Toms Gully Underground Project EIS Supplement

Appendix H– Risk Assessment Framework

TOMS GULLY UNDERGROUND PROJECT

Risk Assessment Framework

July 2018

1. Introduction

The Northern Territory Environment Protection Authority (NT EPA) requires an EIS assessment to be undertaken in a risk assessment framework. The risk framework and assessment as described below has been used to disclose the nature of risks and potential impacts associated with the Toms Gully Underground Project (TGU) and informed the development of appropriate management measures within the EIS supplement.

The risk assessment framework for the project is congruent with international best practice standard methodologies including:

- AS/NZS ISO 31000:2009: Risk management— Principles and guidelines (Standard)
- HB 203:2006: Environmental risk management — Principles and process (Guide)
- HB 158:2010: Delivering assurance based on ISO 31000:2009 — Risk management – Principles and guidelines (Guide)

This risk assessment has also been developed with consideration of the NT EPA Environmental Factors and Objectives (NT EPA 2018) and stakeholder comments from the Draft EIS to ensure that residual impacts can be managed in a manner that the objectives of each environmental factor and stakeholder expectations can be met.

1.1. Establishment of Context

The TGU and associated activities have been subject to a site specific risk assessment. The objective of the risk assessment is to ensure that any significant risks are identified, evaluated and 'treated' to mitigate these risks. The risk assessment framework provides a mechanism to demonstrate to stakeholders and regulators that the proposed projects risks have been considered and appropriately mitigated to minimize any potential impacts.

An initial risk assessment was undertaken early in the project process to identify key risks to guide the site specific technical studies that needed to be undertaken. This initial risk assessment (September 2015) was submitted to the NT EPA as part of the draft EIS. The NT EPA provided comments on the initial risk assessment in which a number of gaps were identified (e.g. poorly defined risk criteria, lack of justification for levels of likelihood and consequences chosen, absence of risk assessment for impacts on terrestrial biodiversity, lack of discussion of the relationship between findings of the risk assessment to overall risk of failure to meet an environmental objective).

These gaps have been revised and addressed in this updated Risk Assessment Framework by

undertaking additional baseline investigations and including a more defined risk framework. The results of these additional studies and investigations have been used to inform and update the potential risks associated with the project to reflect a better understanding of impacts relating to the proposed activities. Once the baseline information was compiled, then mitigation measures were applied and residual risks could be understood. This process was applied to all phases of the project and reinforces the importance of effective control measures for risk reduction and management. This process also offers more transparent and thorough risk assessment outcomes in which public and decision-maker confidence can be secured.

2. Risk Assessment Process and Methodology

Risk assessment requirements for the TGU were identified and documented in the EIS Terms of Reference. This section describes how potential environmental risks from the implementation of the TGU have been identified, evaluated and treated. Primary Gold has considered risks arising from all phases of the project including recommissioning, operation, temporary shutdowns, care and maintenance, decommissioning and closure. The risk register covers environmental, community and health and safety risks.

Primary Gold has undertaken consultation with the relevant stakeholders (outlined in Section 4) to determine the perceived key risks associated with the project. Through this consultation, Primary Gold has collaborated and developed a risk assessment and management of key risks.

The risk assessment will be re-evaluated annually during the life of the mine (or when a significant change is made to the project). This will ensure any new risks can be identified and treated to be maintained at “As Low As Reasonably Practicable” (ALARP) level.

2.1. Risk identification

Risk relates to the effect of uncertainty on objectives. These objectives are primarily environmental goals within the Draft EIS and EIS Supplement as well as the objectives of the NT EPA for each environmental factor applicable to the TGU. Risks are determined and assessed using a combination of the likelihood of occurrence and the consequence of an event. Identifying risks for the projects recommissioning, operational, decommissioning and closure phases are based on the failure of control associated with the environment, people, or equipment in hazardous situations.

Identifying the source of the risk (hazard) and the consequence of that risk occurring; the treatment or mitigation of the risk to reduce its impact and determining the remaining residual risk has been undertaken using a standard qualitative risk matrix (Tables 1-4 below). This process is aligned to the AS /NZS ISO 31000:2009 standard.

The NT EPA decision to require an EIS for the TGU was based on risks detailed in the Statement of Reasons for the decision. These included risks to:

- Ground and surface water quality;
- Terrestrial biodiversity;
- Downstream aquatic ecosystems in Mount Bundey Creek and Mary River National Park; and
- Human health and safety.

A risk assessment workshop was initially undertaken on 10 February 2015 to assist in identifying the key environmental, human health and social-cultural risks associated with the TGU Project and to develop appropriate management measures to be used in Management Plans and the Draft EIS (GHD 2015). The workshop was attended by a suitably diverse group of personnel including the Primary Gold Managing Director and suitably experienced environmental scientists and hydrogeologists. The risk assessment workshop focused on the following key risk areas:

- Failure of existing / new infrastructure;
- Acid, Neutral and Saline Mine Drainage;
- Water management;
- Erosion and Sedimentation;
- Biodiversity;
- Human Health and Safety;
- Rehabilitation and Closure;
- Cultural Heritage; and
- Social and economic impacts.

A preliminary Risk Register was developed as a result of this risk assessment workshop. Following development of the preliminary Risk Register, a number of background studies have since been completed as well as some changes made to proposed environmental management strategies. In light of this, the preliminary Risk Register was updated to capture these changes.

In addition to all of the above, consideration of the NT EPA comments on the draft EIS Risk Register and further additional baseline investigations were used to inform this most recent Risk Register.

2.2. Risk analysis

Assessment of risk has been conducted through considerations 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.

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

Table 1: Qualitative Risk Analysis Matrix

	Consequence				
Likelihood	**(1) Insignificant**	**(2) Minor**	**(3) Moderate**	**(4) Major**	**(5) Significant**
(A) Almost certain	**High**	**High**	**Extreme**	**Extreme**	**Extreme**
(B) Likely	**Moderate**	**High**	**High**	**Extreme**	**Extreme**
(C) Possible	**Low**	**Moderate**	**High**	**Extreme**	**Extreme**
(D) Unlikely	**Low**	**Low**	**Moderate**	**High**	**Extreme**
(E) Rare	**Low**	**Low**	**Moderate**	**High**	**High**

	Consequence				
Likelihood	**(1) Insignificant**	**(2) Minor**	**(3) Moderate**	**(4) Major**	**(5) Significant**
(A) Almost certain	**15**	**10**	**6**	**3**	**1**
(B) Likely	**19**	**14**	**9**	**5**	**2**
(C) Possible	**22**	**18**	**13**	**8**	**4**
(D) Unlikely	**24**	**21**	**17**	**12**	**7**
(E) Rare	**25**	**23**	**20**	**16**	**11**

Extreme	**1**	**8**
High	**9**	**16**
Moderate	**17**	**20**
Low	**21**	**25**

Definitions of likelihood are provided in Table 2. Likelihoods are categorized around the probability of occurrence, within the context of reasonable timeframes and frequencies given the project life. A brief description of each risk classification and the likely responses is also provided below in Table 3.

