distance to site. |
| Potential economic opportunities for Alice Springs in supplying materials, food and other products to site. | Supply contracts will be advertised and considered on a commercial basis. |
| There may be an option to use the existing Ti Tree air strip for the fly-in / fly-out workforce. | The fly-in / fly-out workforce will use Ti Tree air strip and be transported to site. An upgrade of the air strip is proposed. |

| Potential impact or issue | Action |
|---|---|
| Environment | |
| The potential impact to the surrounding groundwater quality / quantity and ecology of sourcing the water supply for the Project was raised as an issue.<br>Current water supplies to the stations need to be maintained during and post mining. | Studies indicate that sufficient water will be available from the Hanson River paleochannel.<br>TNG has committed to the provision of alternative water supply if the Project impacts any existing supplies. |
| Concern was raised regarding the potential impact to Mud Hut Swamp from groundwater drawdown.<br>Mud Hut Swamp is located approximately 7.7 km from the site. | Groundwater modelling indicates that Mud Hutt Swamp will not be impacted by the Project. |
| Concern was raised regarding management of the waste from the process and its potential impacts, including tailings, waste rock and water. | Waste rock and tailings are benign and the process does not use any hazardous chemicals. There will be no direct discharge of any contaminated water from the site. |
| The potential environmental impacts of chemicals used for mining and beneficiation were discussed.<br>The chemicals that may be present on site are diesel, ammonium nitrate for blasting, and potentially chemicals to aid processing and chemical suppressants for dust management. | Diesel will be stored in self-bunded tanks. No hazardous chemicals are proposed to be used on the site. Chemical dust suppression is not proposed. |
| The potential environmental issues associated with insufficient and inappropriate drainage design of the access road and railway siding was raised.<br>This may result in erosion and degradation of the local environment. | Surface water modelling has demonstrated that impacts can be managed. Floodways are proposed across creeks and rivers which removes the potential for upstream flooding. Drainage design has been incorporated into the design of the access road. |
| Concern was raised regarding the potential dust issues along the access road and with stockpiles, and from unloading and loading at the loadout facility. | An air quality assessment has indicated that dust will not be an issue at any sensitive receptor. |
| The potential environmental impacts of the power supply for the Project were raised.<br>It was suggested that solar energy with diesel back-up could be considered. | The main source of power for the project will be gas, reducing emission levels from those of diesel. TNG will investigate alternatives such as some of the energy demand being supplied from solar. |
| A greenhouse gas assessment should be included. | This has been done. |
| Potential environmental offsets were discussed, with local offsets preferred, which could include:<br>• funding to local Aboriginal rangers to undertake monitoring during construction and operation; and<br>• contribution to the Ten Deserts Program, a landscape scale program promoting connectivity between individual desert ecological communities and the building of relationships between mining companies and local communities, for better governance and biodiversity outcomes.<br>The Arid Land Environment Centre is a partner in the Ten Deserts Program. | The Project will not result in any significant residual impact and offsets are not currently proposed. |

| Potential impact or issue | Action |
|---|---|
| Private land | |
| The potential safety issues of the transport corridor not being fenced were raised, given the likely access by cattle from Stirling and Anningie Stations. | The access road will be fenced to exclude cattle from the corridor. |
| The existing road access to Stirling Station on the eastern side of railway line may be impacted by the access road, depending on the alignment. | Discussions will be held with station owners during detailed design of the road to ensure that access can be maintained to the property. |
| Access to strategic areas of the stations, such as bores and gates, may be impacted by the access road and rail siding. | Discussions will be held with station owners during detailed design to ensure that access can be maintained to the property. The intent is that access to these areas of the stations will be maintained or replaced to allow a similar level of access. |
| The potential impact of the Project to Anningie Station's organic certification, and the possible future application of Stirling Station for organic certification, was raised.<br>Anningie Station is currently certified by USDA and AusQual.<br>Potential activities that may affect certification include the use of ammonium nitrate for blasting, transport of magnetite concentrate across properties with the potential for spills of concentrate and diesel, use of chemical suppressants for dust management, potential leaks of waste and sewage from the accommodation village. | Fencing and drainage containment along roads and around the mine and accommodation village will provide appropriate separation from the Project activities and the remainder of Stirling Station and Anningie Station. No hazardous chemicals are proposed for use on the Project. |
| Archaeological sites | |
| Appropriate assessment of the potential impacts to archaeological sites was recommended.<br>It was advised that an archaeological survey is required to consider potential impacts and to address the NT EPA Terms of Reference.<br>Sites of significance will be identified in the Sacred Sites Clearance, however the remaining sites such as artefact scatters will not be identified by this process. | An archaeological assessment has been completed. |
| Emergency response and policing | |
| Remote Health Alice Springs will be responsible for coordinating the Royal Flying Doctor Service to site. | Noted. |
| The transport corridor is within the Ti Tree police district.<br>The mine site is most likely within the Wilaura police district, although the Ti Tree station would likely respond to an incident at the site given their closer access. | Noted. |
| The Ti Tree police station has fire response and roadside recovery capability, and the Ti Tree office of the Central Desert Regional Council has a fire vehicle. | Noted. |
| There may be an option to use the existing Ti Tree air strip for emergency evacuation, although the air strip may need to be designed for night time evacuation. | An upgrade of the airstrip is proposed. |

| Potential impact or issue | Action |
|---|---|
| The Ti Tree police station will adopt the emergency response plan developed by TNG, and will coordinate with the Site Manager for any incidents or emergencies. | Noted. |
| The workforce at the mine site is not considered to pose issues for policing the district. | Noted. |
| Other issues, concerns and feedback | |
| A query was raised regarding the end use of the magnetite concentrate. | Concentrate will be processed at TNGs proposed Darwin Refinery. |
| The naming of the Project as Mount Peake has caused confusion for some Aboriginal communities as to whether their land is affected, as there is an area of cultural significance called Mount Peake west of the site. | Noted. |

## 6.7 Ongoing Consultation

TNG is committed to continued and ongoing engagement with stakeholders throughout the Project planning, development and operation. The objectives of ongoing engagement are to:

- maintain open dialogue regarding the Project timing and activities as approvals are secured; and
- encourage stakeholders to continue to raise concerns and queries directly with TNG for response or resolution throughout the Project planning, development and operation phases.

TNG values all stakeholder comments and feedback, and will assess all stakeholder concerns or issues about the Project and take appropriate action as issues are raised.

### 6.7.1 Public Exhibition of the Draft EIS

Following acceptance by the NT EPA, the Draft EIS will be available for review and comment through the Public Exhibition period, for a minimum of six weeks.

To support Public Exhibition of the Draft EIS, information on the timing of the public comment period, locations for viewing the document (hard copy and electronic) and information on making a submission will be advertised to stakeholders through:

- print advertisements placed in the appropriate local newspapers;
- an update and notification letter to identified stakeholders;
- a Project update placed on the TNG website; and
- briefings to key stakeholder to discuss the outcomes of the Draft EIS.

### 6.7.2 Future Consultation

Information will be disseminated to stakeholders on a regular basis, particularly once construction commences.

# 7. Water Resources

## 7.1 Introduction

The Terms of Reference for the preparation of an EIS (NT EPA 2014) identified the following key risks to ground and surface water resources:

- potential for Acidic and/or Metalliferous Drainage (AMD) from the waste rock dump, tailings storage facility and other mine infrastructure, to contaminate shared water resources;
- surface water quality may be impacted by spills to surface water and runoff containing hazardous substances or elevated sediment concentrations;
- contamination of groundwater could occur through leaks from storages or pipelines and spills during handling of contaminants, chemicals and toxicants; and
- practically available water sources will not be sufficient to supply the needs of the proposed Project configuration, or will not be sufficient without causing environmental or social impacts.

The environmental objectives pertaining to water resource protection (NT EPA 2014) are:

- demonstrate that available water supplies will be sufficient to fulfil the Project needs over the predicted life-of-mine, without causing environmental or social impacts;
- demonstrate that Project configuration will optimise reduction of net water use for the Project and minimise contamination of water resources; and
- ensure that surface water and groundwater resources and quality are protected both now and in the future, such that ecological health and land uses, and the health, welfare and amenity of people are maintained.

The full Groundwater and Surface Water Assessment Report is provided in Appendix F.

## 7.2 Mine Site Water Balance

A water balance model was developed to determine the capacities of the various infrastructure components comprising the water supply system. The water balance also informed the sizing of the proposed borefield. The water balance model was developed for two proposed operation stages:

- Stage 1: processing up to 3 Mtpa of ore (years 1 - 4); and
- Stage 2: processing up to 6 Mtpa of ore (years 5 - 15).

### 7.2.1 Key Water Balance Components

The key water balance components associated with the Project are shown in Figure 7-1.

The two main water outflows from the processing plant are associated with the concentrate and tailings. An allowance has also been made for losses within the plant and a contingency for the makeup requirements. An inflow of treated water has been allowed for the pump glands and the balance, after allowing for water entrained in the ore, is made up with water from the process water dam.

Water associated with the underflow from the processing plant via the tailings thickener will be disposed to the tailings storage facility (TSF). Outflows from the TSF comprise water recovered to the process water dam and losses due to seepage and evaporation.

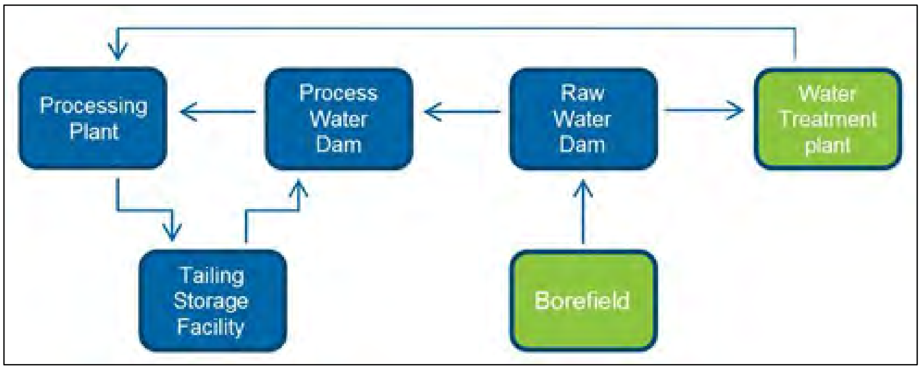



**Figure 7-1 Key water balance components**

The primary function of the process water dam is to supply makeup water to the processing plant and to receive water recovered from the TSF and brine effluent from the water treatment plant. The only other outflow from the dam is evaporation. Inflows to the dam are water recovered from the TSF and the balancing item of makeup water from the raw water dam.

Outflows from the raw water dam are the makeup water supplied to the process water dam and water supply to the water treatment plant, water abstracted for dust suppression purposes and evaporation losses. The balancing item is the raw water inflow supplied from the borefield.

### 7.2.2 Water Balance Summary

In summary, raw water requirements for the two operational stages have been estimated at 178 $m^3$/h (1.6 GLpa) for Stage 1 and 300 $m^3$/h (2.6 GLpa) for Stage 2. GHD (2015a) provides a more detailed explanation of this water balance assessment and assumptions. Figure 2-15 provides a detailed water balance for Stage 2. The above water requirements were used to determine the capacities of the infrastructure components comprising the water supply and storage system, including the sizing of the proposed borefield.

### 7.2.3 Water Supply and Storage

Potable water will be trucked to site during the early stages of construction until supply is established from the borefield and a water treatment plant is constructed. A number of water bores will be established adjacent to the proposed access road to provide road construction water. A permanent construction water supply will be provided through the partial establishment of the main borefield early in the construction program.

The key components of the water supply system for the operational stages of the Project are outlined in Table 7-1 and presented in Figure 7-2.

Based on the results of the groundwater drilling program it was determined that the Hanson River palaeovalley had the capacity to provide Project water supply (GHD 2015a). The borefield will be located along the western bank of the Hanson River (Figure 7-2) and will eventually include up to 10 production and two standby bores to meet Project demand. The borefield will be developed in two stages as summarised in Table 7-2.

### Table 7-1 Key water supply system components

| Water supply system component | Stage 1 | Stage 2 |
|---|---|---|
| Borefield | 8 x 8.5 L/s bores | 12 x 8.5 L/s bores |
| Raw water transfer pipeline | 40.8 km | 48.8 km |
| Raw water dam | 12.3 ML | 20.7 ML |
| Process water dam | 3.6 | 7.2 ML |
| Water treatment plant | 370 $m^3$/d | 650 $m^3$/d |
| Potable water tanks at processing plant | 0.5 ML | 1.0 ML |
| Potable water tanks at accommodation village | 0.3 ML | |
| Potable water supply pipeline | 10 km | |

### Table 7-2 Summary of proposed borefield

| Item | Stage 1 | Stage 2 | Comment |
|---|---|---|---|
| Overall water demand | 1.6 GLpa<br>(51 L per second) | 2.6 GLpa<br>(82 L per second) | Total water demand based on water balance. |
| Minimum number of active production bores required | 6 | 10 | Two bores from Stage 2 to augment supply during any reduction in supply from Stage 1 bores (maintenance/failure). |
| Proposed standby bores | 2 | 2 | |
| Proposed spacing of bores | 1800 m | | Aligned on track parallel to river channel. |
| Proposed continuous pumping rate | 8.5 L/s | | Based on pumping and modelling data. |

In addition to the production bores, development of a groundwater monitoring network will occur. This is discussed further in Section 7.4.4.

Approximately 49 km of water supply pipeline will be constructed between the borefield and the raw water dam predominantly along existing tracks. The pipeline will have a diameter of up to 450 mm. Rather than construct a supply pipeline to the Adnera Loadout Facility it is proposed that water will be trucked from the mine site.

The sizing of the raw and process water dams has been based on the requirements for both emergency storage and for buffering of the daily consumptive fluctuations. The dams will most likely be constructed in two stages, in line with production requirements (Table 7-1). Based on modelled water demand, the raw water dam will have a storage capacity of approximately 21 ML with a footprint of 1.5 ha. This water capacity should be sufficient for three days supply. The dam will be constructed adjacent to the process plant to manage project water supply. A 0.9 ha process water dam will also be constructed adjacent to the process plant to provide process water and to receive recovered water from the plant and TSF. Total storage will be around 7 ML, sufficient for two days supply.

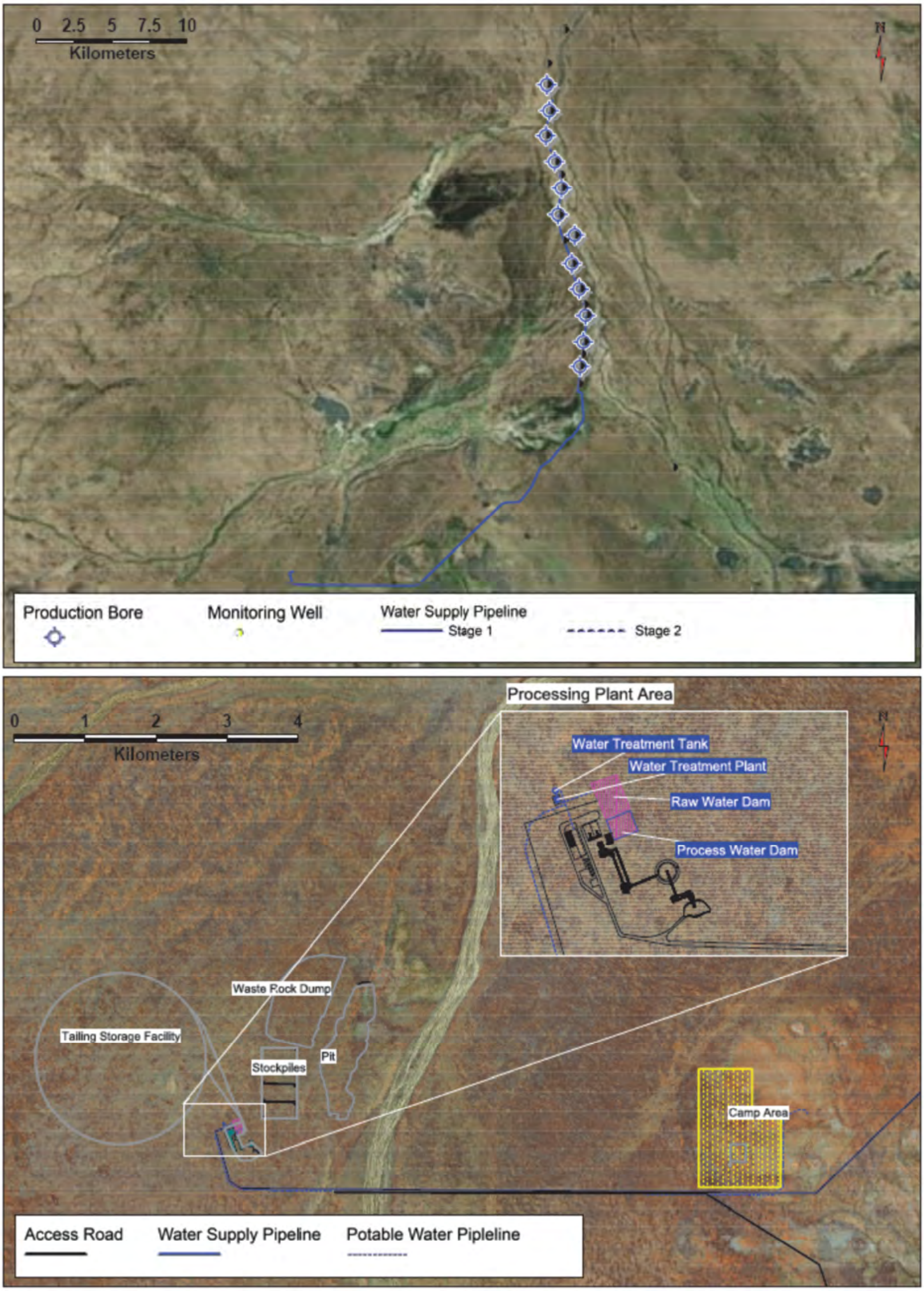



**Figure 7-2 Water supply system conceptual plan**

Water treatment is required to provide water that is suitable for human consumption, amenity irrigation and the slurry pump glands. Water from the raw water dam will be treated to bring it up to potable water standard. To meet expected demand, the water treatment plant (WTP) will be able to produce 370 $m^3$/d initially, increasing to a capacity of 650 $m^3$/d in Stage 2. Water treatment will comprise:

- filtration using multi-media filters (MMF);
- desalination using brackish water reverse osmosis (BWRO);
- disinfection using sodium hypochlorite or similar; and
- discharge of the brine reject to the process water dam.

Potable water tanks are proposed at both the processing plant and the accommodation village. Both tanks have been sized to provide emergency storage capacity and to buffer the daily fluctuations in consumption. The ultimate potable water tank requirements at the processing plant will be 1.0 ML, whereas at the accommodation village a 0.3 ML tank will be required. Based on the proposed locations of the WTP and the potable water tank at the accommodation village, a 10 km pipeline will be constructed to transport this water.

## 7.3 Surface Water

### 7.3.1 Existing Surface Water Environment

The Project is at the southern extent of the Australian monsoon belt and in the centre of the Australian continent. The climate is arid to semi-arid with an annual rainfall of approximately 320 mm recorded at the Bureau of Meteorlogy (BoM) Station 15525 at Barrow Creek, which is located approximately 50 km east of the Project site. Annual rainfall is highly variable, with records at Barrow Creek ranging from 70 mm in 1963 to 1,150 mm in 2010. Rainfall is highly seasonal with the majority of rainfall occuring as thunderstorms between November and March. Monthly rainfall statistics at this station are shown in Figure 7-3. Monthly temperature statistics for the same weather station are presented in Figure 7-4. The mean monthly maximum temperature ranges from about 22°C to 37°C, with the mean monthly minimum temperature ranges from 8°C to 24°C. Average annual evaporation for Barrow Creek weather station totals approximately 2,980 mm with average monthly evaporation exceeding rainfall in all months.

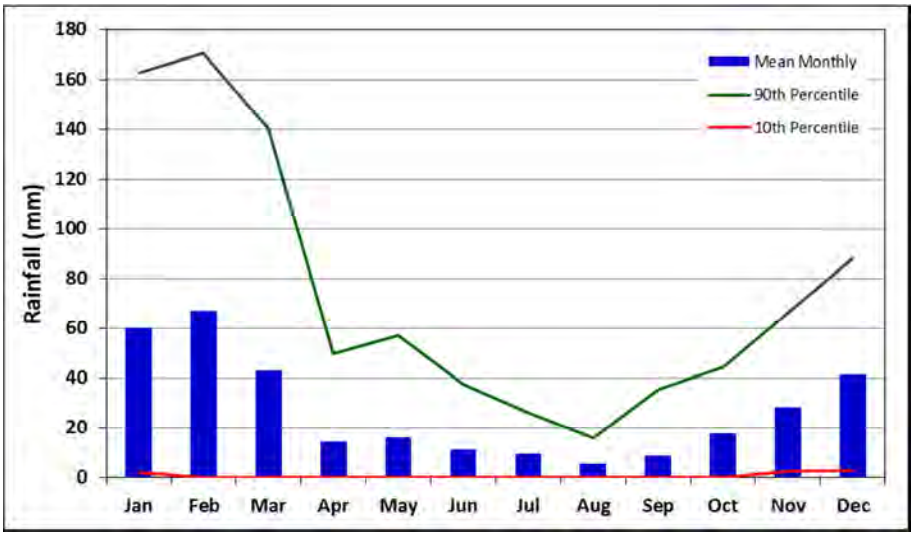



**Figure 7-3 Monthly rainfall statistics at Station 15525 (Barrow Creek)**

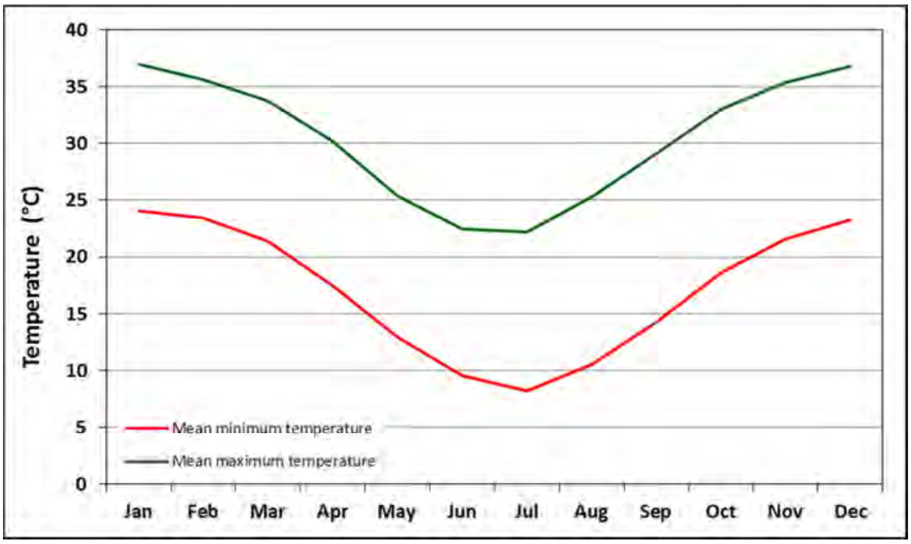



**Figure 7-4 Monthly temperature statistics at Station 15525 (Barrow Creek)**

The Project is located in the Wiso Basin and overlies the Arunta Province in the Burt Plain Bioregion. The Bioregion covers an area of some 73,600 km$^2$ with elevation ranging from 300 to 1,252 m above sea level. The Bioregion is dominated by undulating stepped plains, consisting generally of red soils, with earthy sands and red siliceous sands also occuring extensively across the plain (Neave *et al.* 2006).

Mapping of surface geology by the Department of Natural Resources, Environment, the Arts and Sport (NRETAS 2009, 2009a) identifies predominantly alluvial floodplains in the Project area (Table 7-3).

**Table 7-3 Surface geology across the Project area**

| Location | Water Course/Feature | Surface Geology |
|---|---|---|
| Headwaters of water courses upstream of the proposed mine site | Anningie Creek<br>Murray Creek<br>Bloodwood Creek | Granite plains and rises |
| Incremental catchments of watercourses downstream of the proposed mine site | Mud Hut Swamp | Alluvial plain<br>Desert sandplain<br>Granite plains and rises<br>Sandstone hills |
| | Murray Creek<br>Hanson River | Alluvial plain<br>Desert sandplain |
| Watercourses intersecting and/or downstream of the proposed access road | Stirling Swamp | Salt pans |
| | Hanson River | Alluvial floodplain<br>Desert sandplain |

The Project is located within the Wiso Surface Water Management Basin (Figure 7-5), which comprises numerous ephemeral dendritic drainage systems across the region. Watercourses generally flow north, with a number of smaller watercourses originating out of rocky outcrops into the surrounding plains. Key water courses near the Project site are Murray Creek and Bloodwood Creek. These are tributaries of the Hanson River, the main watercourse draining the western part of the Ti-Tree Basin.

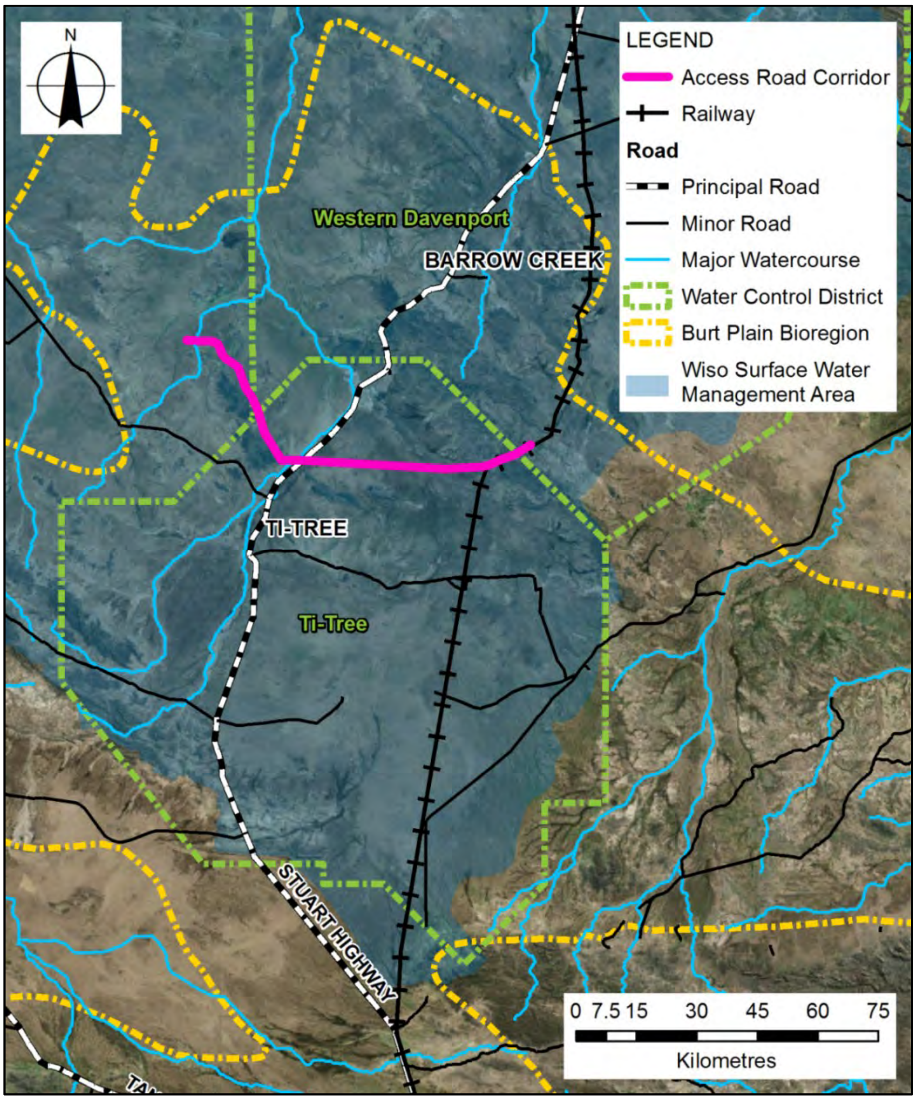



**Figure 7-5 Water Management Area and Control Districts**

The alluvial floodplains that separate the channels are referred to as floodouts (Duguid *et al.* 2005). Several of the water courses are considered to be joined, with shared floodouts in large flood events. Runoff is ephemeral and likely to be rapid in the foothills but slowing substantially on the plain.

Mud Hut Swamp, located in the floodout area of the Bloodwood Creek, and Stirling Swamp (Anmatyerr North Site), an interim floodout area for the Hanson River, are both listed as Sites of Conservation Sigificance (NRETAS 2009, 2009a). The channel of the Hanson River becomes ill defined, or braided, in the vicinity of Stirling Swamp, before becoming more defined again downstream.

The Hanson River rises in the Reynolds Range (also referred to as the Anmatijira Range) to the south west of the Project site, and flows north flooding out into the Tanami Desert, west of Tennant Creek.

This floodout area is an important source for groundwater recharge (Duguid *et al.* 2005). The Australian Natural Resources Atlas (ANRA) indicates the Hanson River flows once in every 12 years on average (ANRA 2013) whereas the Department of Infrastructure, Planning and Environment found that regional rivers in the Ti Tree Groundwater Basin are only likely to flow when monthly rainfall exceeds 100 mm, with this threshold being achieved approximately once every two years on average (DIPE 2002).

Surface water in the Wiso Basin is used primarily for stock watering and domestic supply to rural communities, but is not licenced (DIPE 2002).

Drainage from the Reynolds Range tends to transition from annular water courses generally controlled by geology, to highly distributed channels associated with the formation of an extensive alluvial fan known as the Burt Plain. Significant groundwater recharge is likely in the vicinity of this fan.

Water courses near the Project site are sandy and highly braided along reaches. These drainage channels rise in upland areas where surface runoff feeds into clearly defined channels. Surface water flow within the Project area is likely to spread laterally from channels across the extensive floodplain environment as low energy sheetflow. Sediment transport is dependent on the magnitude of the event, with larger events responsible for sediment transport and channel formation. Active processes observed in the Project area included bank erosion and sediment transport in the alluvial creek beds. Disturbed sites are also likely to result in soil erosion and sediment transport. Localised erosion with the potential to alter surface water flow pathways were observed in the vicinity of Mud Hut Swamp (GHD 2015a).

Given the alluvial nature of the Burt Plain, the presence of ephemeral surface water drainage systems with floodout zones and palaeodrainage channels, there is potential for significant surface water - groundwater interactions within the vicinity of the creeks and rivers.

The Hanson River is considered to contribute significant recharge to the Ti Tree Basin aquifer when floodouts are activated (Knapton 2006). Furthemore anecdotal information aquired from sites in the headwaters of the Woodforde River indicates there is surface water - groundwater interaction within the alluvial formations associated with the drainage networks that may form the main recharge mechanism for local aquifer systems in the region (G. Ride, pers. comm. 2011).

The Hanson River flows across the western and northern zones of the Ti Tree Water Control District Boundary. A regional water balance for the study area identifies a contribution of 760 ML from Hanson River flood recharge to the Ti Tree Basin (Knapton 2006).

Groundwater flows in the Ti Tree Basin are from east to west and south to north, with the water table becoming shallower in the northern extent (Knapton 2007). Stirling Swamp is identified as a natural discharge zone for the basin. Knapton (2007) indicates that groundwater dependent ecosystems occur within the basin with vegetation able to access water in areas where the water table occurs within 10 m of the ground surface.

The proposed access road will traverse the Ti Tree Water Control District Boundary in the vicinity of the Hanson River floodout.

### Sites of Conservation Significance

There are three surface water sites which have conservation significance in proximity to the Project, namely Mud Hut Swamp, Anmatyerr North and Wood Duck Swamp (Figure 8-1).

Mud Hut Swamp has been identified by NRETAS as a Site of Conservation Significance and is listed in the "*Inventory of sites of international and national significance for biodivseritY values in the Northern Territory".* Mud Hut Swamp is a large, isolated, gum-barked coolabah (*Eucalyptus vitrix*) swamp fed by Bloodwood and Murray Creeks in the south-east and runoff from low hills and rises to the north and west (NRETAS 2009). This is the largest swamp in the Burt Plains bioregion and remains inundated for a relatively long time after flooding, possibly retaining water for several months following inundation. It is likely to support a range of wetland birds, fish and plants. Any interruption or alteration of surface water drainage in the vicinity of the Project area has the potential to adversely affect the downstream ecosystem, including Mud Hut Swamp.

The Anmatyerr North site is located across Stirling, Anningie and Ahakeye Stations. This site includes Stirling Swamp, a large wetland complex comprised of claypans, lignum swamp, semi-saline samphire and temporary open water, and the adjacent Hanson River (NRETAS 2009a). The site extends to low rocky ranges about 20 km south of Stirling Swamp to encompass the known extent of the threatended giant sweet potato (*Ipomoea polpha* subsp. *latzii*). Stirling Swamp is noted to form occasionally at the northern edge of the Ti Tree Basin, storing flood waters discharged from the Hanson River and the ridges to the east of Wilora. This area is believed to act as an evaporation area for the basin.

Wood Duck Swamp is an ephemeral swamp that may hold water for many months in an otherwise dry landscape. It fills periodically after heavy rain. Wood Duck Swamp is dominated by smooth-barked coolabah *Eucalyptus victrix*. It is one of the largest such swamps in the Burt Plains bioregion (NRETAS 2009b). Wood Duck Swamp is entirely pastoral leasehold land within one pastoral lease (Mount Skinner). The main land use within the site and broader catchment is cattle grazing on native pastures. Wood Duck Swamp is located approximately 10 km south of the access road, outside of the Project area.

### Water quality (based on sediment analysis)

Sediment sampling was undertaken to characterise sediment quality as a proxy for water quality for the preliminary assessment of ambient conditions at Mount Peake. The accumulation of elements in sediments provides an indicator of baseline sediment quality. This approach was adopted for the following reasons:

- surface water sampling is only possible during streamflow events. These are rare in the ephemeral systems on the site, with there being the potential for several years occurring between events. There were no opportunities for water quality sampling during the investigation;
- a water sample may not be representative of streamflow quality. Water quality can vary depending on the nature, timing and location of the runoff from the upstream catchment. Grab samples during an event may miss the progression/change in water quality. Continuous monitoring/sampling may reduce this risk, but would be excessively expensive; and
- potentially contaminating material is normally associated with sediments following subsidence of flow. This is released from natural sediment traps and trapped again further downstream following successive streamflow events.

This approach is consistent with that adopted by the NT EPA for Waste Discharge Licences for mining activities where ongoing monitoring comprises a combination of sediment and surface water sampling.

Prior to mining commencing water and sediment samples will be collected to establish baseline conditions.

Sediment sampling locations were selected based on the mine plan, access road and environmental site characteristics. Locations were selected that are unlikely to be disturbed by mining activities and the monitoring points would remain active throughout the life of the mine. The sediment sampling locations are presented in Figure 7-6.

Sampling of river bed sediments was based on the Australian Standard - Guide to the investigation and sampling of sites with potentially contaminated soil (AS 4482.1-2005). In the absence of sufficient sediment quality data to determine background sediment concentrations, the ANZECC Sediment quality guidelines were referenced for comparative purposes.

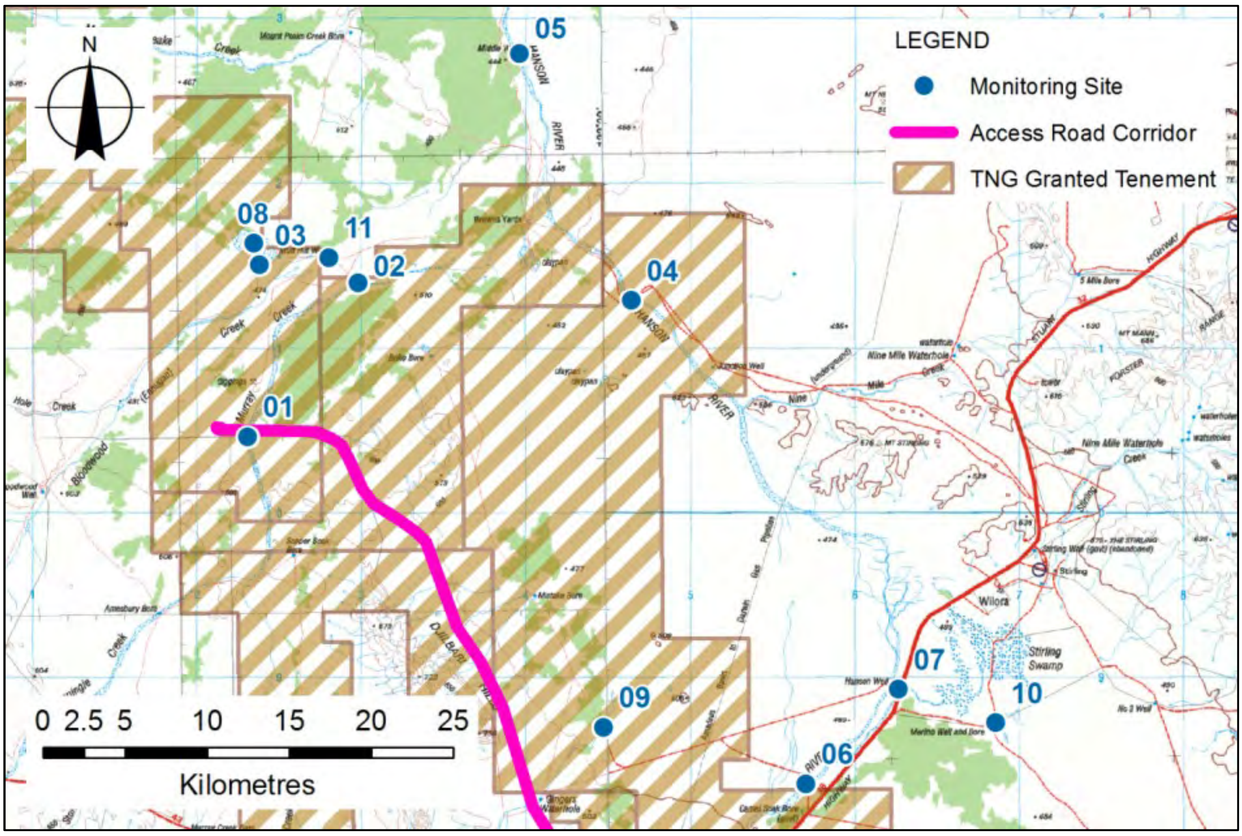



**Figure 7-6 Sediment monitoring locations**

Samples revealed that particle size distribution ranges from 'sand and gravel' to 'fines and sand'. Sediment pH ranges from neutral to very strongly acid and sediment electrical conductivity was observed to be very low. Whilst metals were detected at concentrations above the Limit of Reporting (LOR) in the fluvial samples, none of the sediment samples exceeded the respective ANZECC sediment guideline for metals. The metals concentrations were within the observed range of background levels reported for Australian soils (Hazelton and Murphy 2007). Concentrations of metal parameters were consistently reported highest at monitoring location 10 (Figure 7-6), corresponding to the site with highest proportion of sediment fines. Consistent with metals detected, Site 10 also reported the highest soil total nutrient (nitrogen and phosphorus) concentrations, filterable reactive phosphorus concentration and EC value. No total recoverable hydrocarbon analytes exceeded their respective LOR.

### 7.3.2 Hydrological Impact Assessment

GHD (2015a) completed a hydrological assessment to:

- understand the hydrological regimes of the Hanson River, Murray Creek and Wood Duck Creek to predict the frequency and duration of flooding of the proposed access road;
- evaluate the potential risks associated with Murray Creek inundating the mine site; and
- investigate the potential sheetflow shadows resulting from the construction of the access road.

This section focuses primarily on the results of this assessment, with a detailed description of the assessment method and assumptions provided in GHD (2015a).

### Predicted river and creek impacts on the access road

An assessment of the hydraulics of the access road floodways was undertaken using the Australian Rainfall and Runoff (ARR) guideline (Institute of Engineers Australia 1987). The location of the road crossings in relation to the above mentioned watercourse are depicted in Figure 7-7. The elevation datasets provided are coarse so the relatively simple Rational Method hydraulic modelling approach was adopted to determine flood peaks. This entailed the determination of runoff coefficients for application in the Rational Method, followed by the estimation of peak discharges by parameter transfer from similar gauged streamflow sites. Streamflow data were sourced from the NT DLRM Water Data Portal (http://lrm.nt.gov.au/water/water-data-portal) to inform this assessment.

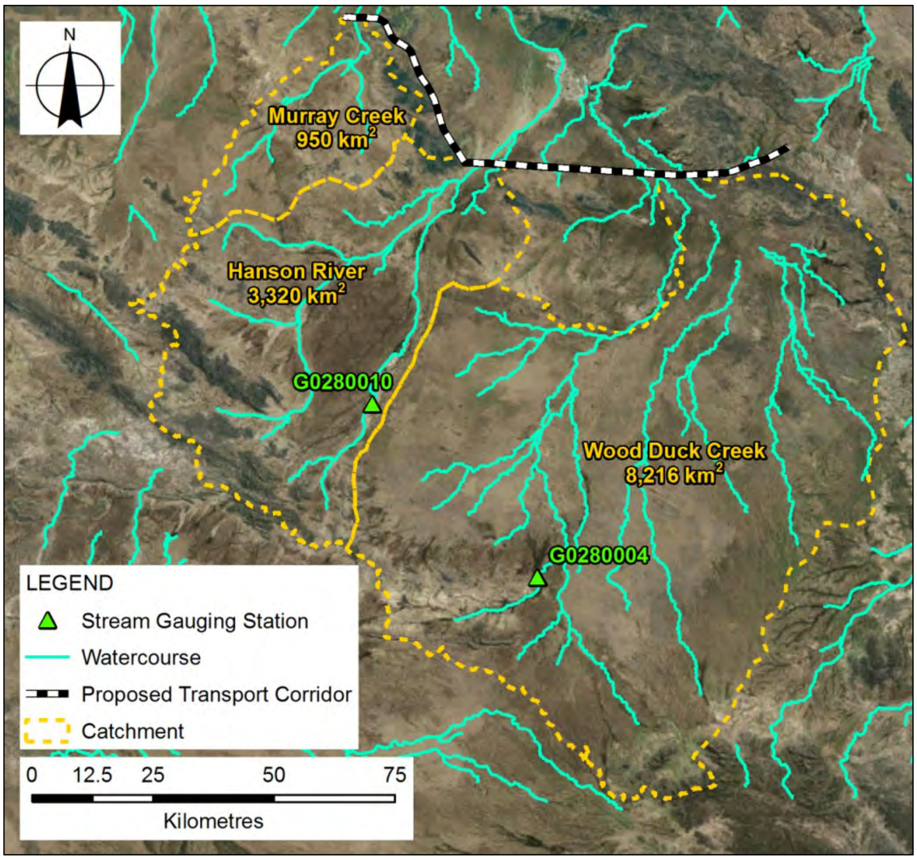



**Figure 7-7 Location of road crossings and catchment extents**

Peak discharges were estimated at the access road floodways across Murray Creek, Hanson River and Wood Duck Creek. The hydrological characteristics that describe these catchments are summarised in Table 7-4. The peak discharges from these catchments are tabulated in Table 7-5 for varying Average Recurrence Intervals (ARI) (ARI is the average or expected period between exceedances of a given discharge value). Floodway flow depths were estimated using Manning's equation based on the peak discharge estimates. An assessment of flow duration was undertaken for a range of storm events with duration between 24 and 72 hours. The flow-duration hydrographs were then converted to depth-duration hydrographs to determine the amount of time that water levels at the proposed crossings exceed a given threshold value, in this case assuming a flow depth of less than 0.2 m would be trafficable. The resulting flow depths and durations are summarised in Table 7-6.

### Table 7-4 Hydrological characteristics of target catchments

| Target catchment | Catchment area ($km^2$) | Longest flow path | | Time of concentration (hours) |
|---|---|---|---|---|
| | | Length (km) | Slope | |
| Murray Creek | 950 | 53 | 1.24% | 24.7 |
| Hanson River | 3,320 | 100 | 2.38% | 57.3 |
| Wood Duck Creek | 8,216 | 141 | 0.81% | 91.4 |

### Table 7-5 Estimated peak discharges at target catchments

| Target catchment | Peak discharge ($m^3/s$) by ARI | | |
|---|---|---|---|
| | 10-year | 20-year | 50-year |
| Murray Creek | 44 | 148 | 247 |
| Hanson River | 173 | 309 | 562 |
| Wood Duck Creek | 281 | 502 | 916 |

### Table 7-6 Peak flow depths and flow duration

| Target catchment | Peak flow depths (m) by ARI | | |
|---|---|---|---|
| | 10-year | 20-year | 50-year |
| Murray Creek | 0.42 | 0.76 | 0.99 |
| Hanson River | 1.44 | 1.81 | 2.15 |
| Wood Duck Creek | 0.37 | 0.51 | 0.71 |
| Target catchment | Flow duration (hours) by ARI | | |
| | 10-year | 20-year | 50-year |
| Murray Creek | 25-27 | 35-51 | 43-86 |
| Hanson River | 81-129 | 81-129 | 91-129 |
| Wood Duck Creek | 93-104 | 98-117 | 107-148 |

The drainage lines of Murray Creek and the Hanson River are reasonably well defined and relatively narrow (~300 m and ~400 m respectively) and properly constructed floodway type crossings will be installed. Such crossings would not be expected to interrupt natural streamflow and geomorphological processes, but would require ongoing maintenance to ensure accessibility.

There is no evidence of a single specific drainage line associated with Wood Duck Creek and surface flows in this vicinity are likely to present as sheet flow. Given the relatively long length of the crossing (~1,800 m) and the likely long duration of standing water, TNG intends to install regularly spaced culverts along this section of road.

#### The potential risk of Murray Creek inundating the mine site

A mine site flood risk assessment was undertaken using the HEC-RAS one dimensional hydraulic model. The resulting flooding extents along Murray Creek in the vicinity of the mine site indicate the mine site is not expected to experience any significant flooding for events up to the 50-year ARI. However, it is noted that there is a bench of lower lying topography in the vicinity of the proposed mine pit that may be prone to flooding during more extreme events (Figure 7-8). Detailed design will determine the need for flood protection for the mine pit.

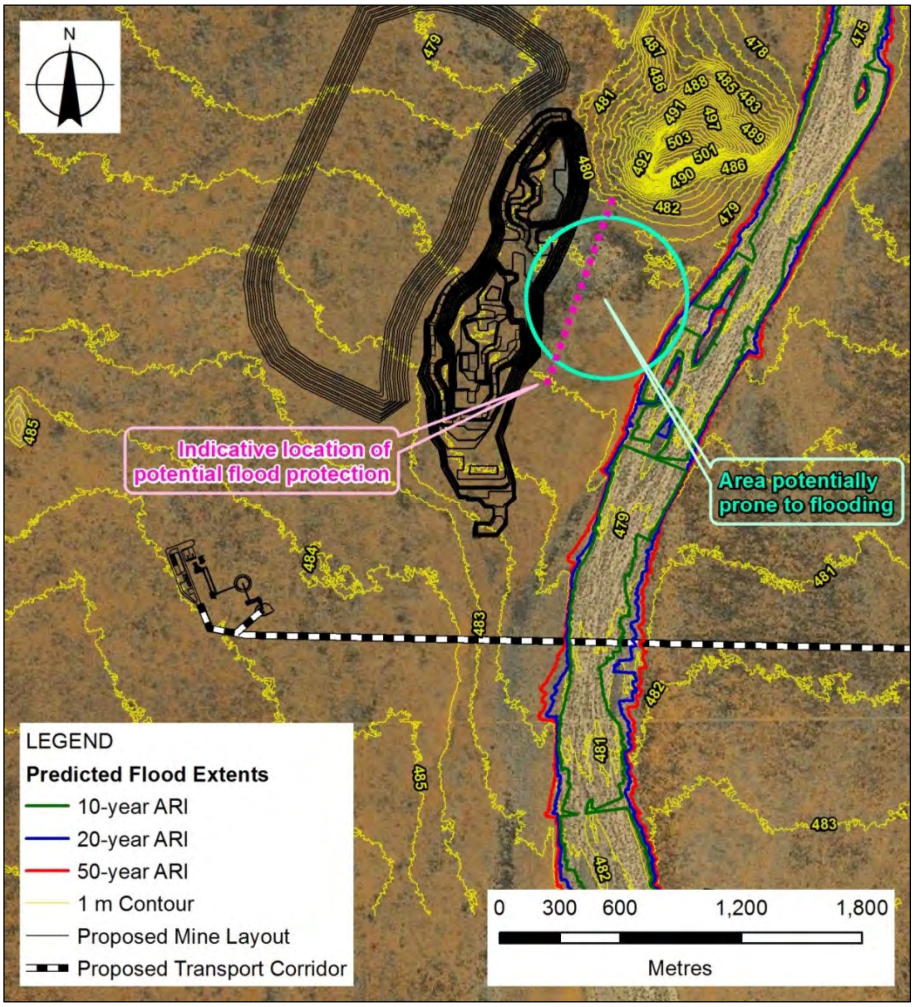



**Figure 7-8 Predicted flood extents along Murray Creek**

### Sheetflow shadows resulting from the access road

An inspection of the elevation data and aerial imagery indicates that the alignment of the access road is associated with areas where sheet flow may be the dominant surface water runoff response. Extensive tracts of Mulga (*Acacia aneura)* dominate the shrublands connected to the alluvial plains to the east of the Stuart Highway. These species are an indicator of sheetflow processes.

The elevation profile along the access road alignment is provided in Figure 7-9, which indentifies the locations of the main water course crossings as well as areas where sheet flow may be present. As no specific drainage lines were noted in the areas of potential sheet flow, TNG will regularly space culverts to prevent the creation of sheetflow shadow zones downgradient of the access road.

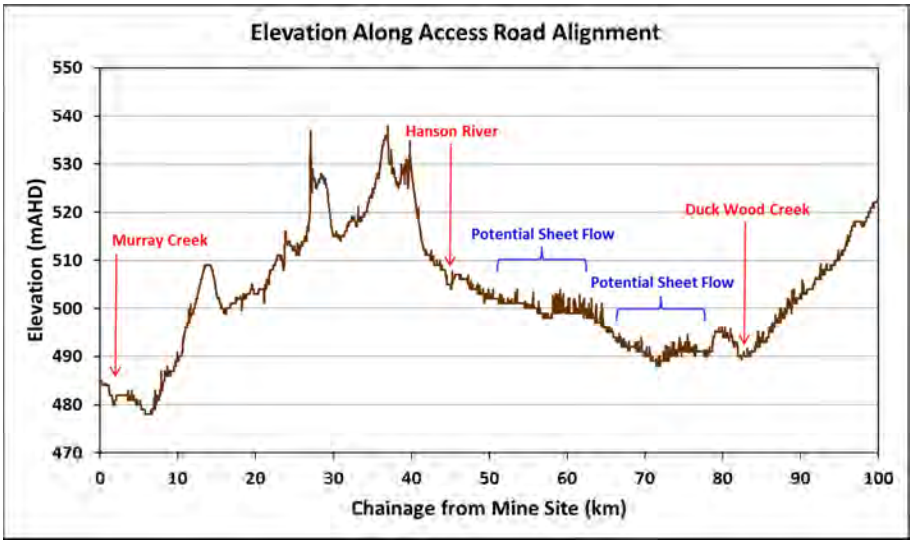



**Figure 7-9 Elevation profile along access road**

## 7.4 Groundwater

### 7.4.1 Existing Groundwater Environment

#### Geology

The Project area is located predominantly within the northern province of the Palaeoproterozoic Arunta Block, with the eastern area of the Project being within the western margin of the Neoproterozoic Georgina Basin. These two broad geological regions form the main basement geology of the Project area and are most commonly observed forming the outcropping rocks of the ranges. More recent Quaternary and Tertiary aged deposits dominate surface geology and regolith and generally mask the underling Palaeozoic and Proterozoic units.

The orebody target is the mineralised Mount Peake gabbros, which are contained at relatively shallow depths of around 40 m, and are generally found concealed beneath recent Quaternary sediments. The gabbro unit is located within outliers of Neoproterozoic sediments of the Georgina Basin. The Neoproterozoic sediments rest unconformably on metasediments and granites of the Aileron Province within the Lower Proterozoic Arunta Region. Immediately to the northeast of the proposed pit, a small outcrop of the Mount Stuart Formation is present forming a small rise immediately adjacent to Murray Creek. The same unit also forms the high ground east of the proposed accommodation village area.

The proposed borefield is located on the western bank of the Hanson River. The dominant surface geological unit here is the alluvial deposits of relict fluvial system largely covered by sheet sand and alluvial/red soil plain deposits. The palaeodrainages of the Hanson River have resulted in the alluvial units within the proposed borefield location being significantly thicker in comparison to the general alluvial units found on the plains. It is likely that the thickened alluvial units are geologically equivalent or related to the same units found at depth in the Ti Tree Basin (approximately 70 km to the south).

The access road transects various differing geologies and regolith units. The eastern half of the road alignment is predominately within the Georgina Basin, whereas the western half is within the Arunta Block. The alignment is located on the plains and therefore the surface geology and regolith is mainly comprised of alluvials. In the western area where the alignment is to the east of the ridge line formed from the Stuart Ranges, some localised scree and colluvial fan deposits are present. In the eastern area of the alignment, the road passes through the palaeovalley associated with the Hanson River. In this location, older Cainozoic sediments are mapped, which are expected to include calcrete deposits. Where the road alignment meets the existing rail line, the alluvial plain is relatively narrow with units of the Central Mount Stuart Formation being present both north and south of the road alignment.

### Hydrogeology

There have been limited studies into the groundwater potential of the basement rocks of the Arunta and Georgina geological provinces, largely as a result of the regional remoteness. The deep basins may offer groundwater resources, however groundwater drilling investigations have generally focused on providing water for communities or stock watering which only require relatively minor yields that can be obtained at relatively shallow depths (Ryde 2007). Regional aquifer mapping by the Department of Land Resources Management (Tickell 2013) indicates that the general Project area contains two predominant local scale aquifer types:

- fractured and weathered rocks with minor groundwater resources; and
- fractured and weathered rocks.

The distribution of these two systems is illustrated in Figure 7-10. The fractured rock aquifers are likely to offer generally low groundwater yields and are unlikely to yield adequate water for mine operations. In addition to the two units that dominate the Project region, the Ti Tree basin is mapped as an aquifer of 'Unconsolidated sediments with intergranular porosity'.

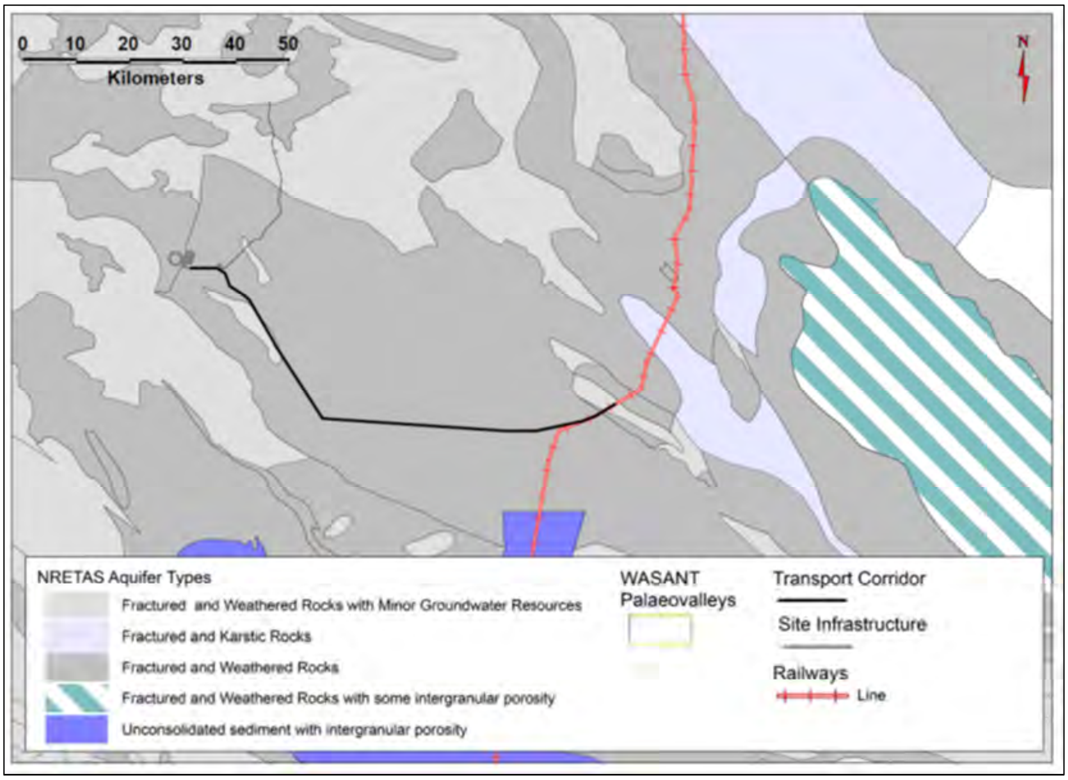



**Figure 7-10 Regionally mapped aquifer systems**

In addition to the broad fractured rock systems that are mapped as present throughout the study area, a number of significant Cainozoic basins and palaeovalley systems have been identified (Tickell 2013).

The Ti Tree Basin is the most studied and the most exploited groundwater resource in the region. The basin is an intracratonic Cainozoic that is approximately 100 km wide from east to west and 75 km north to south. The basin sediments are known to be in excess of 300 m in depth, however the upper 100 m of sediments is most commonly targeted for groundwater abstraction. Groundwater within the basin generally flows from south to north, with discharge known to occur towards the Hanson River and Stirling Swamp. The Stirling Swamp area may be an expression of discharge from the Ti Tree aquifer where evapotranspiration could be a major component of the water balance for the aquifer (English *et al.* 2012). The primary use of the groundwater is for horticultural purposes, with demand increasing to approximately 4 GLpa in 2005. Demand has since reduced with current abstraction less than 2 GLpa.

The extent of the Hanson River palaeovalley is mapped as continuing from the northern discharge of the Ti Tree Basin, passing through Stirling Swamp and connecting with the existing Hanson River Channel. The channel then passes through the Project area before continuing north for approximately 200 km before is merges with the Palparti palaeovalley. The Hanson River palaeovalley is generally identified as being around 4 km wide, but as narrow as 2 km and as wide as 10 km.

With the exception of work undertaken by TNG there has been no known groundwater investigative drilling undertaken in the area of the Hanson River palaeovalley, other than for installing stock bores. Utilisation of the Hanson River palaeovalley is currently limited to the stock bores, with the majority equipped with solar powered low volume shaft driven pumps, which are used to fill water tanks that keep cattle troughs filled.

The Willowra Basin and associated palaeovalley is located approximately 30 km west of the proposed mine site at the junction of the Lander River and Ingallana Creek. The Willowra Basin was investigated for groundwater resources through a drilling program conducted by the Northern Territory Water Resources section in 1963 to determine the extent of the basin and determine the profile of the potential groundwater resource. The drilling investigation determined that around 25 km south of Willowra Homestead the palaeovalley is about 18 m deep and 3 km wide, deepening to 35 m just north of the homestead. The main aquifer unit was identified as a Quaternary lower sand unit with some local confinement by clay rich floodplain deposits (Magee 2009). This aquifer appears to have low volumes of groundwater storage after long periods of low flow, with the watertable depth in the Willowra Homestead bore varying from about 12 m (in dry periods) to near-surface immediately after streamflow. The only known groundwater use within the Willowra Basin is for stock use, although use for horticultural purposes was identified as having potential, but not pursued.

#### Water control districts

The Department of Land Resource Management declares Water Control Districts in areas deemed to need water resources management to avoid stressing groundwater reserves, river flows or wetlands. Water Control Districts are subject to water allocation planning that establishes a framework to share water between environmental requirements and human needs for beneficial uses, as defined in the *Water Act 1992.* Of relevance to the Project are the Western Davenport Water Control District, and the Ti Tree Water Control District (Figure 7-5).

The Western Davenport Water Control District covers an area of almost 25,000 km$^2$, extending north from the Ti Tree Basin Water Control District for around 200 km, including the community of Mungkarta at its northern edge. From the west it includes the Hanson River and the proposed location of the borefield, and extends east to cover most of Murray Downs Station. The Stuart Highway bisects the District passing through Barrow Creek, Wycliffe Well and Wauchope.

The allocation plan (NREAS 2011) recognises that there are currently no known or significant surface water extraction activities and the total of the current licensed and unlicensed groundwater extraction per annum is estimated to be less than 0.004% of estimated storage. The allocation plan and associated technical documentation also note that further scientific work needs to be undertaken to improve the knowledge about the areas water resources and estimation of their characteristics. In particular, more evenly spread and deeper groundwater drilling investigations are recommended to determine bore yields and consequential sustainable yields of aquifers. Identification and measurement of recharge mechanisms is also recommended.

The Water Control District is separated into five management zones based on a consideration of topography, underlying geology, hydrogeochemistry and stratigraphy. The Territory Government has followed the principle that in the absence of adequate scientific information, total extraction of groundwater over a century should not exceed 80% of the estimated total aquifer storage.

The Project area overlaps with part of the Southern Ranges management zone. This zone has an:

- area of 8498 $km^2$;
- estimated storage of 147 GL;
- estimated annualised recharge of 8.5 GL; and
- available allocation of 6.8 GLpa.

The Ti Tree Water Control District covers an area of almost 15,000 $km^2$, covering the extent of the Ti Tree aquifer and its surface water catchments. The northern area of the district extends to Wilora and Stirling Station, and therefore includes a large section of the access road alignment and the rail siding. Unlike the Western Davenport Water Control District, the Ti Tree area has a significant groundwater use, largely for horticultural purposes and public water supply. Abstraction occurs from the Ti Tree aquifer which is present at relatively shallow depths across the majority of the Water Control District. As a result of the demand and utilisation of the aquifer, a groundwater model has been developed, which has been used to develop allocations and sustainable water use volumes. The Water Control District is separated into four management areas, with the Northern Zone being of relevance to the Project due to its overlap with the access road, the Hanson River and Stirling Swamp. The northern zone is relatively un-utilised in terms of abstraction compared to the other areas, with the only groundwater use by the Wilora community and Stirling Station. It is estimated that a total of 50 MLpa is currently used, with 10 MLpa for Public Water Supply (licenced) and 40 MLpa for rural and domestic use (unlicensed).

### Existing groundwater use within the Project area

Although there are relatively few existing groundwater users within the Project area, it is important to identify these so appropriate design and management actions can be incorporated into the Project to minimise potential adverse impacts.

Stirling Station covers most of the Project area, with Anningie Station being immediately to the south of the Project area. Both pastoral stations use stock bores and wells for year-round water supplies. The operational stock bores identified within and around the Project are shown on Figure 7-11. In general, stock bores are relatively evenly distributed around the Project area with typical distance between bores of around 10 km. Most bores are located along existing creek and drainage lines. Due to the relatively low volumes of groundwater required at each location, bores tend to be relatively shallow and generally less than 40 m deep. Due to the widespread nature of these bores, they tend to target different units but are predominately targeting the fresher shallow groundwater associated with recent alluvial sediments. The relatively shallow nature of stock bores means that they have the potential to be impacted by any reduction in groundwater levels.

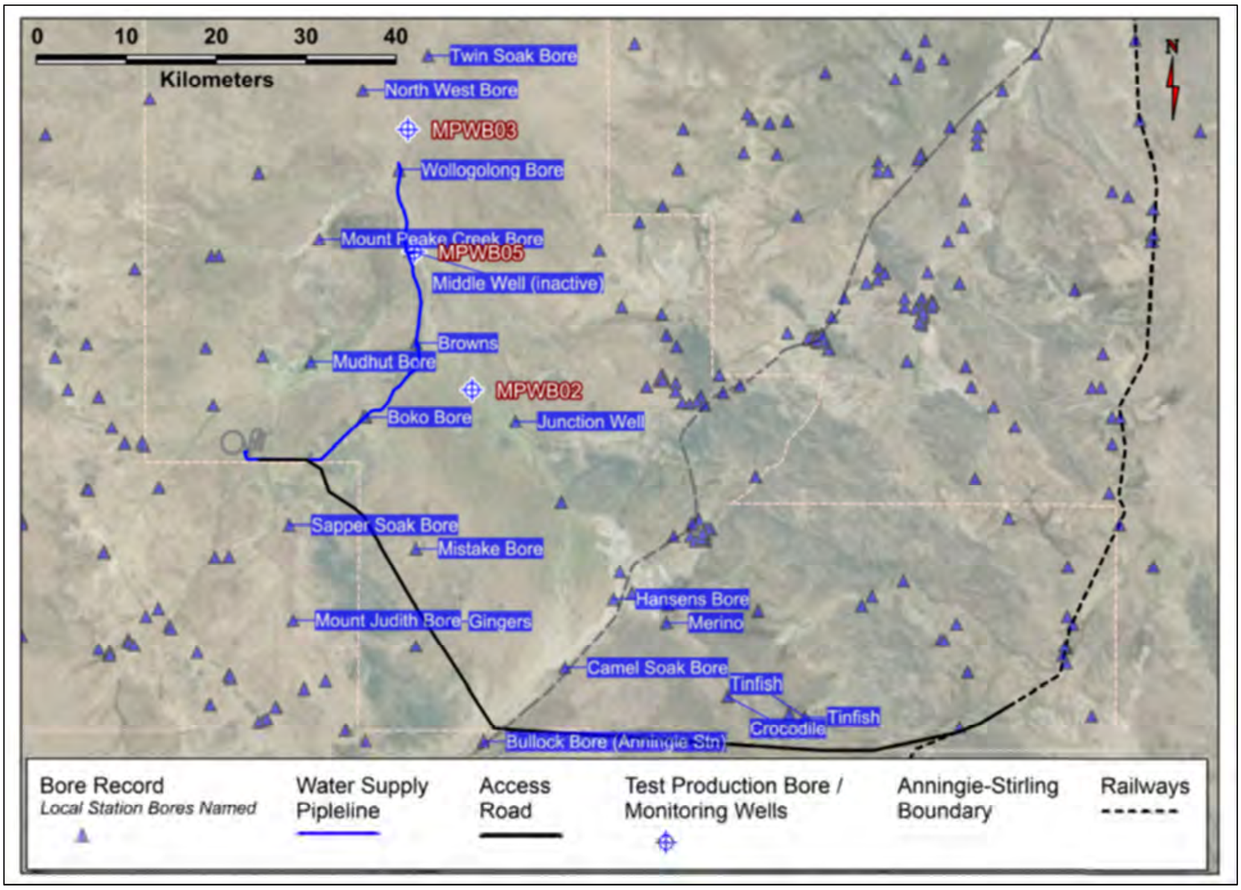



**Figure 7-11 Stock bores within and around the Project area**

TNG has considered potential impacts on these bores when assessing drawdown impacts from the mine site and from the borefield.

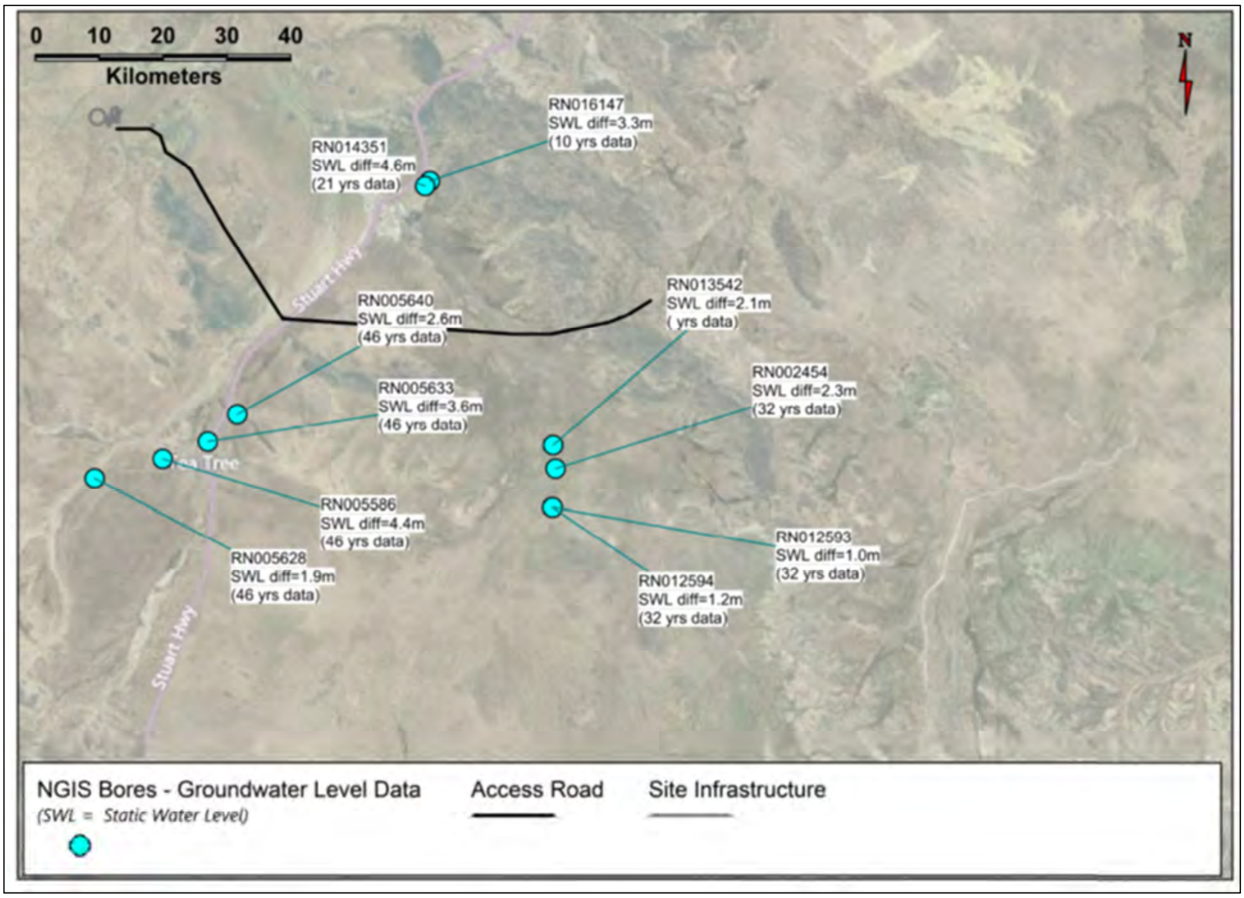
Within the Project area, there are also a number of groundwater abstraction bores for public water supply. These include supply for Stirling Station homestead, Barrow Creek and the Wilora community. All these locations have dedicated bores that provide a permanent water supply. The Wilora community is supplied with groundwater with an existing licence for 40 ML/year (issued to the Power and Water Corporation). Barrow Creek service station is licensed for 1 ML/year. No current licence data is available for Stirling Station homestead.

In addition to anthropogenic needs, groundwater dependent ecosystems also occur in the region. Stirling Swamp, located north of the access road comprises a large network of claypans, lignum swamp, semi-saline samphire and temporary open water, and the adjacent Hanson River. Stirling Swamp is thought to be connected to groundwater through a topographic low forming a 'window' to the relatively shallow Ti Tree aquifer water table. This area is therefore considered a discharge zone of the Ti Tree aquifer. Mud Hut Swamp is located approximately 7.7 km north of the mine site. It is formed from a flood-out of the Bloodwood Creek and, based on its location as an outflow of the creek, it is unlikely that the swamp is maintained by groundwater. There are no known permanent or semi-permanent water holes along the Hanson River, with any pools formed through surface water flow. These are relatively short lived as they are subject to evaporation and drain to the underlying aquifer.

### Groundwater levels and recharge

Developing an understanding of the baseline groundwater levels is required to assist in determining the potential for Project related impacts. It is important to understand the seasonal and temporal changes of groundwater levels.

An interrogation of the NRETAS bore database highlighted the lack of bores close to the Project that have a good record of current and historic groundwater levels. Sites where groundwater level data is available are presented on Figure 7-12.




### Figure 7-12 Sites with groundwater level data

For some of these sites a good record of groundwater levels is available. Groundwater levels tend to vary by between 2 and 4 m, with the data highlighting the response of the aquifers to large river flow and flood events. Data from the bores indicates that groundwater between these locations has a gradient to the north, comparable to the general topographic elevations.

Aquifer recharge predominantly occurs from direct infiltration of rainfall. Due to the sporadic and minimal amount of rainfall typical of the region, this volume is quite low. Large rainfall events and subsequent flooding is known to significantly increase groundwater levels in areas close to active flow channels. However, a lack of monitoring data for the Hanson River channel means that recharge volumes for this system cannot be accurately quantified.

### Project specific groundwater investigations

Two groundwater investigations were undertaken for the Project. One was associated with the proposed mine pit and the other assessed groundwater supply potential of the Hanson River palaeovalley.

An investigation of groundwater potential in the area of the pit was undertaken in March 2014 through airlifting of existing exploration holes. The airlifting program aimed to determine the likely groundwater in-flow to the pit area and whether there may be sufficient volumes of water available for mine site water use. This testing also allowed the determination of indicative aquifer parameters through the analysis of groundwater recovery data at each test site.

Eleven holes were assessed at locations both within and adjacent to the pit area. Groundwater occurred at a depth of around 20 to 22 mbgl with salinity generally between 6000 and 8000 mg/L TDS. During air-lifting of the exploration holes, low volumes of groundwater were able to be purged with only a low flow volume sustained in five of the sites at rates less than 12 L per minute.

The testing demonstrated that alternative sources of water would be required as there will be insufficient volumes available from the pit to meet Project requirements. From a management perspective, the mine pit is unlikely to be subject to significant groundwater inflow and there is no indication that the pit will require substantial dewatering infrastructure.

A second groundwater investigation was undertaken in March 2015 to assess the groundwater supply potential of the Hanson River palaeovalley. Drilling locations were determined by TNG at targeted locations along the existing Hanson River and at maximum distances from existing stock bores. Drilling locations and field results are presented in Figure 7-13.

Groundwater levels were found to be relatively consistent between sites along the Hanson River palaeochannel at a depth of around 10 mbgl. Water quality was brackish to saline, however this was not considered to be an issue as the main use of the water would be for ore processing which has no salinity restrictions. All drilled bores intersected a sequence of sands and gravels to varying thicknesses overlying a variable basement. In general, an upper silty unit was identified above a coarser grained sand and gravel unit (main aquifer). All bores produced significant water during drilling and 150 mm wells were constructed and pump tested at all sites. Highest yields were found at MPWB01 and as a result a test production bore was installed at this location (MPWB05). A test pumping program was completed on the constructed bores following completion of the drilling program. The key pumping test was on the production bore (MPWB05), which included monitoring of the adjacent monitoring well (MPWB01). The analysis of the 48-hour pump test data allowed the determination of aquifer properties and recommendations for operational pump rates of 8.5 L/s for the production bore. Due to the favourable drilling results, an indicative borefield location was chosen (Figure 7-13).

The results of the desktop assessment and field investigations provide an understanding of the Project region and were used to inform the development of a site conceptual and numerical groundwater model discussed in the following section.

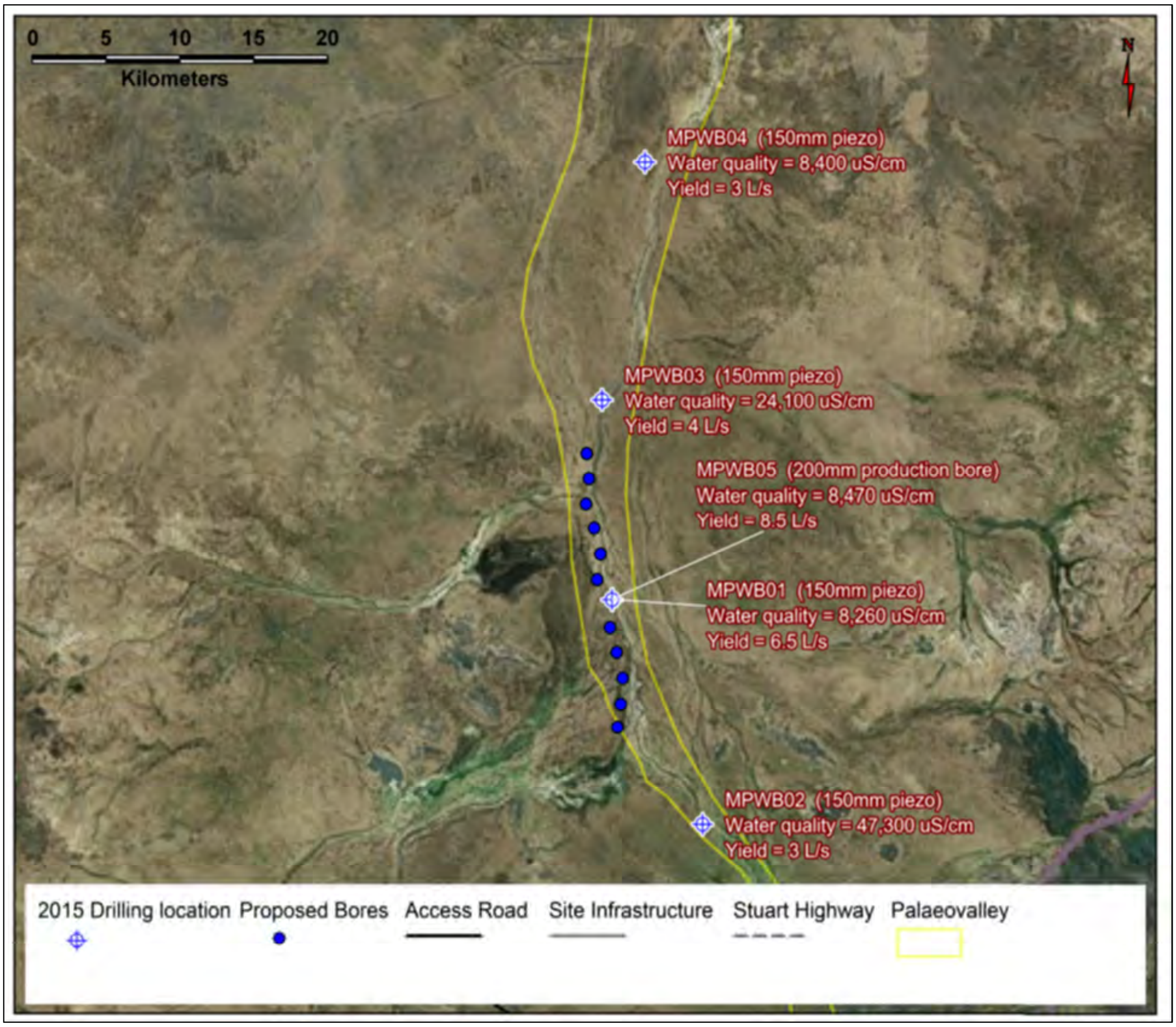



**Figure 7-13 Groundwater drilling locations for a potential water supply associated with the Hanson River palaeovalley**

## 7.4.2 Groundwater Model

### Groundwater model configuration

Groundwater flow modelling was undertaken to assess the cumulative impact of the operation of the borefield and pit dewatering on nearby groundwater users, such as stock bores and potential groundwater dependent ecosystems. The conceptual hydrogeological model developed was based on the available data, maps and reports to provide a framework for numerical model development. The conceptual model incorporated two broad layers, these being the:

- mine site - weathered rock underlain by the fresh rock; and
- palaeovalley area - silty/sandy clay underlain by silty sand/gravel aquifer.

A four layer numerical model was developed to predict the potential cumulative impact of mine dewatering and water supply. The four layers represent the following:

- Layer 1 represents the extent of the weathered zone in the bedrock outside of the palaeovalley and sandy-silt layer in the palaeovalley;
- Layer 2 represents a transition zone between the weathered bedrock and fresh bedrock in the area outside of the palaeovalley and lower sand aquifer in the palaeovalley;
- Layer 3 represents fresh bedrock (igneous and metamorphic) in the area outside of the palaeovalley and sedimentary rock (claystone/sandstone) in the palaeovalley; and
- Layer 4 represents fresh bedrock throughout the model domain in order to account for the potential vertical flow into proposed mine pit.

The four layer model has been graphically conceptualised in Figure 7-14.

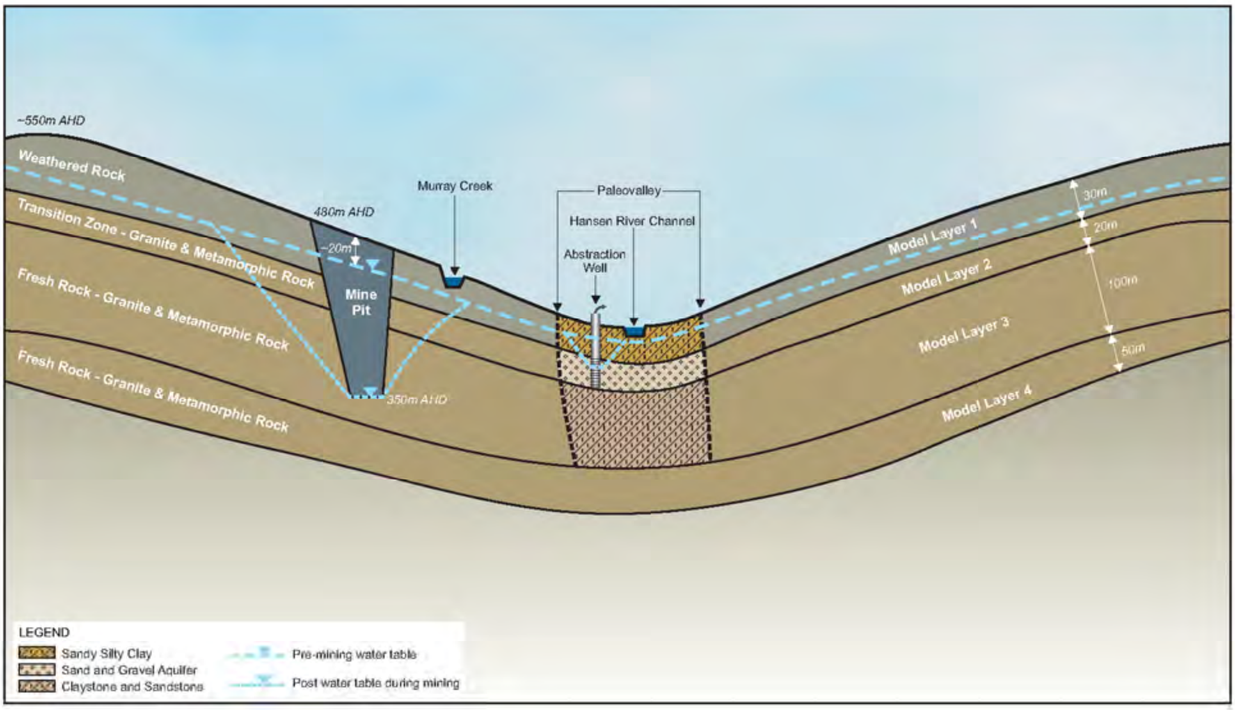



**Figure 7-14 Conceptual hydrogeological model**

The industry standard numerical groundwater flow modelling code MODFLOW-USG (Pandey *at el.* 2013) was employed to predict groundwater flow. Groundwater Modelling System (GMS v 10.1) was used as a graphical user interface (GUI) for pre and post processing of the data.

Whilst a one or two dimensional model could offer simplified results, taking into account the overall considerations of the Project, a more detailed and defensible three-dimensional model was selected for the simulations. A three-dimensional model was selected as groundwater flow is anticipated in all three directions. A relatively large model domain was chosen, with the model extending approximately 84 km in the east-west direction and 92 km in the north-south direction. The grid size was chosen to be 50 m in the area of the proposed mine location, 200 m in the area of the proposed borefield and 800 m towards the boundaries. The model extent is shown in Figure 7-15.

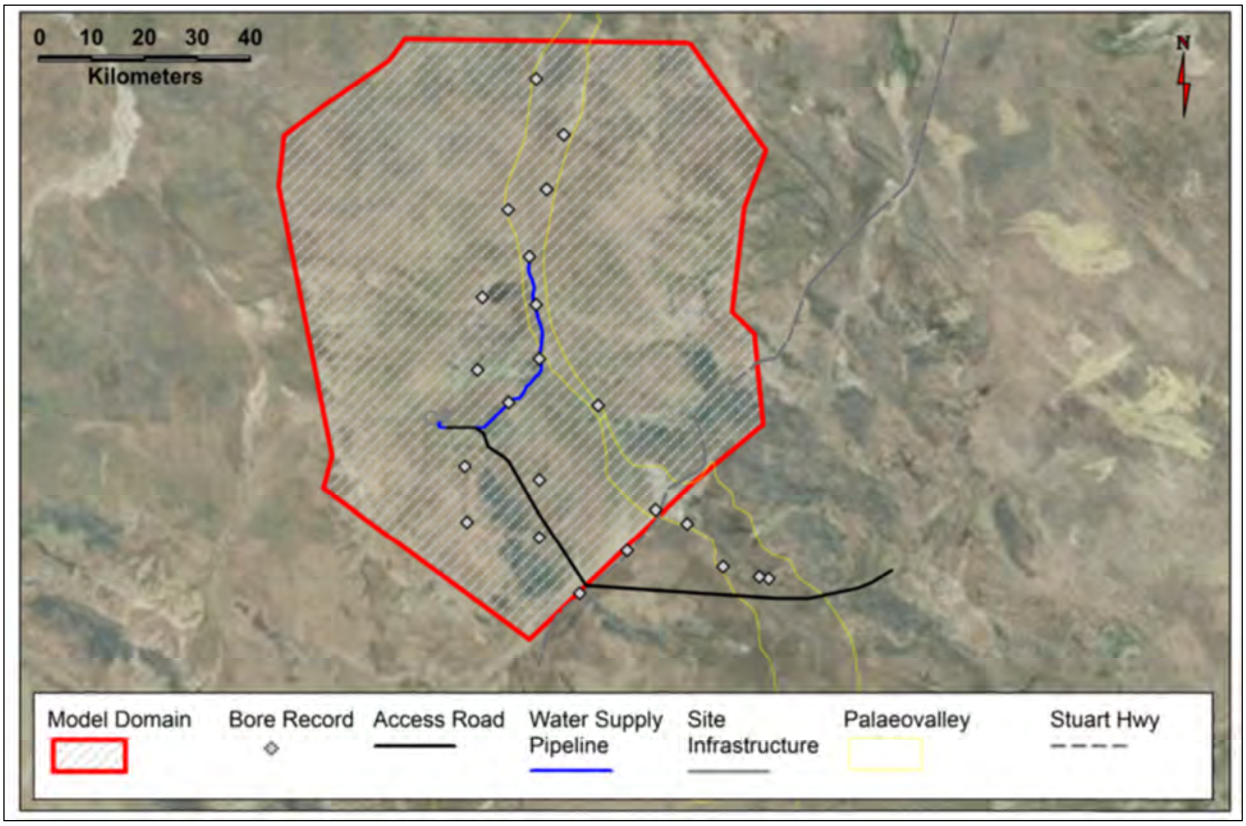



**Figure 7-15 Groundwater model domain**

Layer thicknesses, hydraulic properties and boundary conditions were determined based on resource drilling within and around the mine site, groundwater drilling and testing in the palaeovalley and lithology data from historic drilling. Both steady state and transient modelling was undertaken. No temporal discretisation was applied to the steady state model, however the transient model used to predict the impact of groundwater pumping from the palaeovalley and pit is assigned with stress periods ranging from 1 year (with 12 time steps) to 60 years (with 30 time steps).

The steady state model was calibrated to fit historical water level observations. Model parameters and boundary conditions were changed to match the measured head with the modelled head. Of note, depth to groundwater in the area of Mud Hut Swamp was modelled as being 15 to 20 mbgl (i.e. conceptually the swamp is not connected to the regional groundwater system).

The model was applied in transient state mode to assess the maximum potential drawdown of the palaeochannel aquifer through borefield abstraction and from incremental pit development. This allowed the simulation of both drawdown and recovery in annual increments over a period of 100 years. The drawdown was assumed to occur over 17 years, with two years of mine pre-production (this is conservative as there will be limited borefield extraction and no pit dewatering during this timeframe) followed by 15 years of mining). Following cessation of mining the model was run for a further 83 years to predict groundwater level recovery. Borefield operation assumed a two stage abstraction volume, with the first stage operating at an abstraction rate of 1.6 GL/year (51 L/s) for the first five years. For the second stage (from year 6 to 17), abstraction was increased to 2.6 GL/year (82 L/s).

### 7.4.3 Groundwater Impact Assessment

#### Predicted groundwater impacts during mining

The area proposed for the Mount Peake Borefield falls within the Western Davenport Water Control District but outside of the Surface Water Catchment Divide that defines the main aquifer for the District. The aquifer to be tapped for Mount Peake is not connected with the main Western Davenport Plains aquifer. It does occur down gradient from the Ti Tree aquifer, but at a distance of around 100 kilometres (i.e. extraction from the Mount Peake borefield area will not affect the Ti Tree aquifer.

The predicted maximum drawdown impacts from the Project (both borefield operation and pit dewatering) are illustrated for year 17 in Figure 7-16.

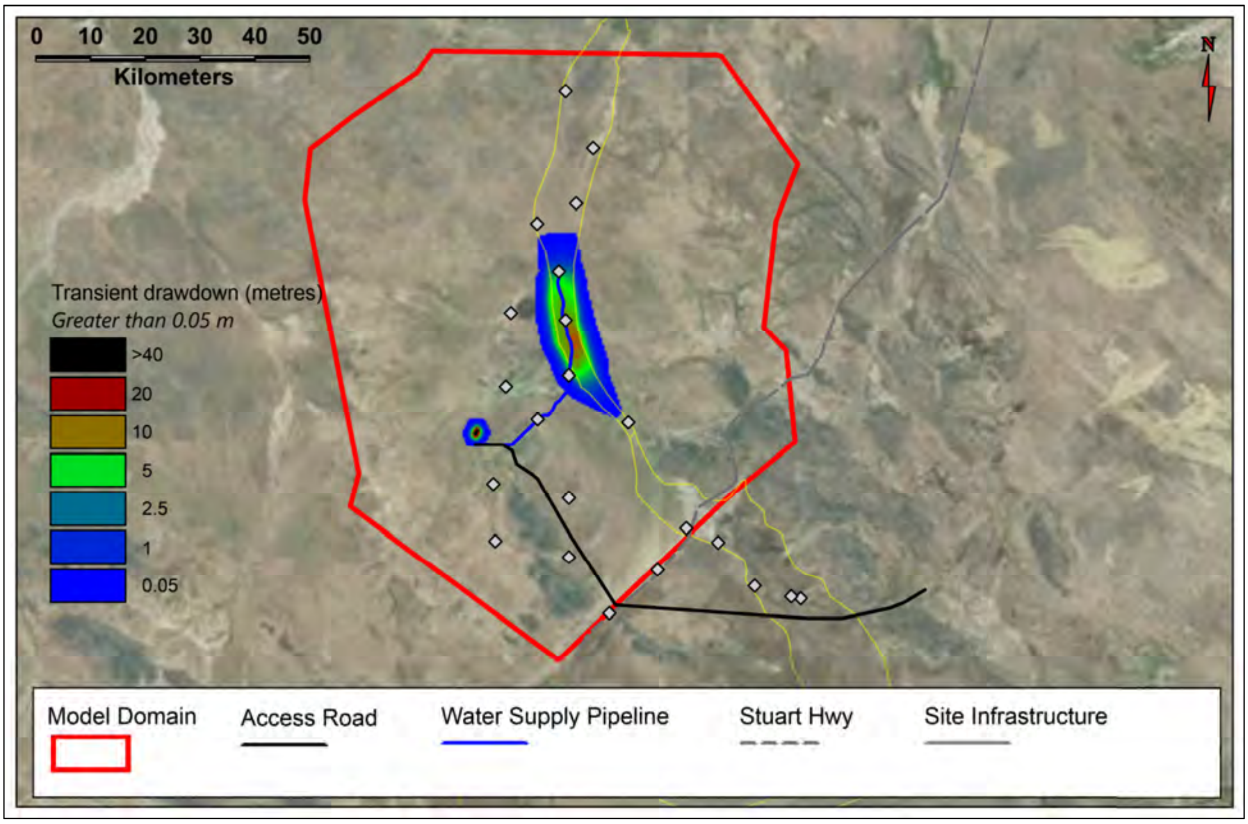



**Figure 7-16 Predicted drawdown at end of operation (year 17)**

For the mine site, drawdown contours less than 50 m have been plotted. Within the pit, drawdown under transient conditions is predicted to reach 100 m at the conclusion of operation (17 years) and rapidly decrease with distance from the pit. The 1 m drawdown contour was predicted to occur approximately 1 km from the pit edge, with the predicted limit of drawdown (0.05 m) a further 1 km from this. As such, no drawdown impacts at 17 years from the mine pit are expected for potential groundwater sensitive receptors such as Mud Hut Swamp. Similarly, Stirling Swamp and the outflow of the Ti Tree basin will also not be impacted by either borefield abstraction or pit dewatering based on the modelling results.

Maximum groundwater drawdown at the borefield at the end of mining is modelled as being up to 12 m at the location of the operating bores in the centre of the borefield. Drawdown decreases significantly with depth away from the palaeovalley. Although the 1 m drawdown contour extended to around 6 km south of the borefield, this was still a considerable distance (approximately 28 km) from the inflow zone around Stirling Swamp.

The modelling predicts selected pastoral wells (Browns and Wollogolong Bores) are likely to be impacted by borefield operation. These wells are the two closest pastoral wells to the borefield and are expected to have groundwater levels reduced by up to 3.2 m. Although this may lead to water supply problems for these wells, they could be deepened to accommodate this temporary lowering of groundwater level at these locations. The predicted impact to the remaining active pastoral wells in proximity to the borefield is less than a 0.05 m drawdown in groundwater level.

### Predicted groundwater impacts post mining

Figure 7-17 presents a plot predicting groundwater level changes over time at a location on the edge of the palaeovalley aquifer. This figure illustrates groundwater levels are slow to recover, largely due to the conservatively low levels of recharge assumed in the model. For locations outside of the palaeovalley, some minor increased drawdown is expected after cessation of abstraction, due to a lag effect.

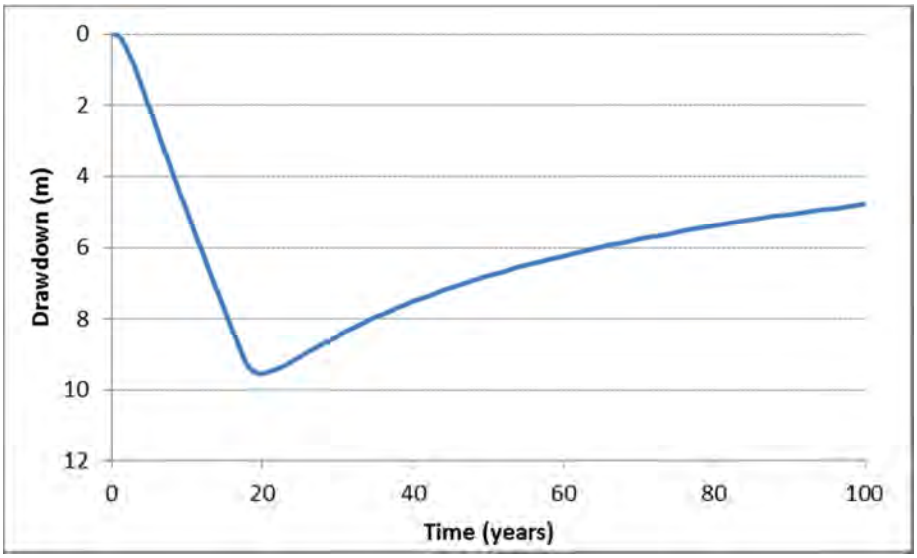



**Figure 7-17 Drawdown and recovery at edge of palaeovalley aquifer**

Predicted drawdown 100 year following Project commencement is presented in Figure 7-18. The 100 year drawdown plot represents the drawdown and subsequent recovery at the borefield and drawdown around the pit after cessation of mining/abstraction for 83 years.

Although drawdown within the immediate vicinity of the borefield has recovered to generally less than 5 m, the extent of drawdown increases slightly as groundwater from storage reserves drain to the area of the recovering borefield.

In the area of the mine site, the extent of drawdown increases slightly with respect to the 17 year drawdown. The 1 m drawdown contour extends to around 3.5 km from the mine pit. Although noting an increase in drawdown extent, the Project is still unlikely to impact sensitive receptors such as Mud Hut Swamp.

The model predicts a pit lake will form in the mine void following cessation of mining. The predicted inflow to the pit is expected to be relatively low, reflective of the low permeability of the pit wall. Modelling suggests the pit lake water levels would stabilise after about a year, at around 365 mAHD, equivalent to around 10 m deep at its deepest part with inflow becoming equal to evaporation. The pit lake will become increasingly saline as salts from groundwater, surface water and rainfall accumulate. By around 7 years post-closure a salinity of around 35,000 mg/L is predicted.

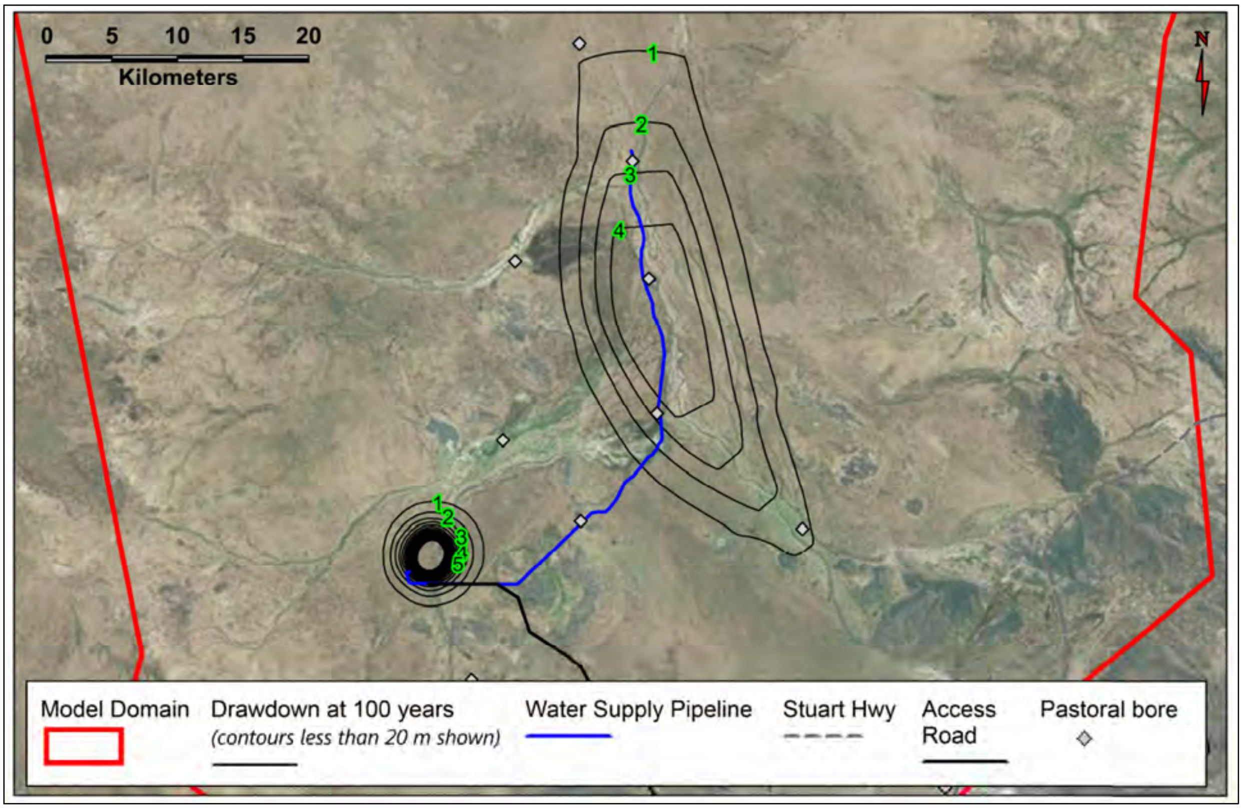



**Figure 7-18 Predicted drawdown at 100 years**

### 7.4.4 Borefield Monitoring and Adaptive Management

In addition to the production bores, a groundwater monitoring network will be installed to ensure that aquifer performance can be measured and adapted where necessary. This is essential to safeguard the water supply for the life of the mine whilst ensuring that impacts are minimised. The monitoring network will be consistent with, and complementary to, the borefield design. The monitoring network will be constructed in stages in parallel with production bores. The ultimate monitoring network will include the following:

- a monitoring well located at each production bore. These will be the investigation holes for each site. The monitoring well will be used to determine aquifer properties from the pump testing and ongoing performance of the aquifer immediately adjacent to the production bore site. One monitoring well has already been established at production bore WB05 (monitoring well WB01);
- approximately four monitoring wells located between selected production bores to determine the aquifer response to pumping and the cumulative impacts from bores;
- the installation of monitoring bores to the north and south of the borefield to assist in determining the impacts up and down gradient of the borefield. This is important as it will show impacts on station wells located close the borefield (for example Browns Bore), and to monitoring for potential saline ingress to the borefield from the known high salinity area in the south; and
- the use of existing bores in regional locations outside the modelled extent of drawdown as control bores. These bores are already in place (WB02 & WB03).

## 7.5 Water Contamination and Management

Most aspects of the Project have some potential to cause water contamination, such as, but not limited to the ore stockpiles, waste landforms including the waste rock dump (WRD), magnetite stockpiles or TSF. Potential release mechanisms for water contamination include:

- erosion of disturbed surfaces;
- inadequate stormwater/runoff separation;
- leaching from WRD and long term stockpiles;
- seepage from the TSF;
- inadequate treatment of waste water prior to discharge; and
- accidental spills.

Key environmental receptors and endpoints potentially sensitive to changes in water quality include:

- receiving aquatic systems (waterways, wetlands, groundwater recharge zones, aquifers);
- fauna and livestock (consumption); and
- humans (recreation and consumption).

TNG has developed an Erosion and Sediment Control Plan (ESCP) and Water Management Plan to monitoring and manage potential water related impacts during operation. The follow provides an overview of some of the details included in these documents.

### Ore stockpiles

Extracted ore will be transported to the Run of Mine (ROM) pad for direct processing or to long-term stockpiles. The mineral resource is hosted by a mafic intrusive rock (a gabbro sill) and the orebody comprises the magnetite-rich portion of the sill. The intrusive rock is oxidised resulting in there being negligible magmatic sulphide within this material. Geochemical investigations by TNG have confirmed the orebody does not contain significant Acid Mine Drainage (AMD) materials, with geological logging rarely encountering visible sulphides and, when so, they were in the order of ~2% of the sample over a few metres. Generally the sulphides seen are associated with structural zones and faults/fractures. Accordingly, the ore body is considered to be benign and the ore stockpiles should not pose any discernible risk to sensitive receptors and endpoints. TNG will undertake periodic testing of the stockpiled ore to confirm the absence of potentially acid forming (PAF) material during mining operations.

Runoff separation will be established for ore stockpiles through bunding and drainage ditches to retain runoff from the stockpiles and to prevent inflow of external drainage to the sites. Runoff from the ore stockpiles will be contained and directed to appropriately sized sedimentation ponds for managed release to the environment. Details of these management measures are detailed as part of ESCP.

### Waste Rock Dump

A WRD will be developed for the life of mine and located west of the pit within a zone characterised by flat topography. The landform will be designed to be safe, geotechnically stable and non-erodible. The WRD will feature benches to collect stormwater drainage and provide access for closure cover installation, reclamation activities and maintenance. Stormwater collected on benches will be conveyed to a surface water collection and sedimentation pond, which will collect and treat runoff prior to either reuse around the site or discharge to the environment.

The material to be stockpiled in the WRD is likely to have well below 1 wt% sulphide content, while the gabbro ore has a lower sulphide content (less than 0.5 wt% sulphide). This sulphide content will not generate a significant AMD issue. Therefore, the WRD should not pose any discernible risk to the identified receptors and endpoints.

TNG will also complete periodic testing of the WRD to confirm the benign nature of this material.

### Concentrate Stockpiles

The Project will produce magnetite concentrate which will be stored in stockpiles at the processing plant and at the Adnera Loadout Facility. Material Safety Data Sheet (Midas METS 2014) identifies that the magnetite ($Fe_3O_4$) product exhibits low risk with regards to health, flammability, reactivity and contact. Although the concentrate is considered inert and non-toxic and does not constitute a threat to identified receptors and endpoints, a key hazard relates to high level prolonged exposure to dust which may cause lung or airway irritation.

The magnetite concentrate is non-toxic to flora and fauna, insoluble, chemically stable and not regulated for transport (Midas METS 2014). Dust emissions will be managed via the concentrate having an inherent moisture content, use of sprays and dust collection systems and covering concentrate loads during transport. Runoff from the concentrate stockpiles will be contained and the drainage water will be recovered and recycled for dust suppression or processing purposes. Details of the management measures are provided as part of a site Water Management Plan.

### Tailings Storage Facility

The tailings stream will consist of non-magnetic silts and sands and will be dewatered using a flocculant in a tailings thickener. The potential hazard of the flocculant to humans is low and there are no known ecotoxicological effects. Water from the surface of the TSF will be decanted to a sump for transfer to the process water dam. All rainfall on the surface of the TSF and internal face of the bund wall will be contained and recovered via an underdrainage system. Runoff from rainfall on the external face of the bund wall will be collected in a drainage ditch and conveyed to an appropriately sized sedimentation pond for managed release to the environment.

The TSF will be unlined but will be constructed with under-drains, toe drains and over drains connected into the sump. There is potential for seepage loss, therefore boreholes will be constructed and monitored to assess the potential interaction between the TSF and the surrounding environment. Details of the management measures and monitoring are detailed in the site Water Management Plan.

Based on the non-toxic nature of the tailings, the impacts from seepage are expected to be negligible. However, as the waste water streams from the multi-media filters and the brackish water reverse osmosis plant will be discharged to the process water dam, there is potential for salt concentrations to build up within the process water cycle resulting in the salinity of the tailings stream increasing over time. Further, cleaning agents used for the filters could also be present in the tailings stream, albeit at extremely low concentrations.

TNG will complete periodic testing of the tailings stream to confirm the stability of the material during the mining operations.

### Other Potential Sources of Water Contamination

In addition to the key Project aspects listed above, other features also have a potential to adversely impact water quality. Saline drainage from mine operations, explosives, chemical and hydrocarbon use and storage are other potential sources of water contamination associated with the Project. The ESCP and/or Water Management Plan provide the management actions proposed to mitigate risks.

## 7.6 Summary of Impacts and Conclusions

### 7.6.1 Surface Water

The Project site comprises numerous ephemeral dendritic drainage systems with a number of smaller watercourses originating out of rocky outcrops into the surrounding plains. The access road will cross Murray Creek, Wood Duck Creek and the Hanson River. Sites of Conservation Significance occur in the Project area, with Mud Hut Swamp, located in the floodout area of the Bloodwood Creek, and Stirling Swamp (Anmatyerr North Site), an interim floodout area for the Hanson River. Sediment sampling was undertaken to characterise sediment quality as a proxy for water quality given the infrequent nature of flow events within the region. Surface water and sediment samples will be collected prior to mining commencing to better characterise the Project area.