Table 2: Definition of Likelihood Classification

Rating	Likelihood	Frequency	Probability	Catastrophic
A	Almost certain	More than once per month	The event is expected to occur at some time as there is a history of continuous occurrence with similar projects/activities	91-100%
B	Likely	Less than once per month, but more than once per year	There is a strong possibility the event will occur as there is a history of frequent occurrence with similar projects/activities.	61-90%
C	Possible	Less than once per year, but more than once per five years	The event might occur at some time as there is a history of infrequent occurrence of similar issues with similar projects/activities.	41-60%
D	Unlikely	Less than once per five years	Not expected, but there's a slight possibility it may occur at some time.	11-40%
E	Rare	Unlikely to ever occur	Highly unlikely, but it may occur in exceptional circumstances.	0-10%

Table 3: Description of Risk Classification

Rating	Definition
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

Rating	Definition
	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 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
Moderate	As suggested by the classification, medium level risks span a group of risk combinations varying from relatively low consequence / high likelihood to mid-level consequences /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.

Table 4 describes the types of consequences that have been identified and assessed as part of the risk assessment process. These are grouped into environmental factors and include the consideration of social factors.

Table 4: Consequence Classification

	Consequence				
Factors	**(1) Insignificant**	**(2) Minor**	**(3) Moderate**	**(4) Major**	**(5) Significant**
Biodiversity, Flora & Fauna and Ecosystems	Alteration or disturbance to an isolated area that is unlikely to affect the habitat species or ecosystem	Alteration or disturbance to less than 5% of a habitat, species or ecosystem resulting in a minor, recoverable impact within 1 year	Alteration or disturbance to 5-30% of a habitat, species or ecosystem resulting in a moderate, recoverable impact within 1-2 years	Alteration or disturbance to 30-70% of a habitat, species or ecosystem result in in a major, recoverable impact within 3-10 years	Alteration of more than 70% of a habitat, species or ecosystem resulting in an extinction or permanent change, or reduce threshold level below 30%. Recovery, if possible is greater than 10 years
Land Degradation	Negligible impact to isolated area	Contained low impact, not impacting on any environmental value	Uncontained impact, able to be rectified in short-term without causing pollution or contamination	Extensive hazardous impact on an environmental value requiring long-term remediation	Uncontained hazardous impact with residual effect, even with long term remediation
Water Resources	Negligible impact to site area and no effect to the use of water	Contained low impact with negligible effect on the use of the water	Uncontained impact that will affect the use of the water but can be remediated in the short term	Extensive hazardous impact that requires long term remediation	Uncontained hazardous impact with residual effect, even with long term remediation
Air Quality	No Detectable impact	Contained low impact not impacting on any	Uncontained impact that will impact on an environmental	Extensive hazardous impact on an environmental	Uncontained hazardous impact on one or more environmental

	Consequence				
Factors	**(1) Insignificant**	**(2) Minor**	**(3) Moderate**	**(4) Major**	**(5) Significant**
		environmental value	value, but able to be remediated in short term	value that requires long term remediation	values with residual effect, even with long term remediation
Mine Closure	Site is safe, stable and non-polluting and does not significantly impact the post mining land use	The site is safe, all major landforms are stable and any stability or pollution issues are contained and require no residual management. Post mining land use is not compromised significantly.	The site is safe and any stability or pollution issues require minor, ongoing maintenance by end land-user	The site cannot be considered safe, stable or non-polluting without long-term management. Agreed end land-use requires ongoing management.	The site is unsafe, unstable and is causing pollution or contamination that will cause an ongoing residual impact. The post mining land use cannot be achieved.
People	Incident with or without minor injury. No impact on human health or very minor short term inconvenience or symptoms	Injuries requiring first aid treatment. Minor short term inconvenience or symptoms to human health	Injury or illness requiring medical treatment. Short term or reversible disabling effect (impairment) to human health	Injuries requiring hospitalisation. Serious long term or permanent disabling effects on human health (one person	Loss of life / fatality or long term or permanent disabling effects on human health

The level of certainty surrounding the proposed risk rankings was also assessed in accordance with Table 5. Where proposed mitigation measures resulted in a reduction in risk ranking from inherent risk to residual risk, justifications for this were also provided.

Table 5: Level of Certainty

Control Rank	Description	Guidance
C1	Low	Risk ranking is based on subjective opinion or relevant past experiences.
C2	Moderate	Risk ranking is based on similar conditions being observed previously and/or qualitative analysis.
C3	High	Risk ranking is based on testing, high fidelity modelling or simulation, use of prototype or experiments. Analysis is based on verified models and/or data. Assessment is based on an historical basis.

2.3. Risk evaluation and assessment

The risk evaluation and assessment section provides a discussion of the key outcomes of the risk assessment. 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 116 different environmental, health and safety and social and economic risks were evaluated. There were a total of 47 environmental risks identified, 52 health and safety and 17 social and economic risks identified.

2.3.1. Risk assessment results

Table 6, summarises the outcomes of the risk assessment process. The specific consequence and likelihood scenarios are detailed in Table 7 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. The fully risk register is provided as Table 9, 10 and 11.

Table 6: Summary of Risks

	Environmental		Health and Safety		Social and Economic	
Risk Level	**No. of Inherent Risks**	**No. of Residual Risks**	**No. of Inherent Risks**	**No. of Residual Risks**	**No. of Inherent Risks**	**No. of Residual Risks**
Extreme	7	0	19	0	1	0
High	26	2	23	9	6	1
Moderate	11	16	8	26	6	8
Low	3	29	2	17	2	6
Total	**47**	**47**	**52**	**52**	**15**	**15**

2.3.1.1. Cumulative Impacts

Considering the cumulative impacts of a proposed project is important in developing an adequate environmental impact assessment approach. A cumulative impact assessment (CIA) considers the combined effects of all elements of a single project on multiple environmental values. It also considers the impacts of multiple projects/activities on a single environmental value or asset. Cumulative impacts can arise directly or indirectly from the action referred (MCA 2015).

Regional Cumulative Impacts

In addition to the TGU Project having impacts on environmental values, a number of other activities / projects on a more regional scale could also be potentially contributing to environmental impacts. At a regional scale to the TGU Project, surrounding mine sites such as Quest 29 and Rustlers Roost as well as pastoral activities from stations such as Old Mount Bundey are notable actions. The Old Mount Bundey Station was purchased by new owners in 2016, who have intensified the use of the land to the east of Coulter Creek, reestablishing plantations of mangoes, and utilising the paddocks with access to the creek for grazing and holding of cattle. The interactions between these activities and the TGU Project have been assessed in terms of geomorphology, groundwater and surface water flow, topography and ecosystem functioning. It should be noted that both the Rustlers Roost and Quest 29 mine sites are currently on care and maintenance and have not been operational since the late 1980s. Therefore the sites have a minor potential to contribute to the

cumulative impact at the Toms Gully site.

Quest 29 is approximately 14 kms south east from TGU (or 19 km upstream) whilst Rustlers Roost is approximately 12 km south (or 16 km upstream). The topography and associated drainage between the three sites also suggest a portion of the surface water being directed away from the creek that flows past the TGU site and thus limits the volume of surface water mixing from each site. Water Quality testing at SWTG1A a sample location positioned upstream of Toms Gully has recorded water quality for the major elements and physical parameters better than the 95% protection level of the ANZECC Australia and New Zealand Guidelines for Fresh and Marine Water Quality with the exception for aluminum that fluctuates between the 80% protection level. The upstream elevated levels of aluminum are probably a function of naturally high background levels (Schultz 2002). Therefore cumulative impacts to surface water flow and quality between the mine sites is deemed negligible.

Mapped geological units across all three sites suggest no interconnectivity between geomorphology (Ahmed 2000). Rustlers Roost and TGU share geological unit characterized by greywacke, shale, siltstone, tuff, phyllite, chert, carbonaceous shale, banded iron formation (BIF), dolostone, however it has a greater topography than TGU and thus groundwater connectivity and flow is unlikely between the two sites.

Mapped vegetation units across all three sites show that each site is largely within their own vegetation unit (Wilson et al. 1990). All three sites share vegetation characterised by eucalyptus with grass understorey – however this vegetation type is extensive in range and well represented beyond all three sites. Thus clearing associated with the TGU project and the other sites is not deemed to have a significant cumulative impact. The immediate vicinity of the TGU Project has been fenced off from livestock grazing since 2013 and thus flora and fauna at the site are not subject to a combination of mining activities (clearing) and cattle grazing.

Controlled and uncontrolled fires in the region occur annually and create fire mosaics of varying sizes dependent on seasonal fire loads and fire breaks (both natural and manmade). Primary Gold has maintained firebreaks around the site to restrict fire from reaching infrastructure and inadvertently protecting vegetation within the project's envelope. On occasions, Primary Gold may undertake controlled burning (with all permitting in place) to create a patch work fire zones inside the project**.** The purpose of this is to manage fire loads by cool burns within the project. This will prevent the potential for large external fires beyond Primary's control entering the site when fire loads are high. High fire loads can also result in hot burns which have a greater effect on vegetation recovery after bushfires –controlled burns will minimize this impact.

Project Cumulative Impacts

When considering the cumulative impacts and associated risks at the project level the spatial, temporal, linked and source impacts of the project need investigation. These impacts then need to be considered in the context of their effect on habitat value, water quality and socio economic aspects (Franks et al. 2010). In order to determine these cumulative impacts, baseline studies of the existing (or pre-impacted) environment

were characterised and understood. Baseline studies provide a benchmark against which potential impacts can be measured and addressed (Franks et al. 2010).

Since lodging the draft EIS, Primary has undertaken numerous additional baseline studies to ensure that any impacts and associated risks are fully understood and appropriate mitigation measures can be applied. This additional baseline work has included the following:

- assessment of current acid mine drainage conditions,
- existing flora and fauna environment (including any conservation significant species),
- aquatic ecosystems within Mt Bundey and Coulter Creek,
- surface water and groundwater characterisation – including the investigations into water treatment options
- tailings characterisation and management and
- the development of site specific trigger values.

These additional studies ensured that the totality of impacts on the receiving environment were understood and therefore was able to better inform the risk assessment and avoid a piecemeal decision making and planning process.

The localised impacts of the existing and future Toms Gully activities can be divided into spatial and temporal components. At a site level the cumulative level impacts can be categorized into two areas:

a) Existing conditions created by past mining and mine rehabilitation which are:

- The formation of acid mine drainage, erosion, and resultant water quality (key pathways: groundwater and surface water; receptors: aquatic ecosystems and fauna, including livestock);
- Ecosystem and biodiversity modification and habitat value associated with past land practices and levels of mine rehabilitation (receptor: flora and fauna species); and
- Legacy of mining on the local community (receptor: recreational fishers and adjacent/immediate landowners).

b) Future developments and activities outside or within preexisting infrastructure:

- Changes in acid mine drainage and erosion conditions (either lessened or enhanced), and resultant water quality (key pathway: groundwater and surface water; receptor: aquatic ecosystem and fauna, including livestock);
- Ecosystem and biodiversity modification associated with mining operations (encompassing clearing of habitat, traffic, dust, noise, feral animals and weeds) and subsequent mine rehabilitation thus effecting habitat value (receptor: flora and fauna); and
- Effect of mining on the local community (receptor: employees, contractors, recreational fishers and adjacent/immediate landowners).

During the preparation of the EIS supplement, the receptors - flora and fauna, aquatic ecosystems, livestock and community (including landowners, local community, employees and contractors) were a fundamental consideration in the project's decision making and revised design process.

Water Quality

In particular, care was taken to consider water quality to ensure that the combination of acid mine drainage, vegetation clearing, dust and chemical storage would not result in a cumulative impact that is more detrimental than the impacts of the individual items. This led to the following design measures and additional investigations at TGU:

- A pilot water treatment plant solution and associated tailings re-processing, these measures will reduce the quantity of AMD contaminated materials on site,
- Limited vegetation clearing requirements and implementation of ground disturbance procedures to avoid any unnecessary clearing
- Commitments to preparing procedures/plans to limit the potential impacts of chemical spills as well as bunded storage of these materials and weekly inspections (e.g. Hazardous Substances Management Plan)
- Management of sediment and dust around TGU via watering carts and management measures (e.g. Erosion and Sediment Control Plan) and
- Identifying and managing actions that have the potential to degrade water quality (e.g. uncontrolled runoff, discharging water into Mt Bundey creek) thus affecting receptors described above.