There are potential surface water impacts associated with the access road. TNG will construct at-grade floodways at Murray Creek and the Hanson River, so that natural streamflow and geomorphological processes are maintained. As there is no evidence of a single specific drainage line associated with Wood Duck Creek and surface flows in this vicinity are likely to present as sheet flow, TNG will install regularly spaced and appropriately sized culverts at this location. Sheetflow is also likely to occur along the access road within the alluvial plains to the east of the Stuart Highway. No specific drainage lines have been defined and regularly spaced and appropriately sized culverts will be installed across the access road to prevent the creation of sheetflow shadow zones.

A preliminary flood risk assessment indicates the mine site is not expected to experience any significant flooding for events up to the 50-year ARI. However, a bench of lower lying topography in the vicinity of the proposed mine pit may be prone to flooding during more extreme events. Further investigation is required to establish the need for flood protection measures in this area.

### 7.6.2 Groundwater

The predominant aquifer type in the vicinity of the pit is comprised of fractured and weathered rocks with minor groundwater resources. Accordingly, dewatering is not expected to yield adequate water for mine operations and alternative sources of water were investigated.

A borefield is proposed on the western bank of the Hanson River. The dominant geological unit here is alluvial deposits of a relict fluvial system largely covered by sheet sand and alluvial/red soil plain deposits. The increased thickness relates to the incised channels of the palaeodrainages of the Hanson River. This system is thought to be the northern discharge of the Ti Tree Basin, passing through Stirling Swamp and connecting with the existing Hanson River Channel. Utilisation of the Hanson River palaeovalley is currently limited to stock bores. Aquifer recharge predominantly occurs from direct infiltration of rainfall. Due to the sporadic and minimal amount of rainfall typical of the region, this volume is quite low. Large rainfall events and subsequent flooding is known to significantly increase groundwater levels in areas close to active flow channels.

Groundwater flow modelling was undertaken to assess the cumulative impact of the operation of the borefield and pit dewatering on nearby groundwater users (stock bores and potential groundwater dependent ecosystems). The MODFLOW-USG model configured in three-dimensional mode was used for simulations of both drawdown and recovery in annual increments over a period of 100 years (17 years of abstraction followed by 83 years of recovery). This also allowed the staging of the borefield operation to be assessed.

The modelling shows there will be groundwater draw down associated with the borefield and mine pit. Maximum groundwater drawdown at the borefield at the end of mining is modelled as being up to 12 m at the location of the operating bores in the centre of the borefield. Drawdown decreases significantly with depth away from the palaeovalley. The 1 m drawdown contour extends to around 6 km south of the borefield. At the end of mining, drawdown reaches a maximum of around 100 m within the location of the pit, and rapidly decreases with distance from the pit. The 1 m drawdown contour is predicted as being approximately 1 km from the pit edge, and the approximate limit of drawdown (0.05 m) a further 1 km from this.

Drawdown is predicted at several pastoral bores located close to the borefield, with groundwater levels expected to experience a drop in water level of greater than 3.0 m, which may lead to water supply problems. However it is proposed these wells could be deepened, if required.

Modelling predicts that Stirling Swamp and the outflow of the Ti Tree basin are unlikely to be impacted by either borefield abstraction or pit dewatering. Similarly, no drawdown impacts are expected at Mud Hut Swamp.

Following cessation of mining a shallow pit lake is predicted to form.

### 7.6.3 Contamination

The following is noted with regard to the ore and waste characterisation:

- the ore body and overburden have low sulphide contents and are considered benign in terms of potential acid formation, so the waste rock dump and ore stockpiles should not pose any discernible risk to the identified receptors and endpoints;
- the magnetite concentrate is inert and non-toxic and does not constitute a threat to identified receptors and endpoints; and
- the tailings stream will consist of non-magnetic silts and sands and will be dewatered using a flocculant in a tailings thickener. The potential hazard of the flocculant to humans is low and there are no known ecotoxicological effects.

A variety of chemicals and reagents will be used to facilitate construction and operation of the Project and will include explosives and hydrocarbons. Standard storage and handling measures will be implemented to reduce the hazards associated with these products. The Project will not use any environmentally hazardous chemicals that require special storage or handling.

To further reduce potential impacts to the environment, TNG has developed an ESCP and Water Management Plan to support this Project. The ESCP provides a framework for managing the risk of erosion and release of sediments to receiving environment and the contamination of stormwater. The Water Management Plan for mine operation has a particular focus on mine affected water to be retained within the mine water system.

Where there is the potential for the Project to release water to the environment, for example from high level overflow from sediment basins, water storage ponds and the tailings storage facility, TNG will apply for a Waste Discharge Licence from the NT EPA.

# 8. Biodiversity

## 8.1 Flora and Vegetation

### 8.1.1 Introduction

This chapter describes the flora and vegetation of the Mount Peake Project area and assesses the potential for impact to local and regional biodiversity during the construction and operation of the Project.

A detailed report is provided in Appendix G.

### 8.1.2 Methodology

#### Desktop review

Prior to completing field survey a desktop literature and database review was undertaken to gain an understanding of the ecological context of the Project area. Data reviewed included existing broad scale vegetation mapping, land system data, aerial photography, land unit mapping and flora records from NT and Commonwealth ecological databases.

#### Field survey

The vegetation and flora survey was undertaken in April 2013. Flora survey techniques used were consistent with the *Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping* (Brocklehurst *et al.* 2007).

The study area included the proposed mine area, accommodation area, a 1 km wide corridor along the proposed access road and the proposed rail siding facility. Field survey of the proposed borefield, associated pipeline and access road, and road base borrow pit areas were not undertaken as part of this assessment as the locations of these features were not known at the time of the survey.

The study area was first divided into relatively homogenous or discrete vegetation zones using existing vegetation mapping, aerial imagery and lithological data sets. Forty five survey locations were then randomly distributed within each vegetation zone. Data and information was collected through quadrats at each survey location which included habitat information, level of site disturbance, flora species (including introduced and threatened species) and structural information. Further assessments were collected through secondary check sites, aerial surveys and opportunistic collections.

### 8.1.3 Results

#### Desktop assessment

**Burt Plain Bioregion**

The Mount Peake Project will be located entirely within the Burt Plain Bioregion, which is characterised by plains and low rocky ranges with extensive areas of mulga and other acacia woodlands. The bioregion covers an area of 73,605 square kilometres which represents approximately 5% of the Northern Territory (NRETAS 2005). Less than 0.3% of the bioregion is reserved in National Parks and other conservation reserves.

Pastoralism represents the major industry in the bioregion, with pastoral leases occupying approximately 82% of the land area (Neave *et al.* 2006).

Soils of the bioregion are generally shallow sands and massive earths. The bioregion is dominated by undulating plains which are interrupted by major drainage lines associated with terraces and levees, and sporadic hills and rocky ranges. Several ephemeral rivers drain the rocky ranges and flow through the bioregion in a northerly direction into the Tanami Desert.

Five broad vegetation communities have been mapped within the bioregion (Wilson *et al.* 1990), the most abundant being Acacia woodland. Other broad communities include Eucalyptus low woodland with tussock grass understory, Eucalyptus woodland with hummock grass understory, Hummock grassland and Tussock grassland (NRETAS 2005).

The bioregion is known to contain more than 1,100 flora species with three listed as vulnerable under the *Territory Parks and Wildlife Conservation Act 2009* (TPWC Act), with one also listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). Additionally 64 species listed as data deficient, 41 listed as near threatened in the NT and seven listed as endemic to the bioregion have been recorded (Neave *et al*. 2006).

There are 16 sites of botanical significance within the bioregion, three of these, Anmatyerr North, Mud Hut Swamp and Wood Duck Swamp, occur within or near to the study area (Neave *et al.* 2006).

Potential and existing threats to biodiversity identified within the bioregion include exotic flora, introduced animals, fire, erosion, land clearing, pastoralism and mining (Neave *et al.* 2006). Exotic predators are widespread and fifteen declared weed species are known to occur. Other exotic plants species, most notably buffel and couch grass, also pose significant threats to some habitats.

The Burt Plain Bioregion is comprised of four sub-regions. The study area occurs mostly within the Burt Pain 1 subregion with a small portion in the south located within the Burt Plain 2 subregion. These subregions have been assessed as being in mostly good condition with native vegetation cover exceeding 90%. A high proportion of both subregions however, have been impacted by grazing and exotic flora species (particularly Buffel Grass) (Neave *et al.* 2006).

**Hydrology**

The Project is located within the Wiso Surface Water Management Basin, which comprises numerous ephemeral dendritic drainage systems. Key water courses near to the Project include Murray Creek, Bloodwood Creek and the Hanson River. No wetlands within the bioregion are listed in the 'Directory of Important Wetlands in Australia' or under the 'Convention on Wetlands of International Importance' (Ramsar Convention). Mud Hut Swamp, located in the floodout area of Bloodwood Creek, Stirling Swamp (Anmatyerr North Site), an interim floodout area for the Hanson River, and Wood Duck Swamp, 10 km south of the access road and outside of the study area, are listed as wetlands of national conservation sigificance (NRETAS 2009).

**Land systems**

The Project area is covered by land system mapping of the Alice Springs area. A total of eight broad land systems have been mapped across the Project area. The majority of the area is covered by two lands systems, the Singleton system which is characterised by spinifex sand plains and the Bushy Park system which primarily consist of mulga plains on red earths.

**Flora of the Project area**

The Northern Territory Government flora records for the locality contain 1,392 records of 494 species (DLRM 2015). These records include one threatened flora species listed under the TPWC Act, the Dwarf Desert Spike-rush *Eleocharis papillosa*, which is also listed as vulnerable under the EPBC Act.

Database records for the locality include 1 vulnerable, 7 near threatened species[1], 6 endemic species and 13 species recorded as being data deficient[2]. A total of 16 exotic species have also been recorded. Table 8-1 provides a list of vulnerable, threatened and data deficient species previously recorded in the locality. The locations of vulnerable and near threatened flora are shown on Figure 8-1.

Ten threatened plant taxa are known to occur in the Burt Plain bioregion. Eight of these are listed under the TPWC Act and four are listed under the EPBC Act. Based on an assessment of habitats present it is unlikely that any of these species occur in the Project area.

No EPBC Act-listed Ecological Communities occur within or near the Project area.

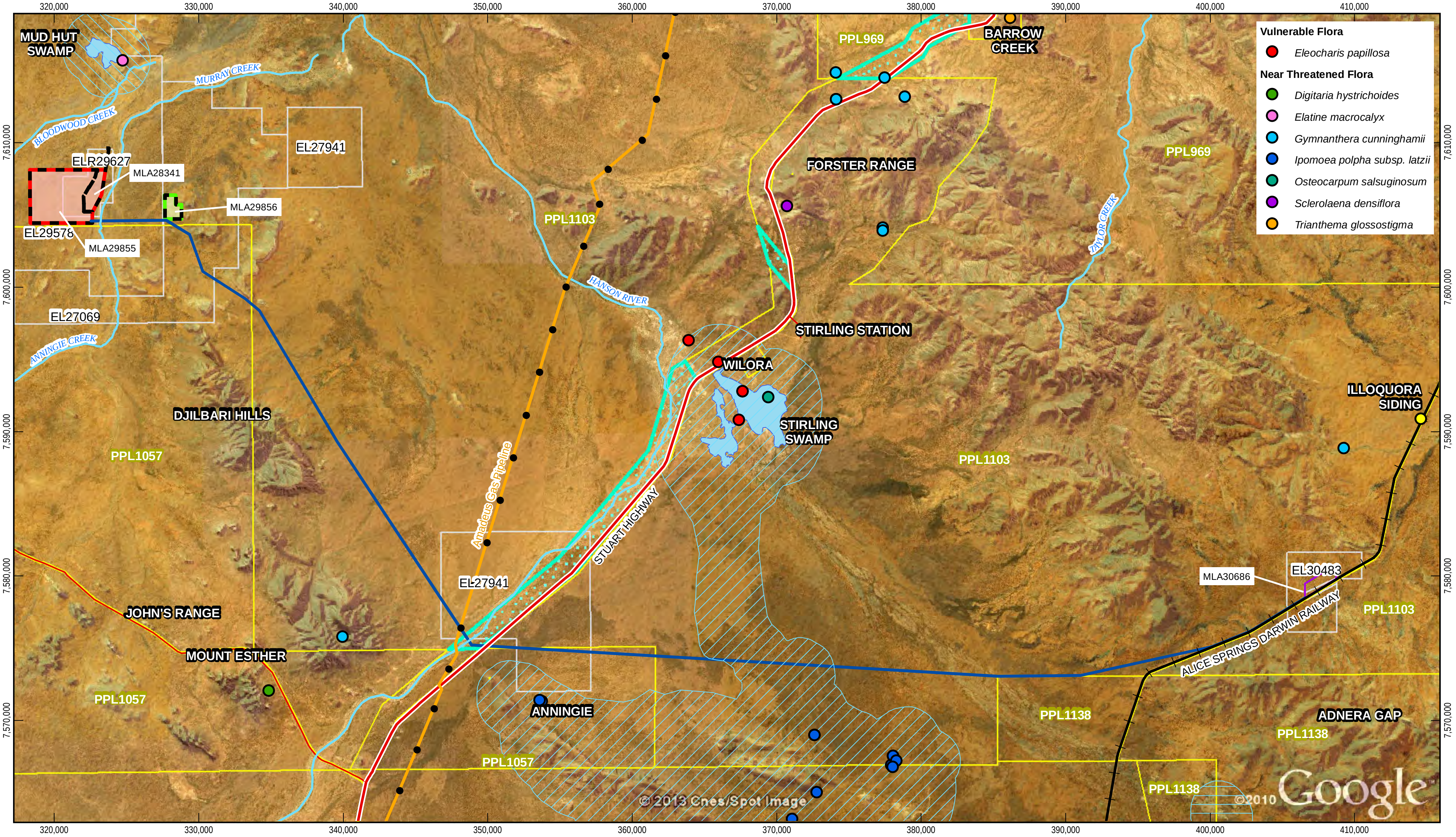
### Table 8-1 Threatened flora records within the locality

| Scientific name | Common name | TPWC Act Conservation Status | EPBC Act Conservation Status | Number of records within locality |
|---|---|---|---|---|
| *Eleocharis papillosa* | Dwarf Desert Spike-rush | V | V | 5 |
| *Goodenia cylindrocarpa* | - | dd | - | 3 |
| *Lawrencia viridi-grisea* | - | dd | - | 2 |
| *Brachyscome ciliaris* | Variable daisy | dd | - | 13 |
| *Ectrosia schultzii* var. *schultzii* | - | dd | - | 3 |
| *Acacia oswaldii* | Umbrella Wattle | dd | - | 4 |
| *Acacia incurvaneura* | - | dd | | 2 |
| *Acacia pteraneura* | Mulga | dd | | 1 |
| *Eriachne* sp *Davernport Ranges* | | dd | | 3 |
| *Triumfetta chaetocarpa* | Urchins | dd | - | 2 |
| *Triumfetta deserticola* | | dd | | 1 |
| *Ixiochlamys nana* | | dd | | 2 |
| *Peplidium foecundum* | | dd | | 1 |
| *Swainsona acuticarinata* | | dd | | 1 |
| *Bulbostylis pyrifolmis* | | nt | | 1 |
| *Ipomoea polpha* subsp. *latzii* | Giant Sweet Potato | nt | - | 11 |
| *Gymnanthera cunninghamii* | - | nt | - | - |
| *Osteocarpum salsuginosum* | - | nt | - | 1 |
| *Sclerolaena densiflora* | - | nt | - | 1 |
| *Spartothamnella puberula* | | nt | | 2 |
| *Trianthema flossostigma* | | nt | | 2 |

Key: V = vulnerable, dd = data deficient, nt = near threatened

[1] Under IUCN criteria this conservation category is defined as taxa that do not meet the criteria for Critically Endangered, Endangered or Vulnerable at present but is close to qualifying for or is likely to quality for a threatened category in the near future.

[2] Under IUCN data deficient taxa are defined as species where there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status.




Paper Size A4

0 2.5 5 7.5 10

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

- Illoquora Siding
- Principal Road
- Minor Road
- Major Watercourses
- Railway
- Amadeus Gas Pipeline
- Mud Hut Swamp
- Rail Siding Loading Facility
- Mount Peake Mining Area
- Crown Land
- Mount Peake Granted Tenements
- Mount Peake Mineral Leases
- Cadastral Boundaries
- Access Road
- Camp Facilities
- Anmatyerr North Site of Conservation Significance
- Mud Hut Swamp Site of Conservation Significance
- Wood Duck Swamp Site of Conservation Significance

TNG Ltd
Mount Peake EIS

## Flora and Sites of Conservation Significance

| | |
|---|---|
| Job Number | 61-29057 |
| Revision | A |
| Date | 20 Nov 2015 |

# Figure 8-1

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239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au



Data source: NRETAS - Vulnerable Flora 2013; TNG - Site of Conservation Significance, Gas / Slurry Pipeline Study Corridor, Camp Facilities, Transport Study Corridor, Mount Peake Mining Area, Mount Peake Granted Tenements (2015). Geoscience Australia - Waterways, mainland, placename, road (2008). Google Earth Pro - Imagery (Date extracted: 13/02/2014). Created by: RB

**Sites of Conservation Significance**

There are 67 Sites of Conservation Significance (SOCS) across the NT, and there is broad community recognition of the importance of long term protection of conservation values within these sites. Three SOCS are located within or near the study area (Figure 8-1):

- Mud Hut Swamp is located approximately 7.7 km to the north of the proposed mine pit. Mud Hut Swamp is a large, isolated, gum-barked coolabah (*Eucalyptus vitrix*) swamp that is fed by Bloodwood and Murray Creeks in the south-east and runoff from low hills and rises to the north and west (NRETAS 2009). This is the largest swamp in the Burt Plain bioregion and remains inundated for a relatively long time after flooding, possibly retaining water for several months (NRETAS 2009). The swamp is likely to support a range of wetland birds, fish and plants. Mud Hut Swamp is listed in the "*Inventory of sites of international and national significance for biodiversity values in the Northern Territory*";
- the Anmatyerr North site includes Stirling Swamp, a large wetland complex comprised of claypans, lignum swamp, semi-saline samphire and temporary open water as well as parts of the adjacent Hanson River (NRETAS 2009a). The Anmatyerr North site is located across Stirling, Anningie and Ahakeye Stations and extends to the low rocky ranges about 20 km south of Stirling Swamp to encompass the known extent of the near threatened Giant Sweet Potato (*Ipomoea polpha* subsp. *latzii*) as well as a population of the threatened Dwarf Desert Spike-rush (*Eleocharis papillosa*). Stirling Swamp is noted to form occasionally at the northern edge of the Ti Tree Basin, storing flood waters discharged from the Hanson River and the ridges to the east of Wilora. This area is believed to act as an evaporation area for the basin (NRETAS 2009a); and
- Wood Duck Swamp is located approximately 10 km south of the access road, outside of the study area. Wood Duck Swamp is an ephemeral swamp that may hold water for many months in an otherwise dry landscape. It fills periodically after heavy rain. The swamp is dominated by smooth-barked coolabah *Eucalyptus victrix*. It is one of the largest such swamps in the Burt Plains bioregion (NRETAS 2009b). Wood Duck Swamp is located entirely on the Mount Skinner pastoral lease.

### Field Survey

**Flora species**

A total of 238 species of flora were recorded within the study area, comprising 233 native species and five exotic species. This represents approximately 22% of all flora species know to occur in the Burt Plain bioregion.

The Poaceae (grass family, 47 species: 45 native, 2 exotic), Fabaceae (pea family, 47 species: 46 native, one exotic), Malvaceae (19 native species) and Amaranthaceae (20 native species) were the most species-rich families recorded.

Flora species recorded and their associated vegetation communities are relatively common in the region with the exception of a few species. Species richness is relatively high with highest diversity recorded in areas of rocky outcrops (43 ± 2) and mulga shrublands (38 ± 6) although plant species were well represented across the study area with a mean species richness of 32 plant taxa per quadrat.

Seventy-seven species recorded during the survey had not previously been recorded on the DLRM database for the locality. These new records combined with the existing NT Government flora records takes the total flora records for the locality to 571 species.

The full list of plant species recorded is presented in Appendix G.

#### Nationally and state significant flora

No flora species listed as threatened under the TPWC Act or EPBC Act were recorded.

The EPBC PMST and NT herbarium database results indicate that one threatened flora species (*Eleocharis papillosa*, Dwarf Desert Spike-rush) listed as vulnerable under both the TPWC Act and EPBC Act has been recorded within the Project locality.

Dwarf Desert Spike-rush occurs within freshwater and semi-saline ephemeral wetlands, with above-ground plant material emerging from tubers in response to inundation or flooding (DSEWPaC 2008). There are several records of Dwarf Desert Spike-rush from Stirling Swamp, approximately 12 km to the north of the proposed access road. A review of the habitat requirements and ecology also indicates that there is habitat for this species within and surrounding Mud Hut Swamp which is situated approximately 7.7 km north of the proposed mine pit.

The survey identified one species listed as data deficient (*Euphorbia ferdinandii*) under the TPWC Act. *E. ferdinandii* is an upright, sparsely branching herb, up to 30 cm tall. Four records of *E. ferdinandii* were recorded within the study area, all of which were located in Mulga shrubland and Triodia grassland communities along the proposed access road.

#### Near threatened flora

No flora species classified as near threatened were recorded within the study area, however six species listed as near threatened have been recorded within the Project locality.

Based on a review of habitat requirements and ecology for these species it is likely that one of these species (*Ipomoea polpha* subsp. *latzii)* will occur. Furthermore based on the presence of suitable habitat, there is also a possibility that the following near threatened species may occur:

- *Elatine macrocalyx*;
- *Gymnanthera cunninghamii*;
- *Digitaria hystrichoides*; and
- *Sclerolaena densiflora.*

#### Endemic flora

No flora species endemic to the Northern Territory were recorded.

#### Regionally significant flora

Four species listed as having bioregional conservation significance were recorded. These species have conservation significance due to being either at the limit of their range or being a disjunct population in the bioregion (DLRM 2015). These species and their regional conservation codes are listed in Table 8-2.

**Table 8-2 Species with bioregional significance recorded within the study area**

| Species Name | Common Name | Regional Conservation Code DLRM 2015) |
|---|---|---|
| *Acacia murrayana* | Colony Wattle, Murrays Wattle | BRT (northern range limit) |
| *Eucalyptus trivalvis* | Victoria Spring Mallee | BRT (eastern range limit) |
| *Sclerolaena calcarata* | Red Copper Burr, Red Burr | BRT (disjunct), MAC (disjunct) |
| *Spartothamnella teucriiflora* | Mulga Stick-plant, Scented Stick-plant | BRT (northern range limit) |

### Groundwater dependant ecosystems

Serov *et al.* (2012) defines GDEs as 'ecosystems which have their species composition and natural ecological processes wholly or partially determined by groundwater'. GDEs are known to occur in almost every environment across the landscape including terrestrial dry land, freshwater, marine and subterranean environments.

Wetlands within the Project area have the potential to be maintained by groundwater. Stirling Swamp is located to the north of the access road. The swamp area is formed from a large network of claypans, lignum swamp, semi-saline samphire and temporary open water, and the adjacent Hanson River. The site also forms part of the Anmatyerr North SOCS (Duguid *et al.* 2005). Stirling Swamp is thought to be connected to groundwater through a topographical low forming a 'window' to the relatively shallow Ti Tree aquifer. This area is thus a discharge zone of the Ti Tree aquifer.

Mud Hut Swamp is located approximately 7.7 km to the north of the mine site. The swamp is formed from a flood-out of the Bloodwood Creek (Duguid *et al*. 2005). Based on its location as an outflow of the Bloodwood Creek, it is unlikely that the swamp is maintained by groundwater (GHD 2015a).

There are no known permanent or semi-permanent water holes along the Hanson River, with any pools formed through surface water flow. These are relatively short lived as they drain to the underlying aquifer and are subject to evaporation.

Eucalyptus trees can access water in deep soil layers and access groundwater by extending roots to the water table. Given the intermittent nature of creek and drainage lines within the study area, Riparian woodlands are also likely to be at least partially dependant on groundwater.

### Introduced flora species

Five exotic flora species were recorded:

- *Cenchrus ciliaris* (Buffel Grass);
- *Citrullus lanatus* (Bitter Melon);
- *Eragrostis tenuifolia* (Elastic Grass);
- *Tribulus terrestris* (Caltrop); and
- *Vachellia farnesiana* (Mimosa bush).

One of these species (*Tribulus terrestris*) is listed as a Class B (spread must be controlled) and Class C (not to be introduced to the NT) noxious weeds under the NT Weeds Management Act. This species was found in low abundance throughout all vegetation communities within the study area. It is likely that this species is spread by cattle and vehicle movement.

No weeds of national environmental significance (WONS) were recorded.

Introduced flora species, including *Tribulus terrestris* occur in relatively low abundance across the study area. The most abundant exotic species recorded was *Cenchrus ciliaris* (Buffel Grass) which occurs in moderate densities (5 - 25% cover abundance) along creeks and major drainage lines as well as in low abundance (0-5% cover abundance) through the remaining vegetation communities.

Areas of Riparian woodland along watercourses and drainage channels also commonly contain scattered individuals of the exotic species *Vachellia farnesiana* and *Citrullus lanatus.*

### Vegetation communities

Native vegetation within the study area is generally in moderate to good condition. High to moderate level impacts from pastoral activities (trampling, grazing and weed invasion) are localised and generally confined to watering points, ephemeral watercourses, wetlands and stockyards. There are numerous cleared tracks, but little other evidence of vegetation clearing. Although low level grazing impacts are evident, vegetation is generally healthy with active seedling recruitment. Some modification to vegetation structure from fires is evident, particularly within Mulga shrublands and Triodia grassland communities.

The study area contains a high level of vegetation/habitat heterogeneity (diversity) including hummock grasslands, shrublands and riparian woodlands. This is largely due to the variety of landforms (watercourses, alluvial plains, eolian plains, alluvial foothill fans, rocky hills).

Based on the fine-scale vegetation mapping and flora sampling, eight broad vegetation communities were identified as occurring within the Project area. Vegetation communities have been described in accordance with the NVIS framework to hierarchical Level V: (Association). The communities are summarised in Table 8-3 and their distributions shown in Figure 8-2. Detailed descriptions of each community are provided in Appendix G.

The dominant communities are Mulga shrublands, which occur on alluvial fans and plains containing clayey red earths and Triodia hummock grasslands which grow on sandy plains and undulating hills. Vegetation across the study area is generally in good condition with little anthropologic disturbance and high species richness. In more fertile riparian areas and associated floodplains there is clear evidence of impacts associated with cattle grazing including weed invasion, reduction in ground cover species and soil erosion. In particular there is a high abundance of the invasive grass *Cenchrus ciliaris* (Buffel Grass).

**Table 8-3 Vegetation communities within the study area**

| Veg. code | Vegetation community | NVIS Description (Level III broad floristic formation) | Area (ha) |
|---|---|---|---|
| VT 1 | Low open Eucalyptus woodland on limestone | Triodia hummock grassland | 775 |
| VT 2 | Mulga shrubland on sandy red earths | Acacia shrubland | 11,885 |
| VT 3 | Riparian woodland along watercourses and drainage channels | Eucalyptus open woodland | 554 |
| VT 4 | Low Corymbia woodland on loamy alluvial plains | Tussock grassland | 675 |
| VT 5 | Floodplains dominated by *Eucalyptus victrix* | Eucalyptus open woodland | 609 |
| VT 6 | Triodia grassland on sandy plains | Triodia hummock grassland | 8,115 |
| VT 7 | Low Acacia shrubland on rocky slopes | Triodia hummock grassland | 441 |
| VT 8 | Tall Acacia shrubland on stony quartz | Acacia shrubland | 223 |
| **Total** | | | **23,278** |

### Nationally and regionally significant vegetation communities

No nationally significant vegetation communities were recorded.

Dominant vegetation communities within the study area include mulga on red earths, woodlands on alluvial flats and hummock grasslands on sand plains. Most of the communities are well represented within the Burt Plain Bioregion, however less than 1% of the Burt Plain bioregion is conserved and thus vegetation communities within the study area are poorly represented in conservation reserves.

A number of less common vegetation communities occur in small patches or along linear drainage lines. These include Riparian woodland (VT 3) dominated by bean trees (*Erythrina vespertilio*) and Tall Acacia shrubland on stony quartz (VT 8).


Paper Size A3

0 5 10 15

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

- Flora Survey Locations
- Check Sites
- Rail Siding Loading Facility
- Mount Peake Mining Area
- Camp Facilities
- Access Road Corridor
- Tracks (Unverified)
- Major Watercourses
- Principal Road
- Minor Road

**Vegetation Communities**

- 1 Low open Eucalyptus woodland on limestone ridges
- 2 Mulga shrubland on sandy red earths
- 3 Riparian woodland along watercourses and drainage channels
- 4 Low Corymbia open woodland on loamy alluvial plains
- 5 Floodplains dominated by *Eucalyptus victrix*
- 6 Triodia grasslands and sandy plains
- 7 Low Acacia shrubland on rocky slopes
- 8 Tall Acacia shrubland on stony quartz

TNG Limited
Mount Peake EIS

| | |
|---|---|
| Job Number | 61-29057 |
| Revision | A |
| Date | 13 Nov 2015 |

Vegetation communities
recorded within the study area **Figure 8-2**

G:\61\29057\11 GIS\Maps\MXD\EIS_MDS\6129057_005_VegCommunities_Overview.mxd

999 Hay Street, Perth WA 6000 Australia **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com **W** www.ghd.com



Data source: TNG - Gas / Slurry Pipeline Study Corridor, Camp Facilities, Transport Study Corridor, Mount Peake Mining Area, Mount Peake Granted Tenements (2013). Geoscience Australia - Waterways (2008). Google Earth Pro - Imagery (Date extracted: 13/02/2014). GHD - Tracks, Flora Survey Sites, Vegetation Communities (2014). Created by: CM

The NT Land Clearing Guidelines identify a number of sensitive or significant vegetation communities to avoid clearing including rainforests, monsoon vine thicket, riparian or closed forests. Vegetation communities include the Riparian woodland that occurs along creeks and major drainage lines within the Project area.

Riparian vegetation is a key component of the catchment, providing a range of ecosystem services such as filtering contaminants and nutrients, providing habitat for flora and fauna and preventing soil erosion. The Riparian woodland vegetation community is a locally significant community.

Neave *et al.* (2006) provides an overview of important vegetation communities within the Burt Plain Bioregion. These include a number of wetlands and mesic areas, sites of botanical significance and flora and fauna hotspots. The study area does not contain any of these identified sites however Mud Hut Swamp and Stirling Swamp are located near to the study area and considered to contain important vegetation that should be protected during construction and operation of the Project.

Despite most of the vegetation communities within the study area being well represented in the bioregion, Neave *et al.* (2006) recognise that common communities can be regarded as having conservation significance if they meet any of the following criteria:

- habitat with high species richness that supports a high abundance of native species, and/or is structurally complex;
- habitat supporting species of high conservation values (e.g. threatened species, endemic species, poorly reserved species and/or rare species);
- habitat that is of good quality (i.e. its compositional and structural integrity and ecological processes have not been undermined); and
- habitat that is poorly reserved.

A number of vegetation communities within the study area partially meet these criteria as they are known to support threatened species, including brush-tailed mulgara, black-footed rock-wallaby and grey falcon, which were detected during fauna surveys within or near the Project area (GHD 2015b). All of these habitat types however are well represented in the region and the Project area is not considered to provide unique habitat for any of these species.

### 8.1.4 Potential Impacts

The proposal has the potential to impact on flora and vegetation, or exacerbate existing threatening processes, through:

- clearing of flora and vegetation and associated loss of habitat during construction;
- alteration of hydrological regimes associated with earthworks and construction activities, and associated changes to land surface areas, and/or impediments to surface flows;
- groundwater drawdown and/or changes to groundwater flows impacting groundwater dependent ecosystems;
- contamination of surface and/or groundwater;
- introduction and/or spread of invasive exotic flora species;
- changes to fire regimes;
- dust emissions from construction, mining and processing activities; and
- erosion and sedimentation resulting from vegetation clearing during construction.

### Clearing

Approximately 1,058 ha will be disturbed for construction of the pit, waste rock dump, tailings storage facility, accommodation village, access roads, mine infrastructure, stockpile sites and the Adnera Loadout Facility. The location and area of borrow pits still needs to be determined.

Mapped areas of each vegetation community to be impacted by the Project (1,008 ha) are provided in Table 8-4. Vegetation clearing in these communities will involve removal of a moderately diverse range of non-threatened native plants, including mature trees.

### Table 8-4 Vegetation communities impacted by the Project

| Veg code | Vegetation community | Area to be impacted[1] | % of Project area |
|---|---|---|---|
| VT 1 | Low open Eucalyptus woodland on limestone | 8.35 | 0.83 |
| VT 2 | Mulga shrubland on sandy red earths | 420.25 | 41.68 |
| VT 3 | Riparian woodland along watercourses and drainage channels | 2.90 | 0.29 |
| VT 4 | Low Corymbia woodland on loamy alluvial plains | 4.61 | 0.46 |
| VT 5 | Floodplains dominated by *Eucalyptus victrix* | 0 | 0 |
| VT 6 | Triodia grassland on sandy plains | 558.58 | 55.40 |
| VT 7 | Low Acacia shrubland on rocky slopes | 3.50 | 0.35 |
| VT 8 | Tall Acacia shrubland on stony quartz | 10.00 | 0.99 |
| **Total** | | **1008.19** | |

[1] these impact areas do not include vegetation disturbance associated with the borefield and associated pipeline

In addition to the clearing areas included in Table 8-4 the proposal will result in approximately 50 ha of disturbance within the borefield area and associated pipeline and access track. Within this area approximately 20 ha has already been cleared for existing access tracks. The proposal will therefore result in the clearing of an additional 30 ha of native vegetation. The borefied will disturb around 1 ha adjacent to the Hanson River with an 11 ha disturbed to accommodate the pipeline and access track. Although this area was not assessed during the field survey a review of geological and topographic information as well as aerial imagery suggests that vegetation within this area is primarily Triodia grassland on sandy plains (VT 6), Low Corymbia woodland on loamy alluvial plains (VT 4) as well as a small amount of Riparian woodland along water courses (VT 3). A preclearance survey will be undertaken prior to any clearing works in the area to assist in the final location of infrastructure and ensure that no significant or sensitive vegetation communities will be impacted by clearing.

The remaining 18 ha to be cleared is for the pipeline and access track that runs between the borefield and the Raw Water Dam. The majority of this vegetation is likely to include Triodia grassland on sandy plains (VT 6) and Mulga shrubland on sandy red earths (VT 2). There may also be small areas of Riparian woodland along watercourses and drainage channels (VT 3).

No vegetation communities listed as threatened under the EPBC or TPWC Act will be cleared.

The average species richness within vegetation communities present within the Project area varies from 17 within Mulga shrublands (VT 2) to 31 within Riparian woodlands (VT 3). None of the vegetation communities are considered to have high species richness or structural complexity. Vegetation communities present are well represented in the Burt Plain Bioregion.

The two most common vegetation communities within the Project area are Triodia grassland on sandy plains (VT 6) and Mulga shrublands on sandy red earths (VT 2). Together these vegetation communities comprise 97 % of the vegetation proposed to be impacted.

Fifty-five percent of the Project area is comprised of Triodia grassland on sandy plains. This vegetation community best corresponds to vegetation Map Unit 76 – *Triodia pungens* (Soft Spinifex), *Plectrachne schinzii* (Curly Spinifex) hummock grassland with Acacia tall sparse-shrubland overstorey, which covers an area of 1,098,704 ha or 23.17% of the Burt Plain bioregion (Wilson *et al.* 1990, Pert 2006). Removal of 558 ha of this community will represent less than 0.05% of this community within the bioregion.

Mulga shrublands on sandy red earths comprise 41% of the Project area. This vegetation community corresponds to the vegetation Unit 65 – *Acacia aneura* (Mulga) tall open –shrubland with *Eragrostis eriopoda* (Woollybutt) open grassland understorey. There is approximately 2,771,054 ha of this vegetation community mapped within the Burt Plain Bioregion (*Wilson et al.* 1990, Pert 2006). Removal of 420 ha of this community will represent approximately 0.01% of this community within the bioregion.

There are a number of less common vegetation communities that occur in small patches or along linear drainage lines throughout the study area. These include Riparian vegetation (VT 3) dominated by bean trees (*Erythrina vespertilio*) and Tall Acacia shrubland on stony quartz (VT 8). These communities are not considered to be rare or threatened at the national or region scale.

Management measure will be adopted to minimise direct and indirect impacts to flora and vegetation during construction and operation (section 8.1.5).

### Alteration of hydrological regimes

Vegetation in riparian zones and floodplain areas are likely to be at least partially dependent on surface water flows. The construction of linear infrastructure such as access roads and pipelines has the potential to interfere with natural surface water flows by blocking or disrupting the movement of water across the landscape. These potential impacts are likely to be most significant where the access road crosses the Hanson River and in areas within the borefield area adjacent to the Hanson River.

The Project may also impact surface water flows through changes to areas of inundation, concentration of flows and/or disruption to sheet flow regimes. Changes to flow pathways may change the flow regime experienced by downstream receptors. Flow pathways include drainage channels, distributed channels and sheet flow areas. The key receptors that are vulnerable to changes in environmental flows are vegetation communities that are at least partially dependent on surface water flows including sheet flow (i.e. Mulga shrubland) and the riparian vegetation within drainage channels and Mud Hut Swamp.

Approximately 37% of the Project area is comprised of floodplains and plains that will be subject to seasonal inundation or surface water flows. A reduction in surface water flows has the potential to result in the death of understorey species and also overstorey mulga shrubs during low rainfall periods and may in the long term lead to alterations to community composition (Anderson and Hodgkinson 1997).

Management measure will be adopted to maintain existing hydrological regimes during construction and operation (section 8.1.5).

### Groundwater drawdown

A new borefield will be established within the alluvial aquifer of the Hanson River. Six supply bores with two standby bores will provide water for the first four years of the Project with an additional four bores installed from year 5. Bores will be spaced approximately 1,800 m apart and will pump at around 8.5 L/s each. The Project will result in progressive water table drawdown from groundwater extraction.

Changes to the water table can lead to changes in surface vegetation and habitat characteristics. Lowering of the water table has the potential to cause the following impacts on vegetation and flora:

- decline in availability of water to ecosystems including riparian vegetation resulting in loss of habitat for species relying on riparian habitat; and
- potential impacts to the threatened species *Eleocharis papillosa* which is known to occur in Stirling Swamp.

Groundwater modelling was undertaken to predict the likely extent of groundwater drawdown from abstraction (GHD 2015a).

Maximum predicted drawdown contours for the borefield at the end of mining are shown in Figure 8-3. The maximum drawdown is modelled as being up to 12 m below current groundwater levels (which are 10 – 12 m below ground level) at the operating bores in the centre of the borefield. The 1 m drawdown contour extends to around 6 km south of the borefield.

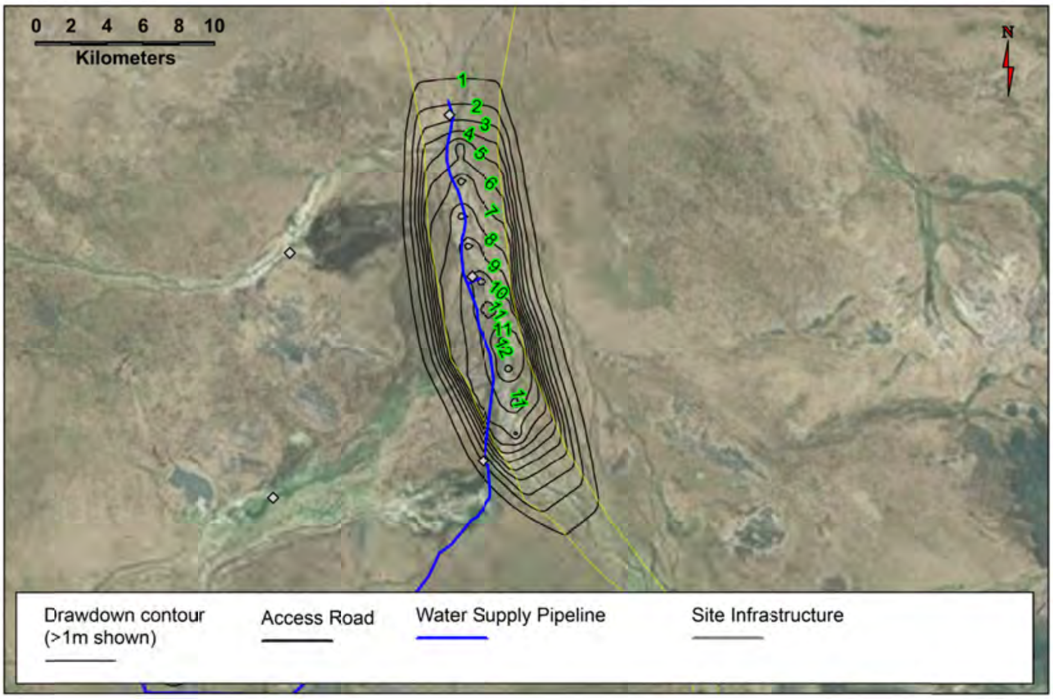



**Figure 8-3 Simulated groundwater levels for the borefield at the end of mining (contours are depths below current water table levels)**

A drawndown of 12 m below current groundwater levels is likely to result in impacts to groundwater dependent species. This will include *Eucalyptus camaldulensis* (River Red Gum) and *Corymbia aparreninja* (Ghost Gum) that line riparian areas within the Project area. A reduction in groundwater depth has the potential to starve these individuals of water and result in plant death and alterations in the structure of the riparian community.

Groundwater modelling indicates that groundwater levels in the area adjacent to Stirling Swamp and the outflow of the Ti Tree basin will not be impacted by abstraction (GHD 2015a). Mud Hut Swamp will also not be impacted by drawdown associated with pit dewatering (GHD 2015a).

Measures to minimise risks associated with lowering of the water table during groundwater extraction from the borefield will include:

- further predictive modelling to confirm the extent of groundwater drawdown;
- establishing a groundwater monitoring program to quantify drawdown during abstraction;
- monitoring vegetation potentially at risk of impact from a lowering of the water table; and
- if significant impacts are identified consider mitigation options. This could include modification of the pumping regime to manage groundwater levels.

### Contamination of surface and ground waters

There are several risks associated with the construction and operation of the Project that could lead to contamination of surface and groundwater. These include contamination of waterways or groundwater caused by embankment failure or overtopping and subsequent uncontrolled release from storage ponds, the processing site and the TSF. Inappropriate storage and handling of hazardous substances may also result in uncontrolled release, spills or passive discharge into drainage lines.

Geochemical investigations by TNG have not identified the presence of material within the orebody with significant Acid Mine Drainage (AMD) potential.

There are a number of sensitive riparian habitats close to the development footprint, including drainage lines, Bloodwood Creek (and onto Mud Hut Swamp), Murray Creek and the Hanson River. These areas are all sensitive receptors for any adverse impacts on water quality potentially arising from the Project. Vegetation and flora reliant on surface flows and groundwater uptake may also be impacted by surface water and groundwater contamination.

After closure, the mine void will act as a sink concentrating salts. Evaporation exceeds precipitation in the Project area so any lake that forms will be confined to the bottom of the pit.

Project design has incorporated a number of control measures to minimise the potential for the release of contaminants to the environment. These include storage of diesel at the mine site in self bunded tanks.

Within the flood plain of the Hanson River elevated drill pads will be constructed to ensure the well casings, headworks, generators and fuel tanks remain above the 100-year ARI level. Generators and fuel tanks at the borefield will be located within lined and bunded structures constructed on top of the drill pad with bunded storage sufficient to accommodate simultaneously an appropriate ARI wet season rainfall event and failure of a full fuel tank

The site has also been designed so that there will be no process or contaminated water stream discharged to the environment. Clean water will be diverted around the site.

### Introduced species

There is the potential for Project activities to introduce or spread of weeds via the transportation of seeds on vehicle tyres and machinery, movement or stockpiling of soil and inappropriate waste management.

A number of weed species are known to be present within the Project area. One of the exotic species (*Tribulus terrestris*), recorded during the survey is a declared weed under the *Weeds Management Act 2001* and buffel grass (*Cenchrus ciliaris*) has been identified as a high threat environmental weed in the Burt Plain Bioregion.

A Weed Management Plan (WMP) has been developed for the Project to minimise the risks associated with the introduction of spread of weeds throughout the site.

### Changes to fire regimes

Construction and operational activities, particularly hot works, are potential ignition sources, and could result in a bushfire. In addition, it may be necessary to conduct controlled burns to minimise fuel loads in the vicinity of the mine site. Without adequate fire management in place, there is potential for these activities to result in bushfires. Although wildfire has an influential role in arid zone ecology and is a necessary ecological process in some habitats, fire can have detrimental impacts on vegetation.

A Fire Management Plan has been developed for the Project.

### Dust emissions

The following activities are identified as potentially the main generators of dust for the Project:

- vehicle movements over unsealed surfaces;
- release of particulates from the handling and transport of materials and product;
- clearing of vegetation resulting in exposed soils that are more susceptible to wind erosion; and
- wind erosion mobilising dust from exposed surfaces such as the pit, waste rock dump, tailings storage facility, laydown areas, stockpiles and roads.

Dust deposition on leaf surfaces may physically affect individual plants such as by blocking and damaging stomata, and abrasion of the leaf surface or cuticle which may in term impact on metabolic processes. Dust could also contribute to cumulative effects such as drought stress on already stressed individuals which may in turn lead to the loss of individual plants.

Dust is unlikely to result in the loss of any vegetation communities within the Project area but may result in impacts on individual plants. It is unlikely that these impacts will be significant in terms of the relative numbers of plants that could be impacted, particularly if management actions are implemented to minimise the impacts of dust (e.g. watering of unsealed roads). Any impacts to vegetation from dust are likely to be relatively minor and largely restricted to areas close to the Project (50 to 100 m).

Industry standard dust control measures will be adopted for the Project.

### Erosion and sedimentation

There is potential for the Project to result in the loss of soils in areas that have been stripped of vegetation. Soil erosion has the potential to impact Murray Creek and the downstream Mud Hut Swamp through the release of sediments from site during flow events.

Potential water quality impacts may be associated with sediment runoff from disturbed areas, including vegetation clearing areas, construction lay down areas and access roads if risks are not effectively managed. Concentrated and/or altered water movement within the construction footprint could increase the potential for sediment mobilisation and transport. Negative effects on aquatic habitats may include increases in stream sediment load, changes in channel form and changes in stream hydrology. Infrastructure impinging on a stream channel may also cause increases in sediment input and consequent declines in water quality and stream habitat integrity.

Soil protection measures will be implemented during construction and operation including the implementation of an Erosion and Sediment Control Plan (section 8.1.5).

### 8.1.5 Flora and Vegetation Management Measures

Detailed Project design will consider options for locating infrastructure footprints to avoid or minimise vegetation clearing. In particular the Project will aim to avoid, where possible, direct impacts to sensitive vegetation communities such as riparian vegetation. However, the Project will result in some unavoidable residual impacts to flora and vegetation. These impacts are not expected to impose a significant negative effect on the local or regional occurrences of vegetation communities or flora species.

#### Construction phase

Land disturbance and vegetation clearing will be kept to as small an area as practicable. Construction personnel will be briefed during inductions regarding the conservation value of surrounding habitats and their responsibilities with regard to protecting these habitats during construction.

A preclearance survey of the borefield, pipeline route and borrow pit areas will be undertaken prior to any clearing works in the area to assist in the final location of infrastructure and ensure that no threatened species or significant or sensitive vegetation communities are impacted by clearing.

Engineering controls that assist in maintaining surface water flows have been incorporated into road designs to ameliorate potential risks to vegetation and flora due to changes in flow. Design features include installing at-grade flood ways where the access road crosses a water course and culverts to maintain flows under the access road where the drainage line is not well defined.

To control surface runoff and avoid erosion of the perimeter embankment of the TSF, collector drains will be constructed along the downstream toe of the embankment. These drains will collect clean surface runoff and direct the flow away from the TSF.

To limit impacts on riparian areas buffer widths recommended by the NT Land Clearing Guidelines will be adhered to where possible.

A CEMP which will include industry-standard measures for the management of soil, surface water, weeds and pollutants, as well as site-specific measures including:

- strategies to minimise vegetation clearance where possible;
- procedures for demarcating the limits of clearing and no-go areas;
- staged clearing of vegetation to minimise areas of bare ground and clear land only as required;
- strict vehicle hygiene protocols to prevent new weed incursion and spread, including a vehicle wash down facility on site;
- fire prevention management protocols to prevent wildfire during clearing activities;
- maintenance of fire breaks around high-risk areas/activities;
- use of already-disturbed areas (rather than undisturbed areas) wherever possible (e.g. lay down areas for construction);
- development and implementation of a land stabilisation and revegetation strategy;
- progressive revegetation of cleared land as activities are completed;
- application of industry standard dust control measures;
- an Erosion and Sediment Control Plan; and
- a Weed Management Plan.

### Operation phase

Measures to minimise risks associated with lowering of the water table during groundwater extraction from the borefield will include:

- further predictive modelling to confirm the extent of groundwater drawdown;
- establishing a groundwater monitoring program to quantify drawdown during abstraction;
- monitoring vegetation potentially at risk of impact from a lowering of the water table; and
- if significant impacts are identified consider mitigation options. This could include modification of the pumping regime to manage groundwater levels.

Weed control measures will include:

- regular monitoring of the Project area (including rehabilitated areas) and surrounding vegetation to identify new weed populations and monitor the effectiveness of weed control measures;
- vehicles and equipment inspected prior to entering the site if there is a risk of importation of soil, seed and plant material;
- vehicle access restricted to designated roads and access tracks;
- areas supporting existing weed infestations, or vulnerable to weed infestation, avoided where practicable;
- topsoil from weed affected areas stockpiled in a designated area with appropriate signage and bunding. Weed infested topsoil will be treated as required to eradicate weeds prior to re-spreading in rehabilitation areas;
- all staff and contractors informed of weed hygiene measures and weed reporting requirements during the site induction; and
- ongoing maintenance of erosion and sediment controls.

Fire management measures will include:

- development of a Fire Management Plan;
- welding, cutting and grinding works undertaken will require approval via an internal hot works permit;
- maintenance of fire breaks around high-risk areas / activities;
- all site personnel will be required to undertake fire control training, including the correct use of extinguishers;
- all vehicles are required to carry a fire extinguisher and two-way radio;
- emergency procedures; and
- active fire management, and the use of cool-season control burns if needed.

### Rehabilitation

Progressive rehabilitation undertaken over the Project area will be guided by the following principles:

- areas not required for ongoing operations will be progressively rehabilitated with local provenance native species;
- locate and design landforms to be rehabilitated to optimise blending with the surrounding topography;
- topsoil will be stripped and stockpiled in a designated area, to prevent erosion or run-off;
- minimise soil erosion particularly on the batters of the waste rock dump;
- stockpile vegetative material and topsoil for later use;
- minimise length of stockpiling of vegetation and topsoil;
- seeds collected for the rehabilitation program will be sourced locally, within a 20 km radius of the Project area, wherever possible;
- annual monitoring of rehabilitation areas will be undertaken prior to, and following completion of rehabilitation; and
- if monitoring identifies that completion criteria are not being met, additional rehabilitation and monitoring will be completed until such criteria are met.

Rehabilitated areas will be monitored to ensure the success of the rehabilitation programme and impacts from mining activities. Monitoring of rehabilitated sites will be undertaken annually until completion criteria have been met. Monitoring will assess species diversity, plant density and community structure against agreed completion criteria, which include:

- species richness, species diversity and plant density of the restored community exceeds the median in the range of values established for baseline vegetation communities; and
- dominant species in the restored community are also dominant in the baseline vegetation communities.

### Closure

A Conceptual Mine Closure Plan has been developed and will be refined as a component of the Mine Management Plan. The plan outlines general and area specific decommissioning and closure measures, completion criteria and post closure monitoring requirements for the Project. The Conceptual Mine Closure Plan aims to ensure that:

- mining is planned and carried out to ensure a sustainable mine closure outcome is achieved; and
- self-sustaining native vegetation communities are returned after mining, which in species composition and ecological function are representative of naturally occurring analogue sites.

A post-closure monitoring programme will be initiated, with the aim of confirming that rehabilitation and closure has been effective and the closure criteria satisfied. Post-closure monitoring will include assessments of public safety, geotechnical stability, physical stability, chemical stability and revegetation success.

### 8.1.6 Summary of Impacts and Conclusions

The current survey identified 238 flora species (233 native and 5 introduced) within the study area.

No threatened flora species were recorded during the survey, although there is potential habitat for one threatened species (*Eleocharis papillosa* Dwarf Desert Spike-rush). This species is listed as vulnerable under both the TPWC Act and EPBC Act.

Eight vegetation communities were mapped within the study area:

- Mulga shrubland on sandy red earths;
- Riparian woodland along watercourses and drainage channels;
- Triodia grassland on sandy plains;
- Floodplains dominated by *Eucalyptus victrix*;
- Open Corymbia woodland on loamy alluvial plains;
- Low Acacia shrubland on rocky slopes;
- Tall Acacia shrubland on stony quartz; and
- Low open Eucalyptus woodland on limestone.

All of these vegetation types are well represented at the local scale within the bioregion.

The proposal would result in the removal of approximately 1038 ha of native vegetation. None of the vegetation communities proposed to be removed has national or regional significance. The majority of the vegetation to be cleared for the project would be from two vegetation communities (Mulga shrubland on sandy red earths and Triodia grassland on sandy plains). Both of these communities are well represented at the local and regional scale.