Habitat Value

A number of significant fauna species are listed to potentially occur in the general area, however none of these species were found at the TGU project during the fauna surveys, except for a single Mertens Water Monitor (*Varanus mertensi*) upstream of Toms Gully Mine (LES 2017 and GHD 2018c). As discussed in the Draft EIS the Mary River catchment covers a total area of 8,100 km^2. Implementation of the project will result in an additional footprint of approximately 83 hectares or 0.83 km^2 of the total catchment. At a project level, infrastructure has been amended which has resulted in a reduction in habitat disturbance and management measures to improve water have been put in place to improve water quality and tailings chemistry. In the situation of dust, noise and vibration the distance between operations will have little if any cumulative effect on the overall ambient regional air quality.

A number of significant fauna species are listed to potentially occur in the general area of the operation. All species have a widespread distribution in the region and there is no critical habitat for the listed species LES 2017).

Socio-Economic Aspects

Socio-economic effects of the project and management have been discussed in detail within Chapter 12 of the Draft EIS document. The proposed project will contribute to further employment and economic activity in the region. To manage these community impacts the following measures will be adopted:

- Open communication with all stakeholders (including landowners adjacent and downstream).
- Continual engagement with the local communities and organisations, with open and responsive

dialogue.

- Identify issues early and consult with the affected groups.
- Providing employment and training opportunities for local communities.
- Comply with regulatory requirements and stakeholder commitments.

The regional and project level cumulative impacts have been identified and assessed across the lifecycle of the TGU Project. This includes all of the activities from exploration, though to post-closure and from extraction and processing through to recycling and waste management. The cumulative impact process is an iterative one and will be reviewed annually as part of the risk assessment to ensure all new risks are identified and appropriately mitigated. By implementing the mitigation and measurement measures for each individual impact and then monitoring environmental and social performance across the site, the potential for cumulative impacts are minimised. If monitoring demonstrates a deviation from the predicted outcome and where necessary remediation measures will be implemented. These measures will also take into account the potential for future cumulative impacts. Based on the discussion above and the further work underlying this EIS supplement no specific management measures in regard to the cumulative impacts are proposed.

2.3.1.2. Positive Impacts

The risk assessment process also highlighted a series of positive impacts and benefits that would flow from the approval and implementation of the TGU Project. These positive impacts are summarised in Table 7 below.

Table 7: Positive Impacts of the TGU Restart.

Aspect	Positive Impact
Community	• Training and skill development for local employees and contractors • Social benefits associated with employment • Supply of quality water to pastoralist
Economic	• Taxes and mineral royalties payable to the NT government. • Money flowing into the economy from operational expenditure and, capital expenditure associated with TGU. • Opportunities for local employment
Environment	• Increased levels of monitoring and management for site • Opportunity to improve the environmental status and risk settings for the TGU
Closure and Rehabilitation	• Potential retreatment of existing tailings and future tailings to lower the potential to generate acid mine drainage. • Residual tailings after reprocessing will be closed and rehabilitated according to current best practice for the long term storage of tailings • Investigations and planning completed for WRD long-term improvements • Clean construction/capping materials won from WSD footprint • Dewatering and treating water provides decreased risk of poor quality water escaping off-site by increasing water storage capacity on-site
Health and Safety	• Training opportunities for local employees

2.3.2. NT EPA Environmental Factors and Objectives

The NT EPA has released a guideline for the purposes of undertaking environmental impact assessments as required by the NT *Environmental Assessment Act* (EA Act). EIAs are similar to risk assessments in that they are tools for identifying environmental risks and impacts associated with a project.

The NT EPA has developed environmental factors and objectives to improve certainty and increase transparency within the EIA process (NT EPA 2018). The NT EPA has identified 13 environmental factors categorized under five themes of: Land, Water, Sea, Air and, People and Communities. An environmental objective for each factor has been developed which reflects the values of those parts of the environment.

The results of this risk assessment have been used to inform whether the objective of each relevant environmental factor relating to the proposed TGU can be achieved. See Table 8:

Table 8: NT EPA Environmental Factors and Objectives

Factor	NT EPA Objective	Inherent Impacts	Mitigation Measures to Address Impacts	Proposed Regulatory Mechanisms for Ensuring Mitigation	Predicted Outcome to Meet EPA Objective
Terrestrial Flora and Fauna	Protect the NT's flora and fauna so that biological diversity and ecological integrity are maintained.	Direct Clearing Impacts • Clearing of a maximum of 83 ha of native vegetation (WSD and contingency TSF if required) • Loss of native vegetation communities • Fragmentation of vertebrate fauna habitat resulting in displacement of fauna • Vehicle strike causing injury or death to native fauna • Increase in pest species impacting native fauna Indirect Impacts • Dust generated from mining activities resulting in reduced vegetation health and condition • Spread or introduction	Flora and Fauna • Land disturbance will be kept to the minimum necessary • Land clearing will be undertaken progressively with the amount of active disturbance minimised where possible • Progressive rehabilitation will be undertaken on disturbed areas as they become available • Monitoring of analogue and rehabilitated areas will be undertaken to ensure short, medium and long-term rehabilitation objectives are achieved. Monitoring will be carried out on a regular basis to assess the success of revegetation in rehabilitated areas • Inductions will provide information on protection of vegetation and ground disturbance authorisation procedures • Vehicles and mining equipment will keep to designated roads • Dust suppression will be carried out during construction and operations when weather conditions dictate	• Internal Ground Disturbance Procedures • Annual MMP • Biodiversity Management Plan • Mine Closure Plan • Traffic Management Plan	• No flora species of conservation significance were recorded during any surveys and therefore high unlikely to be impacted by clearing. • The only areas to be cleared are for the WSD and (potentially) the TSF, and are within the broad scale mapped vegetation *Type 4: Eucalyptus with grass understorey* (Wilson *et al*., 1990). Which corresponds to the detailed site mapped vegetation type 1a/1 (GHD 2015). This vegetation type extends beyond the TGU Project boundary and is well represented in undisturbed areas. • Progressive rehabilitation will be undertaken • Based on risk assessment results, the risks associated with flora/vegetation and fauna have been identified. • Fauna injury/death due to vehicle strikes may occur but is unlikely to impact native fauna at the

Factor	NT EPA Objective	Inherent Impacts	Mitigation Measures to Address Impacts	Proposed Regulatory Mechanisms for Ensuring Mitigation	Predicted Outcome to Meet EPA Objective
		of weeds resulting in reduced native vegetation cover and diversity • Modification of surface water flows resulting in loss, or reduced health and condition of native vegetation	• A weed hygiene system will be implemented in consultation with the pastoralist • Weed inspections will be included in the rehabilitation monitoring program <u>Fauna</u> • Implementation of vehicle speed limits, driving on designated tracks and drive to road/weather conditions to minimise fauna strike and habitat destruction • Large water bodies will have egress mats installed		population level • Clearing associated with the TGU Project will result in some habitat fragmentation but the impacts on fauna are likely to be incidental due to availability of habitat outside of the project area • The EPA objective for terrestrial flora and fauna can be met
Terrestrial Environmental Quality	Maintain the quality of land and soils so that environmental values are protected.	• Clearing of vegetation leading to increased dust and soil erosion • Introduction of new weed species or spread of existing weed infestations due to vehicle and machinery earthwork movements • Hydrocarbon or chemical spills leading to localised soil contamination • Creation of new	• See management measures for flora and fauna • Ensure appropriate storage of hydrocarbons and chemicals according to Australian Standards and spill kits contained on site • Weekly inspections of storage areas • Positioning of infrastructure and water diversion structures to prevent inundation and installation of diversion drains or bunds • Ensure resourcing for rehabilitation and closure early on in planning stages • Reprocessing of existing tailings	• AMD Management Plan • Mine Closure Plan • TSF Operating Manual • Water Management Plan • Annual MMP	• The proposed reprocessing of tailings material as well as the water treatment plant will result in much less acid producing landforms or storage areas and thus reducing the risk of AMD contamination to terrestrial features (vegetation, soil etc.) • Based on risk assessment results, the risks associated with terrestrial environmental quality have been identified. • The EPA objective for terrestrial environmental quality can be met

Factor	NT EPA Objective	Inherent Impacts	Mitigation Measures to Address Impacts	Proposed Regulatory Mechanisms for Ensuring Mitigation	Predicted Outcome to Meet EPA Objective
		landforms (WSD and TSF) leading to altered surface water flows • Liberation of leachates from TSF or waste dumps leading to AMD • Ineffective rehabilitation	material which will result in more benign waste landforms • Water treatment plant to treat all existing AMD contaminated water on site before being discharged		
Aquatic Ecosystems	Protect aquatic ecosystems to maintain the biological diversity of flora and fauna and the ecological functions they perform.	• Discharging Mine Affected Water to Mt Bundey Creek • Increased salinity and/or acidity in Mt Bundey Creek affecting aquatic ecosystem health • Increased metal concentrations in Mt Bundey Creek affecting aquatic ecosystem health • Poor fish condition, as well as low abundance and diversity due to water quality parameters that are potentially ecotoxic	• Treatment of all mine affected water prior to discharge (quality of water to be aligning to SSTVs) • Implementation and maintenance of all surface water runoff via bunds and drains to ensure all water is captured and treated before going off site • Surface water monitoring program and Site Specific Trigger Values (SSTVs) • Reprocessing of tailings which will result in a more benign TSF thus reducing any AMD runoff into the creeks	• Water Management Plan (including sampling of creeks and assessing Aquatic ecosystem health) • Biodiversity Management Plan • Annual MMP • Site Specific Trigger Values (ANZECC 90%) • Water Treatment Plant	• The results from the May 2017 (GHD 2018) aquatic sampling indicated that water quality in Mount Bundey Creek is of poorest quality around TSF2. Reprocessing of tailings material and an upgraded facility as well as a water treatment plant is likely to improve the quality of water runoff and discharge into the creek • Water quality results to meet SSTVs • Based on risk assessment results, the risks associated with aquatic ecosystems have been identified. This means that ongoing management and monitoring for these factors will enable a reasonably acceptable level of impact

Factor	NT EPA Objective	Inherent Impacts	Mitigation Measures to Address Impacts	Proposed Regulatory Mechanisms for Ensuring Mitigation	Predicted Outcome to Meet EPA Objective
					• The EPA objective for Aquatic ecosystems can be met
Inland Water Environmental Quality	Maintain the quality of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are protected.	• Increased salinity, acidity and metal concentrations into groundwater and surface water bodies as a result of AMD runoff and / or seepage • Accidental spills (hydrocarbon or chemical (i.e. cyanide)) causing contamination of surface water and groundwater	• Groundwater and surface water monitoring sampling program • Water treatment plant to extract metals and sulphates in existing AMD affected surface water (e.g. pit, evaporation ponds, TSF) • All hydrocarbons and chemical storages and refueling areas will be designed and constructed in accordance with Australian Standards • Transport, storage and management of cyanide aligned to International Cyanide Management Code for the Gold Mining Industry • Weekly inspections of storage and refueling areas will be undertaken • Vehicles and machinery will be regularly maintained and serviced to reduce likelihood of spills and leaks • Spill kits will be present onsite • Tailings material will be reprocessed resulting in more benign materials and TSF will be upgraded to be compliant with ANCOLD 2012 guidelines • Adherence to SSTVs	• Water Management Plan (including groundwater and surface water sampling in line with SSTVs) • Annual MMP • As built TSF design report • AMD Management Plan	• Controls to be implemented by Primary will ensure that any spills are contained and remediated to avoid impacts to surrounding water environment • Surface water management infrastructure will ensure that potentially contaminated waters are contained and treated and discharged appropriately • Based on risk assessment results, the risks associated with inland environmental quality have been identified. This means that ongoing management and monitoring for these factors will enable a reasonably acceptable level of impact. • The environmental objective for inland water environmental quality can be met and the residual impacts are acceptable.