The proposal has the potential to impact on flora and vegetation, or exacerbate existing threatening processes through:

- clearing of flora and vegetation and associated loss of habitat during construction;
- alteration of hydrological regimes associated with earthworks and construction activities and associated changes to land surface areas, and/or impediments to surface flows;
- groundwater drawdown and/or changes to groundwater flows impacting groundwater dependent ecosystems;
- contamination of surface and/or groundwater;
- introduction and/or spread of invasive exotic flora species;
- changes to fire regimes;
- dust emissions from construction, mining and processing activities; and
- erosion and sedimentation resulting from vegetation clearing during construction.

Management and mitigation measures would be implemented throughout the construction, operation and decommissioning phases of the Project to ameliorate potential impacts on vegetation and flora. Overall, impacts to flora and vegetation are expected to be low.

## 8.2 Fauna

### 8.2.1 Introduction

This chapter describes the fauna of the Mount Peake Project area and assesses the potential for impact to local and regional biodiversity during the construction and operation of the Project.

A detailed report is provided in Appendix H.

### 8.2.2 Methodology

#### Desktop review

Prior to completing field survey a desktop literature and database review was undertaken to gain an understanding of the ecological context of the Project area. Data reviewed included fauna records from NT and Commonwealth ecological databases.

#### Field survey

A baseline fauna survey was undertaken in April 2013. Fauna survey techniques used were consistent with the *Guidelines for assessment of impacts on terrestrial biodiversity* (NT EPA 2013).

The study area included the proposed mine area, accommodation area, a 1 km wide corridor along the proposed access road and the proposed rail siding facility. Field survey of the proposed borefield, associated pipeline and access road, and road base borrow pit areas was not undertaken as part of this assessment as the locations of these features were not known at the time of the survey.

The study area was divided into relatively homogenous or discrete vegetation habitat types using existing vegetation mapping and aerial imagery. Sites were ground-truthed to verify their vegetation/habitat characteristics, or to move them to more appropriate locations. Sites were chosen to maximise the likelihood of detecting fauna, including threatened species. Sixteen survey sites were established proportionately across the five main vegetation types represented. The site survey adopted a number of techniques including habitat assessment, baited Elliot-type traps, baited cage traps, pitfall buckets, funnel traps, Anabat® bat call detectors, bird surveys, active diurnal and nocturnal searches, remote surveillance cameras and opportunistic observations.

Due to the absence of water, an aquatic fauna survey was not undertaken.

### 8.2.3 Results

#### Desktop assessment

**Burt Plain Bioregion**

The Project area occurs entirely within the Burt Plain Bioregion.

The bioregion is broadly characterised by plains of Acacia shrubland, tussock and hummock grasslands, Acacia and Eucalyptus woodlands, and mountain ranges in the east, north and west of the bioregion. More than 80% of the bioregion is devoted to pastoralism. The Project area lies mainly within Stirling Station which is currently used for cattle grazing.

Much of the bioregion has been impacted by a range of pervasive factors such as grazing by livestock and/or feral animals, feral predators and weed infestations.

The bioregion has suffered substantial losses of its mammal fauna over the last century and there are ongoing declines of some bird and mammal populations. Exotic predators are widespread. Other exotic plants species, most notably buffel and couch grass, also pose significant threats to some habitats.

Many fauna species have been lost from this bioregion over the last 150 years. Of those that persist, 13 species are currently listed as threatened at the National and/or Territory level.

**Sites of Conservation Significance**

Three Sites of Conservation Significance have been idenitified in the vicinity to the Project area.

Mud Hut Swamp (NRETAS 2009) is is the largest swamp in the Burt Plains bioregion and is approximately 7.7 km north of the proposed mine area. The swamp is likely to support a range of wetland birds, fish and plants. Any interruption or alteration of surface water drainage in the vicinity of the Project area has the potential to adversely affect the downstream ecosystem, including Mud Hut Swamp.

The Anmatyerr North site includes Stirling Swamp, and is noted to form occasionally at the northern edge of the Ti Tree Basin, storing flood waters discharged from the Hanson River and the ridges to the east of Wilora. This area is believed to act as an evaporation area for the basin (NRETAS 2009a).

Wood Duck Swamp is an ephemeral swamp that may hold water for many months after heavy rain. The swamp is dominated by smooth-barked coolabah *Eucalyptus victrix*. It is one of the largest such swamps in the Burt Plains bioregion (NRETAS 2009b). Wood Duck Swamp is located approximately 10 km south of the access road, outside of the Project area.

**Fauna of the Project area**

In total, 280 fauna species are identified for the Project area (Appendix H). This species list is derived from a combination of information contained in the PMST report (22 species), DLRM database (249 species), and the GHD baseline fauna survey in April 2013 (116 species). Many of these species would be expected to use one or more of the habitat types in the Project area, either as residents, occasional or seasonal visitors, fly-overs or vagrants. These records include 18 threatened species, 13 of which are listed under the TPWC Act and 16 listed under the EPBC Act.

Database records for the locality include 9 near threatened species[3], and two species recorded as being data deficient[4]. Table 8-5 provides a list of threatened and data deficient species previously recorded in the locality. The locations of vulnerable and near threatened species are shown in Figure 8-4.

Based on an assessment of habitats present and known restrictions of populations, 10 out of the 18 threatened species are unlikely or highly unlikely to occur in the Project area. No EPBC Act-listed Ecological Communities occur within or near the Project area.

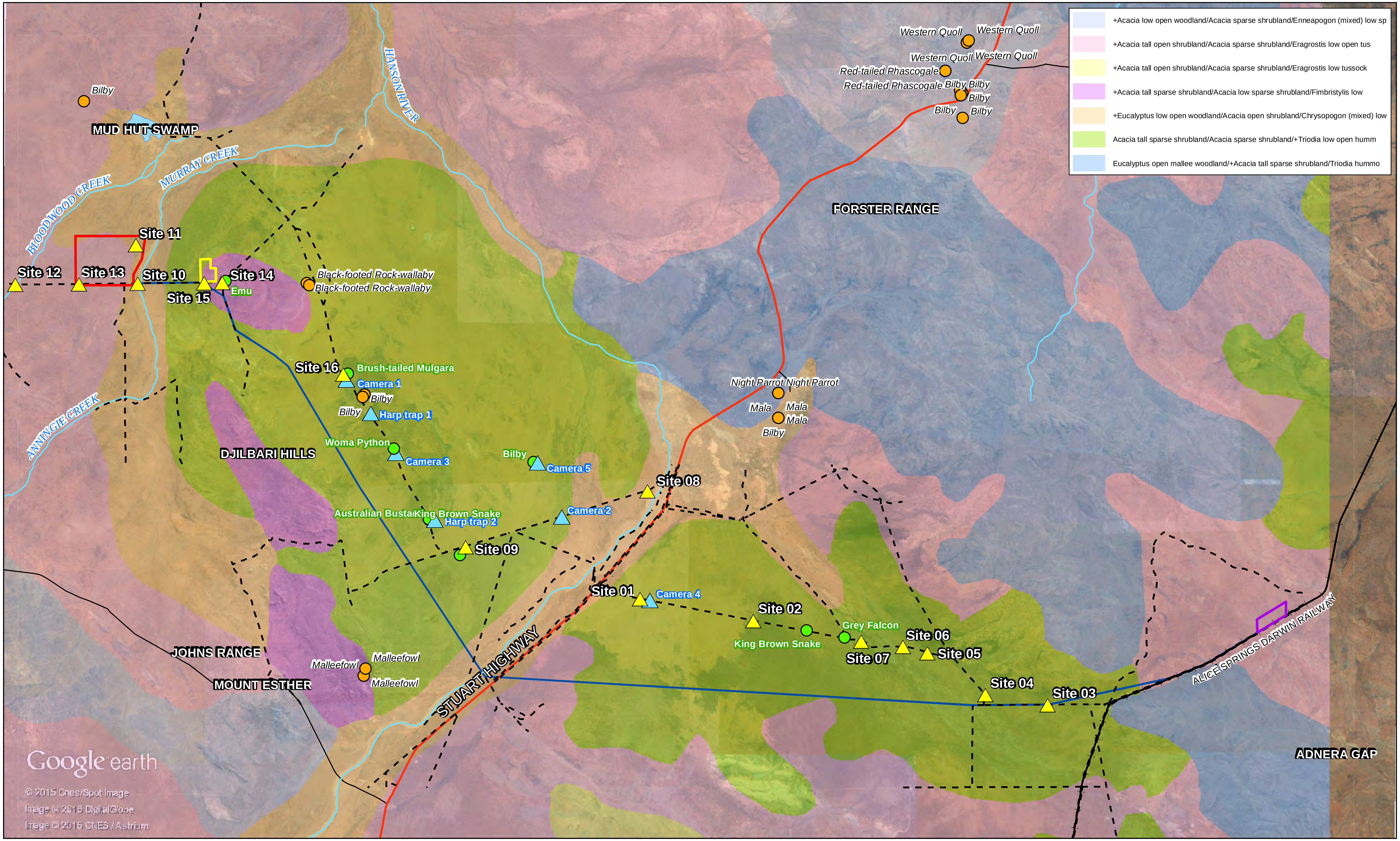
[3] Under IUCN criteria this conservation category is defined as taxa that do not meet the criteria for Critically Endangered, Endangered or Vulnerable at present but is close to qualifying for or is likely to quality for a threatened category in the near future.

[4] Under IUCN data deficient taxa are defined as species where there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status.

### Table 8-5 Threatened fauna records within the locality

| Scientific name | Common name | TPWC Act Conservation Status | EPBC Act Conservation Status | Likelihood of Occurrence |
|---|---|---|---|---|
| *Dasycercus blythi* | Brush-tailed mulgara | V | V | Present |
| *Dasycercus cristicauda* | Crest-tailed mulgara | V | V | Unlikely |
| *Dasyuroides byrnei* | Kowari | RX | V | Highly unlikely |
| *Dasyurus geoffroii* | Western quoll | RX | V | Highly unlikely |
| *Phascogale calura* | Red-tailed phascogale | RX | EN | Highly unlikely |
| *Chaeropus ecaudatus* | Pig-footed bandicoot | EX | EX | Highly unlikely |
| *Isoodon auratus* | Golden bandicoot | EN | V | Highly unlikely |
| *Macrotis lagotis* | Bilby (= greater bilby) | VU | V | Possible/Present |
| *Macrotis leucura* | Lesser bilby | EX | EX | Highly unlikely |
| *Trichosurus vulpecula vulpecula* | Common brushtail possum (southern N.T.) | EN | - | Possible |
| *Bettongia lesueur* | Burrowing bettong | RX | EX | Highly unlikely |
| *Lagorchestes hirsutus* | Mala | EW | EN | Highly unlikely |
| *Petrogale lateralis* | Black-footed rock-wallaby | NT | V | Present |
| *Notoryctes typhlops* | Southern marsupial Mole | V | EN | Unlikely |
| *Notomys longicaudatus* | Long-tailed hopping-mouse | EX | EX | Highly unlikely |
| *Leipoa ocellata* | Malleefowl | CR | V | Highly unlikely |
| *Erythrotriorchis radiatus* | Red goshawk | V | V | Highly unlikely |
| *Falco hypoleucos* | Grey falcon | V | - | Present |
| *Rostratula australis* | Australian painted Snipe | V | EN | Highly unlikely |
| *Polytelis alexandrae* | Princess parrot | V | V | Possible |
| *Pezoporus occidentalis* | Night parrot | CR | EN | Possible |
| *Liopholis kintorei* | Great desert skink | V | V | Possible |
| *Antechinomys laniger* | Kultarr | NT | - | Possible |
| *Lagorchestes conspicillatus* | Spectacled hare-wallaby | NT | - | Possible |
| *Onychogalea unguifera* | Northern nailtail wallaby | NT | - | Unlikely |
| *Dromaius novaehollandiae* | Emu | NT | - | Present |
| *Ardeotis australis* | Australian bustard | NT | - | Present |
| *Burhinus grallarius* | Bush stone-curlew | NT | - | Possible |
| *Lonchura flaviprymna* | Yellow-rumped mannikin | NT | - | Unlikely |
| *Aspidites ramsayi* | Woma python | NT | - | Present |
| *Pseudechis australis* | King brown snake | NT | - | Present |
| *Platyplectrum ornatus* | Ornate burrowing frog | DD | - | Unlikely |
| *Litoria australis* | Giant frog | DD | - | Possible |

Key: V = vulnerable, EN= endangered, CR= critically endangered, EX= extinct, EW= extinct in the wild, RX= regionally extinct, DD = data deficient, NT = near threatened

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0 2.5 5 7.5 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

- Fauna Survey Sites
- Camera/Harp Trap Sites
- GHD Threatened Fauna Records
- LRM Threatened Species
- Tracks (Unverified)
- Major Watercourses
- Principal Road
- Minor Road
- Rail Siding Loading Facility
- Mount Peake Mining Area
- Camp Facilities
- Mud Hut Swamp
- Access Road

TNG Limited
Mount Peake EIS

| | |
|---|---|
| Job Number | 61-29057 |
| Revision | A |
| Date | 27 Oct 2015 |

## Fauna Site Locations

## Figure 8-4

G:\61\29057\11 GIS\Maps\MXD\6129057_012_Fauna_Site_Location.mxd

GHD House, 239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com W www.ghd.com



Data source: TNG - Gas / Slurry Pipeline Study Corridor, Camp Facilities, Access Road, Mount Peake Mining Area, Mount Peake Granted Tenements (2013). Geoscience Australia - Waterways (2008). NRETAS - Vulnerable Fauna (2013). Google Earth Pro - Imagery (Date extracted: 10/09/2015). GHD - Tracks, Fauna Survey Sites (2013). Created by: RB

## Field Survey

### Fauna species

A total of 116 fauna species were recorded within the study area, comprising 112 native species and four introduced species. This includes 24 mammal species (four of which are introduced species), 58 birds and 34 reptiles. Although amphibians were monitored for, their presence was not detected. 18 species detected during the survey were new records for this area and had not previously been recorded on the DLRM database for this area.

Of the eight vegetation types identified from the Project area, five are of importance to fauna: Mulga woodland, Riparian woodland, Rocky rises, Spinifex grassland and Corymbia woodland.

Fauna richness varied between survey site and habitat type (Figure 8-4). Sites with the greatest species richness (Sites 3, 7 and 8) were from different habitat types (mulga woodland, rocky rises and Corymbia woodland, respectively). The lowest species richness was at Sites 13 and 14, both mulga woodland dominated sites. Adjusting for survey effort, the mean number of fauna species by habitat type was:

- Riparian woodland – 34.0 species;
- Rocky rises – 25.7 species;
- Mulga woodland -21.4 species;
- Corymbia woodland- 19.5 species; and
- Spinifex grassland- 18.0 species

The full list of fauna species recorded is presented in Appendix H.

### Nationally and state significant fauna

Three species listed as threatened under the TPWC Act or EPBC Act were recorded during this baseline survey (Table 8-6). The locations of these sightings or suspected sightings are illustrated in Figure 8-4.

**Table 8-6 Observations of threatened fauna**

| Common Name | Scientific Name | EPBC | TPWC | Evidence of Presence |
|---|---|---|---|---|
| Mammals | | | | |
| Brush-tailed mulgara | *Dasycercus blythi* | VU | VU | At least one active burrow located during baseline survey. Thus species may occur wherever suitable habitat is present in the study area. |
| Bilby (= Greater bilby) | *Macrotis lagotis* | VU | VU | Diggings/scratchings observed in suitable habitat during fauna survey are thought to have been made by a Bilby. |
| Birds | | | | |
| Grey falcon | *Falco hypoleucos* | | VU | Observed during the baseline survey. |

The brush-tailed mulgara was not observed, but is considered likely to be present on the basis of a single burrow observed during the survey at Site 16. Only the crest-tailed is listed as vulnerable under the EPBC Act, however due to historical challenges in differentiating this species from the crest-tailed mulgara (*D. cristicauda*) and the listings being made prior to publication of the two species' currently accepted identification, the brush-tailed records in the Mount Peake area are listed as vulnerable.

Diggings/scratchings, thought to have been made by a bilby/greater bilby were detected in recently burnt spinifex/acacia grassland during the fauna survey. There are numerous historical records of this species around the Project area and the species is considered likely to still be present in this part of the Northern Territory, albeit possibly in small numbers.

The grey falcon was observed during the fauna survey and there are numerous records of this species in the vicinity of the Project area. The grey falcon occurs in most of the drier parts of Australia, including much if not all of the Northern Territory. It is generally scarce wherever it is found.

**Near threatened fauna**

Four species listed as near threatened under the TPWC Act were recorded during this baseline survey (Table 8-7). The locations of these sightings are illustrated in Figure 8-4.

### Table 8-7 Observations of near threatened fauna

| Common Name | Scientific Name | TPWC | Evidence of Presence |
|---|---|---|---|
| Birds | | | |
| Emu | *Dromaius novaehollandiae* | NT | Observed at one location during GHD survey. |
| Australian bustard | *Ardeotis australis* | NT | Observed at four locations during GHD survey. |
| Reptiles | | | |
| Woma python | *Aspidites ramsayi* | NT | Observed at one location during GHD survey. |
| King brown snake | *Pseudechis australis* | NT | Observed at two locations during GHD survey. |

Emu (*Dromaius novaehollandiae*) feathers were observed in a barbed-wire fence at Site 15, although no birds were observed. Emus are likely to be sparse across the entire Project area.

The Australian bustard (*Ardeotis australis*) was recorded on four occasions. A total of 11 birds were recorded, although it is possible or even likely that the same individuals were seen on multiple occasions, since observations tended to occur within the same general location (approximately 3 km north-west of Site 9) on successive days. The bustard is likely to occur in small groups across the entire Project area.

One woma python (*Aspidites ramsayi*) was detected 6.8 km south-west of Site 16. This python occupies a broad variety of arid habitats and is likely to be widespread but sparse across the Project area.

Two king brown snakes (*Pseudechis australis*) were detected. Both were observed on the road while driving between sites, rather than being captured in traps. One large individual was detected very near Site 9, and another smaller individual was seen east of Site 2. The king brown snake occupies a broad variety of arid habitats and is likely to be widespread across the Project area.

**Migratory fauna**

Seven species (all birds) predicted or known to occur within the Project area are listed as Migratory under the EPBC Act (Table 8-8). Of these, the rainbow bee-eater (*Merops ornatus*) is the only one that is known to occur historically (NT DLRM Database), and this species was detected during the baseline fauna survey. Each of these Migratory species occupies a very broad area that includes much if not all of the Australian mainland, and none is linked strongly to habitats in the Project area likely to be impacted.

**Table 8-8 EPBC Act-listed Migratory fauna species identified for the Project area (50 km buffer)**

| Common Name | Scientific Name | Source |
|---|---|---|
| Fork-tailed swift | *Apus pacificus* | PMST |
| Great egret | *Ardea alba* | PMST |
| Cattle egret | *Ardea ibis* | PMST |
| Oriental plover | *Charadrius veredus* | PMST |
| Australian painted snipe | *Rostratula australis* | PMST |
| Oriental pratincole | *Glareola maldivarum* | PMST |
| Rainbow bee-eater | *Merops ornatus* | DLRM, PMST, GHD |

### Introduced Fauna Species

Twelve non-native fauna species are identified for the Project area (Table 8-9). Of these, four were observed during the survey including cattle which are currently used as an agricultural asset. Non-native fauna that occur at the site are likely to have had, and to continue to have, an adverse impact on the area's ecology, however the Project area does not appear to be unusually or excessively overrun by feral animals, compared with other parts of the NT or Australia.

**Table 8-9 Non-native fauna species identified for the Project area**

| Common name | Scientific name | DLRM | PMST | GHD |
|---|---|---|---|---|
| Mammals | | | | |
| Cat | *Felis catus* | X | X | X |
| European rabbit | *Oryctolagus cuniculus* | X | | X |
| Donkey | *Equus asinus* | X | | X |
| Dog (domestic) | *Canis lupus familiaris* | | X | |
| House mouse | *Mus musculus* | X | X | |
| Red fox | *Vulpes vulpes* | | X | |
| Horse | *Equus caballus* | X | | |
| Pig | *Sus scrofa* | X | | |
| Cattle | *Bos taurus* | X | X | X |
| Camel | *Camelus dromedarius* | | X | |
| Birds | | | | |
| Rock dove | *Columba livia* | X | X | |
| Reptiles | | | | |
| Asian house gecko | *Hemidactylus frenatus* | X | X | |

### 8.2.4 Potential Impacts

Key threatening processes that may impact fauna include:

- clearing of flora and vegetation (breeding and foraging habitat, habitat fragmentation and creation of barriers to fauna movement);
- change in water quality (hydrological regimes, contamination of surface and/or groundwater, lowering of the groundwater table);
- introduction and/or spread of non-native flora and pest animals;
- changes to fire regimes;
- dust emissions from construction, mining and processing activities;
- industrial and domestic wastes;
- noise disturbance;
- visual disturbance (including artificial lighting); and
- risks associated with traffic during construction and operation.

#### Vegetation clearing

Approximately 1,038 ha of vegetation will be disturbed for construction of the pit, waste rock dump, tailings storage facility, accommodation village, access roads, mine infrastructure, stockpile sites and the Adnera Loadout Facility. The location and area of borrow pits still needs to be determined.

Table 8-4 provides mapped areas of each vegetation community (1,008 ha) impacted by the Project. Vegetation clearing will involve removal of a moderately diverse range of non-threatened native plants, including mature trees. The fauna habitats affected by clearing comprise eight distinct vegetation communities Table 8-10.

**Table 8-10 Fauna habitat and vegetation communities impacted by the Project**

| Fauna habitat | Corresponding vegetation community | Area (ha) | % of area to be impacted |
|---|---|---|---|
| Mulga woodland | Mulga shrubland on sandy red earths (VT 2) | 420.25 | 41.68 |
| | Tall Acacia shrubland on stony quartz plains (VT 8) | 10.00 | 0.99 |
| Riparian woodland | Riparian woodland along watercourses and drainage channels (VT 3) | 2.90 | 0.29 |
| | Floodplains dominated by *Eucalyptus victrix* (VT 5) | 0 | 0 |
| Rocky rises | Low open Eucalyptus woodland on limestone ridges (VT 1) | 8.35 | 0.83 |
| Spinifex grassland | Triodia grassland on sand plains (VT 6) | 558.58 | 55.40 |
| | Low Acacia shrubland on rocky slopes (VT 7) | 3.50 | 0.35 |
| Corymbia woodland | Low Corymbia open woodland on plains with red earths (VT 4) | 4.61 | 0.46 |
| TOTAL | | 1008.19 | 100 |

A further 30 ha will be required to be cleared for the borefield and associated infrastructure which is likely to be Triodia grassland on sandy plains (VT 6), Low Corymbia woodland on loamy alluvial plains (VT 4) and a small amount of Riparian woodland along water courses (VT 3). A preclearance survey will be undertaken prior to any clearing works in the area to assist in the final location of infrastructure and ensure that no significant or sensitive fauna communities will be impacted by clearing.

Clearing of native vegetation could result in:

- killing/injuring fauna;
- displacement of fauna;
- disruption to nesting/roosting/foraging and/or behaviour;
- reduction of area of fauna habitat locally and/or regionally;
- fragmentation of remaining habitat;
- erosion and sedimentation impacts, including degradation of surface water quality;
- increasing likelihood of weed establishment in cleared areas;
- habitat fragmentation and creation of barriers to fauna movement, particularly for small ground-dwelling fauna; and
- introduction and/or spread of exotic plants (weeds).

This table shows that the two habitat types expected to be most impacted are mulga woodland (~41% of area) and spinifex grassland (~55% of area). These habitats have the potential to support the following threatened species:

- Mulga woodland – greater bilby, princess parrot and grey falcon; and
- Spinifex grassland – greater bilby, brush-tailed mulgara, night parrot, princess parrot, grey falcon and great desert skink.

Habitat fragmentation is most likely to impact ground-dwelling fauna, and particularly small fauna that tend not to cover large areas in their normal activities (e.g. foraging, breeding). For this Project, habitat fragmentation is of greatest concern for greater bilby, brush-tailed mulgara and great desert skink.

Management measure will be adopted to minimise direct and indirect impacts to fauna during vegetation clearing for construction and during operation (section 8.2.5).

### Water quality

A number of Project activities can lead to potential changes in water quality.

Vegetation in riparian zones and floodplain areas are likely to be at least partially dependent on surface water flows (section 8.1.4). The key receptors that are vulnerable to changes in environmental flows are vegetation communities that are at least partially dependent on surface water flows including sheet flow (i.e. mulga shrubland) and the riparian vegetation within drainage channels and Mud Hut Swamp. Fauna that rely on riparian habitats and that may be impacted by altered hydrology in, and downstream of, the Project area include the common brushtail possum. Management measure will be adopted to maintain existing hydrological regimes during construction and operation (section 8.2.5). This will include the installation of floodways and culverts along the access road to maintain existing water flows.

The tailings dam will contain benign silts and sands and no hazardous substances are expected to be stored in the dam, therefore the potential to contaminate fauna drinking water is a low risk.

Groundwater modelling was undertaken to predict the likely extent of groundwater drawdown from abstraction (GHD 2015a). Maximum predicted drawdown contours for the borefield at the end of mining are shown in Figure 8-3. The maximum drawdown is modelled as being up to 12 m below current groundwater levels and could result in the following impacts to fauna:

- decline in availability of water to ecosystems including riparian vegetation resulting in loss of habitat for species relying on riparian habitat; and
- shorter hydroperiod in waterbodies that may provide water for fauna.

Pit modelling indicates that groundwater drawdown will not impact any groundwater dependent ecosystems or wetlands. After decommissioning, the mine void will act as a sink with a shallow lake forming. This feature does not have the potential to impact fauna habitat.

A number of Project related activities could cause potential contamination of surface and groundwater systems. There are a number of sensitive riparian habitats close to the development footprint and vegetation and flora reliant on surface flows and groundwater uptake may also be impacted by contamination. In turn, common and threatened herbivorous species (including the black-footed rock-wallaby and common brushtail possum) may be impacted over time by grazing/browsing on contaminated vegetation. Changes in water quality may also directly affect threatened fauna (e.g. black-footed rock-wallaby and princess parrot) that drink from such water sources.

### Introduced species

As detailed in Section 8.1.4, there is potential for Project activities to introduce or spread weeds (resulting in a decline in native fauna habitat quality) and to introduce or increase the spread of animal pests (resulting in a decline in habitat for native fauna, increased competition for resources and increased predation on native fauna). This could occur during construction, operation and closure activities.

### Changes to fire regimes

Construction and operational activities, particularly hot works, are potential ignition sources, and could result in a bushfire. In addition, it may be necessary to conduct controlled burns to minimise fuel loads in the vicinity of the mine site.

Fire can benefit some disturbance-tolerant species, but can be detrimental to other types of fauna and fauna habitat, if it occurs at the wrong time of year, or in habitats that do not respond well to fire.

Direct impacts from death or mortality to fauna are possible, as well as behavioural disturbance, reduction and fragmentation of habitats and soil erosion. It is expected that all of the threatened species that do or may occur within the Project area would be affected by fire (both positive and negative impacts). Controlled and strategic cool patch burns of spinifex sandplain habitat could have positive outcomes for species such as the greater bilby (promotes food plants). Extensive burns (as distinct from small-patch burning) of great desert skink and black-footed rock-wallaby habitat could be detrimental to those species as the fire could remove important shelter and food resources. Burning of rocky habitat is unlikely to be beneficial for many species and should be avoided. Continued persistence of the black-footed rock-wallaby in the area will depend on prevention of wildfire in the surrounding rocky habitats. There is limited information regarding the response to fire for mulgara. Woinarski *et al.* (2007) mentions that changes to fire regimes may have been a factor in historic declines. Extensive frequent fire may reduce ground-layer vegetation cover which could increase the likelihood of predation by cats/foxes (Dr R. Paltridge *pers. comm.*).

### Dust emissions

As detailed in Section 8.1.4, a number of construction and operational activities could lead to increased dust emissions. There is a paucity of evidence on dust impacts on fauna, but high concentrations have the potential to cause disease, and degradation of habitats and surface water quality through deposition.

It is likely that a range of non-threatened taxa that exist within the vicinity of the mine site could be adversely impacted by dust generated by mine operations. This would include birds, small ground-dwelling mammals and possibly reptiles. However, the majority of the threatened species identified for the Project area (brush-tailed mulgara, greater bilby, common brushtail possum, grey falcon, red goshawk, princess parrot, night parrot and great desert skink) either do not or would not regularly occur in the vicinity of the mine site, and hence would only ever be subjected to very low dust levels mainly from vehicle movements along unsealed roads. There is habitat for the black-footed rock-wallaby within 2 km of the mine site, and this species may be exposed to higher levels of dust.

### Industrial and domestic wastes

The Project will generate waste rock from the mine and tailings from the process plant. Both of these waste streams are benign and do not pose a contamination risk.

Domestic refuge could attract non-native pest fauna which could predate threatened fauna, particularly small fauna that spend considerable time on or near the ground (e.g. night parrot, black-footed rock-wallaby, greater bilby, brush-tailed mulgara and the great desert skink).

### Noise emissions

Noise emissions have the potential to impact fauna through behavioural changes that can displace fauna toward sub-optimal habitats and cause disruption to life cycles.

The majority of the threatened species that do or may occur within the Project area use habitats that occur some distance from the mine site (generally >10 km) and are unlikely to be affected by construction or operational noise. Vehicle noise along the access road may have localised and isolated low-level impacts.

Most of the area covered by the Project is not typically suitable habitat for the black-footed rock-wallaby, but there are rocky outcrops scattered throughout the area that are likely to be suitable. The species is known to occur in nearby rocky ranges and may occasionally move through the Project area to access different patches of suitable habitat. Noise generated by the mine is likely to preclude rock-wallaby movements through the mine site.

### Light emissions

Artificial lighting can cause a range of behavioural responses in fauna including displacement, changing of predator-prey interactions, disorientation and disruption of nesting/roosting activities.

Fauna in the immediate vicinity of the mine site would be most exposed to artificial lighting that could impact ‘normal’ nocturnal behaviours (e.g. bats, migratory birds). The majority of the threatened species that do or may occur within the Project area tend to occur some distance (>10 km) from the mine site and would be unlikely to be affected by operational lighting.

Most of the area covered by the Project is generally unsuitable habitat for the black-footed rock-wallaby, but there are rocky outcrops scattered throughout the area that are likely to be suitable. The species is known to occur in nearby rocky ranges and may occasionally move through the Project area to access different patches of suitable habitat. Light emitted from the mine site could impact on nocturnal movements of rock-wallabies and could reduce dispersal activities in the immediate vicinity of the mine.

Rock-wallaby habitat occurring at distances of 2 km or more from the mine site is unlikely to be adversely impacted by artificial lighting.

### Road traffic

Potential impacts to fauna from road traffic can include direct injury and mortality, dispersal of contaminants, noise emissions, barriers to faunal movement and fragmentation of habitats. Species such as the brush-tailed mulgara, greater bilby, common brushtail possum, black-footed rock-wallaby and great desert skink would potentially be at risk from a road collision.

### Risks to threatened species

A risk assessment was undertaken to evaluate individual sources of potential impact for threatened species (Appendix H). The threatened species considered were those that are known to be present or likely to be present within the Project area, even though the presence of some populations is unconfirmed.

Threatened species that occupy similar habitats or that are predicted to be similarly vulnerable to impacts were grouped for the purposes of the risk assessment. These species are likely to encounter similar impacts and be impacted in similar ways, and the management and mitigation measures proposed to reduce the level of risk are likely to be similar. The species considered were:

- rocky habitats - black-footed rock-wallaby;
- sandplain ground-dwelling fauna - greater bilby, brush-tailed mulgara, great desert skink, southern marsupial mole;
- arid-zone avifauna with high mobility - night parrot, red goshawk, princess parrot, grey falcon; and
- fauna in riparian habitat - common brushtail possum.

The level of risk to fauna from most potential sources of impact without management or mitigation was determined to be very low, low or medium. No extreme risks were identified.

The level of unmitigated risk to some fauna was considered to be high for two sources of impact:

- an increase in predator numbers (cats, foxes and dingos) through the inadequate management of garbage could increase levels of predation on rock wallaby (particularly of more vulnerable juveniles), sandplain ground-dwelling fauna and avifauna (principally the night parrot which spends the majority of its time at or near the ground); and
- the introduction or spread of weeds leading to weed-dominated habitats that are generally less favourable for fauna than weed-free habitats, and may introduce additional risks (e.g. more intense fires, less suitable foraging habitat). At risk is the rock wallaby and sandplain ground-dwelling fauna.

### Impact significance for threatened species listed under the EPBC Act

Significant impact criteria were used to assess each EPBC Act-listed threatened species against the likely risks and consequences before mitigation. Threatening processes with the potential to pose a medium or higher risk to threatened species before mitigation measures are applied were:

- impacts from habitat clearing: greater bilby, brush-tailed mulgara, southern marsupial mole and the great desert skink;
- impacts from habitat fragmentation: greater bilby, brush-tailed mulgara and the great desert skink;
- impacts associated with management of industrial waste material: greater bilby, brush-tailed mulgara, southern marsupial mole and the great desert skink;

- indirect impacts associated with inadequate management of domestic waste material: black-footed rock-wallaby, greater bilby, brush-tailed mulgara, princess parrot, night parrot and the great desert skink;
- impacts associated with vehicle movements (e.g. collisions): greater bilby, brush-tailed mulgara and the great desert skink;
- impacts associated with invasion by exotic plants and animals, particularly predators: black-footed rock-wallaby, greater bilby, brush-tailed mulgara, southern marsupial mole, princess parrot, night parrot and the great desert skink;
- impacts associated with inappropriate or ineffective rehabilitation: black-footed rock-wallaby, greater bilby, brush-tailed mulgara, southern marsupial mole and the great desert skink; and
- impacts of unplanned wildfire: black-footed rock-wallaby, greater bilby, brush-tailed mulgara, southern marsupial mole, princess parrot, night parrot and the great desert skink.

None of the potential impacts identified for the Project pose a medium or high risk to the red goshawk.

Application of appropriate management and mitigation measures is expected to reduce the likelihood and severity of risk to acceptably low levels for all hazards, such that the residual risk is unlikely to be significant according to EPBC Act significant impact guidelines. Impacts to EPBC species are further discussed in Chapter 15.

### 8.2.5 Fauna Management Measures

Detailed Project design will consider options for locating infrastructure footprints to avoid or minimise impacts to fauna, both directly and indirectly. In particular the Project will aim to minimise clearing of fauna habitat. Although the Project will result in some unavoidable residual impacts to fauna habitat, these impacts are not expected to significantly impact the fauna that inhabit these areas.

Provided below are the key management measures that will be employed to reduce residual impacts to fauna. A comprehensive list is provided in Appendix H.

#### Construction phase

Land disturbance and vegetation clearing will be kept to as small an area as practicable. Construction personnel will be briefed during inductions regarding the conservation value of surrounding habitats and their responsibilities with regard to protecting these habitats.

A preclearance survey of the borefield, pipeline route and borrow pit areas will be undertaken prior to any clearing works in the area to assist in the final location of infrastructure and ensure that no threatened species or significant or sensitive vegetation communities are impacted by clearing.

Engineering controls that assist in maintaining surface water flows have been incorporated into road designs to ameliorate potential risks to vegetation due to changes in flow. Design features include installing at-grade flood ways where the access road crosses a water course and culverts to maintain flows under the access road where the drainage line is well defined.

A CEMP which will include:

- strategies to minimise vegetation clearance;
- procedures for demarcating the limits of clearing and no-go areas;
- staged clearing of vegetation to minimise areas of bare ground and clear land only as required;
- vehicle hygiene protocols to prevent new weed incursion and spread, including a vehicle wash down facility on site;
- strict fire prevention management protocols to prevent wildfire during clearing activities;
- maintenance of fire breaks around high-risk areas/activities;
- use of already-disturbed areas (rather than undisturbed areas) wherever possible (e.g. lay down areas for construction);
- progressive revegetation of cleared land as activities are completed;
- a Weed Management Plan;
- pre-clearing fauna surveys prior to mine construction, with qualified ecologists on site to assist/translocate animals that are found during the clearing process and that require assistance in getting to safety;
- limiting construction and clearing to times of the year when fauna are least sensitive to disturbance (e.g. avoiding breeding period); and
- ongoing pest-animal control in all areas.

### Operation phase

Operation phase management measures for fauna typically adopt measures proposed to manage impacts associated with flora and vegetation. These are outlined in section 8.1.5 and are not repeated here. Specific additional management measures for fauna are provided below.

Waste material and pest control management measures will include:

- fencing of the landfill used to dispose of putrescible waste;
- daily covering of putrescible waste;
- ongoing monitoring for pest species; and
- baiting or control if pest numbers increase to unacceptable levels.

Noise management measures will include:

- implement standard noise minimisation measures to reduce noise wherever possible; and
- restricting high-impact noises to daylight hours only (i.e. avoid excessively loud noises at night, when the majority of relevant threatened species are likely to be active).

Light emission management measures will include:

- limiting artificial light to areas where it is essential;
- turning off lights when not required;
- use of light shields and deflectors to reduce light spill out of Project area;
- using lower (i.e. closer to the ground) rather than higher lighting installations;

- using lower wavelengths of light wherever possible i.e. red/yellow lights;
- using light intensities that are as low as possible without reducing safety or efficiency; and
- avoiding painting large structures bright or reflective colours and minimise use of bright or reflective construction materials and finishes for large structures.

Traffic management measures will include:

- keeping the proposed road network to a minimum;
- upgrade high-use areas to be safer for vehicles and fauna (e.g. no blind curves, wider shrub-free verges);
- fencing of the access road;
- providing road safety and awareness training with respect to safe driving in areas where native wildlife is prevalent; and
- documenting roadkill (location and time of day) of threatened species within the Project area, to determine high-risk periods or locations.

### 8.2.6 Summary of Impacts and Conclusions

In total, 280 fauna species have been identified for the Project area. The Project area has the potential to support 10 threatened fauna species, including eight listed as vulnerable or endangered under the EPBC Act. These species are:

- fauna in rocky habitat - black-footed rock-wallaby;
- ground-dwelling sandplain fauna with limited mobility - greater bilby, brush-tailed mulgara, great desert skink, southern marsupial mole;
- arid-zone avifauna with high mobility - night parrot, red goshawk, princess parrot, grey falcon; and
- fauna in riparian habitat - common brushtail possum.

Adjusting for survey effort, the mean number of fauna species by habitat type was:

- Riparian woodland – 34.0 species;
- Rocky rises – 25.7 species;
- Mulga woodland -21.4 species;
- *Corymbia* woodland- 19.5 species; and
- Spinifex grassland- 18.0 species.

The proposal would result in the removal of approximately 1,038 ha of native vegetation. The clearing of the most species rich areas (riparian and rocky rises) amount to less than 2% of the Project area (~ 11 ha). These fauna habitats are well represented at the local and regional scale.

The Project has the potential to impact native fauna through:

- clearing of vegetation and associated loss of habitat, and habitat fragmentation during construction;
- alteration of hydrological regimes associated with earthworks and construction activities and associated changes to land surface areas, and/or impediments to surface flows;
- groundwater drawdown and/or changes to groundwater flows impacting groundwater dependent ecosystems;

- contamination of surface and/or groundwater;
- introduction and/or spread of weeds and animal pests;
- changes to fire regimes;
- dust emissions from construction, mining and processing activities;
- light spill;
- noise emissions; and
- fauna road-kill.

Impacts to threatened fauna species were assessed and it was concluded that no species will be significantly impacted as a result of the Project.

A range of management measures will be implemented throughout the construction, operation and decommissioning phases of the Project to ameliorate potential impacts to native fauna. Overall, impacts to fauna are expected to be low.

# 9. Air and Greenhouse Gasses

## 9.1 Existing Environment

### 9.1.1 Meteorology

Temperatures vary significantly, with mean daily maximum temperatures ranging from 22°C (August) to 37°C (January), and mean daily minimum temperatures from 8°C (July) to 24°C (January). Average annual evaporation for Barrow Creek totals around 2,980 mm, with average monthly evaporation exceeding rainfall in all months (BOM 2015).

The climate of the region is arid to semi-arid with a mean annual rainfall of approximately 320 mm recorded at Barrow Creek, approximately 65 km east of the mining area. The climate is characterised by hot, wet summers and warm, dry winters.

Rain tends to fall during heavy rain events between November and March, with little follow on rain. The highest annual rainfall for Barrow Creek of 1,153 mm was recorded in 2010. Annual rainfall is highly variable.

Annual and seasonal wind roses for the Territory Grape Farm AWS, based on hourly observations, are shown for 2 July 2011 to 30 June 2012 in Figure 9-1. The wind roses show graphically the frequency of occurrence of winds by direction and strength, from varying compass points. The length of the bar represents the frequency of occurrence of winds from that direction and the colour corresponds to the wind speed categories, as defined in the legend. Figure 9-1 shows a dominant south easterly wind direction throughout the year.

### 9.1.2 Existing emissions

The Project is situated in a relatively isolated location, with sensitive receptors sparsely distributed across the region. Land use immediately adjacent to the Project is pastoral activities. There are no existing industrial air emission sources, nor has there been any air quality monitoring performed at or near the Project area. Fugitive air emissions occur within the region, with dust associated with wind erosion from exposed ground, station related vehicle traffic on unsealed roads and smoke emissions from seasonal bushfires.

### 9.1.3 Sensitive receptors

Sensitive receptor locations were identified based on aerial photographs and discussions with stakeholders. The nearest non-mining sensitive receptor to the Project is Anningie Station approximately 30 km to the south-west of the proposed mine site. The mine access road is located approximately 20 km to the south of the Wilora Aboriginal community. The Project will itself introduce an important sensitive receptor, the mine camp site. The sensitive receptors considered in the air quality assessment and their distance from the mine site are detailed in Table 9-1.

Whilst the majority of these receptors are unlikely to experience any impact during the construction or operation of the Project (due to the separation distance), they have been included in this assessment for completeness. Figure 9-2 shows the Project site and the relative location of these sensitive receptors.

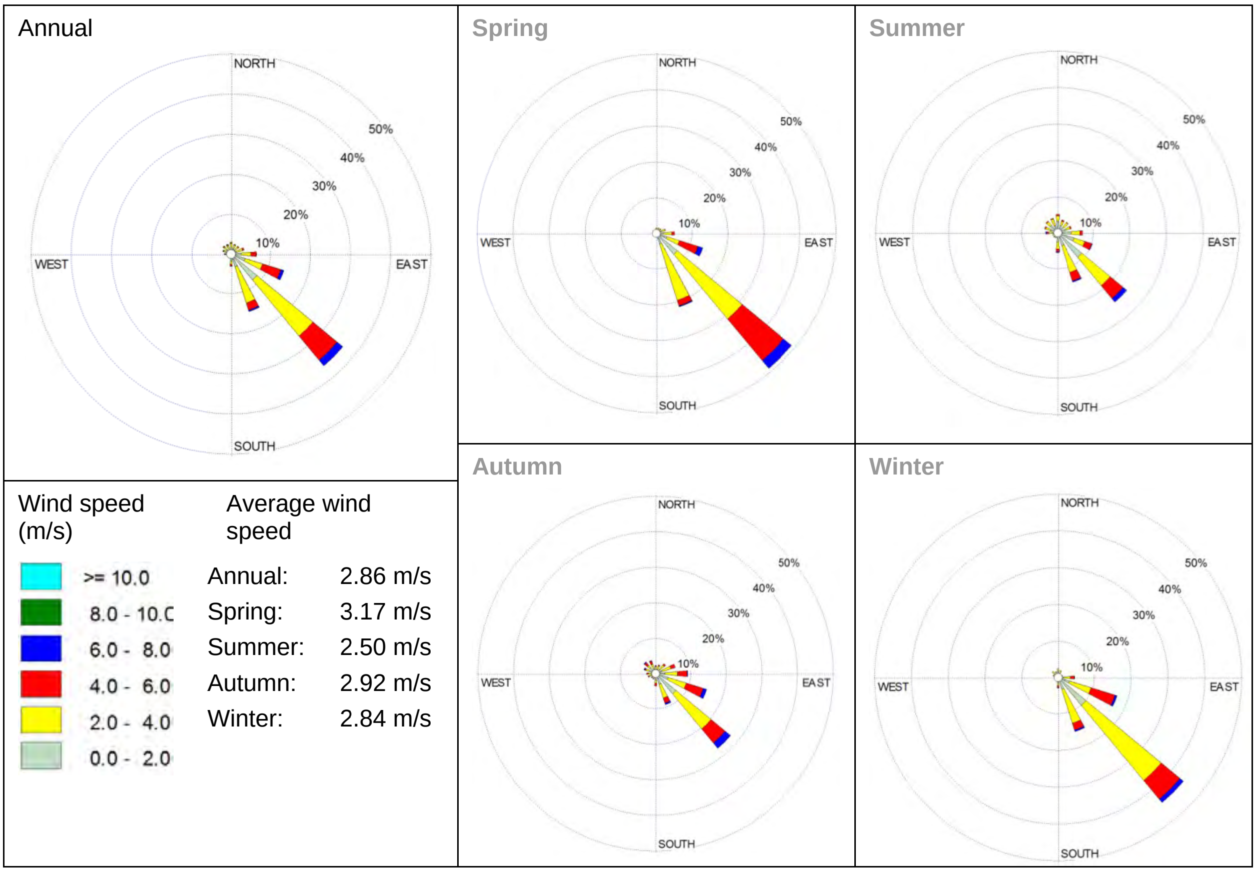


**Figure 9-1 Annual and seasonal wind roses for observed meteorological data at the Territory Grape Farm AWS**

**Table 9-1 Sensitive receptors**

| Receptor name | Description | Distance from mine site (km) |
|---|---|---|
| Mine camp site | Mine accommodation village | 5 |
| Anningie Station | Pastoral lease homestead | 30 |
| Wilora | Aboriginal community | 47 |
| Stirling Station | Pastoral lease homestead | 51 |
| Ti Tree | Small town | 52 |
| Barrow Creek[1] | Small town | 62 |
| Willowra | Aboriginal community | 80 |

[1] This location was included to represent the two semi-permanently occupied Indigenous outstations (Patsy's and Walkabout) on the western side of Stuart Highway between Wilora and Barrow Creek.

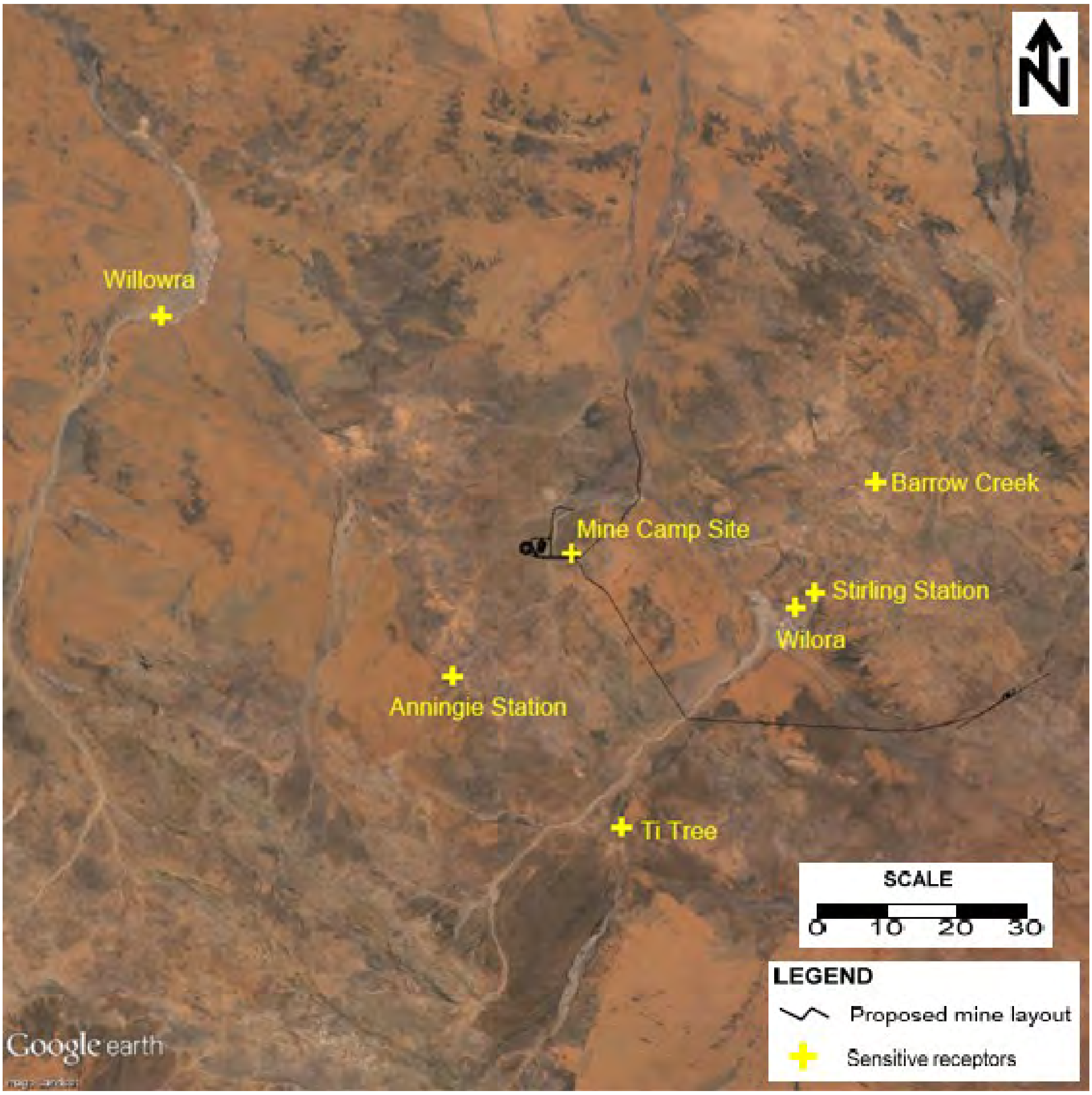


**Figure 9-2 Project site and the closest sensitive receptors**

## 9.2 Assessment Criteria

### 9.2.1 Air Emissions

Air quality impacts are assessed by comparing monitoring results or model predictions with appropriate pollutant criteria.

The impacts of emissions from mining activities in the NT are primarily assessed with reference to the *National Environment Protection (Ambient Air Quality) Measure* (Air NEPM) $PM_{10}$ and $PM_{2.5}$ ambient standards. However, the Air NEPM criteria were selected to guide the management of emissions within air sheds with significant populations (and not specifically to individual emitters in more remote areas).

Alternative air criteria for assessment of individual facility emissions include the WA EPA criteria for total suspended particulates (TSP)[1], the Victoria Mining Protocol for Environmental Management (PEM) criteria for $PM_{2.5}$ and $PM_{10}$ (EPA Victoria 2007), and the Victorian Environment Protection Authority (Vic EPA) Design Criteria for $PM_{10}$[2]. All of these criteria are presented in Table 9-2.

**Table 9-2 Assessment levels for dust (in-air concentrations and deposition)**

| Pollutant | Averaging period | Max. / 99.9th %ile | Criterion | Source |
|---|---|---|---|---|
| TSP | 24-hours | Maximum | 90 µg/m$^3$ | WA EPA |
| $PM_{10}$ | 1-hour | 99.9th %ile | 80 µg/m$^3$ | SEPP-AQM |
| | 24-hours | Maximum | 50 µg/m$^3$ | Air NEPM |
| | 24-hours | Maximum | 60 µg/m$^3$ | Mining PEM |
| | Annual | Maximum | 20 µg/m$^3$ | Air NEPM[3] |
| Dust deposition | Annual | Maximum | 2.0 g/m$^2$/month | NSW OEH |

The Victorian Mining PEM criteria have been specifically developed for mining operations, where sources are primarily mobile / area-based, and are therefore the more appropriate criteria to apply for this Project.

There are no specific criteria for dust deposition in the NT and the NSW Office of Environment and Heritage (NSW OEH 2015) dust deposition standard provided in the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW has been applied. Assessment goals for an annual average dust deposition such that nuisance dust impacts could be avoided are provided in Table 9-2.

The impacts of particle emissions fall under two distinct categories, being health and amenity:

- potential health impacts are attributable to the concentration of respirable particles in ambient air. Respirable particles of dust ($PM_{10}$) would have maximum impact under light winds and stable atmospheric conditions. These conditions most frequently occur overnight and very early in the morning; and
- the presence of total suspended particles (TSP) greater than 35 microns, is likely to affect amenity by reducing visibility (whilst in the air column) and by soiling of materials via dust deposition. Amenity impacts are most marked in high wind conditions, when larger particles may be displaced and transported a significant distance before being deposited. Mitigation of amenity related dust impacts would in turn act to reduce health impacts associated with respirable particles emissions.

The proposed gas fired power station will generate the exhaust pollutants carbon monoxide (CO), oxides of nitrogen (NOx) as nitrogen dioxide ($NO_2$) and volatile organic compounds (VOCs). CO and $NO_2$ were assessed against the Air NEPM and Vic EPA design criteria. The pertinent emissions of VOCs were assessed against the Air Toxics NEPM and Vic EPA design criteria. Assessment criteria for emissions from the gas fired power station are outlined in Table 9-3.

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[1] The *Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1999* (Kwinana EPP) specifies a standard of 90 µg/m$^3$ for least dust impacted areas (rural residential areas beyond the buffer area).

[2] Established under the Victorian State Environment Protection Policy (Air Quality Management) (SEPP-AQM).

[3] Proposed addition to the Air NEPM.