Factor	NT EPA Objective	Inherent Impacts	Mitigation Measures to Address Impacts	Proposed Regulatory Mechanisms for Ensuring Mitigation	Predicted Outcome to Meet EPA Objective
			• Commitment to WRD investigations to reduce AMD producing facility		
Social, Economic and Cultural Surroundings	Protect the rich social, economic, cultural and heritage values of the NT.	• Land degradation on surrounding pastoral stations due to weeds, dust, erosion or AMD contamination, death of livestock due to mining activities – all causing strained relationship with pastoralist • Impacts to the local communities including traffic volumes, use of resources and employment opportunities. • Inadvertent impact on aesthetic values leading to cultural land use changes	• Early ongoing stakeholder engagement with underlying land users and communities. • Economic and social impact statement • Adherence to all land access agreements. • Weed and dust management measures implemented.	• Implementation of and adherence to Stakeholder Engagement Strategy (as per MMP and Mine Closure Plan) • Complaints register and associated follow up procedure (to report in annual MMP).	• No registered Aboriginal sites or other places of heritage significance at TGU. Key stakeholders include the pastoralist, native title claimants, the residents and businesses surrounding Mt Bundey. • The proposed TGU impacts on social surroundings are considered to be minimal. • Based on risk assessment results, risks associated with people and social surrounds have been identified. This means that ongoing management and monitoring for these factors will enable a reasonably acceptable level of impact. • The EPA objective for social, economic and cultural surrounds can be met

2.4. Risk treatment

When considering risk mitigation for safety hazards, the hierarchy of controls provides a useful guide for determining appropriate controls. This is a regularly used set of control principles, applied across the industry in the mitigation of safety hazards. These control principles can also be applied to environmental hazards. The hierarchy applies a prioritised order ranging from elimination, (the most desirable strategy), to personal protective equipment, (the least desirable strategy). The more significant the risk, the higher the control strategy from the hierarchy, or combination of control strategies should be applied.

The ultimate aim is to eliminate hazards and their subsequent risk or, if this is not possible, to minimise exposures to as low as reasonably practicable:

1. ELIMINATION - Remove or avoid the hazard completely, i.e. cease using a device, tool, practice etc.
2. SUBSTITUTION - Replacing with a safer alternative.
3. ISOLATION - Separating the hazard from the person, environment or process at risk by isolation, guarding, barricading, alternate duties etc.
4. ENGINEERING CONTROLS - Constructing new devices to reduce risk, e.g. ergonomic devices, shock absorbent mats, robotics, etc.
5. ADMINISTRATIVE CONTROLS - Promote awareness of hazards. Delineation - signage, procedures, training etc.
6. PERSONAL PROTECTIVE EQUIPMENT (PPE) - Personal protective equipment is considered only when other controls are not practical or to increase protection.

The hierarchy control principle has been used in the risk assessment matrix to assist in developing appropriate mitigation measures where risks cannot be eliminated. Generally, mitigation measures for significant environmental risks include ongoing monitoring as outlined in the relevant management plans (see table 7 and section 2.4.1 below for more details).

2.4.1. Risk Management Plans

Primary Gold has developed a number of environmental management plans for the proposed project which will be used as a tool for mitigating the identified risks. The management plans to be implemented during the life of the project are overarched by the Mining Management Plan (MMP) and include:

- Biodiversity Management Plan
- Hazardous Materials Management Plan
- Water Management Plan
- Mine Closure Plan
- Acid Metalliferous Drainage Management Plan
- Emergency Crisis Management Plan
- Traffic Management Plan
- Environmental Management Plan
- Erosion and Sediment Control Plan

- Fire Management Plan
- Ground Disturbance Management Plan

The overarching MMP will be completed for the project once the EIS Supplement has been assessed and accepted by the NT EPA. The MMP will incorporate all management plans and annual reporting against the MMP and management plans will be undertaken and submitted to Department of Primary Industry and Resources (DPIR). These measures will ensure that risks are continually monitored and any significant impacts can be identified as soon as possible.

3. Monitoring and review

As mentioned in Section 2.3.1. the high and medium risks flagged in the risk matrix (Table 6) will have management in place to monitor the risk during the various phases of the project. All management, mitigation and monitoring measures will be subject to annual reviews and updates / improvement depending on circumstances and performance. Reviewing the management plans and associated mitigation measures will ensure that risk management is effective during all phases of the project. Any significant changes to the project or operations will prompt an immediate review of the risk assessment and management plans to ensure any new risks are identified and treated appropriately.

3.1. Reporting and Non-compliance

Records of all applications, approvals and commitments will be stored at Primary Gold's Perth head office. During operations regular environmental inspections will be undertaken with details of compliance with approvals forwarded to the Northern Territory DPIR as part of the annually submitted MMP. In addition, the MMP includes proposed activities and an assessment of the associated risks.

As part of the reporting requirements in the annual MMP, all environmental incidents and non-compliances are to be recorded. Employees and contractors will be required to internally report all environmental incidents. These include, but are not limited to:

- spills of hydrocarbons, chemicals and any other potentially toxic substance greater than 50 litres
- significant discharge of acidic mine water.
- injury to, or deaths of, native fauna caused by activities (including light vehicles)
- wildfires caused by Primary Gold
- the occurrence of declared weeds
- disturbance beyond approved vegetation clearing envelopes.

Any significant environmental incidents/accidents or major breaches of undertakings during mining are to be reported to DPIR as per the *Mining Management Act 2001*. An incident register will be kept and maintained, all reported incidents for the reporting period applicable to this document shall be noted in successive MMP's.

4. Communication and consultation

In developing the risk assessment, Primary Gold completed risk workshops and prepared a risk register which incorporates the ToR identified risks, stakeholder and regulator feedback on the Draft EIS and other relevant risks identified through the risk assessment process.

All new employees, contractors and visitors to Primary Gold's site will be inducted using an induction checklist. Adherence to company environmental policies and procedures is required.

Inductions will include the following information and requirements:

- Environmental policy, procedures and commitments;
- Areas of environmental significance;
- Relevant legislation and discussion of the consequences of breaching legislative requirements;
- Significant fauna and flora within the Project area;
- Flora and vegetation management and procedures (including the requirement to keep to existing tracks);
- Storage and handling requirements for chemicals, fuels and other potentially polluting substances;
- Waste disposal requirements;
- Spill management procedures; and
- Environmental incident reporting.

Awareness programs will be undertaken as part of the Primary Gold's project, and include all personnel. In addition, daily planning and toolbox meetings are held where specific issues can be raised and information passed on to employees and contractors. Take-5's, incident reporting, safety meetings and the communication of roles and responsibilities will all form part of the Project operations and ensure risks are continually being identified, monitored, managed and mitigated.

5. References

Franks, DM, Brereton, D, Moran, CJ, Sarker, T and T, Cohen. 2010. *Cumulative Impacts – A Good Practice for the Australian Coal Mining Industry*. Centre for Social Responsibility in Mining & Centre for Water in the Minerals Industry, Sustainable Minerals Institute, The University of Queensland. Australian Coal Association Research Program. Brisbane

GHD, (2015). Primary Gold Limited, Toms Gully Mine Biodiversity Report. Report prepared for Primary Gold Ltd.

GHD, (2015a). Primary Gold Limited, Toms Gully Mine Flood Risk Study. Report prepared for Primary Gold Ltd.