**Table 9-3 Assessment criteria for stack emissions from the gas fired power station**

| Pollutant | Averaging period | Max. / 99.9th %ile | Criterion | Source |
|---|---|---|---|---|
| Nitrogen dioxide | 1-hour | Maximum | 247 µg/m$^3$ | Air NEPM |
| | 1-hour | 99.9th %ile | 190 µg/m$^3$ | SEPP-AQM |
| | Annual | Maximum | 62 µg/m$^3$ | Air NEPM |
| Carbon monoxide | 1-hour | 99.9th %ile | 29,000 µg/m$^3$ | SEPP-AQM |
| | 8-hours | Maximum | 11,254 µg/m$^3$ | Air NEPM |
| Acetaldehyde | 3-minutes | 99.9th %ile | 76 µg/m$^3$ | SEPP-AQM |
| Benzene | 3-minutes | 99.9th %ile | 53 µg/m$^3$ | SEPP-AQM |
| | Annual | Maximum | 10.5 µg/m$^3$ | Air Toxics NEPM |
| Formaldehyde | 3-minutes | 99.9th %ile | 40 µg/m$^3$ | SEPP-AQM |
| | 24-hours | Maximum | 53.6 µg/m$^3$ | Air Toxics NEPM |
| Toluene | 3-minutes | 99.9th %ile | 650 µg/m$^3$ | SEPP-AQM |
| | 24-hours | Maximum | 4114 µg/m$^3$ | Air Toxics NEPM |
| | Annual | Maximum | 411 µg/m$^3$ | Air Toxics NEPM |
| Xylenes | 3-minutes | 99.9th %ile | 350 µg/m$^3$ | SEPP-AQM |
| | 24-hours | Maximum | 1183 µg/m$^3$ | Air Toxics NEPM |
| | Annual | Maximum | 946 µg/m$^3$ | Air Toxics NEPM |

### 9.2.2 Greenhouse Gas Emissions

Unlike emissions for air pollutants, there are no set criteria for greenhouse gas. However, there is legislation relevant to the greenhouse gas emissions from the Project. The key acts are:

- *National Greenhouse and Energy Reporting Act 2007*. The National Greenhouse and Energy Reporting Scheme applies to Scope 1 and 2 emissions at facilities that emit over 25,000 t $CO_2$-e per year or consume more than 100 TJ of energy, or corporations that emit over 50,000 t $CO_2$-e per year or consume more than 200 TJ of energy. The Project will trigger both the facility and corporation thresholds. Participation will need to be determined based on actual annual greenhouse gas emissions and energy consumption; and
- *Carbon Credits (Carbon Farming Initiative) Act 2011*. The Carbon Farming Initiative was developed to give farmers, forest growers and landholders the ability to generate accredited domestic offsets for access to domestic voluntary and international carbon markets.

## 9.3 Methodology

The main air emissions are expected to be from material transport, processing and wind erosion (particles as TSP, $PM_{10}$ and $PM_{2.5}$), and the power station (CO, NOx as $NO_2$ and VOCs). Greenhouse gas emissions will also occur throughout the life of the mine.

### 9.3.1 Air Emissions

#### Construction

Air pollutant emissions during construction are not considered to represent a significant source of emissions. Potential air quality impacts during construction and site establishment for the Project will be emissions from heavy vehicle exhausts, particle generation from heavy equipment during earthworks and wind erosion from disturbed soil surfaces. Extensive inventories (NPI 2012, US EPA 2001) for $PM_{10}$ and TSP emissions from earth moving machinery are commonly used to characterise the source dust emission rates from activities on-site during the construction phase.

At this stage, the reference design has not specified the schedule of construction or exact type and number of heavy machinery to be used, so it is not possible to accurately characterise these sources. For this reason, rather than attempt to estimate emissions that are not likely to be significant, the focus will be on developing a framework which includes a comprehensive range of mitigation measures for the management of dust emissions during the construction phase of the Project. Dust management and mitigation measures that will be consider and implemented where appropriate during the construction phase are discussed in Section 9.5.1.

#### Operation

The predominant mine operation dust sources include mechanical sources (trucking, conveying, dozing and grading) and wind erosion sources (cleared areas and stockpiles). Mine operations have the potential to generate particulate emissions from activities outlined in Table 9-4.

Wind erosion emissions will be affected by the size of the particles present. Shao *et al.* (1996) describes the process by which dust lift off occurs for different particle aerodynamic diameters:

- large particles (>1000 µm) remain stationary or move along the ground (creep) as they are too aerodynamically heavy;
- sand particles (typically between 60 and 1000 µm) are easily lifted from the surface into saltation motion as they have small threshold velocities. This leads to sand drift; and
- dust particles (typically <60 µm) are not lifted directly from the surface (under normal conditions) due to large inter-particle cohesive forces. However, when saltation bombardment occurs (by sand particles), dust particles are ejected from the surface due to sand grain impacts. In the atmosphere, turbulence and buoyancy keep the dust particles suspended for a period of time (determined by a number of factors) until deposition occurs, often many kilometres from the original source.

These movements are illustrated in Figure 9-3.

The method used by GHD to calculate wind erosion emissions was based on and adapted from work by SKM (2004) and Shao *et al.* (1996). A detailed description of the equations and coefficient factors used are detailed in the GHD (2015). This methodology has been adopted for a number of similar studies (GHD 2009, 2013, 2014).

### Table 9-4 Potential dust sources from mine operations

| Source type | Source location |
| --- | --- |
| Wind erosion | Mine pit, long-term ore stockpiles, crushed ore stockpile, waste rock dump and tailings storage facility |
| Drilling of ore and waste rock | Mine pit |
| Blasting of ore and waste rock | Mine pit |
| Loading ore and waste rock into haul trucks using excavators/shovels or front end loaders | Mine pit |
| Hauling ore and waste rock | Haul roads from mine pit to the crushing plant, long-term ore stockpiles and waste rock dump |
| Unloading ore and waste rock from haul trucks | Crushing plant, long-term ore stockpiles and waste rock dump |
| Dozing of waste rock and long-term ore stockpiles | Waste rock dump and long-term ore stockpiles |
| Ancillary vehicle movement | Mine roads |
| Grading haul roads | Haul roads |
| Primary crusher | Crushing plant |
| Ore handling and transfer | Crushing plant, crushed ore stockpile and crushed ore stockpile to processing plant |

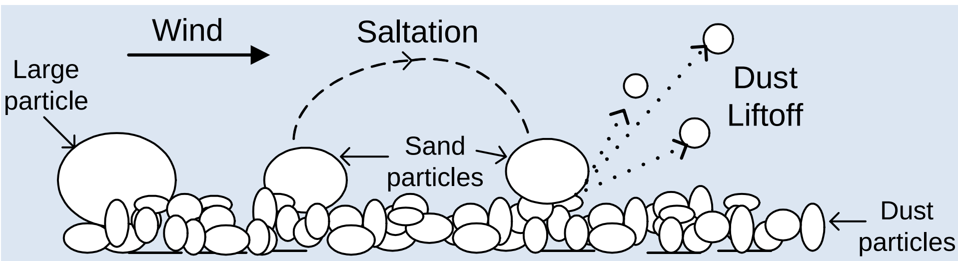



**Figure 9-3 Dust lift off resulting from saltation of sand particles**

Dust emissions from mechanical processes associated with the Project were calculated using a combination of process rates, ore properties and emission factors from the National Pollutant Inventory (NPI) estimation manual for mining (NPI 2012). Consideration was given to mitigation measure available to manage dust emissions. Emission factors were multiplied by various ratios, depending on controls employed to reduce dust emission from various dust sources. Control factors are from the NPI manual for mining (NPI 2012). The following control factors were used in this study for various activities:

- hauling – 75% for level 2 watering (>2 litres/m$^2$/h);
- wind erosion from stockpiles – 50% for water sprays; and
- unloading trucks – 70% for water sprays.

The power station is proposed to be natural gas fired. The primary pollutants from gas engines are $NO_X$ formed by high temperatures generated in the combustor and CO and VOCs which are formed predominantly by the incomplete combustion of fuel. Emissions and its constituents were estimated using emission factors from the NPI emissions estimation manual for combustion engines (NPI 2008). Sulphur dioxide and particulate emissions were not modelled from the power station due to the negligible quantity of sulphur in the natural gas and negligible contribution of dust compared to other mine site activities.

The emissions assessment assumed the power station was operating at 100% of its maximum capacity rating and not the estimated load, to ensure a conservative approach that provides for increased loading if required. A risk assessment of air quality impacts due to upset conditions did not identify any significant risk from power station plant failure or malfunction. It was determined that gas supply failure or engine malfunction would result in the partial or full shut down of power generation systems and cessation of emissions to air. Therefore, power station upset conditions were not assessed as part of the modelling assessment. Emissions from gas engines would be mitigated by tuning for optimum performance, efficiency and lowest emissions. This involves using lean burn technology, involving combustion of a lean air-fuel mixture, which has more air than is required for the stoichiometric combustion of the fuel. This results in lower peak combustion temperatures, which in turn reduces NOx formation.

The emission characteristics for the various Project point and fugitive sources were incorporated into an air dispersion and deposition model to predict the fate and impact of these emissions. The US EPA approved CALPUFF dispersion model (version 5.8.4) was used to simulate the dispersion characteristics and concentrations of pollutants generated by the Project. CALPUFF is an advanced Lagrangian, non-steady state air dispersion model that utilises a three dimensional wind field to simulate the dispersion of air pollutants to predict ground level concentrations across a gridded domain. The model has been approved by the US EPA (2005), as the preferred model for assessing long range transport of pollutants. Surface meteorological observations from a nearby Bureau of Meteorology station were used to inform CALMET (the 3D meteorological model pre-processor to CALPUFF) in combination with upper air data synthesised using CSIRO’s The Air Pollution Model (TAPM). Model development was for the year 1 July 2011 to 30 June 2012. Mining Year 4 was chosen to represent the highest emissions year during operations. This year was chosen as it was identified to have one of the higher mining rates, and the pit depth is shallow such that wind erosion would be relatively high compared to subsequent years. More detailed information on the models used and their configuration is provided in the GHD Air Assessment report for the Project (GHD 2015). This report also details the identified emissions sources and characteristics as they relate to the fourth year of mine operation.

### 9.3.2 Greenhouse Gas Emissions

Fuel combustion for power generation and vehicle use (site and trains) will comprise the majority of greenhouse gas emissions from the Project. Other smaller emissions will include clearing of vegetation, use of explosives and wastewater treatment. Associated, but off site greenhouse gas emissions will include embodied emissions associated with the production of major construction materials, and transport of materials and employees to and from site.

Typically the smaller emissions identified above comprise approximately 20% of the total emissions from mine sites (GHD 2012). As this assessment has been undertaken at an early stage in the development of the Project and quantities of construction materials have not yet been estimated for some of the smaller emission sources, these emissions have not been estimated separately. Rather than attempt to separately estimate the emissions from these smaller sources, a 20% uplift has been added to the total emissions estimates for fuel combustion for vehicle use and power generation. This is considered to be an acceptable approach to ensure these ancillary emissions are accounted for in the assessment.

The greenhouse gases considered for the Project are listed in Table 9-5 together with their global warming potential. Global warming potential is a relative measure of how much heat a greenhouse gas traps in the atmosphere compared to a similar mass of carbon dioxide.

**Table 9-5 Greenhouse gases and 100 year global warming potentials**

| Greenhouse gas | Global warming potential |
|---|---|
| Carbon dioxide ($CO_2$) | 1 |
| Methane ($CH_4$) | 21 |
| Nitrous oxide ($N_2O$) | 310 |
| Hydrofluorocarbons (HFCs) | 140-11,700 |
| Perfluorocarbons (PFCs) | 6,500-9,200 |
| Sulphur hexafluoride ($SF_6$) | 23,900 |

In accordance with the Greenhouse Gas Protocol, emissions are separated into three scopes:

- Scope 1 emissions are created directly by a person or business from sources that are owned or controlled by that person or business;
- Scope 2 emissions arise from the generation of electricity, heating, cooling or steam that is purchased and consumed by a person or business. These are indirect emissions as they arise from sources not owned or controlled by the person or business who consumes the electricity; and
- all other emissions associated with the Project are defined as Scope 3, since they are produced outside of the Project site, and TNG does not have operational control of the facilities from which they originate. For example, TNG will not own or operate vehicles used to transport raw materials to site and emissions resulting from the combustion of fuels for this transportation are classified as Scope 3.

Scope 1 emissions will be produced by the combustion of fuels such as natural gas and diesel at the mine site, and by vehicles, plant and equipment which TNG has operational control over. The site will also combust fuel for power generation. As the Project generates its own power, no Scope 2 emissions are included in this assessment. The main Scope 3 emission is diesel used in trains for the export of concentrate from site. All other Scope 3 emissions have been accounted for by adding 20% to the emissions calculated from fuel combustion. A detailed description of the equations and coefficient factors used to calculate emissions are detailed in the GHD Air Assessment report for the Project (GHD 2015).

## 9.4 Potential Impacts

### 9.4.1 Air Emissions

The Project is not anticipated to have adverse air impacts during the construction phase. TNG will develop a framework which includes mitigation measures for the management of dust emissions during the construction phase of the Project. More details are provided in Section 9.5.1.

The Project's air emissions during operation are modelled to have limited adverse impacts, with particle and other air pollutant concentrations well below the assessment criteria. Table 9-6 summarises the predicted $PM_{10}$ and TSP concentrations at receptors during operation. A representation of the predicted 1-hour (99.9 %ile) $PM_{10}$ emissions via a contour plot is provided in Figure 9-4.

### Table 9-6 Predicted particle concentrations at sensitive receptors

| Receptor | $PM_{10}$, µg/m$^3$ | | | TSP, µg/m$^3$ | |
|---|---|---|---|---|---|
| Averaging period | Annual | 24-hour | 1-hour | 24-hour | 1-hour |
| Rank | Max | Max | 99.9 %ile | Max | 99.9 %ile |
| Guideline | 20 | 50 | 80 | 90 | - - |
| Mine camp site | 0.5 | 9.7 | 35 | 26.4 | 95.6 |
| Anningie Station | 0.04 | 1.2 | 4.3 | 3.3 | 11.7 |
| Wilora | 0.004 | 0.1 | 0.4 | 0.3 | 1.1 |
| Stirling Station | 0.004 | 0.01 | 0.3 | 0.3 | 0.8 |
| Ti Tree | 0.007 | 0.2 | 0.6 | 0.4 | 1.6 |
| Barrow Creek | 0.001 | 0.05 | 0.1 | 0.1 | 0.4 |
| Willowra | 0.05 | 0.2 | 8.8 | 0.6 | 2.4 |

Dust deposition is 2 g/m$^2$/mth in the direct vicinity of the mine site and quickly decreases to below detection beyond the mine site.

The highest predicted particle concentrations are located at the closest sensitive receptor (mine camp) where predicted concentrations range between 2.5% and 44% of the various assessment criteria. Predicted particle concentrations at non-mining receptors range between 0.005% and 5% of the assessment criteria. These low impacts were expected due to the large separation distances. From a cumulative perspective, the model shows the Project will not significantly impact non-mining sensitive receptors, with background regional and their own local neighbourhood sources expected to dominate.

It is noted that the second highest predicted concentrations occur at the furthest receptor (Willowra). This is a result of the predominant south easterly wind direction (Figure 9-1) directing emissions in a north westerly direction towards Willowra, and away from receptors south east of the mine site.

Table 9-7 presents the predicted concentrations for CO, $NO_2$ and VOCs at the sensitive receptor locations during operation. The predicted concentrations at all receptors are below the assessment criteria for all assessed pollutants. As there are limited anthropogenic sources of pollutants other than dust in the area, background levels are unlikely to be of any significance.

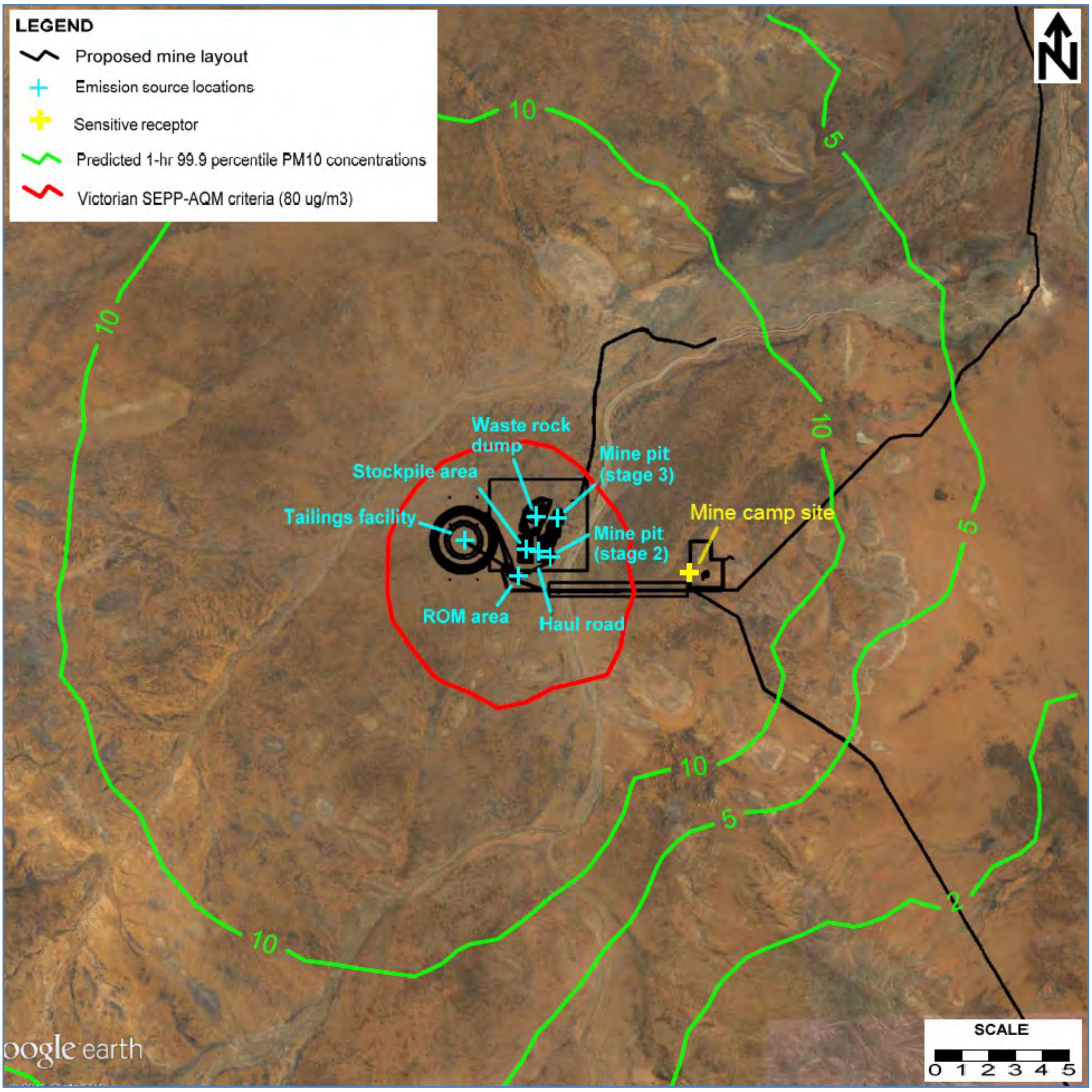



**Figure 9-4 Predicted 99.9 percentile $PM_{10}$ 1-hour concentration contour plot**

### Table 9-7 Predicted CO, $NO_2$ and VOCs concentrations at sensitive receptors

| Receptor | CO | $NO_2$[4] | | Acetaldehyde | Benzene | Formaldehyde | Toluene | | | Xylene |
|---|---|---|---|---|---|---|---|---|---|---|
| Averaging period | 8-hour | 1-hour | Annual | 3-min | 3-min | 3-min | 3-min | 24-hour | annual | 3-min |
| Rank | Max | Max | - - | 99.9%ile | 99.9%ile | 99.9%ile | 99.9%ile | max | - - | 99.9%ile |
| Guideline | 11,254 µg/m$^3$ | 247 µg/m$^3$ | 62 µg/m$^3$ | 76 µg/m$^3$ | 10.5 µg/m$^3$ | 40 µg/m$^3$ | 650 µg/m$^3$ | 4114 µg/m$^3$ | 411 µg/m$^3$ | 350 µg/m$^3$ |
| Mine camp site | 1.02 | 20 | 1.49 | 0.37 | 0.37 | 0.37 | 0.37 | 0.0007 | 0.000021 | 0.0084 |
| Anningie Station | 1.72 | 12.78 | 1.57 | 0.24 | 0.24 | 0.24 | 0.24 | 0.0008 | 0.000041 | 0.0054 |
| Wilora | 0.14 | 1.79 | 0.19 | 0.03 | 0.03 | 0.03 | 0.03 | 0.0001 | 0.000003 | 0.0008 |
| Stirling Station | 0.17 | 1.91 | 0.21 | 0.04 | 0.04 | 0.04 | 0.04 | 0.0001 | 0.000003 | 0.0008 |
| Ti Tree | 1.57 | 6.48 | 1.43 | 0.12 | 0.12 | 0.12 | 0.12 | 0.0007 | 0.000020 | 0.0027 |
| Barrow Creek | 0.14 | 1.47 | 0.17 | 0.03 | 0.03 | 0.03 | 0.03 | 0.0001 | 0.000002 | 0.0006 |
| Willowra | 0.45 | 2.20 | 0.46 | 0.04 | 0.04 | 0.04 | 0.04 | 0.0002 | 0.000026 | 0.0009 |

4 Taken as 20% of NOx results

### 9.4.2 Greenhouse Gas Emissions

The Project's total greenhouse gas emissions for the life of mine were estimated based on two years of construction emissions and 15 years of operational emissions. The predicted source contribution, individual and total greenhouse gas emissions are presented in Table 9-8. Total emissions for the life of mine are estimated at 3,212,358 t $CO_2$-e.

**Table 9-8 Summary of total emissions (life of mine)**

| Source | Total Emissions (tonnes $CO_2$-e) | Percentage of total |
|---|---|---|
| Fuel combustion - diesel (site vehicles) | 500,235 | 16% |
| Fuel combustion – diesel (trains exporting concentrate) | 701,516 | 22% |
| Fuel combustion – natural gas (power generation) | 1,332,595 | 41% |
| Fuel combustion – diesel (power generation) | 35,540 | 1% |
| Other emissions | 642,472 | 20% |
| All emissions | 3,212,358 | 100% |

The Commonwealth Department of the Environment (DotE) estimates annual greenhouse gas emissions for Australia. The latest estimates are for 2013 (DotE 2013). Australia's total greenhouse gas emissions for 2013 were estimated at 548.6 Mt $CO_2$-e and the NT's emissions for the same period were estimated at 13.8 Mt $CO_2$-e. The major sources for NT emissions were agriculture (primarily the burning of savannah vegetation) and fuel combustion for stationary energy purposes. For comparison, global greenhouse gas emissions for 2012 from Annex 1 countries to the Kyoto protocol were 15.1 gigatonnes of $CO_2$-e (UNFCCC 2014).

Total greenhouse gas emissions for the Project are released over a 15+ year period, whereas the territory, national and global emissions listed above are for only one year. Average annual emissions from the Project are estimated at 178,000 tonnes $CO_2$-e. Assuming that NT emissions remain constant over the next 15 years, the Project's emissions will constitute approximately 1%, 0.03% and 0.001% of annual NT, national and global emissions respectively.

## 9.5 Emission Management and Mitigation Measures

### 9.5.1 Air Emissions

Dust emissions will be controlled by application of a dust management processes, defined as part of the site Environmental Management Plan. Using this approach, a staged management plan for dust mitigation and management measures would be influenced by the proximity of sensitive receptors. Due to the separation distance between the Project site and the nearest sensitive receptor, the dust management measures would detail actions for typical dust control, based on the principles found in the *Environmental Guidelines for Major Construction Sites* (EPA Victoria 1996). These management measures will be implemented during the construction phase and where relevant continue during operation.

From the identification of potential dust emission sources, appropriate dust management and mitigation measures would include:

- all construction and maintenance equipment/vehicles to be operated and maintained to manufacturer's specifications in order to minimise exhaust emissions;
- defined haul routes to be used wherever it is necessary for vehicles to traverse unsealed surfaces or unformed roads;
- vehicular speeds would be limited to 25 km/h on areas of unconsolidated or unsealed soil associated with the project; and
- prompt mitigation of excessive visible dust emissions, which may be a combination of:
  - stabilisation of surface silt content through application of localised water sprays, or the use of appropriate chemical dust suppressants (suitable for roads which are traversed less frequently);
  - control of mechanically induced dust emissions (from clearing, excavation, loading, dumping filling and levelling activities) by application of water sprays;
  - awareness of operational areas more frequently exposed to higher winds and the predominant wind directions in these areas at various times of the year. Temporary wind barriers may be employed where necessary;
  - review of daily weather updates from BoM or a private meteorology service provider, to give warning of likely strong winds to assist with daily management of wind-blown dust from unconsolidated soil surfaces and material stockpiles; and
  - all haulage vehicles are to have their loads covered while transporting material to or from the work area through off-site routes that may have sensitive receptors.

### 9.5.2 Greenhouse Gas Emissions

Impacts of the Project on greenhouse gas emissions have been avoided or minimised where possible through the planning and design process. The majority of emissions for the Project are from the combustion of natural gas to provide the Project with electricity. The greenhouse gas intensity of the power station was estimated to be 0.53 kg $CO_2$-e/kWh, whereas the grid electricity in the Northern Territory is 0.67 kg $CO_2$-e/kWh. Therefore, the onsite power station significantly reduces emissions associated with electricity supply. The consumption of diesel will be a necessary Project requirement. However, a reduction in the quantity of fuel consumed may be achievable through optimisation of operational activities and logistics and use of more efficient plant and vehicles. This will be investigated further during the detailed project design and planning stage.

The most significant greenhouse gas mitigation option for fuel related emissions is likely to be the potential use of biodiesel blends; however, this is dependent on a number of factors including the origin of the biodiesel feedstock. When sourced from appropriate feedstocks, the reduction in emissions is approximately equivalent to the percentage of biodiesel in the blend (for example diesel with 20% biodiesel will reduce greenhouse gas emissions by approximately 20%). There are other factors that require consideration prior to the use of biodiesel. There is debate over the suitability and / or the percentage of biodiesel that can be used in various engines.  Biodiesel may not be suitable for some engines without major modifications.  Plant operators are also concerned that warranties may be void if biodiesel or biodiesel blends are used. Opportunities for the use of biodiesel on the Project will be further examined.

A commitment to energy efficiency and management will be recognised via the site Environmental Management Plan. Appropriate management will be integrated into site activities and processes, and greenhouse gas emissions would be monitored. The company will undertake regular energy audits and reviews to identify energy efficiency improvement opportunities which may be implemented to progressively improve operations and subsequent energy efficiency. Through assessment and review, the Project will seek continuous improvement in compliance and emissions reduction.

TNG is also considering the potential use of solar power and storage battery systems which, if implemented, will also reduce greenhouse gas emissions.

The feasibility of generating carbon offsets at the Project site under the Carbon Farming Initiative is likely to be limited.

There are a number of legislative requirements for measuring, monitoring and reporting greenhouse gas emissions and energy consumption that are applicable to the Project. Scope 1 and 2 emissions will be measured or estimated as part of the National Greenhouse and Energy Reporting Scheme, in line with the technical guidelines for measuring and reporting these emissions. The legislative measuring and reporting requirements will be used to assist in the identification of greenhouse gas reduction opportunities and track performance throughout the Project life.

## 9.6 Summary of Impacts and Conclusions

### 9.6.1 Air Emissions

Due to the relatively large separation distances between the non-mining sensitive receptors and the Project, no adverse air quality impacts are predicted to occur during construction or operation. The modelled emissions are well below the relevant assessment criteria at the sensitive receptors. Given the lack of other major anthropogenic sources in the region, cumulative impacts were limited, with non-anthropogenic background regional sources and local neighbourhood sources expected to dominate sensitive receptor exposure.

Dust emissions will be controlled through the application of a dust management processes, defined as part of the site Environmental Management Plan. It is proposed that these management measures will be implemented during the construction and, where relevant, will continue during operation.

### 9.6.2 Greenhouse Gas Emissions

The total greenhouse gas emissions (for the life of mine) are estimated to be 3,212,358 t $CO_2$-e. This equates to an annualised average emission of 178,000 t $CO_2$-e. The Project's emissions are estimated to contribute a small percentage to NT (1%), national (0.03%) and global (0.001 %) annual emissions. The following management measures will be implemented to avoid, mitigate and offset greenhouse gas emissions arising from the Project:

- commitment to energy efficiency within the site Environmental Management Plan;
- monitoring of greenhouse gas emissions and reporting of Scope 1 and Scope 2 emissions as part of National Greenhouse and Energy Reporting Scheme; and
- continuous improvement in compliance and emissions reduction throughout the Project life through assessment and review processes including legislative reporting requirements.

# 10. Noise and Vibration

## 10.1 Existing Noise Environment

### 10.1.1 Meteorology

Section 9.1.1 provides an overview of the meteorology for the region, which will influence the fate of Project noise emissions. Figure 9 1 shows that the dominant wind direction throughout the year is from the south east, resulting in noise levels radiating further in a north westerly direction. The Project area is also expected to be associated with temperature inversions at night, which will trap noise emissions allowing them to travel longer distances.

A detailed description is provided in Appendix J.

### 10.1.2 Existing emissions

The Project is situated in a relatively isolated location, with sensitive receptors and noise sources sparsely distributed across the region. Land use immediately adjacent to the Project is pastoral activities. Existing land use activities in the region that are likely to be associated with noise emissions include machinery operations on Anningie and Stirling stations, traffic noise on Stuart Highway and rail noise from the Alice Springs to Darwin railway.

### 10.1.3 Sensitive receptors

Noise sensitive receptors for the Project are considered consistent with those identified for the air quality assessment. Section 9.1 provides a list of the sensitive receptors, their distance to the Project and a figure presenting their location.

## 10.2 Noise and Vibration Criteria

In the absence of relevant Northern Territory guidelines or policies, noise and vibration criteria were selected from relevant state and international criteria. Where relevant, the assessment of potential noise impacts was confined to the nigh time criterion, as this is the time likely to have the greatest impact - that is, when temperature inversions usually occur and disturbance to sleep is possible.

### 10.2.1 Construction noise

Predicted construction noise was assessed with consideration to NSW Department of Environment and Climate Change (DECC) *Interim Construction Noise Guidelines* (ICNG) (DECC 2009). The ICNG recommend standard hours for construction activity and blasting (Table 10-1), with different criteria applied outside these times.

It is reasonable to assume working hours will extend outside the recommended standard hours, particularly for concrete pours during the hotter months, construction material delivery or to catch up on schedule delays. However, given the location of the mine site and the large distance between sources and receptors, this is not expected to cause an issue.

**Table 10-1 ICNG recommended standard hours for construction works**

| Work type | Recommended standard hours of work |
|---|---|
| Normal construction | Monday to Friday: 7.00 am to 6.00 pm<br>Saturday: 8.00 am to 1.00 pm<br>No work on Sundays or public holidays |
| Blasting | Monday to Friday: 9.00 am to 5.00 pm<br>Saturday: 9.00 am to 1.00 pm<br>No work on Sundays or public holidays |

The ICNG provides noise management for construction noise levels at residential receptors. The noise affected level is the background noise level plus 10 dBA during recommended standard hours and the background noise level plus 5 dBA outside of recommended standard hours. These criteria apply at the boundary of the most affected residences or within 30 m from the residence where the property boundary is more than 30 m from the residence. The noise affected level represents the point above which there may be some community reaction to noise. Where the noise affected level is exceeded, all feasible and reasonable work practices to minimise noise should be applied and all potentially impacted residents informed of the nature of the works, expected noise levels, duration of works and a method of contact.

Based on the distance between the Project and the closest non-mining sensitive receptor (approximately 30 km), background monitoring was not completed for this assessment. The NSW *Industrial Noise Policy* (INP) (EPA 2000) states where the background noise level is found to be less than 30 dBA then it is set to 30 dBA. The construction noise criteria were derived based on this (Table 10-2).

**Table 10-2 Construction noise criteria $L_{Aeq(15\text{-}min)}$**

| Within recommended standard hours | Outside recommended standard hours | |
|---|---|---|
| | Evening (6.00 pm to 10.00 pm) | Night (10.00 pm to 7.00 am) |
| 40 | 35 | 35 |

The ICNG states where construction works are planned to extend over more than two consecutive nights, the impact analysis should include maximum noise levels and the extent and number of times the maximum exceeds the rating background levels. As there is the potential for night works during construction, a maximum noise level criterion has also been set. The *Road Noise Policy* (RNP)(DECCW 2011) indicates people are unlikely to be woken by maximum internal noise levels below 50-55 dBA, and one or two noise events per night with maximum internal noise levels of 65–70 dBA are not likely to affect health and wellbeing significantly. For this Project a maximum noise level based on sleep disturbance criteria was set at 65 dBA based on the RNP recommended maximum internal noise levels of 55 dBA, and assuming a 10 dBA reduction in noise from outside to inside the building.

### 10.2.2 Operation noise

Operational noise criteria applied to this assessment were derived with consideration to the NSW INP. This policy provides guidance on the assessment of operational noise impacts and gives consideration to intrusive and amenity criteria designed to protect receptors from individual and cumulative noise sources significantly louder than background levels near a sensitive receptor.

Intrusive noise limits control the relative audibility of operational noise compared to the background level; whereas amenity criteria limit the total level of extraneous noise. The amenity criteria are determined based on the overall acoustic characteristics of the receptor area and the existing level of noise excluding other noises that are uncharacteristic of the usual noise environment. Residential receptor areas are characterised into ‘urban’, ‘suburban’, ‘rural’ or other categories based on land uses, the existing level of noise from industry, commerce and road traffic. The nearest residential receptors to this development were classified as rural.

Both intrusive and amenity criteria were calculated for each time period (day, evening and night) and the more stringent of the two applied for this assessment. Similar to the construction noise criteria, given the limited noise sources present in the region a background level of 30 dBA was set, consistent with the INP. The project specific noise levels for the proposed mine at identified sensitive receptors are provided in Table 10-3. These criteria apply at the boundary of the most affected residences or within 30 m from the residence where the property boundary is more than 30 m from the residence.

**Table 10-3 Project specific noise criteria**

| Criterion | Nearest residential receptor | | |
|---|---|---|---|
| | Day<br>7.00 am to 6.00 pm | Evening<br>6.00 pm to 10.00 pm | Night<br>10.00 pm to 7.00 am |
| A: Rating background level[1] | Not applicable since there is no existing industrial noise | | |
| B: Intrusiveness criteria - (A + 5 dB) | 35 LAeq (15-min) | 35 LAeq (15-min) | 35 LAeq (15-min) |
| C: Rural amenity criteria | 50 LAeq (day) | 45 LAeq (evening) | 40 LAeq (night) |
| D: Amenity criteria | Not applicable since there is no existing industrial noise | | |
| Project specific noise level | 35 LAeq (15-min) | 35 LAeq (15-min) | 35 LAeq (15-min) |

[1] The NSW INP states where the rating background level is found to be less than 30 dBA, then it is set to 30 dBA

Consideration was given to potential low frequency noise emissions from the Project, namely the power station. Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. Where required, the INP sets out the corrections to be applied for tonal, impulsive and intermittent and low frequency noise. However, this Project was not found to trigger this adjustment based on the sources present and model results.

### 10.2.3 Vibration

Vibration criteria have been adopted with consideration to the BS 6472-1:2008 (*Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting*), which provides suitable values for assessing human comfort criteria for residential building types. Typically, mine activities generate ground vibration of an intermittent nature. Under BS 6472-1:2008, intermittent vibration is assessed using the vibration dose value (VDV). Whilst the assessment of response to vibration in BS 6472-1:2008 is based on VDV and weighted acceleration, for construction related vibration, it is considered more appropriate to provide guidance in terms of peak particle velocity (PPV), since this parameter is likely to be more routinely measured based on the more usual concern over potential building damage.

Humans are capable of detecting vibration at levels well below those causing risk of damage to a building. The degrees of perception for humans are suggested by the vibration level categories given in BS 5228-2:2009 (*Code of practice for noise and vibration on construction and open sites – Part 2: Vibration*) as shown in Table 10-4.

### Table 10-4 Guidance on the effects of vibration levels

| Approximate vibration level | Degree of perception |
|---|---|
| 0.14 mm/s | Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration. |
| 0.30 mm/s | Vibration might be just perceptible in residential environments. |
| 1.00 mm/s | It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents. |
| 10.00 mm/s | Vibration is likely to be intolerable for any more than a very brief exposure to this level. |

As there are no Australian Standards for the assessment of building damage caused by vibration, reference to German Standard DIN 4150-3 (*1999 Structural Vibration – Part 3: Effects of vibration on structures*) occurred. The vibration criteria presented in this standard exceed the human comfort criteria presented above. Therefore, the human comfort criteria were used to provide a conservative assessment of vibration.

The Australian and New Zealand Environment and Conservation Council (ANZECC) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990)* are typically referred to when dealing with potential blasting noise and vibration. This guideline recommends the noise and vibration limits shown in Table 10-5.

### Table 10-5 Recommended ANZECC 1990 blasting limits

| Air blast overpressure | Ground vibration |
|---|---|
| 115 dB(lin) peak | 5 mm/s PPV. |
| The level of 115 dB may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 120 dB(lin) peak | The level of 5 mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 10 mm/s. |

ANZECC guideline recommends that blasting should only be permitted during the following hours:

- Monday to Saturday, 9.00 am to 5.00 pm; and
- no blasting on Sundays or public holidays.

The frequency of blasting should not take place more than once per day. This requirement does not apply to minor blasts such as clearing crushers, feed chutes, etc. When considering a time to initiate the blast, weather conditions must be assessed. Generally the atmosphere is most stable early morning and late afternoon due to the absence of direct ground heating from the sun.

Stuart Highway is the only public road potentially affected by the Project. It is not planned for redevelopment or upgrade. In the absence of NT road traffic noise criteria, construction works and operation road traffic noise targets for this road have been sourced from the NSW RNP. Recommended noise levels associated with land use developments are shown in Table 10-6. Where noise criteria levels are already exceeded, construction and operational traffic arising from the proposal should not lead to an increase of more than 2 dBA in existing noise levels.

**Table 10-6 Road traffic noise criteria**

| Road category | Type of project / land use | Assessment criteria dBA | |
|---|---|---|---|
| | | Day<br>7.00 am to 10.00 pm | Night<br>10.00 pm to 7.00 am |
| Local road | Existing residences affected by noise from new local road corridors.<br>Existing residences affected by noise from redevelopment of existing local roads.<br>Existing residences affected by additional traffic on existing local roads generated by land used developments. | $L_{Aeq\ (1\ hour)}$ 55 dB (external) | $L_{Aeq\ (1\ hour)}$ 50 dB (external) |

## 10.3 Methodology

A summary of the method used to predict noise and vibration emissions and potential impacts is provided in the following sections.  A more detailed description is provided in Appendix J.

### 10.3.1 Noise emissions

Construction will occur over a 24 month period and include civil excavation and earthworks, building construction, equipment fabrication and installation, waste removal and materials transfer. Typical noise levels produced by construction plant to be used on-site were sourced from AS 2436 – 2010 (*Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites*) and GHD's database.

Construction noise impacts were estimated using a distance attenuation relationship formula which takes into account sound intensity losses due to spherical spreading, but ignores minor losses such as atmospheric absorption, directivity and ground absorption. As a result, predicted received noise levels are expected to slightly overstate actual received levels and thus provide a measure of conservatism.

Predicted maximum received noise levels during construction are shown in Table 10-7 for a variety of distances, with no noise barriers or acoustic shielding in place and with each plant item operating at full power. It is important to keep in mind the actual magnitude of off-site noise impact associated with construction will be dependent upon a number of factors. For example, the type of equipment used, intervening terrain and prevailing weather conditions will affect the noise levels present at sensitive receptor locations. Construction machinery will also move about the Project site, altering the directivity of the noise source with respect to individual receptors. It is also appropriate to assume machinery will not operate at maximum sound power levels constantly, and it is unlikely that all construction equipment would be operating at their maximum sound power levels at any one time.

### Table 10-7 Predicted plant activity noise levels

| Plant | Estimated Sound Power Level (dBA) | Estimated Sound Pressure Level, dBA at distance (m) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 50 | 250 | 500 | 750 | 1000 | 3000 | 5000 |
| Backhoe | 104 | 62 | 48 | 42 | 39 | 36 | 26 | 22 |
| Backhoe (with auger) | 106 | 64 | 50 | 44 | 41 | 38 | 28 | 24 |
| Bulldozer | 108 | 66 | 52 | 46 | 43 | 40 | 30 | 26 |
| Compactor | 113 | 71 | 57 | 51 | 48 | 45 | 35 | 31 |
| Compressor (silenced) | 101 | 59 | 45 | 39 | 36 | 33 | 23 | 19 |
| Concrete agitator truck | 109 | 67 | 53 | 47 | 44 | 41 | 31 | 27 |
| Concrete pump truck | 108 | 66 | 52 | 46 | 43 | 40 | 30 | 26 |
| Concrete saw | 117 | 75 | 61 | 55 | 52 | 49 | 39 | 35 |
| Concrete vibratory screed | 115 | 73 | 59 | 53 | 50 | 47 | 37 | 33 |
| Crane (mobile) | 104 | 62 | 48 | 42 | 39 | 36 | 26 | 22 |
| Excavator | 107 | 65 | 51 | 45 | 42 | 39 | 29 | 25 |
| Front end loader | 113 | 71 | 57 | 51 | 48 | 45 | 35 | 31 |
| Generator (diesel) | 104 | 62 | 48 | 42 | 39 | 36 | 26 | 22 |
| Grader | 110 | 68 | 54 | 48 | 45 | 42 | 32 | 28 |
| Hand tools (electric) | 102 | 60 | 46 | 40 | 37 | 34 | 24 | 20 |
| Hand tools (pneumatic) | 116 | 74 | 60 | 54 | 51 | 48 | 38 | 34 |
| Jack hammers | 121 | 79 | 65 | 59 | 56 | 53 | 43 | 39 |
| Piling (bored) | 111 | 69 | 55 | 49 | 46 | 43 | 33 | 29 |
| Rock breaker | 118 | 76 | 62 | 56 | 53 | 50 | 40 | 36 |
| Roller (vibratory) | 108 | 66 | 52 | 46 | 43 | 40 | 30 | 26 |
| Scraper | 116 | 74 | 60 | 54 | 51 | 48 | 38 | 34 |
| Truck (>20 tonnes) | 107 | 65 | 51 | 45 | 42 | 39 | 29 | 25 |
| Truck (dump) | 117 | 75 | 61 | 55 | 52 | 49 | 39 | 35 |
| Truck (water cart) | 107 | 65 | 51 | 45 | 42 | 39 | 29 | 25 |
| Vehicle (light comm/4WD) | 106 | 64 | 50 | 44 | 41 | 38 | 28 | 24 |
| Welder | 105 | 63 | 49 | 43 | 40 | 37 | 27 | 23 |

During mine operation, the Project will have a number of noise sources, which will change over the life of the mine. Noise impacts will be most significant during early mine life as the depth of the pit will be minimal. As mine development progresses, the depth of the pit will increase, reducing the impact of noise emissions to sensitive receptors from equipment operating in the pit. For a conservative assessment, noise modelling against assigned night time $L_{A\,10}$ noise levels has been completed for early mine life (end of year four) to predicted worst case noise levels. This year will also see the movement of around 11.6 Mt or ore and waste, a typical maximum annual production.

During early mine life, haul trucks will haul waste rock to the waste rock dump. As such, noise modelling has assumed haul road traffic at the required volumes to transport the estimated daily throughput from the pit. Blast hole drilling operations have been assumed to occur during day only.

All other Project sources (including the crushing and processing plants, tailings storage facility and gas fired power station) are assumed to be operating continuously. As such, these sources have been modelled as continuous sources at maximum sound power levels which is conservative.

Typical mining equipment noise levels have been obtained from noise assessments conducted on similar projects and GHD's noise source database. The noise model includes the operational mobile and fixed noise sources as presented in Table 10-8 and Table 10-9. These sound power levels are maximum predicted levels produced when machinery is operating under full load

### Table 10-8 Modelled noise sources – mobile sources

| Noise source | Number of items modelled | Sound power level (dBA) |
|---|---|---|
| Dump truck (Cat 777F) | 7 | 115 |
| Drill rig (Cat MD5125) | 2 | 120 |
| Track dozer (Cat D9T) | 2 | 110 |
| Wheel dozer (Cat 834) | 1 | 115 |
| Shovel (Cat 6018) | 2 | 113 |
| Shovel (Cat 6015) | 1 | 107 |
| Grader (Cat 16M) | 1 | 111 |
| Water truck (Cat 777D WT) | 2 | 115 |
| Wheel loader (Cat 980H) | 7 (mine pit x 2, siding x 4) | 113 |
| Wheel loader (Cat 966H) | 1 (bene plant) | 105 |
| Roller (Cat CS74) | 1 | 108 |
| Fuel truck (Cat 777G FT) | 1 | 115 |
| Road train | 5 | 104 |
| Light vehicles (utes and 4WDs) | 10 | 100 |

**Table 10-9 Modelled noise sources – fixed sources**

| Noise source | Number of items modelled | Sound power level (dBA) |
|---|---|---|
| Primary crusher (Grizzly) | 1 | 116 |
| Secondary crusher (jaw) | 2 | 112 |
| Dust collection (dry, silenced) | 3 | 98 |
| Screening plant | 2 | 111 |
| Apron feeders | 1 | 99 |
| Conveyor | 11 | 94 per linear metre |
| Conveyor drive (unenclosed) | 11 | 112 |
| HPGR mills | 2 | 117 |
| Ball mill | 2 | 117 |
| Pumps (feed, sump or tails) | 6 | 101 |
| Pumps (slurry) | 4 | 108 |
| Agitated tank drive | 2 | 110 |
| Thickener drive | 2 | 107 |
| Filtration plant | 2 | 120 |
| Gas genset engine casing (1.4 MW) | 28 | 106 |
| Gas genset exhaust (1.4 MW, silenced) | 28 | 115 |
| Transformer (16 MVA) | 4 | 64 |
| Transformer (4 MVA) | 4 | 53 |
| Diesel genset engine casing (1.2 MW) | 3 (emergency) + 12 (borefield) | 108 |
| Diesel genset exhaust (1.2 MW, silenced) | 3 emergency) + 12 (borefield) | 117 |

Noise impacts during operation were predicted using the acoustic computer model, CadnaA v4.4. CadnaA calculates environmental noise propagation according to the Conservation of Clean Air and Water in Europe (CONCAWE) noise prediction method (CONCAWE 1981). The CONCAWE prediction method is widely used in Australia for predicting noise impacts of mines, power stations and other industry. Terrain topography, ground absorption and atmospheric absorption were taken into account in the calculations. The model also considered buildings that have potential to affect noise propagation by means of screening or reflection, such as those that house the generators.

The noise model for end of year four operations gave consideration to four likely weather scenarios:

- neutral conditions – no wind;
- temperature inversion – worst case winds towards closest receptor;
- dry Season – 3 m/s wind from the south-east; and
- wet Season – 3 m/s wind from the north-west.

The assessment has been modelled based on available data, including proposed layouts for the mine and noise generating equipment and environmental factors. As such, although the modelling results are considered relatively conservative, they should be used as a guide for comparative purposes against the relevant noise criteria.

Road access for the traffic including construction, service, delivery and workforce vehicles will be exclusively from the existing Stuart Highway. As such, the estimated increase in traffic noise due to the Project is not expected to be noticeable to sensitive receptors and was not modelled.

### 10.3.2 Vibration emissions

The nature and levels of vibration emitted by the Project will vary with the activities being carried out on site. Energy from construction equipment is transmitted into the ground and transformed into vibrations, which attenuate with distance. Table 10-10 outlines typical vibration levels for different plant activities that may be generated on the Project site, sourced from the NSW Roads and Traffic Authority (RTA) *Environmental Noise Management Manual* (RTA 2001).

**Table 10-10 Typical vibration levels for construction equipment**

| Plant item | Peak particle velocity at 10 m (mm/s) |
|---|---|
| Pile driving (impulsive) | 12 - 30 |
| Roller (15 tonne) | 7.0 - 8.0 |
| Dozer | 2.5 - 4.0 |
| Compactor (7 tonne) | 5.0 - 7.0 |
| Rock breaking | 7.0 |
| Backhoe | 1.0 |

The magnitude and attenuation of ground vibration is dependent on the:

- efficiency of the energy transfer mechanism of the equipment (i.e. impulsive, reciprocating, rolling or rotating equipment);
- frequency content;
- impact medium stiffness;
- type of wave (surface or body); and
- ground type and topography.

The above factors cause inherent variability in ground vibration predictions in the absence of site specific measurement data. However the rate of vibration attenuation can be calculated using a regression analysis formula. Applying this formula, predicted ground vibrations at various distances are shown in Table 10-11 for typical construction equipment.

**Table 10-11 Predicted construction equipment vibration levels (mm/s PPV)**

| Plant item | Human perception preferred criteria (maximum criteria) | | Predicted ground vibration | | | | |
|---|---|---|---|---|---|---|---|
| | Day | Night | 10 m | 30 m | 50 m | 100 m | 300 m |
| Pile driving (Impulsive) | 8.6 (17.0) | 2.8 (5.6) | 21.0 | 4.0 | 1.9 | 0.7 | 0.1 |
| Roller (15 tonne) | 0.28 (0.56) | 0.2 (0.4) | 7.5 | 1.4 | 0.7 | 0.2 | <0.1 |
| Dozer | 0.28 (0.56) | 0.2 (0.4) | 3.3 | 0.6 | 0.3 | 0.1 | <0.1 |
| Compactor (7 tonne) | 0.28 (0.56) | 0.2 (0.4) | 6.0 | 1.2 | 0.5 | 0.2 | <0.1 |
| Rock breaking | 0.28 (0.56) | 0.2 (0.4) | 7 | 1.3 | 0.6 | 0.2 | <0.1 |
| Backhoe | 0.28 (0.56) | 0.2 (0.4) | 1 | 0.2 | 0.1 | <0.1 | <0.1 |

## 10.4 Potential Impacts

### 10.4.1 Noise emissions

Given the intermittent and mobile nature of construction noise, the predicted impacts are considered conservative as they represent the maximum possible distances over which an acoustic impact may be audible during quiet ambient conditions. If such impacts were to occur, they would likely be intermittent and infrequent. Even with this conservative approach, the technical assessment concluded the construction activities were unlikely to cause audible noise or nuisance to any sensitive receptors, due to the distance between the construction works and receptors. Similarly the night-time sleep disturbance criterion for the Project was predicted to be met at all sensitive receptors during the construction period.

Predicted night $L_{Aeq\ (15\text{-}min)}$ noise levels generated at the end of year four of operation by the Project at the noise sensitive receptor locations are summarised in Table 10-12. For each of the four weather scenarios modelled it was assumed the mining, waste rock dumping, crushing plant and concentrator operations were at full production rates. No predicted night time $L_{Aeq\ (15\text{-}min)}$ noise levels are over the appropriate project specific noise level of 35 dBA.

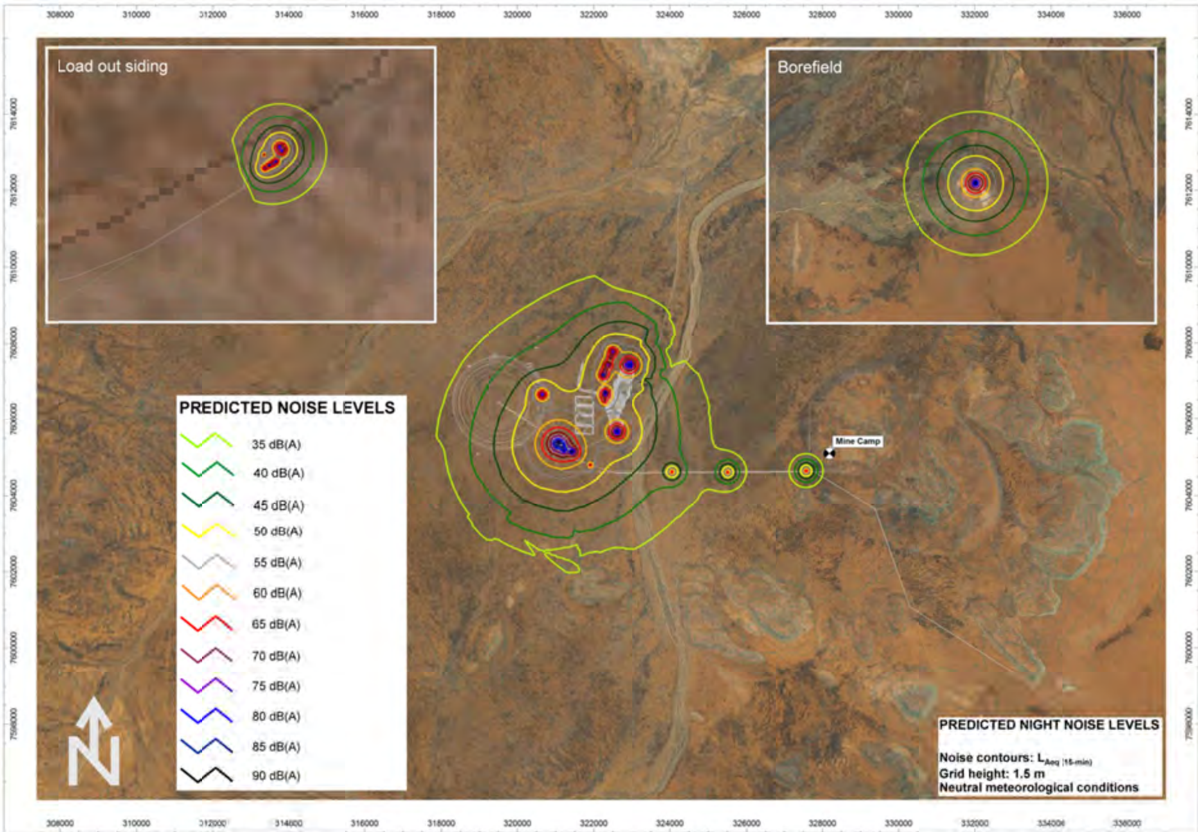
Night $L_{Aeq\ (15\text{-}min)}$ noise level contour plots for the Project during operation under each of the four weather scenarios modelled is shown in Figure 10-1. These plots provide the same information as presented in Table 10-12, only graphically. As with the tabulated information, the plots show there are no exceedances of the night level of 35 dBA predicted at any sensitive receptors.

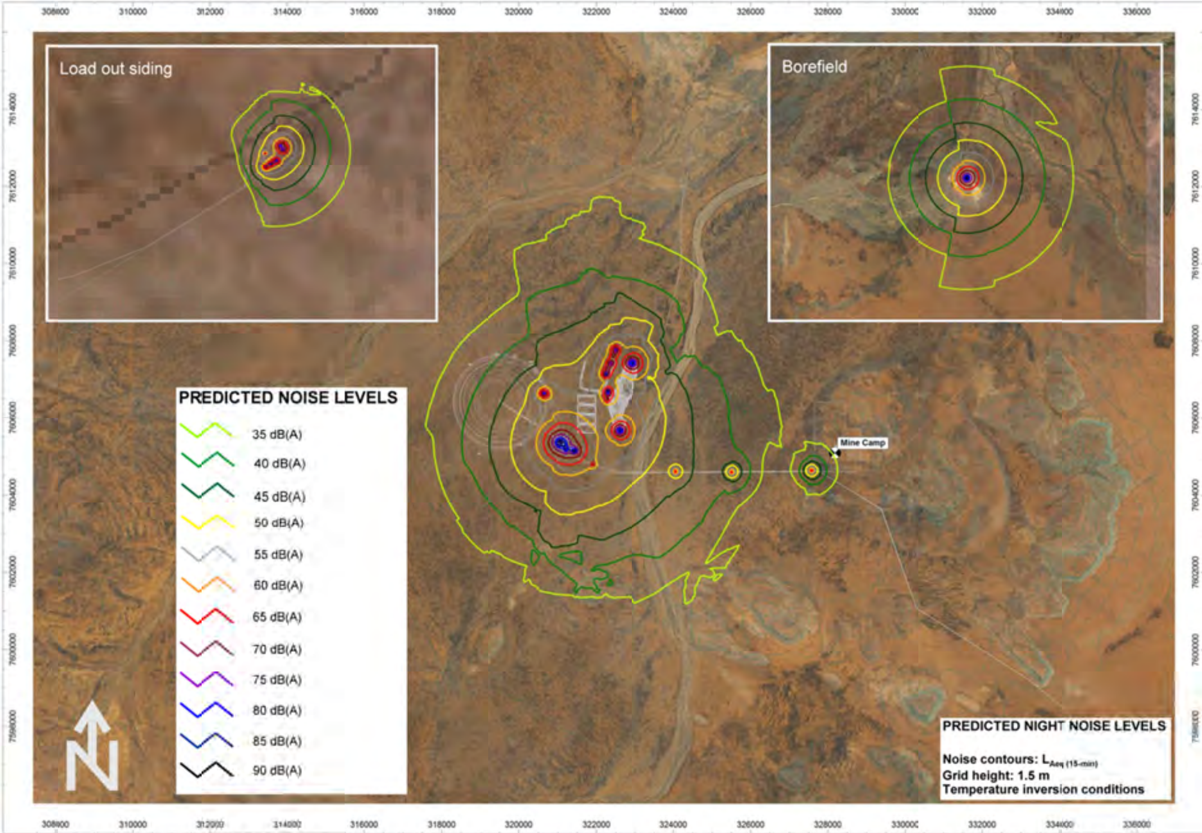
**Table 10-12 Predicted night $L_{Aeq\ (15\text{-}min)}$ noise levels, dBA**

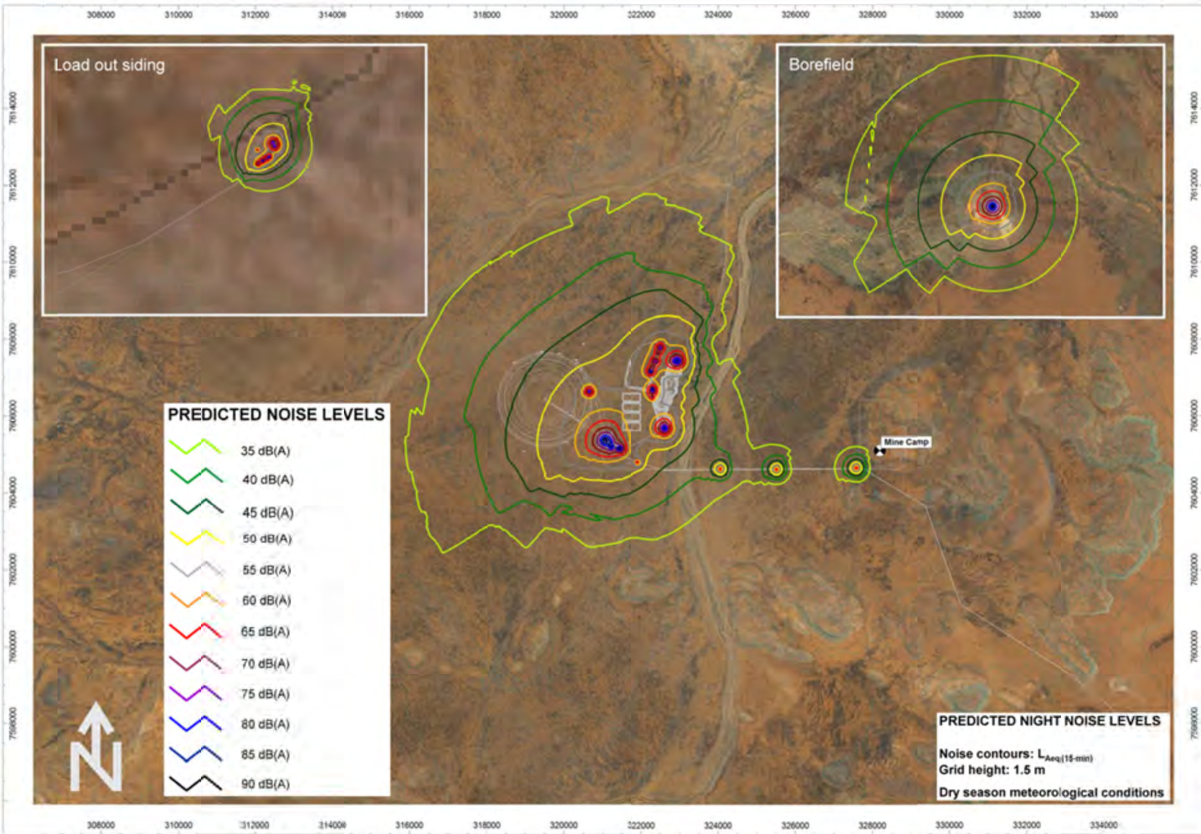
| Receptor | Neutral | Temperature inversion | Dry season | Wet season |
|---|---|---|---|---|
| Mine camp site | 29.3 | 34.3 | 28.6 | 33.0 |
| Anningie Station | 10.5 | 7.2 | 4.9 | 17.2 |
| Wilora | 13.1 | 12.5 | 6.3 | 21.8 |
| Stirling Station | 13.1 | 12.3 | 6.4 | 21.9 |
| Ti Tree | 7.3 | 7.0 | 0.8 | 16.3 |
| Barrow Creek | 9.6 | 7.3 | 2.2 | 18.7 |
| Willowra | 4.7 | No impact predicted | 6.2 | 0.3 |

### 10.4.2 Vibration emissions

Table 10-11 indicates that human perception guidelines for predicted ground vibration are likely to be met at a distance greater than 50 m, but less than 300 m from the construction activities. Given the distance to the nearest receptor from the mine site is 30 km, construction vibration is highly unlikely to exceed the human perception criteria and is not discussed further in this assessment.




Load out siding
Borefield
Mine Camp
PREDICTED NOISE LEVELS
35 dB(A)
40 dB(A)
45 dB(A)
50 dB(A)
55 dB(A)
60 dB(A)
65 dB(A)
70 dB(A)
75 dB(A)
80 dB(A)
85 dB(A)
90 dB(A)
PREDICTED NIGHT NOISE LEVELS
Noise contours: $L_{Aeq\ (15\text{-}min)}$
Grid height: 1.5 m
Temperature inversion conditions


Load out siding
Borefield
Mine Camp
PREDICTED NOISE LEVELS
35 dB(A)
40 dB(A)
45 dB(A)
50 dB(A)
55 dB(A)
60 dB(A)
65 dB(A)
70 dB(A)
75 dB(A)
80 dB(A)
85 dB(A)
90 dB(A)
PREDICTED NIGHT NOISE LEVELS
Noise contours: $L_{Aeq\ (15\text{-}min)}$
Grid height: 1.5 m
Dry season meteorological conditions

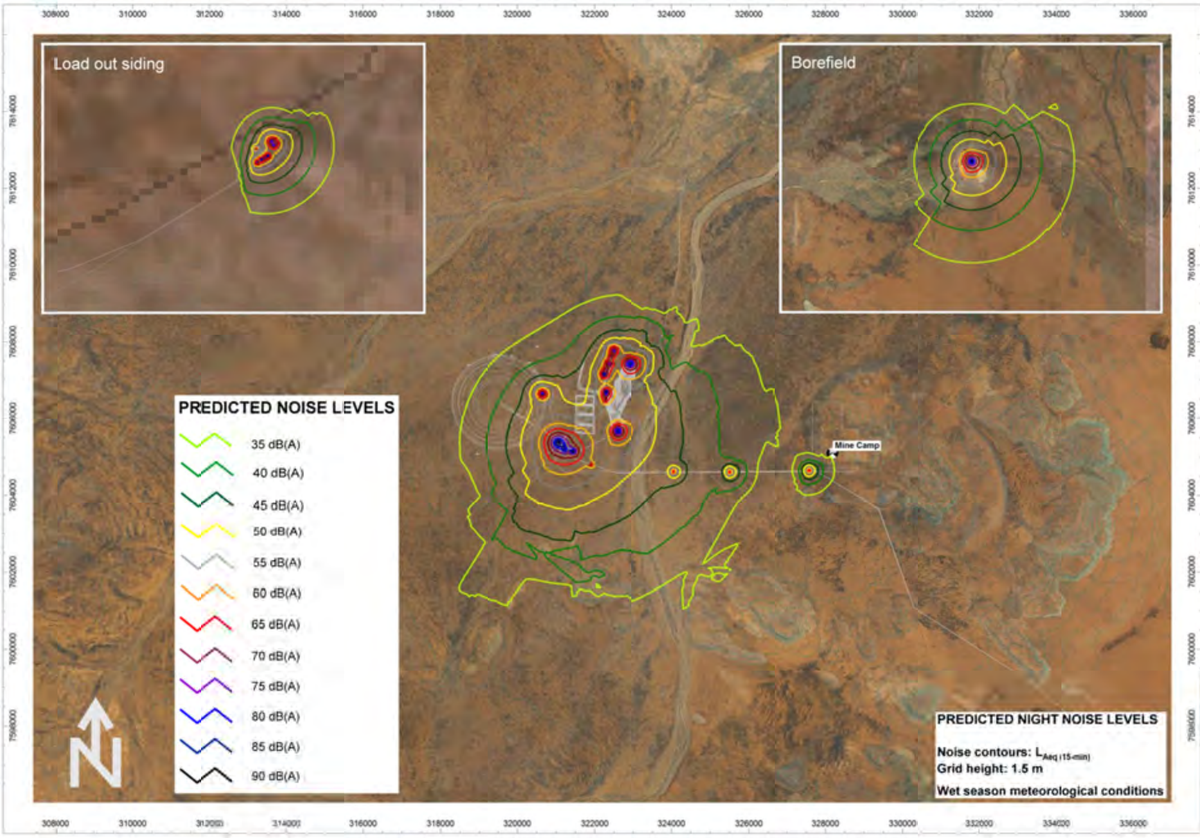



**Figure 10-1 Predicted night $L_{AEq\ (15\text{-min})}$ noise levels during operation**

## 10.5 Noise Management Measures

Although the Project is not expected to cause adverse noise impacts, TNG will adopt the following measures during construction and operation to reduce emissions:

- where practical, construction work will be kept within the working hours prescribed by the ICNG (DECC 2009);
- equipment used on site will be in good condition, working order and fit for purpose, with preference given to silenced equipment whenever possible;
- equipment will be operated as intended by the manufacturer;
- as far as possible, material drop heights into or out of trucks will be minimised;
- preference will be given to broadband reversing alarms (audible movement alarms);
- fixed and mobile plant will be kept properly serviced and fitted with appropriate mufflers;
- where practical, machinery will be operated at low speed or power and will be switched off when not being used rather than left idling for prolonged periods;
- machines found to produce excessive noise compared to industry normal standards will be investigated and if required rectified or replaced;
- site workers will be made aware of the potential for noise impacts and encouraged to take practical and reasonable measures to minimise the impact during the course of their activities; and
- blasting will occur between 9:00 am and 5:00 pm.

Available literature suggests that the impact of noise from the Project is unlikely to result in negative impacts to either livestock or native fauna. As such, no specific management measures, other than those proposed in regard to management of impacts to human receptors, are required.

## 10.6 Summary of Impacts and Conclusions

This Project in unlikely to cause adverse noise or vibration impacts during construction or operation. The technical assessment completed predicts noise and vibration levels at sensitive receptors will comply with the noise criteria at all times. Even under worst case weather conditions and with plant operating continuously at maximum capacity, the Project was still showing compliance.

Predicted noise levels under the worst case conditions (wind assisted conditions during temperature inversion) at the nearest noise sensitive receptor (the Project's own mine camp) is 34 dBA, which is below the noise criteria of 35 dBA.

Although the Project is not expected to cause adverse noise impacts, the mitigation measures detailed in Section 10.5 will be applied to further reduce the risk of noise impacts.

The estimated increase in traffic noise levels due to the Project is not expected to be noticeable.

The nature and levels of vibration emitted by the Project will vary with the activities being undertaken. However, due to the distances between the sources and receptors, vibration is unlikely to have a significant impact.

# 11. Aboriginal and Historic Heritage

TNG commissioned Australian Museum Consulting (AM Consulting) to prepare an Aboriginal and Historic Heritage Assessment for the Project. This report is presented in Appendix K and has been prepared in accordance with the principles of the *Burra Charter; The Australia ICOMOS charter for the conservation of places of cultural significance 2013* and in accordance with current heritage best-practice guidelines as identified in the Department of Lands, Planning and the Environment Heritage Branch's *Scope of Works for an Archaeological Survey* and associated supplementary publications.

## 11.1 Statutory Context

The conservation and management of heritage items, places, and archaeological sites takes place within the framework of relevant Commonwealth and Territory legislation. Non-statutory heritage lists and registers, ethical charters, conservation policies, and community attitudes and expectations can also have an impact on the management, use, and development of heritage items. The following describes the relevant legislation, and statutory and non-statutory heritage listis for the study area.

### *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act provides a legal framework for the protection and management of places of national environmental significance. Several heritage lists are addressed by the EPBC Act, including the National Heritage List (protects places that have outstanding value to the nation) and the Commonwealth Heritage List (protects items and places owned or managed by Commonwealth agencies). The Minister's approval is required for controlled actions which would have a significant impact on items and places included on either of these lists.

There are no Aboriginal or historic heritage items, places or archaeological sites listed on the National or Commonwealth Heritage Lists within or near the Project area.

### *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*

The purpose of this Act is to preserve and protect areas and objects in Australia and in Australian waters, that are of particular significance to Indigenous people in accordance with their traditions. The Act allows the Minister for the Environment to make a declaration protecting significant Indigenous areas or objects, including human remains, from 'threat of injury or desecration'. The Act does not protect all forms of Indigenous heritage; for example, it does not cover areas and objects whose heritage significance is due to their archaeological, scientific or historical interest (DotE 2014).

There are no areas or objects near to the Project area that are the subject of a declaration under this Act.

### *Native Title Act 1993*

Native title is the recognition by Australian law that Aboriginal peoples or Torres Strait Islanders have rights and interests to land and waters that arise from traditional laws and customs. The Native Title Act recognises and protects native title in Australia, and establishes a mechanism for determining native title claims. It also provides for negotiations between native title holders or registered native title claimants and other parties regarding the use and management of land and waters, in the form of Indigenous Land Use Agreements (ILUAs).

The Native Title Registrar of the National Native Title Tribunal (NNTT) keeps three public registers of native title information: the National Native Title Register, the Register of Native Title Claims, and the Register of Indigenous Land Use Agreements. Registered native title holders are recognised as having a right to speak for Country on Aboriginal culture and heritage.

There are no ILUAs or Aboriginal places listed on the National Native Title Register near the study area. The mining area and part of the access road is covered by one native title determination application that has met the requirements for registration on the Register of Native Title Claims: the Stirling and Neutral Junction (NNTT Application Reference DC2011/002).

### *Aboriginal Land Rights (Northern Territory) Act 1976*

The Aboriginal Land Rights (Northern Territory) Act (ALR (NT) Act) provides the basis upon which Aboriginal people in the Northern Territory can claim rights to land based on traditional occupation. The Act provides for the creation of at least two Aboriginal Land Councils (there are four Land Councils, with the Central Land Council being relevant to this Project) to administer certain areas of land in the Northern Territory and for the creation of Aboriginal Land Trusts to hold freehold title land and land granted by way of a successful land claim. The Act contains provisions setting out the terms and conditions upon which mineral exploration licences, mining interests and other leases and interests can be granted over land held by an Aboriginal Land Trust. The Act also controls entry onto Aboriginal Land and prohibits a person (other than an entitled Aboriginal person or group) from entering onto or remaining on Aboriginal land without a permit. The Central Land Council (CLC) can issue a Sacred Site Clearance Certificate (SSCC) to prevent damage to, and interference with, Aboriginal sacred sites. The certificate achieves this by setting out conditions in relation to entering and working on the subject land. An applicant, when applying for a certificate, agrees to be bound by the conditions of the certificate. A SSCC not only protects the applicant against prosecution for entering, damaging, or interfering with sacred sites under the ALR (NT) Act, but also the *Northern Territory Aboriginal Sacred Sites Act 1989*. It achieves this by providing the applicant with documentary evidence that the custodians and traditional owners of the subject land have been consulted and consent to the applicant's proposed works.

TNG submitted an application to the CLC for a SSCC for the Project. A certificate (SSCC2015-034) covering the mine, camp, transport corridor and rail siding was issued by the CLC on 30 June 2015. The certificate identifies Sacred Site Exclusion Zones and Restricted Work Areas. TNG will comply with the conditions set in the approval. TNG also received a certificate (SSCC 2015-169) on 29 January 2016 covering the water pipeline and borefield. The borefield clearance allows for a 100 m wide corridor by 20 km long for the pipeline following existing station tracks from the mine site past Boko bore to Browns bore/yards, thence a 1000 m wide zone to the north covering the borefield and going from west of the existing station track (from Browns to Wollagalong bores) to the Hanson River.

### *Northern Territory Heritage Act 2011*

Under the provisions of the Northern Territory Heritage Act (Heritage Act), the Minister for Lands and Planning is responsible for the care, control, management and protection of natural and cultural heritage places, items, buildings, works, relics, moveable objects, precincts and archaeological sites throughout the NT. The Heritage Council is responsible for assessing the heritage significance of places and making recommendations to the Minister. All Aboriginal or Macassan archaeological places and objects are automatically protected under the Heritage Act regardless of their significance or land tenure. Aboriginal objects and places can include pre-contact features such as scarred trees, rockshelters and open camp sites, as well as physical evidence of post-contact use of the area such as Aboriginal reserves and pastoral stations. Other places can be declared by the Minister as a heritage places if they meet the criteria for listing and have historical, scientific, aesthetic or social significance.

There are no Aboriginal or historic heritage items or places listed on the NT Heritage Register in or near the Project area. A limited number of identified Aboriginal and historic sites were registered in the NT Aboriginal and Macassan Archaeological Places Database (three Aboriginal artefact scatter sites). According to the Heritage Branch of the Department of Lands, Planning and the Environment, this limited number is reflective of a lack of archaeological investigation, rather than an absence of archaeological sites (D. Bensley pers. comm. July 2015). Three Aboriginal artefact scatter sites have been previously identified in the survey area, located on relatively flat sandy plains in close proximity to ephemeral creeks (Smith 1997). These results correlate with the body of archaeological and academic research in the broader central desert region, where people tended to camp more frequently in close proximity to water, resources or vantage points (Napton & Greathouse 1985; Smith 1988, 2005, 2006).

***Northern Territory Aboriginal Sacred Sites Act 1989***

This Act provides protection for Aboriginal sacred sites throughout the NT. Sacred sites are defined as sites that are 'sacred to Aboriginals, or otherwise of significance to Aboriginals according to Aboriginal tradition'. Aboriginal sacred sites are declared by the Aboriginal Areas Protection Authority (AAPA). It is an offence for a person to enter or remain on, carry out work on or use, or desecrate a Sacred Site without the prior issue of an Authority Certificate. The Authority Certificates set out the conditions on which work may be carried out or the land used, according to Aboriginal custodians' wishes.

A search of the Register of Sacred Sites by TNG identified Sacred Sites that required an Authority Certificate to be issued. See the discussion the *Aboriginal Land Rights Act 1976* above for approvals granted.

## 11.2 Survey Method

### 11.2.1 Desktop Assessment

The key heritage requirements for this assessment were:

- identify any previously recorded Aboriginal sites or landscape features that indicate the presence of Aboriginal objects likely to be impacted by the Project;
- identify any previously recorded historic heritage items, places or archaeological sites or features that indicate the presence of historical archaeological sites likely to be impacted by the Project; and
- identify any constraints and heritage impacts arising from the presence of known or potential built heritage, archaeological or Aboriginal sites.

To fulfil the requirements of the assessment, the following tasks were undertaken:

- search and review of the AAPA Register of Sacred Sites, as well as the Heritage Branch's Heritage Register databases, to determine the location and nature of any Aboriginal or historic sites recorded within or near the Project area;
- review of relevant statutory and non-statutory Commonwealth and NT registers and lists;
- review of relevant previous archaeological and heritage consultancy reports, to determine the extent of past archaeological research in the local area; and
- review the environmental and Aboriginal heritage context of the Mount Peake area, and development of a predictive model for Aboriginal heritage for the local region, based on the current understanding of Aboriginal heritage and archaeology.

### 11.2.2 Field Survey

An archaeological survey of the Project area was undertaken in June 2015 by AM Consulting. This targeted survey investigated potential historic and Aboriginal heritage sites within areas of high or moderate archaeological potential in the study area, to establish their extent and current condition. The field survey targeted landforms and environments across the Project area, based on the predictive modelling. The purpose of the survey was to:

- inspect a large proportion of the Project area through targeted pedestrian and vehicular survey;
- identify the location and extent of the previously identified artefact scatter sites;
- record any Aboriginal or historic archaeological sites identified during the survey; and
- identify any areas of potential Aboriginal or historic heritage sensitivity, and determine the likelihood of Aboriginal archaeological sites occurring within the proposed Project area.

Where Aboriginal artefacts were encountered, notes were taken regarding their type, size and material, a description of the site and GPS coordinates.

### 11.2.3 Consultation

AM Consulting contacted the Central Land Council (CLC) to facilitate engagement and participation with the local Aboriginal community for the archaeological survey. Unfortunately, due to an unexpected death in the community immediately prior to the scheduled survey, the CLC was unable to contact the appropriate community members, and AM Consulting was forced to proceed without community involvement in fieldwork. AM Consulting provided their draft report to CLC for community review and comment, with feedback incorporated in to the final report.

In addition to the work by AM Consulting, TNG in conjunction with the Central Land Council and members of the local Aboriginal community undertook Aboriginal community consultation, as part of the methodology for obtaining Sacred Sites Clearance.

## 11.3 Environmental and Cultural Setting

### 11.3.1 Environmental Setting

Understanding the environmental setting of the Project area provides a context for past human occupation and history, as well as to contextualise archaeological material and feed into predictive archaeological sites modelling. Both current and historic land use have the potential to impact the identification, quality and existence of archaeological material.

The region is characterised by flat to gently undulating sandplains and is dominated by linear or longitudinal dunes and sand ridges and valleys. Vegetation patterns in arid Australia are controlled by a combination of low and highly unpredictable rainfall, soil characteristics and the local topography, though there are few areas that are not at least sparsely vegetated (Hesse *et al*. 2005; Tille 2006). The central NT desert is characterised by several major river systems that generally only flow for short periods after heavy rains (Wilson *et al.* 1990; Smith and Hesse 2005). The Hanson River, Murray Creek and Bloodwood Creek bisect the Project area, while a number of small unnamed and ephemeral creeks and channels have been formed at the foot of the Djilbari Hills and Central Mount Stuart in the west and Mount Tops and Mount Octy in the east. These drainage systems do not contain permanent water, but after heavy rains are likely to have been a source of fresh water for Aboriginal people in the past.

The Project area is predominantly held under Pastoral lease, with a small corridor of Crown Land adjacent to Stuart Highway. The Stirling Pastoral Station was established in the 1890s and a small homestead, a number of storage sheds and outbuildings, and numerous stockyards, dams and bores were constructed. The majority of the land remains unfenced for cattle grazing and has not been significantly disturbed by current land use practices. The study area is likely to retain a high degree of archaeological integrity.

### 11.3.2 Aboriginal History

#### Occupancy

Aboriginal occupation of the Australian desert is likely to have spanned at least 35,000 years. Aboriginal occupation seems to have intensified during the Late Pleistocene, and by around 30,000 BP small groups of highly mobile hunter-gatherers were using pockets of country across the interior of the continent (O'Connor *et al*. 1998; Smith 2005). Occupation of the central Australian desert appears to have intensified during the Holocene (Gould 1977). Little archaeological work has been undertaken in the central Australian desert region (Smith 2006; Thorley *et al.* 2011).

At the time of European settlement, the Aboriginal people of the central Australian desert were organised into named territorial groups. Those groups local to the study area are likely to have spoken the Anmatyerre [Anmatyerr] language (Tindale 2015 [1974]). The Forster Range marked the northern boundary between Anmatyerre and Kaitish country, while Mount Barkly and Mount Leichhardt marked the western boundary between the Anmatyerre and neighbouring Walpiri people (Spencer & Gillen 1904; Meggitt 1962). However, it should be noted that there is significant overlap between the Anmatyerre and the neighbouring Walpiri, Arrernte and Alyawarr language groups.

#### Utilising Natural Resources

The sandplain and scrub country of the Anmatyerre region is comparatively rich in water, animal and plant resources and natural resources, and would have been particularly attractive to Aboriginal people (Young 1987; Rea 2009). After heavy rains rock holes, soakages, springs, and creeks provided fresh water and more abundant plant foods, and often terrestrial animals were also drawn to the water. The Anmatyerre people relied on a mixed but rich economy of plant and animal resources. The types of traditional foods consumed and the methods for their procurement are described in contemporary ethnographic sources and the later oral testimony of traditional elders (Spencer & Gillen 1899 1904; Long 1971; Green 2000, 2003, 2003a; Rea 2009). The majority of these plant foods were cooked in open fires or on coals, consumed raw, or mixed with water and drunken. Plant resources were also utilised for the fabrication of tools, implements and shelters (Spencer & Gillen 1904; Green 2003; Flood 2004; Moloney 2005).

Grant Bluff and Central Mount Stuart sandstone provided limited material with which to make tools, though when overhanging it provided shelter from the elements. It was also a surface on which engraved and pigmented images were likely to be depicted, and on which ground edge implements could be shaped and sharpened. Although no engraved or pigmented art has been identified within the Project area, rock art complexes have been identified in the Amadeus Basin near Alice Springs approximately 220 km south of the study area (Edwards 1971; Ross 2005).

### Maintaining Religious Traditions & Ceremonies

The passage from childhood to adulthood was marked by traditional initiation ceremonies, bringing about greater spiritual awareness, knowledge and responsibility for both men and women. Many Aboriginal places of significance are secret and sacred, however, there are a number of natural landscape features in the Anmatyerre region that have mythological importance. Anmatyerre people perceive the land as comprising more or less discrete 'countries'. Each country is associated with one or more of the *Altyerrenge* (Dreaming) Beings, and contains sites marking the scenes of their travels and activities. Some of these beings travelled widely and have sites along their tracks which span several countries, or are limited to a single country. These Beings reside in significant landscape features such the Hanson River (*Mer Petyal*), Central Mount Stuart (*Amakweng*), waterholes, rock outcrops and other mountain peaks (Green 2003a; Rea 2009). The travels and activities of the *Altyerrenge* beings are recorded in stories and songs and are depicted in ceremonies. Honey Ant (*Yerrampe*) and Native Cat (*Malpwenke*) Beings camped at several sites as they travelled across Anmatyerre country (Office of the Aboriginal Land Commissioner 1987).

### Aboriginal Heritage Site Predictive Modelling

Although limited (see discussion in Section 11.1 Northern Territory Heritage Act), based on the archaeological sites registered in the region and review of previous studies, AM Consulting concluded that the potential presence and location of Aboriginal heritage sites within the landscape of the study area are as follows:

- open artefact sites are likely to appear as surface scatters of stone artefacts, in areas where vegetation is limited and ground surface visibility increases. Such scatters may become exposed by erosion, pastoral activity and the creation of informal, unsealed access tracks. There is potential for artefact scatters to be found in all environmental contexts and landforms, although larger and denser sites are predominantly located on the riverbanks and lower slopes facing watercourses, and on elevated ridgelines;
- flat, open areas associated with the creeks and their resource-rich surrounds would have offered ideal camping areas to the Aboriginal inhabitants of the local area. Isolated artefacts may represent a single item discard event, or be the result of limited stone knapping activity. Isolated artefacts are also likely to be located on landforms associated with past Aboriginal activities, such as ridgelines and valley floors that would have provided ease of movement through the area;
- culturally modified trees may be present throughout the study area, in areas where remnant old growth vegetation survives;
- where exposed rock surfaces and shelters occur in Grant Bluff and Central Mount Stuart sandstone geology, pigmented and engraved art sites, as well as grinding grooves may be present; and
- discrete rock outcrops suitable for the manufacture of stone artefacts may be located within the study area, in areas of suitable geology.

## 11.3.3 European History

### Early Exploration

The first Europeans to set foot in Anmatyerre country were members of John McDougall Stuart's exploration party, which crossed the Australian continent from its southern to northern coast in a series of expeditions between 1858 and 1862. A secondary goal of Stuart's expedition was the mapping of a navigable route for the eventual establishment of an overland telegraph line.

### Early Settlement

The region's earliest settlers were principally stock drovers, enticed to the central desert in the 1870s by reports of favourable, relatively well-watered grazing land (Meggitt 1962; Young 1987; Devitt 1994; Paterson 2005). Pastoralists moved into the Northern Territory via the Gulf Country of western Queensland and via Central Australia, and by the late 1870s had claimed large tracts of land in the eastern portion of the Northern Territory, between the Overland Telegraph line and the Queensland border.

Early pastoral ventures relied heavily on the prevalence of surface waters such as waterholes, springs and small lakes, but long periods of drought in the 1880s meant competition for scarce water supplies (Young 1987; Devitt 1994). Successful pastoral ventures relied on the ability to move stock to avail distant waters and pastures. Stock was highly mobile and there was little investment in infrastructure such as fences and elaborate homesteads. Most of these enterprises were short lived, particularly on smaller runs were good water and pasture land was lacking.

The Stirling run was revived in the mid-1890s, most likely as a stocked cattle station; and encompassed land on the eastern and western sides of the Overland Telegraph, in the vicinity of the Hanson River, Mount Stirling and Mount Peake. At the turn of the century, staff from the Barrow Creek Telegraph Station took up grazing licences on the Stirling and Taylor Creeks, to supplement pasture land for the Station's stock. Severe drought in 1902-1905 forced a number of small landholders out of the area, but Stirling Station endured (Meggitt 1962). Francis Robert William Scott operated Stirling Station throughout the 1900s and 1910s, and by 1921 was a notable pastoralist with considerable experience in the region. Following Scott's death in 1923, Stirling Station changed hands a number of times. It was leased by Messrs Spencer, Turner and Harris in 1925 and was purchased by Sir Sydney Kidman and son Walter Kidman in 1928 (Northern Territory Times and Gazette, 3 November 1925; Northern Standard, 15 June 1928). In the late 1930s and early 1940s it was subleased or managed by Stan Brown, and was acquired by the McCarthy family who have managed the property for at least three generations. Today, the property encompasses an area of 7,200 square km and runs 8,000 head of cattle (pers. comm. A McCarthy June 2015).

### The Stuart Highway and Alice Springs to Darwin Railway

The Stuart Highway was first established in the 1870s as a supply track for the Overland Telegraph, and essentially facilitated transportation throughout and settlement of the Northern Territory interior. The dirt track was periodically inspected and maintained in conjunction with the upkeep of the telegraph line. Staged construction of the new bitumen sealed road began at the northern end of the highway in 1941, and was completed by 1944. In the period between 1970 and 1992, further upgrades were made to the highway's alignment, built structures and drainage capacity, in order to meet National Highway Standards. This included the reconstruction of a number of bridges to meet increased loading standards, the provision of overtaking lanes and, more recently, the introduction of open speed limit zones (Department of Transport 2014).

The contract for the Alice Springs to Darwin railway was awarded to the Asia Pacific Transport Consortium in 2000. Work began in 2001 and incorporated substantial earth and drainage works, including the clearance of an approximately 100m wide corridor along the length of the track, and the construction of bridges along the Elizabeth, Adelaide, Cullen, Fergusson, Edith and Katherine Rivers. The Alice Springs to Darwin section was opened to passenger and freight traffic in 2004.

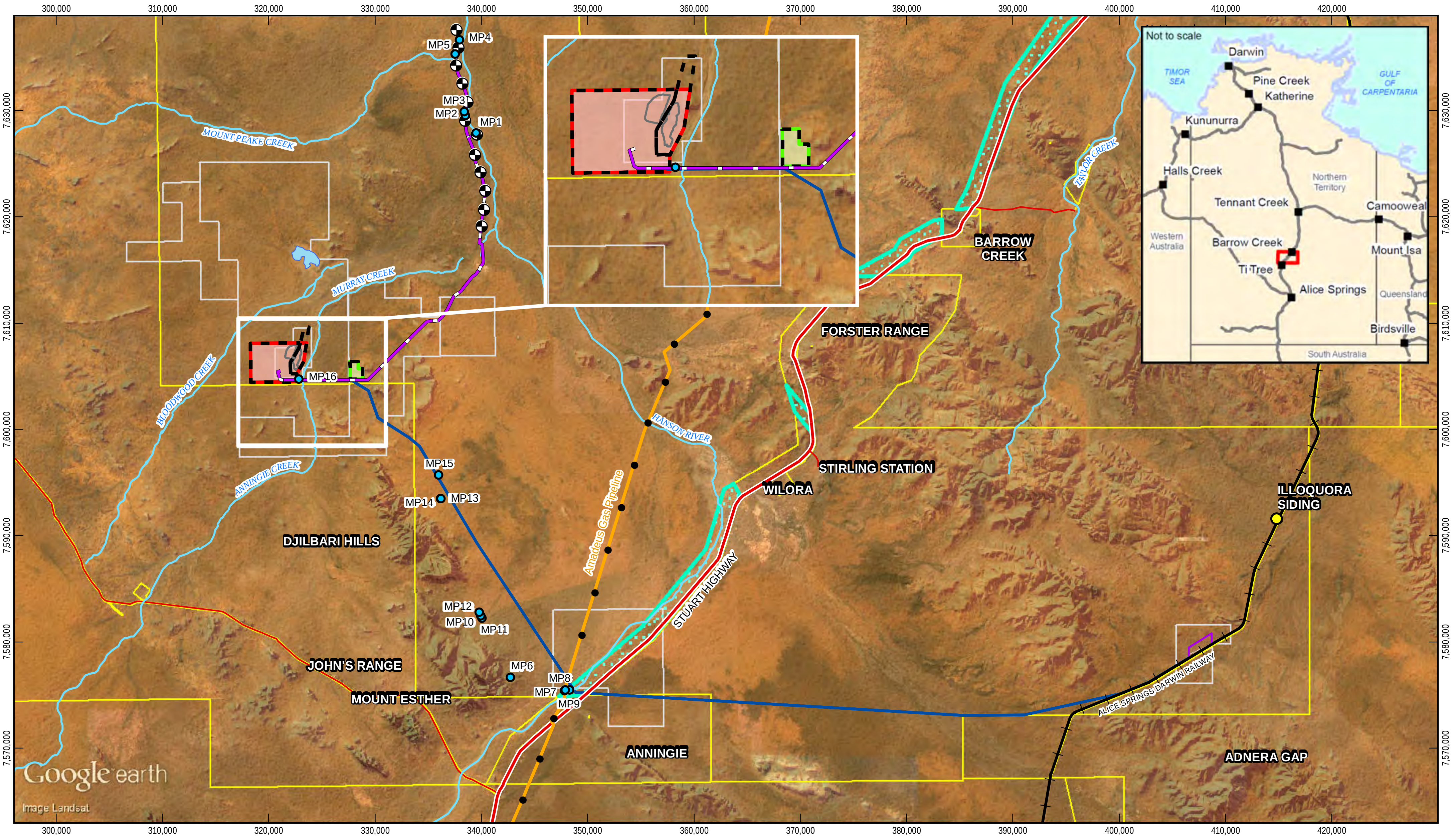
## 11.4 Archaeological Field Survey Results and Significance

No historic heritage structures, places or archaeological sites of known or potential significance were identified within the borefield pipeline and access road corridors nor the mine site and associated infrastructure, or their immediate vicinity, during the field survey.

Sixteen new Aboriginal heritage sites were identified within the survey area by Am Consulting. These are shown in Figure 11-1. The majority of these sites were stone tool artefact scatters or isolated stone artefacts found within 200 m of watercourses. Eight sites were identified on the lower slopes and banks of the Hanson River (MP1-MP5, MP7-MP9), one isolated artefact was found on the bank of Murray Creek (MP16), and five sites were recorded on the banks of ephemeral watercourses at the foot of Djilbari Hills and Central Mount Stuart (MP6, MP10, MP13-MP15). Two isolated artefact sites were recorded on open, flat plains more than 200 m from the nearest watercourse (MP11-MP12); though these sites are likely reflective of more fleeting occupation of the area and may represent one-off discard events by people travelling though the Djilbari Hills/Central Mount Stuart countryside. The predominant raw material employed across the study area was quartzite, quartz, and mudstone, with less frequent use of silcrete, chert and chalcedony. Flakes and scrapers made up a large portion of the assemblages identified, though cores as well as backed blades, retouched flakes and choppers/axes were observed. The characteristics of the 16 new sites Aboriginal heritage are summarised in Table 11-1. A more detailed description is provided in Appendix K.

The presence of these sites corresponds with the results of previous research in the wider region and the predictive model for the study area. The majority of identified Aboriginal heritage sites were exposed in relatively open, partially deflated contexts in close proximity to both ephemeral and significant watercourse, suggesting evidence of camping and utilisation of the resources associated with these watercourses. Wind erosion appears to be impacting a number of sites along the Hanson River, though this does not preclude the presence of sub-surface *in situ* archaeological deposits, particularly where vegetation anchors the surrounding sediment. On the basis of the archaeological survey, it is considered that relatively flat, open land in the vicinity of ephemeral and major watercourses, and significant landscape features, retain the potential for subsurface *in situ* archaeological deposits.

In contrast, no Aboriginal archaeological sites or evidence for Aboriginal occupation was observed in landscapes that lacked adequate water and stone resources and comprised featureless, densely vegetated sandplain country. This included the mine, accommodation village and Adnera loadout sites. These areas were either less frequently occupied or utilised as transitory landscapes; and are less likely to preserve archaeological evidence for Aboriginal occupation.

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Kilometres

Horizontal Datum: GDA 1994
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N

LEGEND

- Illoquora Siding
- Potential Borefield
- Borefield Delivery Pipeline
- Principal Road
- Minor Road
- Major Watercourses
- Railway
- Amadeus Gas Pipeline
- Mine Site Facilities
- Mud Hut Swamp
- Rail Siding Loading Facility
- Mount Peake Mining Area
- Crown Land
- Mount Peake Granted Tenements
- Mount Peake Mineral Leases
- Cadastral Boundaries
- Access Road
- Camp Facilities
- Archaeological Site

GHD

TNG Ltd
Mount Peake EIS

Job Number | 61-29057
Revision | A
Date | 22 Feb 2016

Heritage Constraints

Figure 11-1

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239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au



Data source: TNG - Gas / Slurry Pipeline Study Corridor, Camp Facilities, Borefield Infrastructure,Transport Study Corridor, Mount Peake Mining Area, Mount Peake Granted Tenements (2015). Geoscience Australia - Waterways, mainland, placename, road (2008). Google Earth Pro - Imagery (Date extracted: 13/02/2014); AMC: Archaeological Sites - 20151203; CLC: Sacred Site Exclusion Zone - 20150630. Created by: RB

### Table 11-1 New Aboriginal Heritage Site Characteristics

| Site ID | Location centre point (GDA 1994 MGA Zone 53) | Landform | Site Size ($m^2$) | Exposure | Site Description |
|---|---|---|---|---|---|
| MP1 | 339591E, 7627823N | Flat/ River Bank | 160 | Sparsely vegetated, deflated flat on western bank of Hanson River | 18 stone artefacts, visible on the eroding creek bank and on the flat above. Artefacts comprised quartzite and quartz materials, including a symmetrical leaf-shaped retouched crystal quartz flake. |
| MP2 | 338594E, 7629462N | Flat/ River Bank | 25 | Flat, deflated clearing on the western bank of Hanson River | 2 stone artefacts on the open flat area, and 3 stone artefacts deposited in a disturbed context in the bed of the river. Artefacts were manufactured of quartzite and quartz. |
| MP3 | 338498E, 7629811N | Flat/ River Bank | 80 | Flat, deflated open clearing on the western bank of Hanson River | 12 quartzite and quartz artefacts, including a quartzite bladelet and a quartz thumbnail scraper. |
| MP4 | 338031E, 7636588N | Flat/ River Bank | 20 | Flat, partially deflated open clearing on the western bank of Hanson River | 2 broken quartzite flakes. |
| MP5 | 337647E, 7635247N | Flat/ River Bank | 44 | Eroding, deflated banks of an ephemeral creek; a tributary of Hanson River | A unidirectional silcrete core with approximately 25% cortex and a mudstone thumbnail scraper. |
| MP6 | 342838E, 7576572N | Flat/Creek bank | n/a | Open, deflated flat sparsely vegetated with low spinifex grass | An isolated silcrete flake with a crushed platform and less than 25% cortex. |
| MP7 | 347906E, 7575295N | Flat/ River Bank | 311 | Flat, open and well deflated bank of Hanson River | 32 stone artefacts predominantly manufactured of quartz, quartzite and silcrete and 2 silcrete and quartzite cores. The majority were flakes. |
| MP8 | 348415E, 7575377N | Upper Slope/ Crest | 373 | Sparsely vegetated, partially deflated open upper slope and crest of Hanson River | 13 stone artefacts, comprised of quartz and quartzite flakes and scrapers, as well as a sandstone hammer stone with visible pitting. |

| Site ID | Location centre point (GDA 1994 MGA Zone 53) | Landform | Site Size ($m^2$) | Exposure | Site Description |
|---|---|---|---|---|---|
| MP9 | 347988E, 7575373N | Flat/ River Bank | 200 | Flat open sandplain devoid of ground cover | 18 mudstone, quartzite, quartz and silcrete artefacts. The majority artefacts were flakes and scrapers, which included 2 mudstone thumbnail scrapers. |
| MP10 | 340146E, 7582138N | Lower Slope/ Creek Bank | 43 | Open, sparsely vegetated lower slope of southern bank of an unnamed creek | 25 stone artefacts were observed on the lower slope of the creek bank. The majority were manufactured from mudstone, quartzite, silcrete and chert; one small quartz flake was recovered. This site contains 2 large silcrete and chert choppers, a blade, backed blade and bladelet. |
| MP11 | 340060E, 7582359N | Flat | n/a | Open flat sparsely vegetated with low spinifex grass | 3 stone artefacts which included a quartzite scraper with unifacial retouch, a quartz thumbnail scraper and a chalcedony core. |
| MP12 | 53; 339892E, 7582673N | Flat | n/a | Open flat sparsely vegetated with low spinifex grass | 1 isolated mudstone artefact. The artefact is a flake/core with less than 25% cortex, negative flake scars and bifacial retouch along its distal end. |
| MP13 | 336250E, 7593385N | Lower Slope/ Creek Bank | 805 | Open, sparsely vegetated and well deflated lower slope of bank of an unnamed creek | 9 stone artefacts comprised both flakes and cores and were manufactured of quartzite, chert, chalcedony and quartz. |
| MP14 | 336302E, 7593373N | Lower Slope/ Creek Bank | 272 | Open, sparsely vegetated and well deflated lower slope of bank of an unnamed creek | 10 stone artefacts. This included 3 chalcedony scrapers and a chalcedony flake, 3 quartzite flakes, a quartz scraper and flake and a mudstone flake. |
| MP15 | 336067E, 7595622N | Flat/Creek Bank | n/a | Flat, relatively open clearing on bank of an unnamed creek | 1 isolated quartz stone artefact. |
| MP16 | 322940E, 7604635N | Lower Slope/ River Bank | n/a | Small exposure on the lower slopes of the western bank of Murray Creek | 1 quartzite scraper. |

### 11.4.1 Aboriginal Archaeological Potential

Results of the archaeological field survey have been used to inform an estimate of archaeological potential for landforms within the broader Project area and surrounds. For the purposes of this assessment, archaeological potential is described as the potential for selected landforms and areas to contain undetected buried archaeological deposits.

Given the relatively undisturbed nature of the region, landforms present, and the results of the predictive model and archaeological survey, the following conclusions were made by AM Consulting regarding the Aboriginal archaeological potential of the study area:

- creek and river banks within the study area have a high potential for surface Aboriginal stone artefact sites to be present, and may retain undisturbed *in situ* archaeological deposits;
- flat, open plains in the vicinity of watercourses, major landscape features such as large hills and stone resources have moderate to high potential for Aboriginal stone artefact sites to be present, and may retain undisturbed *in situ* archaeological deposits; and
- flat, featureless and densely vegetated plains of a considerable distance from watercourses, significant landscape features and stone resources have low potential to contain Aboriginal archaeological sites.

### 11.4.2 Aboriginal Heritage Significance

The Department of Lands, Planning and the Environment Heritage Branch has identified eight heritage assessment criteria, designed to assess and identify the heritage significance of Aboriginal sites, objects and places in the NT. These criteria are consistent with the Burra Charter guidelines for the assessment of significance. For the purposes of this assessment, Aboriginal heritage sites are considered to have heritage significance if they meet one or more of the specified criteria, as defined in the Heritage Act. The outcome of the significance assessments for the Aboriginal heritage sites associated with the Project pipeline and access road are presented below.

#### Borefield Pipeline

MP1 and MP3 comprise a moderate density of stone artefacts on the banks of the Hanson River and have the potential to retain intact subsurface archaeological deposits despite evidence of erosion and deflation impacts. These sites have the potential to yield information relating to stone tool manufacturing processes and the use of the Hanson River as a campsite by local Anmatyerre people. They contain artefacts of some aesthetic and technical value, including a symmetrical leaf-shaped retouched crystal quartz flake from MP1, and a quartzite bladelet and a quartz thumbnail scraper from MP3. The scatters found at MP1 and MP3 are indicative of complex archaeological deposits, are representative of past activity, and are likely to retain cultural significance, a sense of place, and heritage value for local Aboriginal people. Based on current evidence, stone artefact scatter sites MP1 and MP3 are assessed as having moderate (local) scientific (archaeological) significance and research potential and low (local) aesthetic significance.

Stone artefact scatter sites MP2, MP4-MP5 and isolated find MP16 comprise low density sites on the Hanson River and Murray Creek, and, when compared to other identified sites in the local area, have limited potential to contribute evidence of stone tool manufacturing processes and occupational patterns. They are not representative of complex archaeological deposits, and feature unretouched flakes, cores and angular fragments that are not aesthetically or technically distinctive. Based on current evidence, sites MP2, MP4-MP5 and MP16 are assessed as having low (local) scientific (archaeological) significance and research potential and no aesthetic or technical significance.

### Access Road

Artefact scatter MP10 comprises a high density scatter of *in situ* stone artefacts, on the bank of an ephemeral creek at the foot of the culturally significant Central Mount Stuart. The scatter has the potential to retain intact subsurface archaeological deposits, and may yield information relating to stone tool manufacturing processes as well as the use of ephemeral creeklines as campsites by local Aboriginal people. Scatter MP10 contains two large silcrete and chert choppers, a blade, backed blade and bladelet – all artefact types which appear to be relatively rare in the local area and are of moderate aesthetic and technical value. MP10 is indicative of a complex archaeological deposit, is representative of past activity by local Aboriginal people, and is likely to retain cultural significance, a sense of place, and heritage value for local Aboriginal people. Based on current evidence, stone artefact scatter site MP10 is assessed as having high (local) scientific (archaeological) significance and research potential and moderate (local) aesthetic significance.

Stone artefact scatter sites MP7-MP9 comprise a high density scatter of in situ artefacts on the banks of the Hanson River. These scatters have the potential to retain intact subsurface archaeological deposits, and may contribute evidence for stone tool manufacturing processes, stone tool use, and the use of the Hanson River as a camp site for Aboriginal people. Sites MP7-MP9 are tentatively considered to be typical of other artefact scatters in the region featuring unretouched flakes, cores and angular fragments, and are not considered aesthetically or technically distinctive. They are, however, indicative of complex archaeological deposits, are representative of past activity by local Aboriginal people, and are likely to retain cultural significance, a sense of place, and heritage value for local Aboriginal people. On the basis of current evidence, stone artefact scatter sites MP7-MP9 are assessed as having high (local) scientific (archaeological) significance and research potential but have no aesthetic or technical significance.

## 11.5 Predicted Heritage Impacts

The construction and operation of the mine pit and associated infrastructure, accommodation village and rail loadout facility will not impact areas of archaeological potential. Therefore these aspects of the Project are unlikely to adversely impact surface or *in situ* Aboriginal heritage sites, objects or places. The proposed construction and operation of the borefield pipeline and access road were identified as potentially having negative impacts to Aboriginal heritage sites and *in situ* archaeological deposits which may be present.

Six Aboriginal archaeological sites were identified near to the proposed borefield pipeline alignment. Sites MP2, MP4 and MP5 are located more than 150 m from the alignment and are unlikely to be impacted by the proposed works. Depending on the ultimate disturbance footprint and design, the pipeline may result in indirect impacts to sites MP1 and MP3, and may impact on any subsurface *in situ* artefact deposits along the Hanson River bank. Similarly, installation of the pipeline in the vicinity of Murray Creek has the potential to cause impacts to any surface or *in situ* archaeological deposits along the creek banks, as well as indirect impacts to isolated find MP16.

TNG has re-aligned the borefield pipeline to avoid impact to sites MP1, MP3 and MP16.

The construction of the access road was found to directly impact MP13 and MP14, with sites MP6 and MP10 most likely indirectly impacted. Furthermore, impacts to existing surface scatters and subsurface *in situ* archaeological deposits can be expected wherever the access road crosses Murray Creek, the Hanson River and other ephemeral creeks near Djilbari Hills and Central Mount Stuart. The use of heavy machinery to install engineering solutions to reduce surface water impacts and clear native vegetation will result in disturbance to the land in the access road corridor; and this may impact on underlying *in situ* archaeological deposits in areas of archaeological potential.

TNG has re-aligned the access road to avoid impact to sites MP6, MP10, MP13 and MP14.

The construction of the access road in the vicinity of Tin Fish Well is proposed to follow the disturbed footprint of existing access tracks, located along a fence line and the existing Alice Springs to Darwin railway line. The access road is unlikely to impact on surface or *in situ* Aboriginal heritage sites, objects or places to the east of Tin Fish Well. While the previously identified Mt Tops/Mt Octy 2 and Mt Tops/Mt Octy 3 sites could not be located during the 2015 survey, both sites lie within the rail corridor and were likely destroyed or significantly disturbed by track construction. As such, the construction of the access road is unlikely to impact these previously recorded sites.

## 11.6 Summary of Impacts and Conclusions

No historic heritage structures, places or archaeological sites were identified during the survey. There are no known heritage constraints preventing the construction and operation of these assets and no further assessments are required.

No Aboriginal sites were identified within the footprint of the mine site, accommodation village and loadout facility during the survey.

The archaeological survey did identify sixteen previously unrecorded Aboriginal sites. The results of the survey concur with the predictive model, suggesting areas of archaeological sensitivity with potential to contain surface and subsurface Aboriginal archaeological sites are associated with natural landforms in the vicinity of watercourses, significant landscape features and natural resources. The heritage assessment determined that the proposed borefield pipeline and access road alignments were likely to impact a number of the Aboriginal sites and areas of archaeological sensitivity. Based on the results of this assessment, TNG has re-aligned the access road and borefield pipeline to avoid impacts to aboriginal sites.