GHD, (2018). Toms Gully Gold Project Geochemical baseline and conceptual site model, prepared for Primary Gold Ltd.

GHD (2018a). Flooding. Memorandum prepared for PGO. 13 pp.

GHD (2018b). Tom's Gully EIS – Baseline Studies. Groundwater Assessment and Modelling. 67 pp.

GHD (2018c). Toms Gully EIS – Baseline Studies Aquatic Ecology Monitoring 2017, prepared for Primary Gold Limited.

Low Ecological Services P/L (LES). (2017). Toms Gully, Rustlers Roost and Quest 29 Flora and Fauna Report prepared for Primary Gold Ltd.

Northern Territory Environmental Protection Authority (2018). NTE EPA Environmental Factors and Objectives

Minerals Council of Australia (2015). Cumulative Environmental Impact Industry Guide. Available from: http://www.minerals.org.au/file_upload/files/reports/Cumulative_Environmental_Impact_Assessment_Industry_Guide_FINAL.pdf

Schultz T. J., Townsend S. A., Edwards, C. A. and Dostine P. L. (2002). *Water quality monitoring in the Mary River catchment*. Technical Report 42/2002. Department of Infrastructure, Planning and Environment. Darwin.

Table 9: Environmental Risk Assessment

Inherent Risk									Residual risk				
Risk #	Source of Impact	Consequence	Discussion	Prob	Cons	Risk	Risk	Mitigation & Monitoring	Prob	Cons	Risk	Risk	Certainty and Justification of Residual Risk
1.0 Water and Acid Mine Drainage		Consequence	Discussion	Prob	Cons	Risk	Risk	Controls	Prob	Cons	Risk	Risk	Certainty
E1	Embankment failure of TSF 1 and/or 2 leading to uncontrolled release of tailings material to surrounding environment.	Contamination of Mount Bundey Creek and downstream aquatic ecosystems. Impact on structural integrity of engineered embankments.	Approximately 0.9 Mt of tailings to be stored in TSF 2. TSF 2 will be raised using a downstream construction technique to 1.6m lift. The lift will have a detailed engineered design and TSF construction will align to this to prevent any stability issues. TSF 1 will be subject to geotech assessment prior to recommencement of operations. These measures lead to unlikely events of failure.	E	5	11	High	Detailed engineering assessment and quality assurance/control of TSF 2 in accordance with ANCOLD guidelines. TSF1 and 2 assessed against ANCOLD 2012 guidelines and where required remediated. Use tailings lift design as opportunity to reduce seepage Geotechnical studies, mine closure plan (in-pit storage of tails on closure) Protection of toe of TSF through construction of diversion drains if required under ANCOLD Development of Tailings Management Plan / Operational Manual which includes weekly inspections Groundwater monitoring Implementation of Acid Mine Drainage Management Plan and Water Management Plan	E	3	20	Moderate	High certainty that the tailings embankment will remain stable. Based on historical (over ten years) data analysis, geotech studies and engineering design and modelling. No previous instability issues with either TSF at TGU.
E2	Seepage from TSF 1 and/or 2.	Localised groundwater mounding. Seepage of AMD causing contamination of groundwater systems.	Pyrite, pyrrhotite and arsenopyrite are present in tailings in quantities that are likely to require AMD management. Baseline geochemistry results (GHD 2018) suggest contamination of groundwater from seepage below TSF2. Cone of depression from dewatering of pit results in groundwater flow trending toward pit from TSF area.	A	2	6	High	TSF lift will address existing seepage at new tailings dam Perimeter monitoring bores will be installed and monitored for depth and quality to assess potential interaction between TSF and the surrounding environment. Reprocessing of tailings material which will reduce volumes of AMD material and treatment of tailings which will result in more benign materials Tailings will be managed in accordance with the Tailings Management Plan and Operational Manual (including inspections) The proposed TSF will be designed to ANCOLD guidelines. Existing TSF will be assessed and remediated.	D	2	21	Low	There is moderate certainty that the treatment of the tailings material will result in the desired water quality - based on previous case studies of the water treatment plant. There is high certainty that the upgrade of the TSF facility will not result in continued seepage and uncontrolled runoff, based on engineering design and historical data as well as geotech investigations.
E3	Overtopping from TSF 1 and/or 2.	Contamination of surface water quality and ecosystems. Compromise structural integrity of embankment.	Pyrite, pyrrhotite and arsenopyrite are present in tailings in quantities that are likely to require AMD management	B	3	9	High	Reclaiming water for process plant. Treating water for subsequent discharge or reuse. Inspections as per O&M Manual and TSF management plan. Ensure final construction is in line with engineered design. Cap TSF 1 and 2 and rehabilitate in situ and designed to water shed. Implementation of water management plan and water balance onsite	E	3	20	Moderate	Moderate certainty no overtopping dedicated management of water across site. Based on data analysis, engineering design qualitative analysis (engineering inspection & Toms Gully history). Daily monitoring and standby pumps in wet season.
E4	Failure or overtopping of process water pond resulting in uncontrolled release of water from process circuit.	Adverse impacts on downstream water quality, aquatic ecosystems and downstream users.	A process water pond is also located adjacent to the processing plant – this pond is required as a holding structure for water in the process circuit and provides buffering between the TSF decant and the process itself. Process water pond water quality may contain AMD contaminants.	D	3	17	Moderate	Managing appropriate freeboard. Re-use of water around the mine site for processing. Drainage to processing area sump Management of pond aligned to operating manual which includes weekly inspections and daily water level inspections	E	2	23	Low	Pond managed as part of process plant certainty high no overtopping. Also based on qualitative analysis and similar conditions.
E5	Water treatment system fails to deliver required water quality.	Water does not meet planned quality requirements resulting in adverse impacts to downstream groundwater and surface water systems.	Treatment of approximately 2.6 GL of pit water as well as general site water before being discharged into Mt Bundey Creek. It is anticipated that water quality at the discharge point will attain the SSTVs as detailed in the CSIRO 2018 report. However, if the SSTVs values at the discharge point cannot be achieved then it is anticipated that the water quality target will be at the ANZECC and ARMCANZ (2000) 80% ecosystem protection guidelines level. Water quality at the downstream monitoring compliance point SWTG2 would be approaching 90% after starting at 80% ecosystem protection guideline levels. In addition, by attaining the ANZECC and ARMCANZ (2000) 80% ecosystem protection guidelines level the water quality would be fit for purpose for agricultural and horticultural as it would not exceed the criteria for livestock drinking and irrigation water quality.	C	3	13	High	Contractual obligation for contractor to meet water quality criteria. Dedicated water treatment plant on site Contingency to release treated water at lower rates (higher dilution) to meet discharge outcomes Contingency to re-treat/continue treatment to meet water quality criteria	E	1	25	Low	High certainty water will meet water quality. Based on performance of this technology at Angas, Mt Chalmers and Brukunga sites. Pilot plant to refine Bioaqua process.