Through the detailed design phase of the Project, TNG will look to avoid impacts to Aboriginal sites or areas of archaeological sensitivity. Where impacts are unavoidable, artefact recording and relocation will be undertaken to fully record the condition, extent and significance of artefact sites along the Hanson River and in the Central Mount Stuart/Djilbari Hills foothills. TNG will lodge a Works Approval Application Form with the Heritage Branch to allow further archaeological works within the Project area, including artefact recording and relocation, and archaeological excavations, in accordance with section 72 of the Heritage Act.

Sacred Site Clearance Certificate SSCC2015-034 identifies Sacred Site Exclusion Zones and Restricted Work Areas over the mine, camp, transport corridor and rail siding. TNG will comply with the conditions set in the certificate and also make all staff working on the Project aware of the statutory obligations relating to historic and Aboriginal cultural heritage. TNG has realigned a section of the access road to avoid impacting one of the Sacred Sites.

TNG will also comply with the conditions of certificate SSCC 2015-169 covering the water pipeline and borefield.

# 12. Socio-economics

## 12.1 Introduction

An Economic and Social Impact Assessment (ESIA) was undertaken to identify the positive and negative social and economic consequences arising from Mount Peake Project activities and propose measures to enhance the positive impacts and avoid/minimise the negative impacts on local and regional communities. The methodology was developed based on the following:

- Terms of Reference for the Preparation of an Environmental Impact Statement: Mount Peake Project (NT EPA 2014);
- Guidelines for the Preparation of an Economic and Social Impact Assessment (NT EPA 2013); and
- International Principles for Social Impact Assessment (IAIA 2003).

The full ESIA report can be found in Appendix L.

### 12.1.1 Project Overview

#### Project operations

The mine site will be located approximately 235 km north-northwest of Alice Springs and approximately 50 km west of the Stuart Highway. Mining will occur at a rate of up to 8.4 million tonnes per annum (Mtpa). Ore processing involves crushing, grinding and magnetic separation to produce up to 1.8 Mtpa of concentrate annually.

Concentrate will be trucked via the access road to a new rail siding and loadout facility at Adnera. Road trains used to transport the concentrate will be highway compliant and will operate under shared usage conditions with other highway compliant vehicles such as delivery trucks, busses and light vehicles. An underpass of Stuart Highway will be constructed to separate road trains from Stuart Highway traffic.

Trucks will dump concentrate to a stockpile adjacent to the rail siding for loading in to rail wagons. Around one train movement per day is expected.

A borefield will be established within the alluvial aquifer of the Hanson River to provide water for mining, processing, dust suppression and potable use.

The life of mine is expected to be 19 years, including construction (2 years), mining (15 years) and closure (2 years).

#### Workforce

The construction and operations workforces are estimated to peak at 225 and 170 personnel respectively. The workforces will be largely fly-in fly-out due to low population numbers in the local area. Workers will fly to Ti Tree and then bus to a self-contained accommodation village located approximately 5 km east of the mine for the duration of their roster.

The village will comprise:

- dry mess, wet mess, kitchen and cold room;
- ablutions;
- games room complete with internet and telephone connection;
- swimming pool, tennis court and gymnasium;

- laundry facilities;
- fire water protection with diesel backup;
- sewage treatment plant;
- village administration offices; and
- car parking.

First aid facilities for the workforce will be provided at site.

#### Upgrade of Ti Tree airstrip

The Project is expected to use the existing Ti Tree airstrip, 70 km from the mine site. Negotiations with the Northern Territory Government on this facility are in progress and an upgrade of the current airstrip is anticipated to be covered by the Federal Government's Development Fund for Northern Australia.

The runway will be upgraded by increasing the width and length of seal. A concept for a small terminal has also been prepared (Figure 12-1) which would include check-in desks, baggage collection, amenities, car parking, undercover seated areas and baggage collection area.

**Figure 12-1 Concept schematic for the new Ti Tree terminal**

### 12.1.2 ESIA methodology

The key steps in the methodology included:

- identification of the social study area, where the local study area was considered to be the area under the Project footprint, the regional study area included the Central Desert Shire and the key localities of Ti Tree, Wilora, Stirling Station and Anningie Station, and the wider area of social influence from where the Project would attract some of the workforce and goods and services was considered to be Alice Springs and Darwin;
- preliminary scoping of social issues in the study area and those likely to arise from the Project;
- establishing a social baseline for the study area against which the impacts would be measured. It included a detailed description of the socio-economic characteristics of the study area communities. Data and information was gathered from various sources including:

  - Australian Bureau of Statistics (ABS) Census 2011 data;
  - websites and publications of local governments in the regional study area, territory agencies covering health, education, housing, communities and emergency services;
  - real estate websites;
  - media reports; and
  - stakeholder consultation undertaken in March 2015.
- identification and assessment of social and economic impacts that may be generated from Project construction and operation activities; and
- recommendation of management strategies to avoid/minimise negative impacts and enhance the positive benefits.

### 12.1.3 Stakeholder consultation

Stakeholder consultation was undertaken in March 2015. Stakeholders consulted and the issues raised are outlined in Chapter 6.

## 12.2 Regional Social Baseline

### 12.2.1 Overview of the Regional Study Area

The social baseline describes community characteristics of the regional study area including Central Desert LGA with a focus on key communities closest to the Project area. These communities are Ti Tree State Suburb (SSC) (located approximately 52 km from the Poject area) and Wilora Indigenous Location (ILOC) (located approximately 47 km from the Project area). The social baseline makes references to the wider area of influence such as Alice Springs and Darwin where required.

The Central Desert LGA covers an area of approximately 282,000 square kilometres (Central Desert Regional Council 2015). The Council area spans from the Western Australian border to the Queensland border and has nine major communities - Atitjere (Harts Range), Engawala, Lajamanu, Laramba, Nyirripi, Ti Tree, Yuelamu, Yuendumu and Willowra with a number of occupied outstations.

Ti Tree is a small community located on the Stuart Highway about 194 km north of Alice Springs (Central Desert Regional Council 2015). Ti Tree is identified in the Regional Council Plan (2015) as a service delivery centre. The Council office is located in Ti Tree town and services Ti Tree and the communities of Pmara Jutunta, 6 Mile, Alyuen and Wilora, collectively referred to as Anmatjere (Central Desert Regional Council 2015). Wilora ILOC is an Aboriginal community located 245 km north of Alice Springs.

The Mount Peak Project is predominantly located on Stirling Station and a small portion of the adjacent Anningie Station where the access road alignment may be located. Stirling Station and Anningie Station are both cattle stations. Both stations are identified as outstations and pastoral properties in the regional council plan (Central Desert Regional Council 2015a).

### 12.2.2 Community Characteristics

#### Population, age and gender

The estimated resident population of Central Desert LGA was 4,331 persons in 2014 (Central Desert Regional Council 2015a) and Ti Tree and Wilora were 143 persons and 129 persons respectively. During census 2011 the total population for the same areas was 3,720 persons in Central Desert LGA, 123 persons in Ti Tree SSC and 111 persons in Wilora ILOC (ABS 2011b, c, d). Population figures indicate an increase in population in the regional study areas from 2011 to 2014. The majority of the population in the regional study area is Indigenous (80% in Central Desert LGA, 50% in Ti Tree and 100% in Wilora).

The age profile of the study area was characterised by the following features (ABS 2011a, e, f):

- the median age in Ti Tree was 39 years, 26 years in Wilora and 27 years in Central Desert (23 years for the Indigenous population and 40 years for the non-Indigenous population) (ABS 2011, c, d);
- the largest percentage of the population was in the 25 - 44 year age group for all locations;
- for all locations the smallest percentage of the population was in the 65 years and over category; and
- Wilora and Central Desert had similar age profiles, while Ti Tree had a considerably larger proportion of the population in the 45 - 64 years age bracket. This contributed to the higher median age of 39 years in Ti Tree.

#### Family composition and housing

The family composition and household structure helps to understand the social fabric of the community. According to the Census 2011 data, ‘couple family with children’ was the dominant group in all locations accounting for 44.4% in Ti Tree SSC, 47.6% in Wilora ILOC, and 61.8% in Central Desert LGA (ABS 2011a, e, f). The proportion of ‘couple family without children’ and ‘one-parent family’ was equal in Ti Tree and Wilora. In Central Desert LGA, ‘one-parent family’ was more dominant than ‘couple family without children’.

Average household numbers ranged from 2.5 people per household in Ti Tree to 4.3 in Central Desert and 4.4 in Wilora (ABS 2011a, e, f).

The study area had a high proportion of rented housing (with 68% in Ti Tree and 100% in Wilora) and a high proportion of unoccupied dwellings (18.0% in Ti Tree) (ABS 2011c, d).

#### Labour force, employment and unemployment

Unemployment data shows 14.5% unemployment in Central Desert LGA as a whole (with 26.3% unemployment among the Indigenous population) (ABS 2011b). Unemployment in Wilora ILOC was 35.7% and no unemployment was reported in Ti Tree SSC (ABS 2011c, d).

According to ABS statistics for Central Desert, there were a total of 20 businesses in 2011. Of these, eight had 5 or more employees, four had 1 to 4 employees and eight were non-employing businesses.

The main industries of employment in Ti Tree SSC in 2011 were public administration and safety with 38.8% (22 persons) and retail trade with 32.3% (21 persons) (ABS 2011g). There were 13 industries that did not contribute to the Ti Tree industry profile. Public administration and safety was also the dominant industry of employment in Central Desert LGA with 28.3% (276 persons) (ABS 2011e). This was followed by mining with 19.6% (191 persons).

The main occupations in Ti Tree SSC were labourers with 23.8%, followed by managers, professionals, community and personal service workers, and clerical and administrative workers each having a contribution of 14.3% to the occupation profile (ABS 2011f). Central Desert LGA reported professional as the largest occupation group (17.9%), followed by labourers (16.7%), community and personal service workers (15.6 %) and technicians and trades workers (12.2%) (ABS 2011e).

Industry and occupation data for Wilora ILOC was not available.

### 12.2.3 Social Infrastructure

The regional study area is serviced with limited social infrastructure facilities and services. Higher order services for the region are accessed from Alice Springs and Darwin. Table 12-1 identifies social infrastructure within Ti Tree and Wilora and the wider area of influence, where applicable. This information has been drawn from Council planning and policy documents (Central Desert Regional Council 2015, 2015a) and supported by stakeholder consultation.

**Table 12-1 Social infrastructure available in the region**

| Social infrastructure | Ti Tree SSC and Wilora ILOC (and Central Desert LGA and the wider area of influence where applicable) |
|---|---|
| Education facilities | The Council delivers a range of employment related training activities in several communities including Ti Tree and Wilora through Remote Jobs and Communities Program (RJCP).<br>Stirling station school and pre-school.<br>Ti Tree school and pre-school.<br>School nutrition programs run in Wilora. |
| Community cultural and recreational facilities | One library in Ti Tree.<br>Council's Youth, Sport and Recreation program's - a combination of after school, vacation care, youth, sport, recreation, art and cultural activities are delivered by the team in several communities including the Anmatjere communities of Ti Tree and Wilora and others.<br>Several art galleries in the region. |
| Health and wellbeing facilities | The Council's Aged Services continue to grow and mature into a program that can meet the needs of the aged and disabled older people as identified across the communities including Ti-Tree and Wilora.<br>Hospital in Alice Springs.<br>Royal Flying Doctor Service.<br>Remote health centre in Ti Tree.<br>Family mediation and domestic violence support services in the LGA.<br>Health centre and separate aged care centre in Wilora. |
| Other major facilities and services | Centrelink services in all communities in the LGA.<br>Wilora - 2 night patrol services - a men's and a woman's.<br>CDRC - has 9 Service Delivery centres with one located in Ti Tree.<br>The Ti Tree police station has fire response and roadside recovery capability.<br>The Ti Tree office of the Central Desert Regional Council has a fire vehicle.<br>Ti Tree roadhouse and caravan park.<br>There is one ranger located in Ti Tree. |

### 12.2.4 Summary of Key findings

Key findings of the social baseline include:

- a large Indigenous population within the regional study area (80% in the LGA), almost 50% in Ti Tree SSC and the entire Wilora ILOC community;
- generally younger population with higher percentage between 25 - 44 years of age and communities mostly made up of 'couple families with children';
- Ti Tree SSC reported no unemployment, Central Desert LGA recorded 14.5% and a high level of unemployment was noted in Wilora (35.7%) and among the Indigenous population of Central Desert LGA (26.3%);
- public administration and safety were the key industries of employment in both Ti Tree SSC and Central Desert LGA;
- the majority of dwellings in the study area were rented and a high percentage of dwellings were unoccupied compared to the territory average; and
- basic social infrastructure is located within the communities with higher order services provided from Alice Springs.

## 12.3 Impact Identification and Assessment

This Section identifies, describes and assesses the potential social and economic impacts arising from Project construction and operation on the regional communities, with particular focus on stakeholders that may be directly affected by the impact. The following impacts have been assessed in this section:

- economic impacts;
- demographic changes and impacts on community values;
- impacts on housing and social infrastructure;
- impacts on property;
- amenity impacts; and
- traffic and safety impacts.

### 12.3.1 Economic impacts

#### Business opportunities

The Mount Peake Project has an estimated capital expenditure of $310 million during construction and a total operational expenditure of $2,000 million over the life of the Project. This will bring economic benefits to the region, territory and even nationally. It is expected that through the sourcing of goods and services the Project will generate business opportunities in the regional study area and the wider area of influence, and potentially also from Alice Springs. Where possible the Project will source goods and services from local suppliers in nearby communities, however there are limited opportunities to do so.

#### Employment opportunities and flow on benefits

The Project is expected to generate up to 225 construction and 170 operational jobs. The workforce will be primarily fly-in fly-out (FIFO) from Alice Springs, Darwin and potentially interstate, depending on the availability of required skills.

It is anticipated that, depending on the available skill base, a small proportion of the Project workforce may be recruited locally for activities such as environmental works (monitoring, reporting and rehabilitation), road construction, plant / machinery operation, bus drivers, camp staff and administration staff. However, stakeholder consultation has revealed that due to the small labour pool available in the regional communities recruiting local workers may be challenging.

TNG is committed to long term employment, skills training and mentoring of Aboriginal people for the Mount Peake Project. Through their Indigenous Relations Policy, TNG will maintain ongoing communication with the local Indigenous communities to optimise Project related opportunities.

It is anticipated that local and regional employment and business opportunities will generate some further demand for goods and services creating additional local jobs.

The upgrade of Ti Tree airstrip will also generate some short term employment opportunities during construction with longer term employment for staff manning the terminal.

#### Workforce draw from other industries

The regional communities, including Alice Springs, have a relatively small population and labour force. Stakeholder consultation identified that employment opportunities generated by potential resource projects in the region may lead to skilled workers in existing jobs taking up these opportunities, creating some workforce shortfalls in existing industries.

### 12.3.2 Demographic change and impacts on community values and lifestyle

The majority of the Project workforce is anticipated to be FIFO. The workers will fly to Ti Tree and then bus to the accommodation village near the mine site, for the duration of their roster. Due to the remote location of the mine site and the self-contained nature of the accommodation village, it is highly unlikely that the workers will visit Ti Tree or other regional centres during their roster. Due to the minimal potential for workers to interact with the local communities, the Project will not change local demographics and is unlikely to impact on local community values and lifestyle.

### 12.3.3 Impacts on housing and social infrastructure

#### Impacts on housing and accommodation and other community services

The majority of the Project workforce will be FIFO and when on roster will be housed at the accommodation village. The Project is therefore unlikely to generate any demand for local accommodation, housing or community services.

#### Health services

The Project will maintain an on-site medical facility and ambulance to service the workforce. Local medical and health services are not expected to be accessed by the Project workforce. In the event that personnel need to be medically evacuated they will be conveyed to Ti Tree for airlift by the RFDS.

#### Emergency services - fire and rescue services and police

The Project will develop and implement safety protocols, incident management and emergency procedures. A Health and Safety Plan and Emergency Response Plan will be in place. These plans will consider among other things fire prevention and firefighting equipment and security. It is unlikely that the Project will increase demand for local police services and impact their ability to service the local community.

### 12.3.4 Impacts on property

#### Access within the properties

Concern was raised on the potential for the transport corridor to impact access to strategic areas of Stirling Station, particularly bores and gates, and areas of the station to the east. Stakeholders also expressed safety concerns with the potential for cattle to wander onto the access road. TNG has recognised these concerns by:

- locating the corridor largely along the southern boundary of Stirling Station to minimise disruption to the operation of the property;
- fencing of the corridor to exclude cattle; and
- committing to engage with the station owner to maintaining access to strategic areas of the station.

#### Property viability

Anningie Station has organic certification and Stirling Station is considering applying for it. Concerns were raised by the station owners on the potential for the Project to impact this certification. The Project is not expected to affect the organic certification as:

- no chemicals are used in the production of the magnetite concentrate and the magnetite concentrate product is benign;
- small amounts of ammonium nitrate will be used in blasting with any impact confined to the pit area;
- all hazardous materials (primarily diesel) will be transported and stored in compliance with regulations. Diesel will be stored in self-bunding tanks;
- all waste will be appropriately treated and disposed of;
- chemicals are not proposed to be used for dust suppression; and
- the mine site and access road will be fenced.

### 12.3.5 Amenity impacts

Stirling Station homestead is located 50 km to the east of the mine site and 22 km north of the transport corridor. Anningie Station homestead is located 30 km south west of the mine site. The Wilora Aboriginal Community is located 20 km to the north of the transport corridor.

Air, noise and vibration modelling indicates that no sensitive receptors will be impacted by the Project.

### 12.3.6 Traffic and safety impacts

Concern was raised on the potential for trucks carrying magnetite concentrate to pose a safety issue when crossing Stuart Highway. Project design now incorporates an underpass of Stuart Highway to avoid the potential for traffic conflict.

An at-grade intersection will be provided between the Stuart Highway and the access road to allow vehicle movement to and from the mine site. The design of the intersection will be in consultation with the NT Department of Transport. This will include the design of acceleration and deceleration lanes and the incorporation of appropriate signposting to avoid or minimise any impact on other road users.

During construction the Project is expected to generate up to 30 one-way light vehicle movements, six one-way bus movements and 30 one-way heavy (truck) vehicle movements per day. During operations the Project is expected to generate up to 20 one-way light vehicle movements, five one-way bus movements and five one-way heavy (truck) vehicle movements per day. A traffic assessment indicates that the Project will contribute to a small increase in vehicle numbers on Stuart Highway, and is not likely to impact on the capacity of the highway with the highway operating at around 3% of its design capacity.

### 12.3.7 Summary of social impacts and assessment

A risk assessment was undertaken for the impacts described above, with results provided in Table 12-2.

**Table 12-2 Summary and assessment of social impacts**

| Impact description | Project phase | Nature of impact | Likelihood | Consequence | Impact significance |
|---|---|---|---|---|---|
| Business development opportunities, employment opportunities and flow on benefits experienced in the regional study area and wider area of influence. | Construction<br>Operation | Positive | Almost certain | Significant | High |
| Upgrade of Ti Tree airport. | Construction | Positive | Almost certain | Significant | High |
| Potential draw of existing workers into better paying resource jobs leading to shortfalls in other industries. | Construction<br>Operation | Negative | Possible | Moderate | Medium |
| The remote location of the mine and with the workforce housed at the accommodation village, no impact to local community values, lifestyle and amenity are expected. | Construction<br>Operation | Neutral | - | - | - |
| Due to the remote location of the mine, the medical facilities available on site, and with the workforce housed at the accommodation village, no impacts to local housing and social infrastructure services are expected. | Construction<br>Operation | Neutral | - | - | - |
| Potential impacts from the transport corridor have been avoided by Project design elements which will maintain continued access to and within the station. | Operation | Neutral | - | - | - |
| Potential risk to the organic certification of Anningie and Stirling stations is unlikely due to Project design features. | Construction<br>Operation | Neutral | - | - | - |
| No amenity impacts on surrounding sensitive receptors are predicted | Construction<br>Operation | Neutral | - | - | - |
| Impact from traffic is unlikely due to fencing of the transport corridor, underpass of Stuart Highway, appropriate intersection design and low vehicle numbers. | Construction<br>Operation | Neutral | - | - | - |

In conclusion the assessment has identified the potential economic and employment benefits for the regional communities, with a potential negative impact being the draw of existing workers from their current jobs into higher paying resource related jobs creating shortfalls in existing industries. The assessment shows 'neutral' impacts on other social indicators including demographic changes and impacts on community values, impacts on housing and social infrastructure, impacts on property, amenity impacts, and traffic and safety impacts.

## 12.4 Impact Mitigation and Management Strategies

TNG is committed to a long term relationship with the regional study area and although the Project is not likely to generate significant negative impacts, TNG will have in place adaptive management strategies to enhance their positive contribution to the communities, and to monitor and review impacts on a regular basis and address them if they arise.

### 12.4.1 Stakeholder engagement and grievance management

TNG is committed to continued and ongoing engagement with stakeholders throughout the planning, development and operation phases of the Project. The objectives of ongoing engagement are to:

- maintain an open dialogue regarding Project timing and activities as approvals are secured; and
- encourage stakeholders to continue to raise concerns and queries directly with TNG for response or resolution throughout the Project planning, development and operation phases.

Consultation will continue throughout the life of the Project to ensure the consideration of all relevant and appropriate opportunities and concerns. TNG values all stakeholder comments and feedback, and will assess all stakeholder concerns or issues about the Project and take appropriate action as required.

TNG will have in place a Grievance Management Procedure that is communicated to all relevant staff members. All community enquiries and complaints will be responded to promptly.

### 12.4.2 Opportunities for Indigenous communities

TNG will continue to engage with the traditional owners and maintain community relations with Indigenous communities and Land Councils relevant to the Mount Peake Project. In consultations with the Land Council TNG has negotiated an Indigenous Land Use Agreement with the traditional owners of the Mount Peake Project area.

Through the cultural heritage management plan and native title processes TNG will continue to work with traditional owners to further develop and agree on Indigenous business and employment opportunities. Through the implementation of its Indigenous Relations Policy, TNG will ensure that mutual benefits from mining activities, such as employment and training, are shared with local communities.

### 12.4.3 Workforce management

TNG will have in place a Workforce Management Plan (WMP) to manage the Project workforce, maximise benefits for local employment and manage cumulative impacts on demand for local workers.

A number of specialist contractors will be engaged through the construction and operations phases of the Project. It will be the responsibility of the contractors to recruit and manage the workforce that they require. Through the terms and conditions of engagement the contractors will be responsible for implementing the WMP.

### 12.4.4 Community benefit fund

As the Project will not result in any significant negative social impacts, no impact mitigation strategies are proposed. However as part of the long term relationship with the regional communities TNG will consider establishing a community benefit fund to provide support for social infrastructure or other suitable development activities in the regional study area. The details of the community benefit fund will be developed by TNG in consultation with the Central Desert Shire Council and other key stakeholders.

### 12.4.5 Monitoring and Review

It is possible that changes to the Project and the socio-economic and political context of the region may bring changes to the impacts identified and assessed as part of this ESIA. To accommodate changes over time, TNG will continue to monitor impacts through the ongoing stakeholder engagement and grievance management mechanisms. Reporting on social indicators will be included in TNG's annual internal reporting process.

The ESIA and the community benefit fund arrangements will be reviewed annually during construction and every five years during operations.

# 13. Human Health and Safety

## 13.1 Workforce Exposure to Hazardous Materials

This section addresses the potential impacts from exposure of the workforce to hazardous materials.

### 13.1.1 Project Overview

The primary hazardous materials that will be used on site are hydrocarbon based.

Diesel will be required to fuel the mining and vehicle fleet, and generators at the borefield. At a mining rate of 6 Mtpa the estimated diesel requirement is 15 MLpa. To achieve this there will be three 100,000 L deliveries per week by triple carriage semitrailer.

Oils and lubricants will be used in the vehicle fleet and within the process plant with small amounts also used to service equipment such as generators and pumps. Oils and lubricants will be delivered by truck.

Gas, up to 1.8 PJpa, will be provided from the Amadeus Gas Pipeline via a hot tap. Road train tankers will commute between the pipeline and the mine site along the access road.

Explosives use at site is expected to peak at 2,200 tpa. Around 55% of the explosive required is emulsion for use in fresh material with the balance being ammonium nitrate / fuel oil.

The project will not use any hazardous chemicals that require special storage and handling.

### 13.1.2 Existing Environment

The Mount Peake Project will be located on pastoral lease. Use of diesel is primarily limited to fuel for station vehicles. Stirling Station has its own bulk diesel supply.

Stuart Highway runs through the Project area with hydrocarbons regularly transported to remote towns and communities.

The Amadeus Gas Pipeline runs adjacent to the Stuart Highway.

### 13.1.3 Potential Impacts

Potential impacts to human health and safety could occur from the following:

- release of hydrocarbons due to a vehicle to vehicle accident or rollover;
- release of hydrocarbons due to a spill at the mine site;
- explosion from the gas storage vessel at the mine site; and
- fire, formation of toxic gases or explosion of ammonium nitrate.

### 13.1.4 Management Measures

To minimise the potential for impact to human health and safety, hazardous materials will be transported, stored and handled in compliance with industry standards. Personnel will be trained in the appropriate handling of hazardous materials and in clean-up procedures in the event of a spill.

In the NT, hazardous chemicals and dangerous goods are regulated under the Work Health and Safety (National Uniform Legislation) Act and the Work Health and Safety (National Uniform Legislation) Regulations Administered by NT WorkSafe. The act and regulations are based on the Model Work Health and Safety Regulations and make direct reference to the Australian Dangerous Goods Code.

The *Australian Dangerous Goods Code 2007* relates primarily to the transport of dangerous goods although it provides relevant information on segregation and compatibility of different classes of dangerous goods.

Hydrocarbon transport will be in compliance with the Dangerous Goods Code. All vehicles will be registered.  A component of this registration is that vehicles carry appropriate equipment to respond to a spill, including personal protective equipment (PPE).

Diesel at the mine site will be stored in 85,500 L self-bunded tanks with a total storage capacity of around 850,000 L (Plate 13-1).  The tanks are effective storage solutions for type 1 or 2 combustible fluids. The tanks are manufactured to comply with Australian Standard AS1692 and when installed in compliance with AS1940 for Storage of Combustible Fluids easily meet regulatory requirements.


**Plate 13-1 Example of 85,000 L self-bunded tank**

Lubricating oil will be stored in bulk containers inside a bunded area with spill protection and recovery.

Waste hydrocarbons will be stored in a tank within a bunded area to be held for collection by a contractor for reprocessing and recycling.

Gas at the mine site will be stored in intermodal containers in accordance with AS 4332-2004: The storage and handling of gasses in cylinders.

Ammonium nitrate will be stored in a dedicated standalone building consistent with Code of Practice for the safe storage of solid ammonium nitrate (DMP 2013).  Handling of ammonium nitrate will be by appropriately trained personnel.

In the event of a spill of a hazardous material an Emergency Response Plan has been developed consisting of the following:

- isolate and contain the spill utilising the spill kit;
- evacuate from the area if potential danger;
- notify the Environmental Manager and provide location, extents, substance type, quantity, environments impacted (soils, surface water courses and groundwater) and spill kit contents used;
- use spill clean-up kit to remove the contamination source or, where relevant, excavate and appropriately dispose of contaminated sediments;
- commence investigation into soil, surface and/or groundwater impacts from the spill. The investigation will detail the spill quantity, determine extent and significance of the impact to human health and the ecosystem (including upstream / control samples as required); and
- provide the NT DME with Section 29 Notification and NT EPA with Section 14 Incident Report Form within 24 hours of the incident occurring if the incident caused or is threatening or may threaten to cause pollution resulting in minor or serious environmental harm;

Spill kits will be located at all hazardous substance storage locations.  In addition, spill kits will be available to be relocated to specific areas in accordance with scopes of work.

## 13.2 Traffic

This section addresses potential impacts associated with Project related traffic.

### 13.2.1 Project Overview

An access road will be constructed to connect the mine site with the Adnera Loadout Facility  This road will serve the dual purpose of providing general vehicle access from Stuart Highway to both the mine site and loadout facility, and as the haulage route for concentrate product.

The access road will connect to Stuart Highway via an at-grade intersection.  A conceptual arrangement for the intersection is shown in Figure 13-1.

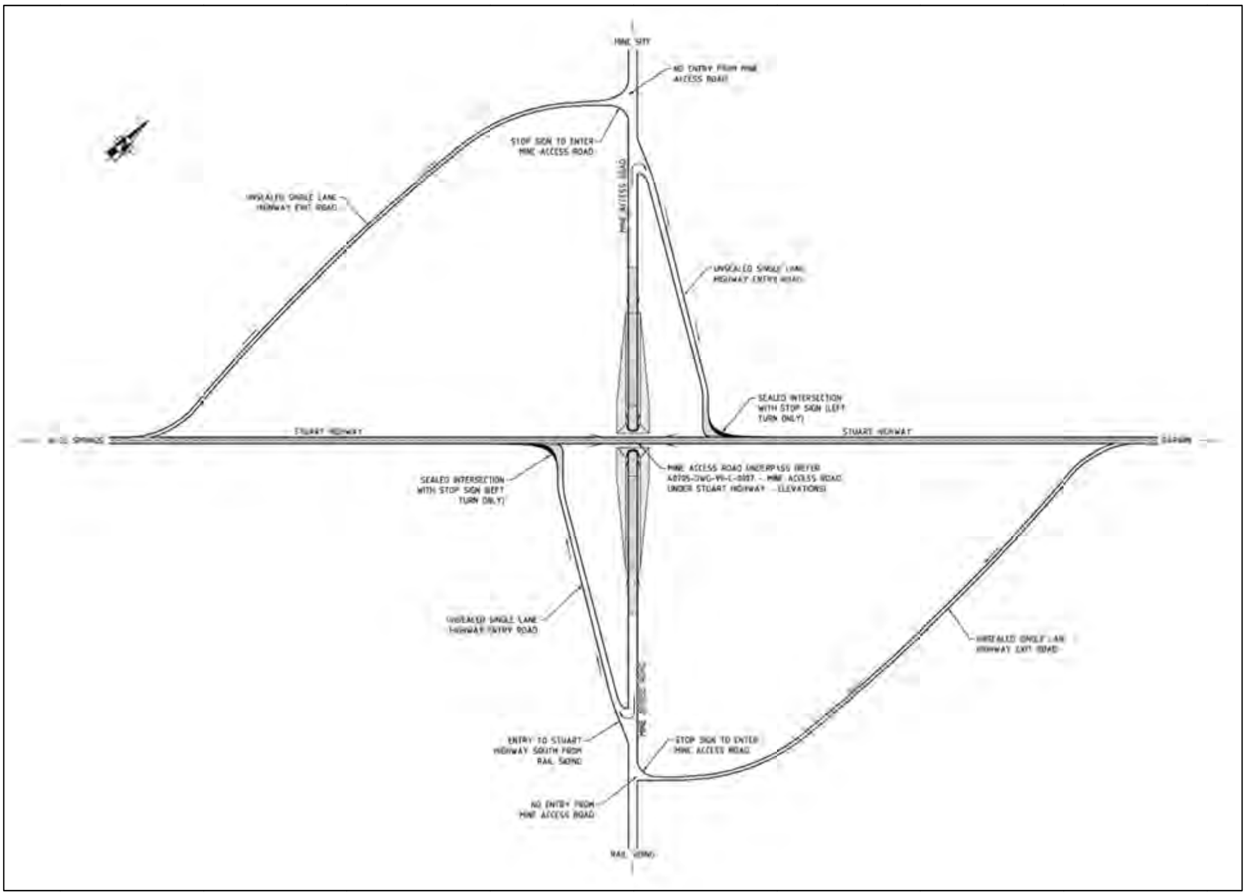



**Figure 13-1 Stuart Highway road connections**

Road trains used to transport the concentrate will be highway compliant and will operate under shared usage conditions with other highway compliant vehicles such as delivery trucks, busses and light vehicles.  An underpass of Stuart Highway will be constructed to remove road trains from the highway. Design details are provided in Figure 13-2 with an artistic impression of the underpass in Figure 13-3.

The Mount Peake Project will generate traffic as a result of construction and operational activities.  Over the approximately two year construction period, materials (steel, plate work, piping, cable, timber, cement, aggregate etc) will be trucked to site from Stuart Highway via the access road.  Transportation vehicles will be a combination of standard and oversize loads.  It is estimated that up to 30 heavy vehicle deliveries will occur per day. Any larger plant and equipment that cannot be assembled on-site will be transported under appropriate permits.

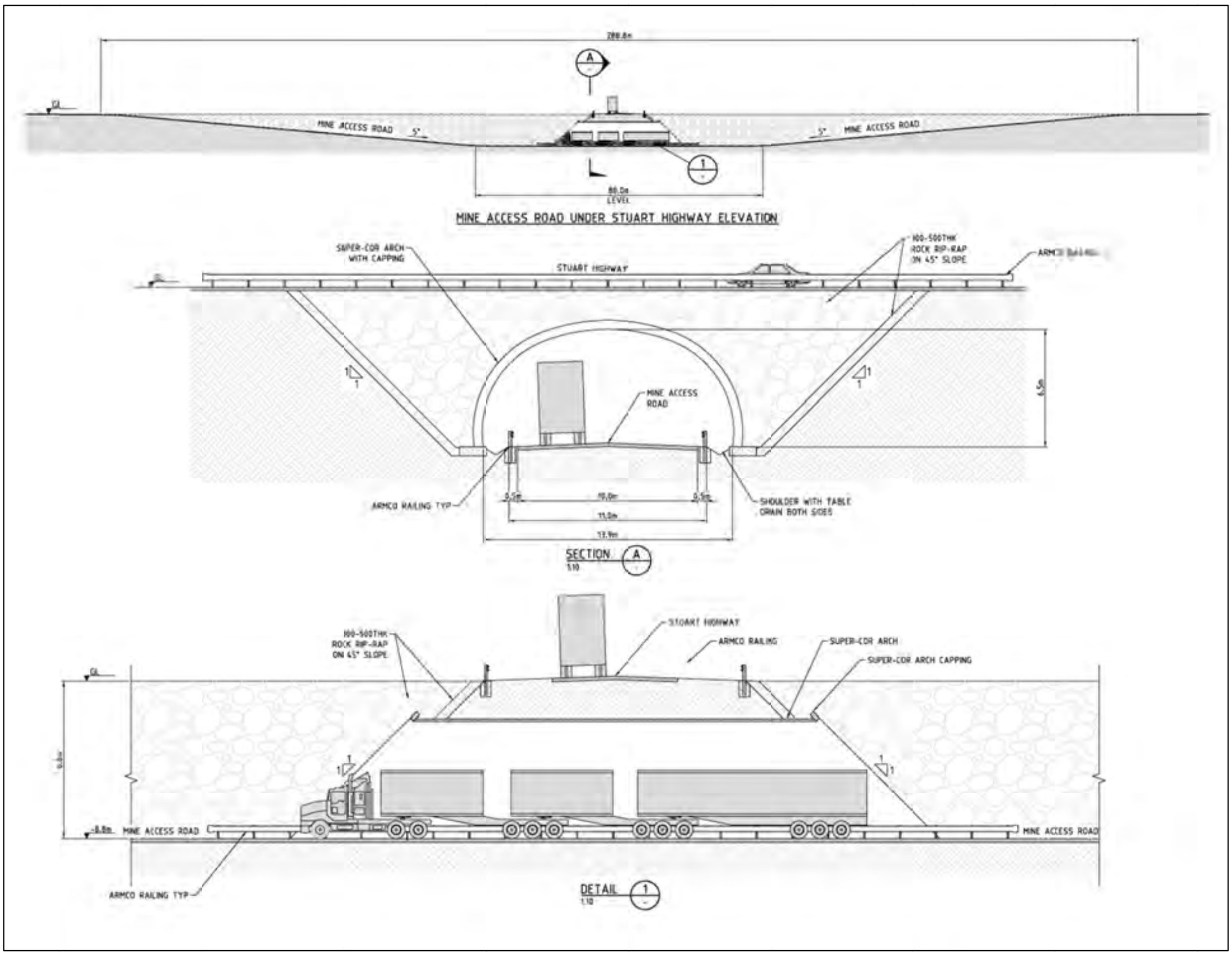



**Figure 13-2 Access road under Stuart Highway**

**Figure 13-3 Artistic impression of Stuart Highway underpass**

During operations, reagents and consumables will be delivered by truck. It is estimated that up to four deliveries per day will occur. Deliveries will include flocculant for the process plant, sodium hypochlorite and antiscalent for water treatment, and consumables in the process plant such as mill balls, wear liners and filter belt components.

Diesel will be required to fuel the mining and vehicle fleet, and generators at the borefield. At a mining rate of 6 Mtpa the estimated diesel requirement is 15 MLpa. To achieve there will be three 100,000 L deliveries per week by triple carriage semitrailer.

The construction and operations workforces of 225 and 170 personnel respectively will be largely fly-in fly-out due to low population numbers in the area. Workers will fly to Ti Tree and will then be bussed to the accommodation village for the duration of their roster. Construction workforce traffic is expected to peak at six return bus trips and 30 return light vehicle trips per day with operation workforce traffic expected to peak at five return bus trips and 20 return light vehicle trips per day.

### 13.2.2 Existing Environment

The main public road in the Mount Peake area is the Stuart Highway. It runs from Darwin in the Northern Territory to Port Augusta in South Australia, a distance of 2,834 km. According to Austroads, as a rural highway it has a design capacity of 8,000 one-way vehicle movements per day i.e. 16,000 two-way movements.

The closest traffic count stations to the Mount Peake area are located approximately 80 km to the north (RTVDC022) and 95 km to the south (RAVDC020) respectively. A review of traffic count data for 2014 (the most recent year published) from these two stations is summarised in Table 13-1 (Department of Transport 2014). The results are very similar and indicate that:

- there are around 190 one-way (380 two-way) vehicle movements per day, around 2.4 % of the highways design capacity;
- short vehicles (sedans, wagons, 4WDs, utilities etc) comprise around 60 % of movements;
- medium vehicles (towing vehicles, two and three axle trucks and busses, and four axle trucks) comprise around 24 % of movements; and
- long to large vehicles (all other vehicles) comprise around 16 % of movements.

**Table 13-1 Traffic count data from the Mount Peake area (2014)**

| Count Station | Vehicles per day – two-way | Vehicle type (grouped)[1] No. (and %) | | |
|---|---|---|---|---|
| | | Short[2] | Medium[3] | Long to Large[4] |
| RTVDC022 | 377 | 233 (61.7 %) | 88 (23.3 %) | 56 (15.0 %) |
| RAVDC020 | 381 | 225 (59.0 %) | 95 (25.1 %) | 61 (15.9 %) |

[1] Based on Austroads vehicle classification system
[2] Includes sedan, wagon, 4WD, utility, light van, bicycle, motorcycle etc
[3] Includes vehicles towing trailer, caravan, boat etc, two and three axle truck or bus, and four axle truck
[4] Includes three, four, five and six axle articulated vehicle, B Double, Double Road Train, Triple Road Train

The Stuart Highway in the area of the proposed intersection is a two lane sealed road. The highway at this location is straight with sight distances of hundreds of metres (Plate 13-2).

### 13.2.3 Potential Impacts

During construction the Project is expected to generate up to 30 one-way light vehicle movements, six one-way bus movements and 30 one-way heavy (truck) vehicle movements per day. This will increase total one-way vehicle movements on Stuart Highway by 35 % to an estimated 256 vehicles per day (512 two-way) or 3.2 % of the design capacity of the highway. The greatest percentage increase is a doubling of heavy (Long and Large in Table 13-1) vehicles.

Looking south

Looking north

**Plate 13-2 Stuart Highway near to the intersection of proposed access road**

During operations the Project is expected to generate up to 20 one-way light vehicle movements, five one-way bus movements and five one-way heavy (truck) vehicle movements per day. This will increase total one-way vehicle movements on Stuart Highway by 16 % to an estimated 220 vehicles per day (440 two-way) or 2.8 % of the design capacity of the highway. The greatest percentage increase is a 17 % increase in light and heavy (Short, and Long and Large in Table 13-1 respectively) vehicles.

Project construction and operational activities are not expected to increase vehicle movements on Stuart Highway to an unacceptable level given the current low vehicle usage of the highway. All vehicles will be registered for transport of their respective loads and will be subjected to local road rules.

The design of the intersection of the access road with Stuart Highway will be in consultation with the NT Department of Transport. This will include the design of acceleration and deceleration lanes and the incorporation of appropriate signposting. No significant impact from the intersection is expected.

From a safety perspective TNG will construct an underpass of Stuart Highway to remove concentrate trucks from the highway. To allow for construction of the underpass Stuart Highway will be temporarily diverted. All construction and reinstatement works will be undertaken in compliance with NT Department of Transport requirements.

### 13.2.4 Management Measures

No specific management measures are required in relation to transport.

## 13.3 Aquifer Contamination

This section addresses the potential for contamination of a shared potable aquifer accessed by workers or a local community.

### 13.3.1 Project Overview

A new borefield will be established within the alluvial aquifer of the Hanson River (Figure 2-1). Up to 10 supply bores and two standby bores will be installed. Bores will be spaced approximately 1,800 m apart and will pump at around 8.5 L/s each. Around 2,625 MLpa of make-up water will be required for mining, processing, dust suppression and potable use. A water treatment plant located at the mine site will treat 35.6 $m^3$/h for potable use, irrigation and process plant gland water.

Power to each bore will be supplied via a 50 kVA generator with a 4,670 L diesel tank, sufficient for around 20 days continuous operation. Diesel will be delivered by tanker.

The pit will be dewatered to allow for mining. An assessment of potential groundwater inflow to the pit indicated that the pit will produce very limited water.

### 13.3.2 Existing Environment

Groundwater at the borefield lies 10 - 12 m below ground level and groundwater flow is to the north west. Groundwater at the pit lies 20 - 22 m below ground level with local flow towards the adjacent Bloodwood and Murry creeks and regional flow to the north towards the Hanson River.

All bores in the Project area are restricted to providing water for stock use.

Within the broader region, a number of dedicated bores are used to provide permanent public water supply. These include:

- Wilora community with a licence for 40 ML/year (issued to Power and Water Corporation). This is the closest potable bore to the proposed borefield, approximately 50 km to the east;
- Barrow Creek service station with a licence for 1 ML/year; and
- Stirling Station homestead where no current licence data is available.

### 13.3.3 Potential Impacts

Potential impacts to shared potable aquifers could include:

- groundwater drawdown at the mine or borefield affecting bores supplying potable water; and
- contamination of groundwater supply at the borefield from leaks or spills of hazardous materials.

Groundwater modelling of the borefield indicates that the maximum drawdown will be up to 12 m below current groundwater levels in the centre of the borefield with the 1 m drawdown contour extending to around 6 km from the borefield. The closest potable water supply is 50 km up groundwater gradient from the borefield and no impact to a potable supply is expected from borefield abstraction.

Groundwater modelling of the pit indicates that groundwater drawdown at the end of mining reaches a maximum of around 100 m within the location of the pit, and rapidly decreases with distance from the pit. The 1 m drawdown contour is predicted as being around 1 km from the pit edge, and the approximate limit of drawdown (0.05 m) a further 1 km from this. There is no potable water supply close to the pit and no impact to a potable supply is expected.

The primary risk of contamination at the borefield is from diesel used to power the generators. Should a spill of diesel occur there is the potential for water quality in the adjacent bore to be contaminated with the result that the bore will need to be shut down until the spill is cleaned up and the area remediated. This would increase reliance on the remaining bores to supply Project water needs and may require the temporary use of a standby bore.

### 13.3.4 Management Measures

Management measures to minimise the potential for a diesel spill at the borefield include:

- constructing bores and installing generators on raised hardstands with the height of the hardstand sufficient to protect infrastructure from a 100 year flood event of the Hanson River;
- each generator and its associated diesel tank being located within a bunded area of the hardstand;
- installation of groundwater monitoring bores to monitor groundwater quality; and
- implementing clean-up of any spills consistent with the Emergency Response Plan.

## 13.4 Mosquito Breeding

This section addresses the potential spread of mosquito-borne disease due to creation of mosquito breeding sites.

### 13.4.1 Project Overview

The Project will construct of a number of structures with the potential to act as mosquito breeding sites. These include:

- raw water dam;
- process water dam;
- tailings storage facility;
- tailings storage facility water recovery pond;
- stormwater ponds;
- sedimentation ponds; and
- borrow pits.

In addition suitable habitat for breeding can also be created where water is allowed to accumulate in empty drums, disused storage containers, used tyres,

### 13.4.2 Existing Environment

No specific assessment of mosquito occurrence in the Project area has been undertaken.

Due to the absence to large areas of standing water, mosquito numbers are expected to be low.

Habitat suitable for mosquito breeding would be provided following rainfall in the area. This would include wheel ruts, topographic lows underlain by impervious soils and tree or rock hollows where water can accumulate. Damp areas around bores also have the potential to act as breeding sites.

### 13.4.3 Potential Impacts

The development of water containment structures at Mount Peake, some with permanent standing water, has the greatest potential to cause a rise in the abundance of biting insects and an increase in the disease threat through an increase in the abundance of suitable breeding sites for mosquitos.

Mosquitos have the ability to transmit a range of viral and parasitic diseases such as Ross River virus, Barmah Forest virus and Murray Valley encephalitis (for example by *Aedes normanensis*) or malaria (by *Anopheles annulipes s.l.*).

The primary management measure for mosquitos is to limit the potential for inadvertent creation of new sites during mine development and operation.

### 13.4.4 Management Measures

The potential for nuisance levels and disease transmission by mosquitos will be mitigated by:

- rectifying any artificially created mosquito breeding sites including:
  - ground depressions around the mine site and alongside tracks;
  - shallow borrow pits;
  - ensuring that stormwater and sedimentation ponds are regularly maintained and cleared of silt and vegetation; and
  - any access tracks crossing floodways should have appropriate culvert or floodway provisions to minimise upstream flooding.
- improving drainage of grassy floodways and poorly draining areas associated with the creeklines around the mine site, or burning dead vegetation in the floodways before the start of the Wet Season to remove mosquito harbourage and nutrient loads;
- preventing potential mosquito breeding in artificial receptacles such as used tyres, drums, rubbish items, and other items that can pond water by storing them under cover, burying or removing rubbish items, or in the case of used tyres, providing them with drainage holes or filling the tyres with soil;
- ensuring that any rainwater tanks are appropriately screened at the inlet and outlet;
- ensuring construction avoids establishment of areas of temporary water;
- treating artificial ponding with an undiluted bleach solution or a residual larvacide if breeding is detected;
- ensuring personnel wear long sleeved shirts, long trousers and mosquito repellent;
- monthly inspections during the Wet Season, to identify areas of potential mosquito breeding associated with constructed or disturbed areas; and
- following the “Guidelines for preventing mosquito breeding sites associated with mining sites” (Medical Entomology Centre for Disease Control 2005).

## 13.5 Sunburn, Environmental Exposure and Heat Exhaustion

### 13.5.1 Potential Impacts

Working in an outdoor tropical environment increases ultra-violet radiation exposure and risk of heat induced medical conditions. The inherent risk of heat injury is extreme.

### 13.5.2 Management Measures

All employees and contractors will be required to wear long-sleeve shirts, trousers and hats to help reduce sun exposure. Sunscreen will also be made available to all employees.

To mitigate the risk of heat induced medical conditions, all personnel will be made aware during staff induction training of the signs and symptoms of overexposure to heat and its effects, including dehydration. Drinking water will be readily available to all staff.

It is anticipated that the health risks associated with heat exposure can be managed.

## 13.6 Animal Attacks / Bites

### 13.6.1 Potential Impacts

Several animals in the Project area are capable of human attack and inflicting bites. These include snakes and dingoes / wild dogs.

Bites from some species of snake (Mulga, Western Brown, Easter Brown, Desert Death Adder) are potentially fatal if not treated. Attack by a dingo / wild dog is unlikely unless the animal is injured or cornered.

### 13.6.2 Management Measures

During the staff induction process, mine personnel will be made aware of the potential wildlife hazards and the best methods to avoid negative encounters. Appropriate training for the treatment of snake bite will be provided to all staff. First-aid facilities will be equipped to respond to incidents of this type and provide appropriate treatment.

To provide protection against snake bite, PPE such as boots, trousers and long sleeves will be required on the mine site. Gloves will also be provided for use during relevant tasks.

# 14. Waste Management

## 14.1 Introduction

This chapter outlines the proposed waste management measures to be adopted during construction, operation and closure of the Mount Peake Project, with the aim of protecting environmental values from the impacts of wastes. A Waste Management Plan has been prepared for the Project.

## 14.2 Waste Management Principles

### 14.2.1 Waste Management Legislation and Requirements

The regulatory requirements in the Northern Territory regarding waste management include:

- *Waste Management and Pollution Control Act 1998*;
- Waste Management and Pollution Control (Administration) Regulations 2001;
- Waste Management Guidelines for Small Communities in the Northern Territory 2009;
- *Public and Environmental Health Act 2011*;
- *Water Supply and Sewerage Services Act 2000*;
- *Water Act 2004*;
- *Mining Management Act 2009*;
- NT Department of Health - Environmental Health Fact Sheet #700 - Requirements for Mining and Construction Projects;
- Code of Practice for Small On-site Sewage and Sullage Treatment Systems and the Disposal or Reuse of Sewage Effluent (1996);
- AS 1940-2004: The storage and handling of flammable and combustible liquids; and
- Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory (2013).

### 14.2.2 Definition of Waste

Under the Waste Management and Pollution Control Act*,* waste is defined as anything that is a solid, a liquid or a gas, or a mixture of such substances, that is left over, surplus or an unwanted by-product from any activity (whether or not the substance is of value) and includes a prescribed substance or class of substances.

A licence is required for collecting, transporting, storing, recycling, treating or disposing of listed waste.

### 14.2.3 Waste Categories

#### Hazardous waste

Hazardous wastes are wastes that pose a threat or risk to public health, safety or the environment. They include substances which may be toxic, infectious, mutagenic, carcinogenic, explosive, flammable, corrosive, oxidising or radioactive. Hazardous wastes include medical waste, excess or spent chemicals, contaminated scrap metals or drums, oily rags and absorbents, solvents, batteries, fluorescent tubes, oily sludge, paints and paint drums, oil filters, sewage and contaminated soil.

#### Non-hazardous waste

Non-hazardous wastes are wastes composed of, or containing, materials which are not harmful to humans and which would not have a serious impact on the environment. Non-hazardous wastes include putrescible solids and liquids, and inert solids, including paper, food waste, domestic waste, scrap metal, plastics, wood, glass, concrete and cardboard.

#### Recyclables

Recycle / recovery is the conversion of wastes into usable materials and / or extraction of energy or materials from wastes. Recyclable materials include paper and cardboard, plastics, glass, metal, wood, tyres, and vegetation and organic matter.

### 14.2.4 Project Waste Management Objectives

The waste management objectives established for the Project are provided in Table 14-1.

**Table 14-1 Waste management objectives**

| Objective | Target | Indicator |
|---|---|---|
| Prevent environmental impact from waste generation. | Zero environmental incidents associated with the landfill and waste collection sites. | Number of incidents which occur in relation to the landfill and waste generation sites. |
| Prevent increased environmental risk by the removal of hazardous substances from storage at the landfill prior to the Wet Season. | Zero hazardous substances stored at the landfill at the commencement of November. | Number of hazardous substances stored at the landfill. |

### 14.2.5 Project Waste Management Practices

Project waste management practices have been derived from a number of sources including the NT EPA who provide guidance on waste management through waste management principles and hierarchies. The principle of the waste management hierarchy states that waste should be managed in accordance with the following order of preference:

- avoidance;
- re-use;
- re-cycling and recovery of energy;
- treatment;
- containment; and
- disposal.

The performance requirements throughout the construction, operation and closure of the Project require that the waste hierarchy is considered, and aims to minimise waste generation through adoption of best practice waste avoidance, minimisation and disposal procedures.

### 14.2.6 Cleaner Production

The NT EPA requires that "cleaner production" should be considered in determining how waste is managed. A cleaner production program to identify and implement ways of improving a production process includes:

- using less energy, water or another input;
- generating less waste; or
- generating waste that is less environmentally harmful.

### 14.2.7 Environmental Values

During the Project construction, operation and closure phases, waste will be managed to avoid adverse impacts on the life, health and wellbeing of people and the diversity of ecological processes and associated ecosystems surrounding the Project site.

## 14.3 Existing Environment

The Mount Peake Project will be developed on a Pastoral lease that has not been exposed to previous industrial and mining activities.  No industrial waste currently occurs on the Project site.

Existing waste disposal facilities in the region are limited to local landfills servicing small communities such as Ti Tree. Alice Springs has a number of operators that can recycle tyres, batteries, waste hydrocarbons, scrap metal, bottles and cans.

## 14.4 Potential Impacts

The Project will generate a variety of waste types during the construction, operation and closure phases.

### 14.4.1 Construction and Operation

Waste generated during the construction and operations phases include:

- waste rock and tailings;
- solid wastes from the water treatment plant;
- sewage;
- packaging materials (e.g. cardboard, paper, plastics, wood);
- scrap material, timber, geotextiles and electrical off-cuts;
- concrete;
- waste batteries, fuels, oils and chemicals;
- tyres;
- green waste from clearing; and
- general domestic waste including food waste from the accommodation facility.

### 14.4.2 Closure

Waste types arising from decommissioning and closure activities include:

- waste rock;
- wastewater / effluent;
- waste fuels, oils and chemicals;
- tyres;
- vegetation;
- food waste from the employee accommodation; and
- steel, concrete and timber from the Beneficiation Plant, power station and other structures.

## 14.5 Waste Management

### 14.5.1 Reuse and Recycling

Wherever practical and economically viable, all waste materials will be recycled. Metals such as steel and copper wire will be collected in designated areas prior to removal from site for recycling. Plastic pipe will be reused wherever possible. Used tyres will be collected and periodically dispatched to off-site recyclers or a re-tread facility.

Recyclable waste will be periodically delivered to various recycling facilities or end users as back loads on regular truck schedules, therefore not impacting traffic volumes.

Green waste, topsoil, packaging waste (including cardboard, timber, plastics and polystyrene foam), scrap metal and general maintenance wastes will be appropriately managed to prevent degradation of amenity, blocking of drainage lines, and avoiding impediments to revegetation efforts.

These wastes represent resources that, if not recovered through reuse or recycling, are lost once placed in a landfill. TNG will seek to maximise the use of existing recycling services wherever possible through contractual arrangements.

To maximise the reuse of on-site material over imported material for reclamation, a site-wide inventory will be prepared for reclamation materials.

### 14.5.2 Process Wastes

#### Waste Rock

Waste rock will be stored in a Waste Rock Dump. Up to 70 Mt of waste rock will be stored over the life of the Project.

The ore body does not contain any significant acid forming materials and therefore selective handling of waste rock will not be required.

A description of the waste rock dump is provided in Section 2.7.1.

#### Tailings

Tailings will be disposed of to a TSF. Up to 63 Mt of tailings will be stored over the life of the Project.

A description of the waste rock dump is provided in Section 2.7.2.

### 14.5.3 Disposal

#### Storage

As part of the site's general waste management, all wastes will be collected and stored in waste management areas until removed from the site to avoid any amenity concerns or other issues arising from wastes lying around the site.

Chemicals, fuels and oils will be stored and contained inside a bunded area with spill protection according to Australian Standards and Regulations.

#### Inert Waste

Concrete and other non-reactive, non-combustive, non-corrosive and non-hazardous demolition waste will be broken up and either:

- placed in the WRD; or
- buried in-place.

Solid waste disposal facilities will be maintained in a manner that would not attract wildlife.

Where inert industrial wastes cannot be practically or economically disposed of off-site they will be co-disposed with other inert waste being disposed on-site. Burial will be at least 2 m below the final surface. Any empty drums will be cleaned and flattened prior to burial.

#### General Waste

Putrescible and domestic waste will be buried in an on-site landfill. The landfill will be fenced to prevent access from vermin.

#### Hazardous Waste

The anticipated hazardous waste types likely to arise include:

- waste oil;
- waste lubricants; and
- batteries.

All hazardous waste material will be collected and stored on-site in designated and bunded areas prior to being transported off-site by a licenced carrier for disposal / treatment at an appropriate facility.

#### Sewage

Sewage treatment at the mine site / accommodation village will be via a packaged treatment plant. The plant will cater for the requirements of up to 225 construction personnel and 170 operations personnel.

Treated effluent from the Sewage Treatment Plant will be used around the site for landscaping purposes.

The untreatable solids will be collected and disposed of offsite by a licensed waste transporter.

Sewage at the Adnera Loadout Facility will be treated by septic tank and leach drains.

Sewage treatment facilities will be licenced by the Department of Health and a Waste Discharge Licence will be applied for to cover the on-site reuse of treated effluent.

### 14.5.4 Monitoring

Monitoring the activities and outcomes related to waste management include:

- recording of waste types and volumes generated on-site and being transported off-site;
- assessing actual waste volumes against forecasted waste volumes; and
- monitoring for potential environmental impacts including water quality monitoring.

### 14.5.5 Waste Commitments and Targets

Waste commitments and targets will be developed to assist in effective waste management to:

- reduce the level of waste produced and any associated environmental impact;
- recover and recycle where practicable;
- create awareness of the waste management strategy and waste commitments / targets; and
- optimise re-use and recycling systems.

# 15. Matters of National Environmental Significance

This chapter documents potential impacts of the Mount Peake Project on Matters of National Environmental Significance (MNES) identified under the EPBC Act. The potential impacts and associated management measures identified in this chapter also contribute to the flora and fauna components of the Project risk assessment undertaken in Chapter 5. The Project risk assessment includes consequence, likelihood and residual risk ratings for impacts associated with flora / vegetation and fauna after management measures are implemented.

Detailed assessments of the ecological values of the Project area are provided in Appendices G and H. These contain the results of desktop investigations, field surveys and likelihood of occurrence assessments. The outcomes of this work are presented in this chapter as it relates to MNES. This chapter should be read in conjunction with Chapter 8 (Biodiversity).

## 15.1 Introduction

The EPBC Act prescribes the Commonwealth's role in environmental assessment, biodiversity conservation and management of MNES. Actions that may have a significant impact on MNES are identified as "controlled actions" and cannot be undertaken without approval under the EPBC Act.

A referral under the EPBC Act was submitted to the DotE on 14 October 2013. The Project (the action) was determined to be a "controlled action" on the 18 November 2013. The controlling provisions were listed threatened species and communities (sections 18 and 18A).

## 15.2 Impact Assessment

The level of risk posed to the MNES by each source of impact is assessed using standard semi-qualitative risk assessment procedures. The process is consistent with AS / NZS ISO 31000:2009 'Risk Management – Principles and guidelines'. The likelihood of a particular consequence to flora / vegetation and / or fauna from a source of potential impact is determined (five levels, "Rare" to "Almost Certain"), as is the severity of that consequence (five levels, "Minor" to "Critical"). These together determine the level of risk on a scale from "Very Low" to "Extreme". Risk assessments assume that standard mitigation of potential impacts has been implemented. The qualitative assessment matrix, level of likelihood and severity of consequences are defined in Table 15-1 to Table 15-3.

**Table 15-1 Qualitative risk analysis matrix**

| Likelihood of Consequence | | Severity of Consequence | | | | |
|---|---|---|---|---|---|---|
| | Likelihood | Critical (5) | Major (4) | Significant (3) | Moderate (2) | Minor (1) |
| | Almost Certain (5) | Extreme | Extreme | High | High | Medium |
| | Likely (4) | Extreme | High | High | Medium | Medium |
| | Possible (3) | Extreme | High | Medium | Medium | Low |
| | Unlikely (2) | High | Medium | Medium | Low | Very Low |
| | Rare (1) | Medium | Medium | Low | Low | Very Low |

### Table 15-2 Definition of level of likelihood

| Level of Likelihood | Definitions |
|---|---|
| Almost certain | The event is expected to occur in most circumstances (the event is likely to occur once per year). |
| Likely | The event will probably occur in most circumstances (the event is likely to occur once every 1 – 2 years). |
| Possible | The event might occur at some time (the event is likely to occur once every 2 – 5 years). |
| Unlikely | The event could occur at some time (the event is likely to occur once every 5 – 10 years). |
| Rare | The event may occur only in exceptional circumstances (the event is unlikely to occur in any 10 year period). |

### Table 15-3 Definitions of levels of consequence

| Levels of Consequence | Definitions |
|---|---|
| Critical | Extensive long term environmental harm and / or harm that is extremely widespread. Impacts unlikely to be reversible within 10 years. |
| Major | Major or widespread, unplanned environmental impact on or off the site. Significant resources required to respond and rehabilitate. |
| Significant | Significant, unplanned environmental impact contained within the site or minor impact that is off the site. |
| Moderate | Moderate, unplanned localised environmental impact contained on-site or with negligible off-site impact. |
| Minor | Minor environmental impact. Any impacts are contained on-site and short term in nature. |

### 15.2.1 Protected Matters Search Tool results

The PMST database was used to identify MNES within the Project area and a surrounding 10 km buffer. A summary of the MNES search results and the potential impact of the Project is provided in Table 15-4.

### 15.2.2 Nationally Threatened Species and Ecological Communities

Twenty listed threatened fauna species and one flora species potentially occur within 10 km of the Project area.

Using a combination of literature reviews, species database record searches and habitat assessment, five of these fauna species were determined to be extinct in the wild and eight of these species were determined to be unlikely to utilise this area. Of the remaining seven fauna species, six were deemed possible or present and one with an unknown presence due to its difficulty in detection. Whilst none of these threatened species were observed during field investigations, indirect evidence of presence and / or the presence of some areas of suitable habitat suggests that the Project area could support some of these species. Potential impact assessment using the DotE Significant Impact Guidelines 1.1 (DotE 2013a) was prepared for the bilby, brush-tailed mulgara, black-footed rock-wallaby, southern marsupial mole, princess parrot, night parrot and the great desert skink (Appendix H).

No evidence of the threatened dwarf desert spike-rush was found and records of habitat preference in the Project area indicate that this species would be confined to areas of swamp. Stirling Swamp, 12 km north of the access road, and Mud Hutt Swamp, 7.7 km north of the mine pit, will not be impacted by the Project. Consequently, no assessment against the DotE Significant Impact Guidelines was undertaken.

### Table 15-4 Impacts of the Project on Matters of National Environmental Significance

| MNES | Risk Rating | Impact of the Project |
|---|---|---|
| Listed Threatened Species | High risk | The PMST search identified 20 threatened fauna species and one threatened flora species (dwarf desert spike-rush *Eleocharis papillosa*). None of the fauna species were observed during the field survey, however there was indirect evidence of mammal presence. There are past records of the bilby (*Macrotis lagotis*), crest-tailed mulgara (*Dasycercus cristicauda*), brush-tailed mulgara (*Dasycercus blythi*) and the black-footed rock-wallaby (*Petrogale lateralis*) and evidence of suitable habitat within the Project area.<br>All other fauna species have not been recorded in or near the Project area for many years, or have not been recorded there at all. These species, if present, are likely to be very rare. Five of the species are considered to be extinct in the NT under the TPWC Act and eight of the species are unlikely to be present. The southern marsupial mole (*Notoryctes typhlops*) is a subterranean species and is extremely difficult to detect. Its likelihood of presence is unknown. The remaining seven threatened species are unlikely to occur in the Project area.<br>There was no evidence of the dwarf desert spike-rush during the field survey and it is known to be largely constrained to swamp areas which will not be impacted by the Project.<br>A summary of assessment against significance criteria is provided in Section 15.2.2. Following the application of management measures, any inherent risk to threatened species is expected to be either low or very low. |
| Listed Threatened Ecological Communities | No | The PMST did not identify any Nationally Threatened Ecological Community in or near the Project area. |
| Migratory Species Protected under International Agreements | No | The PMST search identified 7 migratory bird species. This included the rainbow bee-eater (*Merops ornatus*) which is the only migratory species that is known to occur historically within and around the Project area. These migratory species identified are known to occupy a very broad area and most likely do not occur within the Project area and so were not assessed. Assessments of migratory species in terms of the significance criteria are provided in Section 15.2.3 |
| Wetlands of International Importance | No | The PMST did not identify any Ramsar Wetlands of International Importance in or near the Project area. |
| Commonwealth Marine Areas | No | The PMST did not identify any Commonwealth Marine Areas in or near the Project area. |
| World Heritage Properties | No | The PMST did not identify any World Heritage properties in or near the Project area. |
| National Heritage Places | No | The PMST did not identify any registered National Heritage Place in or near the Project area. |
| The Great Barrier Reef Marine Park | No | The Project area is not located near or adjacent to the Great Barrier Reef Marine Park. It will not impact this marine park. |
| Nuclear actions | No | No nuclear actions will be undertaken as part of the Project. |
| A water resource, in relation to coal seam gas development and large coal mining development | No | The Project is not a coal seam gas or large coal mining development. |

### Greater Bilby

The greatest inherent risk to the potential population of greater bilby is “High” (Table 15-5). A risk of medium or greater was assessed for the potential for habitat clearing, habitat fragmentation, industrial and domestic waste material, unplanned wildfires, introduction of exotic plants and animals and inappropriate / ineffective rehabilitation to cause a population decline and or result in invasive species.

**Table 15-5 Greater Bilby risk assessment**

| Consequence according to the significant impact guidelines | Severity of consequence | Likelihood of consequence | Risk |
|---|---|---|---|
| Lead to a long-term decrease in the size of an important population of a species | Possible | Critical | High |
| Reduce the area of occupancy of an important population | Unlikely | Minor | Very Low |
| Fragment an existing population into two or more populations | Unlikely | Minor | Very Low |
| Adversely affect habitat critical to the survival of a species | Likely | Minor | Low |
| Disrupt the breeding cycle of an important population | Unlikely | Minor | Very Low |
| Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline | Possible | Significant | Medium |
| Result in invasive species that are harmful to the species becoming established | Possible | Critical | High |
| Introduce disease that may cause the species to decline | Rare | Major | Low |
| Interfere substantially with the recovery of the species | Possible | Major | Medium |

If bilby occur within the Project area, the level of residual risk can be reduced to an acceptably low level by implementing the following measures:

- a pre-clearance survey followed by staged vegetation clearing, undertaken during seasons that the bilby is less vulnerable;
- securely fencing domestic wastes to minimise animal pest attraction;
- Fire Management Plan with mine activity planning, maintenance of fire breaks and controlled burns;
- implementing an animal pest eradication / control program and monitoring feral fauna numbers;
- Weed Management Plan with vehicle washdown, weed monitoring and weed control activities; and
- Rehabilitation Strategy and Mine Closure Plan with progressive rehabilitation.

### Brush-tailed Mulgara

The greatest inherent risk to the potential population of brush-tailed mulgara is “High” (Table 15-6). A risk of medium or greater was assessed for the potential for habitat clearing, habitat fragmentation, industrial and domestic waste material, unplanned wildfires, impacts from vehicles / transport, introduction of exotic plants and animals and inappropriate / ineffective rehabilitation to cause a population decline and or result in invasive species.

**Table 15-6 Brush-tailed Mulgara risk assessment**

| Consequence according to the significant impact guidelines | Severity of consequence | Likelihood of consequence | Risk |
|---|---|---|---|
| Lead to a long-term decrease in the size of an important population of a species | Possible | Critical | High |
| Reduce the area of occupancy of an important population | Unlikely | Minor | Very Low |
| Fragment an existing population into two or more populations | Unlikely | Minor | Very Low |
| Adversely affect habitat critical to the survival of a species | Likely | Minor | Low |
| Disrupt the breeding cycle of an important population | Unlikely | Minor | Very Low |
| Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline | Possible | Significant | Medium |
| Result in invasive species that are harmful to the species becoming established | Possible | Critical | High |
| Introduce disease that may cause the species to decline | Rare | Major | Low |
| Interfere substantially with the recovery of the species | Possible | Major | Medium |

If brush-tailed mulgara occur within the Project area, the level of risk can be reduced to an acceptably low level by implementing the following measures:

- a pre-clearance survey followed by staged vegetation clearing, undertaken during seasons that the brush-tailed mulgara is less vulnerable;
- securely fencing domestic wastes to minimise animal pest attraction;
- Fire Management Plan with mine activity planning, maintenance of fire breaks and controlled burns;
- Traffic Management Plan with reduced speed limits, minimised night driving, minimised road traffic and road network and monitoring of roadkill;
- implementing an animal pest eradication / control program and monitoring feral fauna numbers;
- Weed Management Plan with vehicle washdown, weed monitoring and weed control activities; and
- Rehabilitation Strategy and Mine Closure Plan with progressive rehabilitation.

### Black-footed Rock-wallaby

The greatest inherent risk to the potential population of black-footed rock-wallaby is “Medium” (Table 15-7). A risk of medium was assessed for the potential for domestic wastes, unplanned wildfires, introduction of exotic plants and animals and inappropriate / ineffective rehabilitation to cause a population decline.

**Table 15-7 Black-footed Rock-wallaby risk assessment**

| Consequence according to the significant impact guidelines | Severity of consequence | Likelihood of consequence | Risk |
|---|---|---|---|
| Lead to a long-term decrease in the size of an important population of a species | Possible | Major | Medium |
| Reduce the area of occupancy of an important population | Unlikely | Minor | Very Low |
| Fragment an existing population into two or more populations | Unlikely | Minor | Very Low |
| Adversely affect habitat critical to the survival of a species | Likely | Minor | Low |
| Disrupt the breeding cycle of an important population | Unlikely | Minor | Very Low |
| Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline | Possible | Significant | Medium |
| Result in invasive species that are harmful to the species becoming established | Possible | Major | Medium |
| Introduce disease that may cause the species to decline | Rare | Major | Low |
| Interfere substantially with the recovery of the species | Possible | Major | Medium |

If black-footed rock-wallaby occur within the Project area, the level of risk can be reduced to an acceptably low level by implementing the following measures:

- securely fencing domestic wastes to minimise animal pest attraction;
- Fire Management Plan with mine activity planning, maintenance of fire breaks and controlled burns;
- implementing an animal pest eradication / control program and monitoring feral fauna numbers;
- Weed Management Plan with vehicle washdown, weed monitoring and weed control activities; and
- Rehabilitation Strategy and Mine Closure Plan with progressive rehabilitation.

### Southern Marsupial Mole

The greatest inherent risk to the potential population of southern marsupial is “Medium” (Table 15-8). Although not thought to utilise the Project area they have been included due the difficulty in detecting their presence. A risk of medium was assessed for the potential for habitat clearing, habitat fragmentation, industrial and domestic waste material, unplanned wildfires, introduction of exotic plants and animals and inappropriate / ineffective rehabilitation to cause a population decline and or result in invasive species.

If the southern marsupial mole occurs within the Project area, the level of risk can be reduced to an acceptably low level by implementing the following measures:

- securely fencing domestic wastes to minimise animal pest attraction;
- Fire Management Plan with mine activity planning, maintenance of fire breaks and controlled burns;
- implementing an animal pest eradication / control program and monitoring feral fauna numbers;
- Weed Management Plan with vehicle washdown, weed monitoring and weed control activities; and
- Rehabilitation Strategy and Mine Closure Plan with progressive rehabilitation.

### Table 15-8 Southern Marsupial Mole risk assessment

| Consequence according to the significant impact guidelines | Severity of consequence | Likelihood of consequence | Risk |
|---|---|---|---|
| Lead to a long-term decrease in the size of an important population of a species | Unlikely | Moderate | Low |
| Reduce the area of occupancy of an important population | Unlikely | Minor | Very Low |
| Fragment an existing population into two or more populations | Unlikely | Minor | Very Low |
| Adversely affect habitat critical to the survival of a species | Unlikely | Minor | Very Low |
| Disrupt the breeding cycle of an important population | Unlikely | Minor | Very Low |
| Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline | Unlikely | Minor | Very Low |
| Result in invasive species that are harmful to the species becoming established | Possible | Major | Medium |
| Introduce disease that may cause the species to decline | Rare | Major | Low |
| Interfere with the recovery of the species | Unlikely | Significant | Low |

### Princess Parrot

The greatest inherent risk to the potential population of princess parrot is “Medium” (Table 15-9). A risk of medium was assessed for the potential for domestic wastes, unplanned wildfires, and the introduction of exotic plants and animals to cause a population decline.

### Table 15-9 Princess Parrot risk assessment

| Consequence according to the significant impact guidelines | Severity of consequence | Likelihood of consequence | Risk |
|---|---|---|---|
| Lead to a long-term decrease in the size of an important population of a species | Unlikely | Minor | Very Low |
| Reduce the area of occupancy of an important population | Unlikely | Minor | Very Low |
| Fragment an existing population into two or more populations | Unlikely | Minor | Very Low |
| Adversely affect habitat critical to the survival of a species | Likely | Minor | Low |
| Disrupt the breeding cycle of an important population | Unlikely | Minor | Very Low |
| Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline | Unlikely | Minor | Very Low |
| Result in invasive species that are harmful to the species becoming established | Possible | Major | Medium |
| Introduce disease that may cause the species to decline | Rare | Major | Low |
| Interfere substantially with the recovery of the species | Unlikely | Minor | Very Low |

If the princess parrot occurs within the Project area, the level of risk can be reduced to an acceptably low level by implementing the following measures:

- securely fencing domestic wastes to minimise animal pest attraction;
- Fire Management Plan with mine activity planning, maintenance of fire breaks and controlled burns;
- implementing an animal pest eradication / control program and monitoring feral fauna numbers; and
- Weed Management Plan with vehicle wash down, weed monitoring and weed control activities.

### Night parrot

The greatest inherent risk to the potential population of night parrot is “High” (Table 15-10). A risk of high was assessed for the potential for domestic wastes, unplanned wildfires, and the introduction of exotic plants and animals to cause a population decline.

**Table 15-10 Night parrot risk assessment**

| Consequence according to the significant impact guidelines | Severity of consequence | Likelihood of consequence | Risk |
|---|---|---|---|
| Lead to a long-term decrease in the size of an important population of a species | Possible | Critical | High |
| Reduce the area of occupancy of an important population | Unlikely | Minor | Very Low |
| Fragment an existing population into two or more populations | Unlikely | Minor | Very Low |
| Adversely affect habitat critical to the survival of a species | Likely | Minor | Low |
| Disrupt the breeding cycle of an important population | Unlikely | Minor | Very Low |
| Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline | Unlikely | Minor | Very Low |
| Result in invasive species that are harmful to the species becoming established | Possible | Critical | High |
| Introduce disease that may cause the species to decline | Rare | Major | Low |
| Interfere with the recovery of the species | Unlikely | Minor | Very Low |

If the night parrot occurs within the Project area, the level of risk can be reduced to an acceptably low level by implementing the following measures:

- securely fencing domestic wastes to minimise animal pest attraction;
- Fire Management Plan with mine activity planning, maintenance of fire breaks and controlled burns;
- implementing an animal pest eradication / control program and monitoring feral fauna numbers; and
- Weed Management Plan with vehicle washdown, weed monitoring and weed control activities.

### Great desert skink

The greatest inherent risk to the potential population of great desert skink is “High” (Table 15-11). Although not thought to utilise the Project area they have been included due the difficulty in detecting their presence. A risk of medium or greater was assessed for the potential for habitat clearing, habitat fragmentation, industrial and domestic waste material, unplanned wildfires, introduction of exotic plants and animals and inappropriate / ineffective rehabilitation to cause a population decline.

**Table 15-11 Great desert skink risk assessment**

| Consequence according to the significant impact guidelines | Severity of consequence | Likelihood of consequence | Risk |
|---|---|---|---|
| Lead to a long-term decrease in the size of an important population of a species | Possible | Critical | High |
| Reduce the area of occupancy of an important population | Unlikely | Minor | Very Low |
| Fragment an existing population into two or more populations | Unlikely | Minor | Very Low |
| Adversely affect habitat critical to the survival of a species | Likely | Minor | Low |
| Disrupt the breeding cycle of an important population | Unlikely | Minor | Very Low |
| Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline | Possible | Significant | Medium |
| Result in invasive species that are harmful to the species becoming established | Possible | Critical | High |
| Introduce disease that may cause the species to decline | Rare | Major | Low |
| Interfere substantially with the recovery of the species | Possible | Moderate | Low |

If the great desert skink occurs within the Project area, the level of risk can be reduced to an acceptably low level by implementing the following measures:

- a pre-clearance survey followed by staged vegetation clearing, undertaken during seasons that the great desert skink is less vulnerable;
- securely fencing domestic wastes to minimise animal pest attraction;
- Fire Management Plan with mine activity planning, maintenance of fire breaks and controlled burns;
- implementing an animal pest eradication / control program and monitoring feral fauna numbers;
- Weed Management Plan with vehicle washdown, weed monitoring and weed control activities; and
- Rehabilitation Strategy and Mine Closure Plan with progressive rehabilitation.

### 15.2.3 Migratory Species Protected under International Agreements

The PMST database identifies that seven migratory bird species could potentially occur within 10 km of the Project area. Of these, the rainbow bee-eater (*Merops ornatus*) is the only one that is known to occur historically and has been observed within the Project area.

Each of these migratory species occupies a very broad area that includes much if not all of the Australian mainland, and none is linked strongly to habitats in the Project area that are likely to be impacted by the Project. There is no evidence to suggest that the Project area provides “important habitat” for a migratory species, or supports an “ecologically significant proportion” of a migratory species population as defined in the guidelines on significance of impacts to migratory species. Consequently, no specific impact assessment against the DotE Significant Impact Guidelines has been undertaken.

## 15.3 Summary

Seven threatened fauna species were assessed against the ‘DotE Significant Impact Guidelines 1.1’ (DotE 2013a). Four species were assessed as having a high inherent (without mitigation) risk against one of more of the guidelines from Project-related activities (greater bilby, brush-tailed mulgara, night parrot and the great desert skink), and the remaining three assessed as being at medium risk (black-footed rock-wallaby, southern marsupial mole and the princess parrot).

No flora species were deemed to be at risk from the Project. No listed migratory species were likely to be an “ecologically significant proportion” of a population or to occupy “important habitat”.

The main sources of impact on fauna are expected to be from:

- clearing of vegetation;
- unplanned wildfires;
- collisions between fauna and traffic;
- introduction and / or spread of weeds and animal pests;
- industrial and domestic waste; and
- inappropriate / ineffective rehabilitation.

Management measures are proposed that will reduce the residual risk of impact to EPBC threatened species to either low or very low.

# 16. Rehabilitation and Mine Closure

## 16.1 Background

The Project is expected to disturb a total area of approximately 1,060 ha. Table 2-2 provides a breakdown of area according to individual mine feature. In the context of rehabilitation and closure, these mine features can be broadly separated into two categories:

- mine features that remain on site after closure, essentially in perpetuity; and
- mine features that are demolished and removed from site at closure, leaving a bare land surface to be rehabilitated.

The first category comprises the major earthwork mine components; the open pit, the WRD and the TSF. Combined, these three features comprise 642 ha or 60% of the total Project envelope. The pit, which will be approximately 77 ha in area, will remain as an open void and not be rehabilitated.

This leaves a total of approximately 983 ha of land that requires rehabilitation at closure.

Rehabilitation can be separated into two broad phases:

- mine features where progressive rehabilitation methods can be applied; and
- mine features that are fully operational until closure, so rehabilitation can only commence at the conclusion of operation.

Progressive rehabilitation is defined as rehabilitation that can be undertaken through the life of mine. However, a number of mine features remain in operation until the very end of mine life, so progressive rehabilitation of these features is not possible. Portions of the WRD can potentially be progressively rehabilitated during the life of mine, however the nature of most of the other mine features are such that progressive rehabilitation is not feasible. Justification for this position is as follows:

- TSF — Tailings deposition will continue until the site closes. A period of time is then required for the tailings surface to dry sufficiently to allow vehicle movement.
- long term stockpiles — These ore stockpiles will be constructed according to grade and will largely function as an extension to the ROM. These stockpiles will allow blending of ore into the processing plant. They will also provide a storage area for low grade ore that will be reclaimed towards the end of the mine life. At mine closure, all stockpiles will have been removed and the base pad area will be available for rehabilitation.
- infrastructure — This comprises primary mine infrastructure (process plant, power station, process water dam, rail siding) as well as ancillary infrastructure (accommodation village, borefield, access roads). This infrastructure is required to be operational until mine closure. There is almost no ability to progressively rehabilitate parts of this infrastructure.

TNG has prepared a Conceptual Mine Closure Plan (MCP) for the project (Appendix M). This MCP has been prepared consistent with the Western Australian Department of Mines and Petroleum (DMP) and Environmental Protection Authority (EPA) *Guidelines for preparing mine closure plans*, originally released in 2011. The DMP / EPA released a revised version of this Guideline in May 2015.

## 16.2 Objectives

The key rehabilitation objectives for the Project are:

- as far as practicable, rehabilitation achieves a stable and functioning landform which is comparable with the surrounding landscape and other environmental values; and
- prevent and mitigate risks associated with closure and rehabilitation of the Project.

## 16.3 Rehabilitation and Closure Planning

### 16.3.1 Closure Planning Phases

Rehabilitation and closure can be broken into the following key mine phases:

- Progressive — During the operational (life of mine) phase.
- Closure — At or immediately after the mine ceases to operate.
- Post closure — For a number of reasons, mine closure works often need to be scheduled over a number of years rather than being undertaken as a single, uninterrupted exercise.

As described in Section 16.1, the Mt Peake mine configuration is such that most of the mine features remain active until closure. However, progressive rehabilitation can occur in places such as completed borrow pits, embankments of the WRD and TSF and disused access tracks.

At closure, decommissioning, demolition and removal of the bulk of the process plant infrastructure, power station and the majority of the accommodation village can occur. Rehabilitation of completed mine landforms (WRD and open pit) can also occur.

The size and scale of demolition and rehabilitation works, the weather (wet and dry seasons) and the TSF, that needs to dry sufficiently before rehabilitation works can be undertaken, are all reasons why closure and rehabilitation works often need to be scheduled over a number of years.

This extended closure period also requires maintaining some essential infrastructure at the site post closure, to support successive campaigns of contractors mobilising to site to conduct a program of works. At a minimum, this infrastructure is likely to include:

- a portion of the accommodation village that remains connected to the WWTP;
- power generation to power the accommodation village, communications and water treatment facilities; and
- a water supply bore that allows a potable water supply to be produced.

### 16.3.2 Rehabilitation Techniques

#### Clearing

Vegetation clearing in advance of mine activities needs to be managed to ensure clearing is confined to the appropriate area and any specific locations to be avoided are identified and protected. Clearing will be managed through an internal clearing procedure contained in the site Construction EMP.

A key aspect to consider for cleared and stockpiled vegetation is the storage time before its re-use in rehabilitation. The primary role of reinstated vegetation debris is to provide a seed store (if directly reapplied) and also as fauna habitat. Storage for longer than a few days or weeks at most, means that any attached seed pods will usually have dried out and dropped their seed, negating this benefit.

### Topsoil

For the purpose of this document, topsoil is defined as the soil profile that contains the majority of the seed store, organic matter and biological (bacterial and fungal) activity. There is no universal definition of the depth of topsoil layer. In a mining context, the practical depth to which earthmoving equipment is able to remove a layer generally determines the topsoil depth. In most mining operations this is accepted at 100 – 200 mm.

Topsoil storage methods are a key factor in maximising topsoil viability. It is generally recognised that topsoil stockpiles of approximately 2 m high minimise the potential of composting and anaerobic conditions forming at depth.

Storage time is another key factor. It is generally recognised the storage time is inversely proportional to topsoil viability (i.e. the longer the storage time, the greater the loss of seed viability and biological activity).

### Materials for Rehabilitation

In addition to topsoil, which is required for all mine features, some mine features require a supply of specific material. Competent rock is required for the following purposes:

- armour rock. Armour rock is required for erosion protection on drainage diversion structures, spillway discharges and to protect sections of the base of elevated landforms and abandonment bunds that are subject to erosion from surface floodwaters. Armour rock used for these purposes is usually in the order of 300 – 500 mm diameter; and
- abandonment bunds. An abandonment bund is required to be constructed around the perimeter of the pit void to prevent vehicular access. To reduce the potential of erosion of these features over time that then allows vehicle entry, these features are required to be constructed of competent (rocky) material.

### Ripping

A number or ripping methods and types of bulldozer rippers (tines) are used in mine rehabilitation. All ripping should be done on contour, to maximise resistance to surface water flow.

Break soil compaction

Depending on the extent of soil compaction created from earthmoving equipment, ripping to depths of 1.0 – 1.5 m will occur. This allows plant roots and water to penetrate the soil profile to depth. Figure 16-1 shows a single tine with lateral wings used to break compaction on floors of bauxite mine pits. A single or multiple tines without wings can also be successfully used to break soil compaction in dry soil conditions.

**Figure 16-1 Single lateral winged tine**

Water and seed containment on slopes

At Mount Peake, the WRD and ROM pad will be constructed from tipped mine waste which is then pushed down during rehabilitation using a bulldozer to the final batter angle of less than 20°. This situation is different to pit floors that have been traversed repeatedly by mine equipment and are highly compacted. Soil compaction on the embankments of these landforms is not likely to achieve the same compaction as pit floors.

Retaining rainfall and applying seed and fertiliser on these slopes are key criteria in achieving successful vegetation establishment and reduced erosion. Figure 16-2 shows a tine with vertical wings designed to rip to depths of approximately 0.6 – 0.8m but to produce a wide open furrow capable of holding water and applied seed on slopes. Furrows from this tine are shown in Figure 16-3.

**Figure 16-2 Single vertical winged tine**

**Figure 16-3 Winged tine furrows**

**Figure 16-4 Three tine ripper**

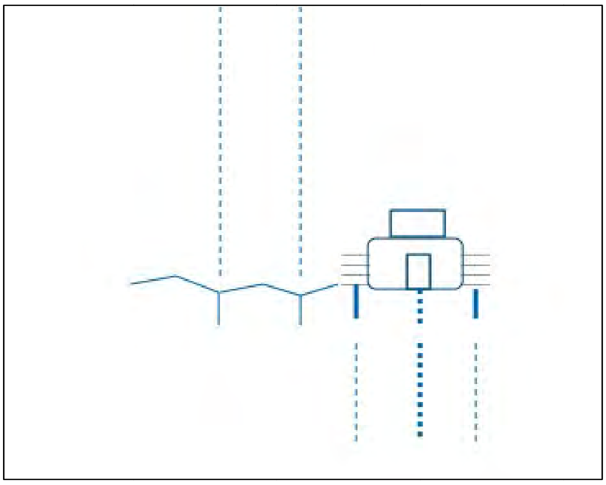


**Figure 16-5 Rip spacing**

Using a single tine on a 'track-to-track' ripping method has a disadvantage in that the intervening space between rip furrows is flattened by the bulldozer tracks. However, this single tine technique is preferred where landforms can include large rocks. In these situations, ripping can bring these rocks to the surface. Multiple tines hook these rocks and the dozer drags them, creating a deep gully. The single tine reduces this risk as the rock is usually turned by the tine with minimal earth displacement.

On WRD's that do not consist of large rocky mine waste, multiple winged tines are recommended, with a minimum of two winged tines behind each track. This would eliminate the track print on the landform embankment. Use of a third tine (Figure 16-4) may be trialled, to determine if the final profile provides an improved water holding and seed retention surface than two tines. Figure 16-5 shows a conceptual rip spacing using double tines (solid lines) and triple tines (dotted line). The dozer passes are off-set from the previous pass so not to drive over previous rip lines.

#### Seed and Fertiliser

Where seeding is specified, the following criteria apply:

- surfaces that have been covered with topsoil and ripped will be seeded with local native species which are compatible with other species in the area;
- seeding will be carried out prior to the onset of the main rainfall period; and
- fertiliser may be applied to maximise the success of plant growth. Seed and fertiliser application will be preferably done in one pass with ripping to reduce soil compaction if hand seeding is not appropriate.

### 16.3.3 Future Trials and Studies

As the site is yet to commence operations, no defined list of trials and studies has yet been determined. There is a clear need to implement some rehabilitation programmes early in the project's life, in order to establish a monitoring – feedback – improvement cycle to develop rehabilitation prescriptions over the life of mine with a successful track record.

### 16.3.4 Completion Criteria

Completion criteria are necessary to provide the basis on which successful rehabilitation and mine closure, and achievements of closure objectives are determined. Completion criteria have been developed from the closure objectives, in order to provide distinct and measurable criteria for successful rehabilitation of the Mount Peake operation.

Completion criteria allow for verification of environmental outcomes for the Project area as well as each features final design and rehabilitation. Verification methods include monitoring results, management audits, design sign-off and comparison against reference documents. Measurement tools have been selected to allow quantitative assessment of rehabilitation performance.

At the current early stage of the mine's life, it is unrealistic to establish final completion criteria. Results of progressive rehabilitation and monitoring of other mine features is required before TNG can be confident that the stated criteria can be achieved. Therefore, interim completion criteria have been proposed. Target (final) completion criteria have also been documented. Future versions of the MCP will review these criteria against the developing body of closure knowledge and revise the criteria if necessary.

The MCP includes a table that identifies closure objectives, completion criteria and measurement tools for each mine feature. An abbreviated version of this table is provided Table 16-1.

**Table 16-1 Closure objectives and criteria**

| Domain | Mine feature | Interim completion criteria | Measurement tools / performance indicators |
|---|---|---|---|
| All | General / site wide | Hazardous materials confined to prevent off site environmental impact.<br>Infrastructure removed.<br>Disturbed areas rehabilitated. | Contaminated sites audit.<br>Decommissioning audit to confirm initial rehabilitation works have been constructed according to design. Complete audit inspection checklist.<br>Rehabilitation monitoring results. |
| 1 | Open pit | Abandonment bund effectively restricts access to open pit.<br>Abandonment bund is constructed in accordance with the Safety Bund Walls Around Abandoned Open Pit Mines Guidelines (DoIR 1997). | Visual inspections and completed checklist.<br>Decommissioning audit to confirm initial rehabilitation works have been constructed according to design. Complete audit inspection checklist. |
| 2 | WRD and ROM pad | The landform is stable and safe.<br>There are no mass vegetation deaths caused by AMD or salt in the vicinity of the landform. | Stability assessment undertaken in accordance with defined procedures.<br>Visual inspections and completed checklist.<br>Decommissioning audit to confirm initial rehabilitation works have been constructed according to design. Complete audit inspection checklist.<br>Rehabilitation monitoring results. |
| 3 | TSF | The landform is stable and safe.<br>Erosion of any waste rock cap does not liberate tailings material.<br>Stability assessment undertaken in accordance with defined procedures or standards.<br>Water quality parameters in groundwater monitoring bores do not exceed values representative of analogue sites and / or baseline data.<br>There are no mass vegetation deaths in the vicinity of the landform. | Stability assessment undertaken in accordance with defined procedures or standards.<br>TSF monitoring register to be maintained.<br>Visual inspections and completed checklist.<br>Water quality monitoring results.<br>Water quality records of local surface and ground water.<br>Rehabilitation monitoring results |
| 4 | Process plant and power station | Hazardous materials confined to prevent off site environmental impact.<br>Infrastructure removed.<br>Disturbed areas rehabilitated. | Contaminated sites audit.<br>Decommissioning audit to confirm initial rehabilitation works have been constructed according to design. Complete audit inspection checklist.<br>Rehabilitation monitoring results. |
| 5 | Rail siding | All infrastructure not subject to a sequential use agreement is removed.<br>Disturbed areas rehabilitated. | Decommissioning audit to confirm initial rehabilitation works have been constructed according to design. Complete audit inspection checklist.<br>Rehabilitation monitoring results. |

| Domain | Mine feature | Interim completion criteria | Measurement tools / performance indicators |
|---|---|---|---|
| 6 | Access road | Roads are reshaped in order to re-instate natural drainage lines and waters are not impounded.<br>Roads required for monitoring and maintenance are in useable condition.<br>Rehabilitated road areas are stable and non-eroding. | Visual inspections and completed checklist.<br>Decommissioning audit to confirm initial rehabilitation works have been constructed according to design. Complete audit inspection checklist.<br>Rehabilitation monitoring results |
| 7 | Bore field | All infrastructure removed.<br>Rehabilitated areas are stable and non-eroding. | Visual inspections and completed checklist.<br>Decommissioning audit to confirm initial rehabilitation works have been constructed according to design. Complete audit inspection checklist. |
| 8 | Pipelines and power lines | Above ground pipelines, pumping and power infrastructure are removed.<br>Buried pipelines are flushed, emptied, grouted at either end and buried at least 600 mm below the surface. | Decommissioning audit to confirm initial rehabilitation works have been constructed according to design. Complete audit inspection checklist. |
| 9 | Ancillary infrastructure areas | All infrastructure, mobile plant, transportable structures and consumables are removed.<br>Concrete is buried to a depth of at least 1 m below ground level. | Decommissioning audit to confirm initial rehabilitation works have been constructed according to design. Complete audit inspection checklist. |

### 16.3.5 Post Closure Maintenance

Should visual inspections or monitoring results indicate the need for maintenance works or remedial action to be undertaken, TNG will mobilise contractors to site to undertake these works. Such maintenance works may include:

- vegetation - if rehabilitation is failing, additional application of fertiliser, additional seeding or planting may be required. Also, weed will be implemented if required;
- erosion - if significant embankment erosion on the TSF, WRD or ROM pad is identified or rehabilitation is not progressing towards a self-sustaining community, the following remedial actions may be considered:
  - construct, improve, or repair drainage control measures to reduce water movement down outer slopes of the landform; and
  - areas of deep erosion and / or instability may need to be remediated with appropriate material.
- access - remedial works will be required if access prevention measures fail to restrict unauthorised access.

### 16.3.6 Data Management

Maintaining an effective data management system is essential to ensure rehabilitation and closure related information is stored and maintained during the life of mine.

TNG will establish and maintain a document management system to store all relevant rehabilitation and closure information for the Mount Peake Project.

### 16.3.7 Relinquishment

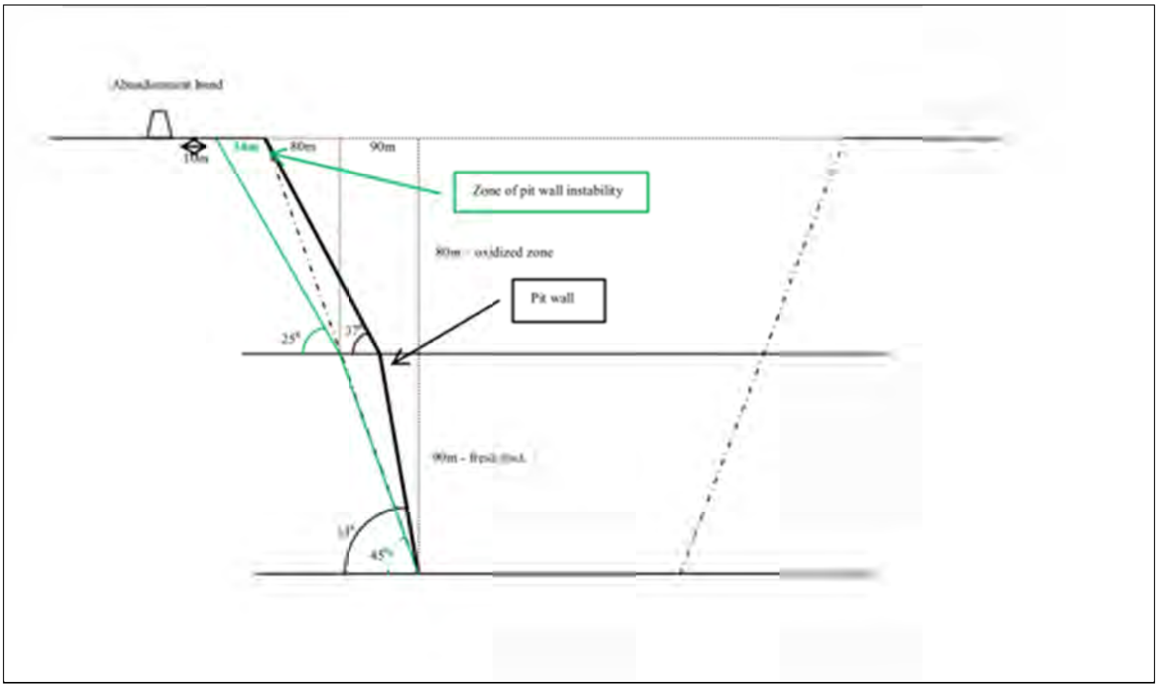
Ultimately, the goal of all mine closure and rehabilitation works is to leave a final landform that meets all stakeholder objectives and achieves the completion criteria. The mine operator can then apply for relinquishment of the mining tenement and return of environmental securities.

## 16.4 Rehabilitation Design

### 16.4.1 Open Pit

The open pit will be left safe, restricting unauthorised public access by utilising abandonment bunding and / or re-profiled mine landforms. Groundwater recovery post closure will result in the formation of a shallow pit lake. Rehabilitation actions include:

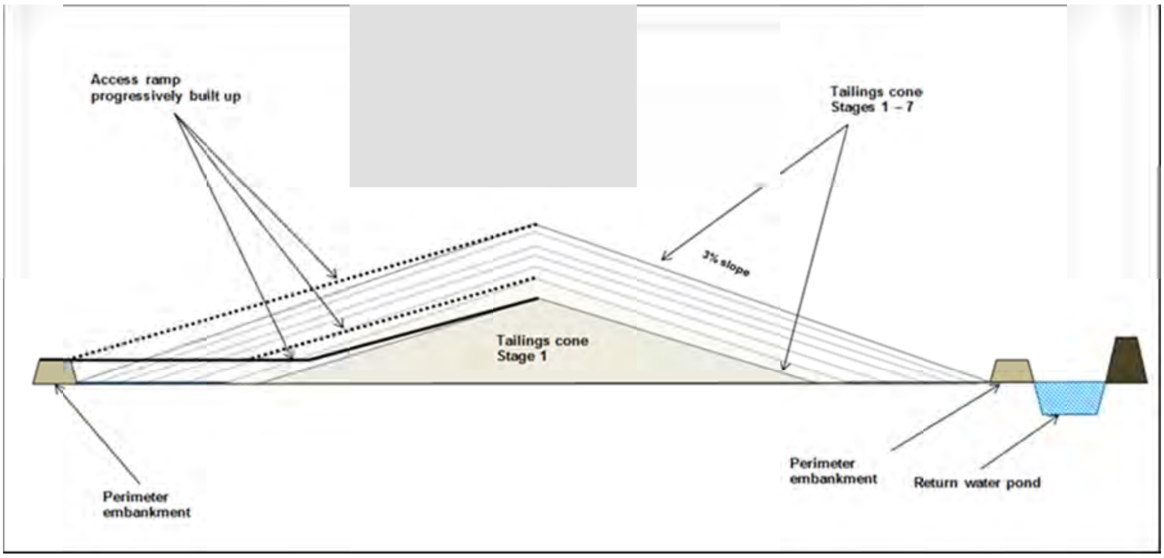
- abandonment bunds will be constructed around the pit in accordance with the Safety Bund Walls Around Abandoned Open Pit Mines Guidelines (DoIR 1997) (Figure 16-6), or in accordance with geotechnical studies conducted to determine the extent of bunding to be constructed; and
- surfaces outside the abandonment bund will be covered with topsoil, ripped and seeded according to the rehabilitation strategies detailed in Section 16.3.2.




## Figure 16-6 Conceptual pit abandonment bund design

### 16.4.2 TSF

Given the nature of the operating TSF, progressive rehabilitation will be limited to the perimeter embankment. Capping of the TSF surface will occur after closure when it has dried sufficiently to allow machine access. Figure 16-7 shows the TSF design.




## Figure 16-7 TSF design

A ‘store and release’ cover design is considered a valid rehabilitation option for the TSF (Figure 16-8). A store and release cover design uses select materials as a monolithic storage layer able to absorb precipitation into the soil / rock mass rather than ponding on top, then either allowing infiltration or evapotranspiration, to manage the water with minimal or no runoff. The intention will be to limit infiltration.

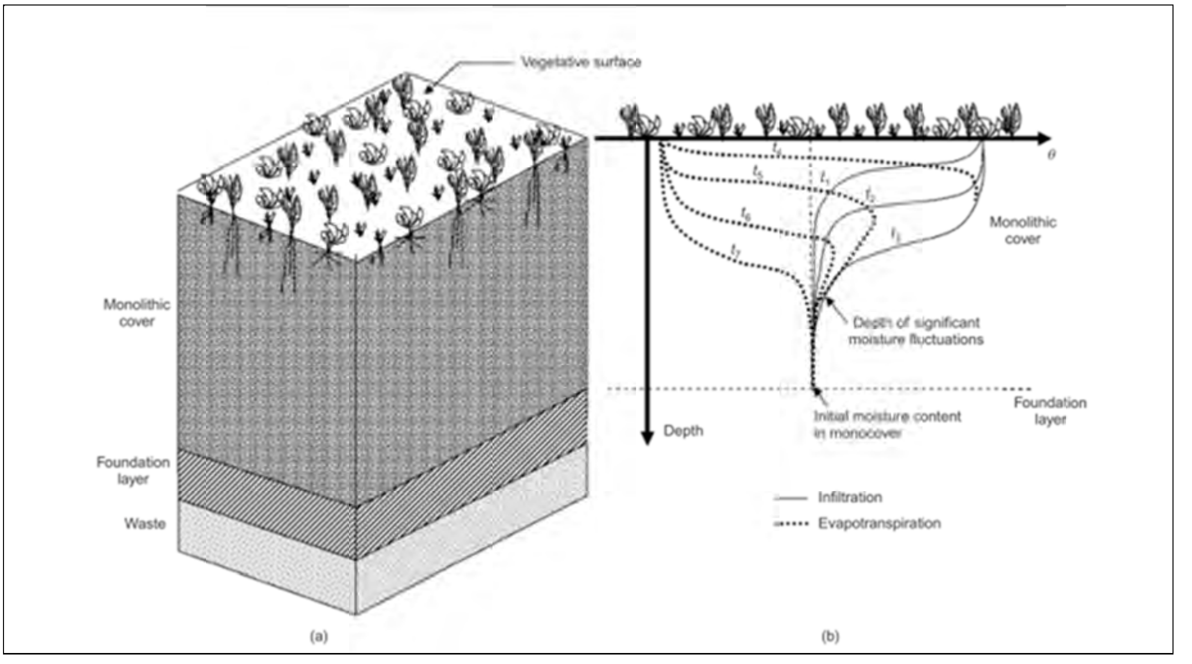



**Figure 16-8 Conceptual TSF closure design**

Source: Zornberg *et al.* (2010)

The following general rehabilitation tasks will be applied to the TSF:

- a review of the TSF by a suitably qualified geotechnical or engineering specialist will be commissioned prior to rehabilitation works commencing;
- all process pipe work and general refuse will be removed;
- the closed TSF will have an inert waste rock cap designed as a 'store and release' cover system (Figure 16-8);
- a materials balance assessment will be undertaken to identify the inert waste rock to be used to construct a waste rock cap (Zornberg *et al*. 2010); and
- the TSF capped surface will be covered with topsoil, ripped and seeded according to the actions detailed in Section 16.3.2.

### 16.4.3 WRD

The following general actions will be applied to close and rehabilitate the WRD:

- all refuse and remaining infrastructure will be removed;
- outer slopes of the facility will be battered to the conceptual design shown in Figure 16-9, or an alternative design approved by a suitably qualified geotechnical engineer;
- water runoff from the outer slopes of the landform will be contained by a toe drain / bund wall and directed to a sump(s) prior to release into natural drainage systems; and
- surfaces will be covered with topsoil, ripped and seeded according to the rehabilitation strategies detailed in Section 16.3.2.

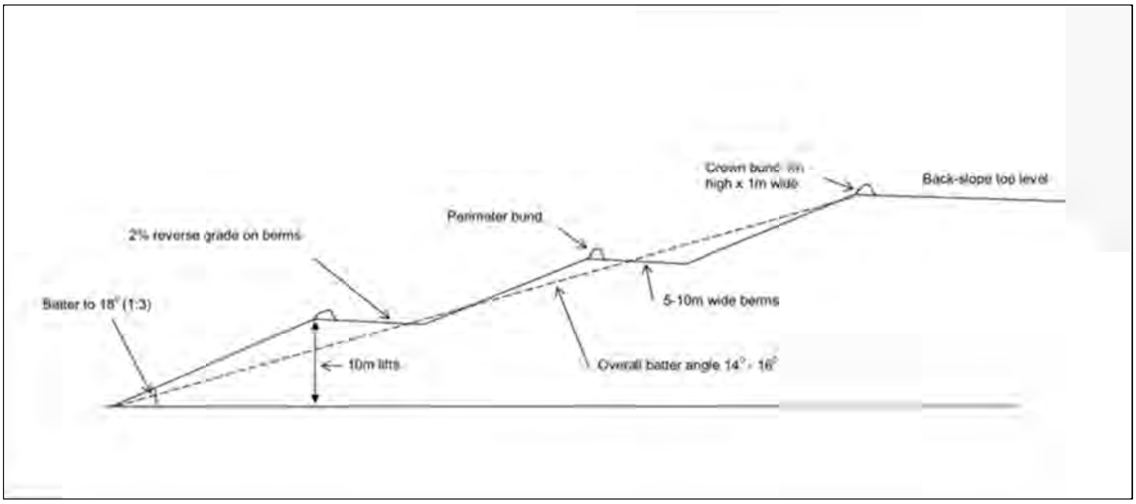



**Figure 16-9 Conceptual WRD design**

### 16.4.4 Infrastructure

General actions for rehabilitation of infrastructure areas are as follows:

- all structures will be decontaminated (if necessary) and washed down prior to the commencement of demolition works;
- structural engineers will determine a safe and efficient dismantling procedure and prepare a demolition plan;
- structures will be pulled to the ground and dismantled;
- concrete slabs and footings will be broken down to a depth of 1 m below the finished ground surface. Alternatively concrete could be covered to provide the necessary cover depth;
- services will be removed or buried at a depth at least 1 m below the final ground surface;
- buried pipes left *in situ* will be flushed and sealed at each end;
- non-recyclable and inert waste will be disposed of in an onsite landfill or similar;
- access roads required to be left for post closure monitoring purposes need to be defined and retained; and
- all areas will be ripped to break compaction prior to overburden and / or topsoil application.

### 16.4.5 Site Roads

The following actions will be taken to rehabilitate roads and hardstand areas:

- sumps, bunding and bitumen will be removed (where applicable);
- windrows respread over the road surface and road crown reshaped (where applicable);
- where haul roads disrupt surface drainage, excavation will occur at low points to re-establish natural drainage paths; and
- surfaces will be covered with topsoil, ripped and seeded according to the action detailed in Section 16.3.2.

## 16.5 Infrastructure to be Retained after Closure

Stakeholder engagement is a key component of mine closure planning. Mines developed in remote regions often require construction of a range of infrastructure that other stakeholders consider have value and should be retained after mine closure. Retention of any infrastructure must be on the basis of a formal sequential use agreement, where the details of retained infrastructure are described and matters of tenure, ongoing maintenance liability and legal liability are clearly established.

At this point in the Project’s development, no sequential use agreements are in place. The following infrastructure is listed as items most likely to be retained by other parties:

- the rail siding may be required to remain as a passing bay or parking location for general rail traffic;
- water bores, storage dams and water tanks may be retained for pastoral use; and
- access roads may be retained for pastoral use, fire breaks and general access.

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