E6	Water treatment system fails to treat tailings material to required quality	Tailings material is not treated to planned quality resulting in continued acid mine drainage impacts to groundwater quality and surface water systems	Baseline geochemistry results have indicated that groundwater and surface water around TSF2 have particularly low pH and thus suggests seepage and contaminated runoff from the facility. It is proposed to reprocess the tailings material from both TSFs by slurrying and pumping to the water treatment plant (where the BioAqaua process is applied). The water treatment process detailed above is used after the tailings is leached by the inherit acidity of the material. The leaching process occurs within a 2.5km section of pipe transporting the tailings from the tailing storage facility to the treatment plant. After the leaching process, silica is physically removed to produce a saleable product. The treated tailings will report to TSF2 and TSF1 which will be upgraded to ANCOLD guidelines and rehabilitated in situ.	A	3	6	Extreme	Commissioning of field trials using a pilot plant to tailor tailing treatment to suit tailings chemistry. Contractual obligation for contractor to meet water quality criteria Contingency option (Option 2) if treatment process does not work: a new purpose built facility will be constructed. This facility would contain future tailings produced by mining. For this option the existing TSFs would have: • TSF1 being reprocessed to extract the residual gold within the tailings and then would be sent to the new tailings storage facility and the emptied structure rehabilitated insitu to be water shedding • TSF2 capped insitu and water shedding Contingency TSF built to ANCOLD guidelines	E	1	25	Low	Moderate certainty tailings will meet water quality. Based on performance of this technology at Angas, Mt Chalmers and Brukunga sites. Pilot plant to refine Bioaqua process
E7	Embankment failure of proposed water storage dam and uncontrolled water and sediment release.	Adverse impacts to Mt Bundey Creek and downstream aquatic ecosystems with movement and deposition of sediments and damage to vegetation and fauna downstream. Localised increase in groundwater levels. Impact on structural integrity of engineered embankments.	The WSD will be constructed to the west of the existing SWRD. The positioning of the WSD has been established based on the location of competent ground (i.e. not situated on the fault window and/or over historical resource drilling locations). The catchment area of the WSD is 1,598,188m2 with a depth of 13.5 m and an emergency overflow to Mt Bundey Creek.	D	5	7	Extreme	Detailed design and quality assurance/control of WSD provided in MMP Geotechnical studies and assessment to ensure structural stability Engineering design to ANCOLD standard Water Management Plan Weekly inspections to check sufficient freeboard and structural integrity	E	3	20	Moderate	High certainty that wall will not fail based on using leading industry practice and regular monitoring. Based on data analysis, engineering design and modelling. However consequence remains high.
E8	Failure of process tanks/pipes/pumps.	Slurry or water release from process water circuit causing localised soil contamination or surface water contamination. Loss of native vegetation or habitat.	Installation of pumps and pipeline to manage water transfers across the site. The installation of pumps will allow active management of infrastructure and reduce the potential for uncontrolled discharges to Mount Bundey Creek or Coulter Creek.	C	3	13	High	Water storage tanks stored in containment bunding Pipelines, pumps and tanks selected for appropriate water capacity Engineering standards for equipment Drainage to processing area sump Pumps operated in accordance to Operating manual Level alarms Weekly inspections for leaks and subsequent maintenance	E	2	23	Low	High certainty low potential for pipes and tank ruptures. Based on engineering design. Standard Industry practice. Similar mitigation used previously at Toms Gully.
E9	Overtopping of evaporation ponds in extreme weather event.	Contamination of surface water quality and ecosystems. Loss of native vegetation habitat. Impact on structural integrity of engineered embankments.	Evaporation Pond 1 and 2 (EP1 and EP2) currently store Mine Affected Water (MAW) from historical activities onsite including surplus TSF2 waters. The ponds collect runoff from the Sulphide Waste Rock Dump (SWRD). They will continue to be utilised for water storage during operations. MAW stored within EP1 and EP2 has the potential to impact on groundwater through seepage. Both TSF 1 and 2 will be rehabilitated either by capping in-situ or rehandle to base of the pit.	D	3	17	Moderate	Treatment of water in evaporation ponds Management of site water balance and pond freeboard Weekly inspections of bank integrity and freeboard Monitoring of groundwater bores surrounding evaporation ponds. Treatment of water to drinking standards	E	2	20	Low	High certainty that no overtopping will occur. Based on engineering design and modelling. Standard Industry practice. Similar mitigation used previously at Toms Gully.
E10	Poor quality runoff or seepage from existing sulphide WRD and oxide WRD.	Contamination of surface water and groundwater quality and ecosystems from release of AMD	The sulphide WRD has AMD material within it and therefore drainage and runoff need to be managed appropriately. The WRD will not be utilised or modified during the recommencement of operations at any time. Waste rock material will be placed in the underground portal or base of the pit during operations. Seepage and runoff from WRD is highly likely and therefore almost certain for AMD to occur. This will be monitored closely during all phases of the TGU Project.	A	3	6	Extreme	SWRD runoff reports to Evaporation Ponds Upgrade bund at OWRD to prevent overtopping Continued use of drainage controls and bunds Maximise pond capacity prior to wet season Ongoing monitoring of existing groundwater bores Investigation and consideration of long term closure options Implementation of AMD management plan Daily inspections for run off and drainage problem areas	D	2	21	Low	High certainty that the seepage and runoff can be contained and treated based on the GHD Conceptual Site Model findings. Previous mitigation used previously at Toms Gully. Site treatment plant in use.
E11	Seepage from Evaporation Ponds	Contamination of groundwater system	Evaporation Pond 1 and 2 (EP1 and EP2) currently store Mine Affected Water (MAW) from historical activities onsite including surplus TSF2 waters. The ponds collect runoff from the Sulphide Waste Rock Dump (SWRD). They will continue to be utilised for water storage. However before recommencement of operations the water will be treated to Site Specific Trigger Values. The evaporations ponds will be renovated and upgraded to ensure they are fit-for-purpose.	D	3	13	Moderate	Treat existing water in evaporation ponds via standalone water treatment plant Surface drainage plan to divert clean surface water run off Manage site water balance Containment and capture of contaminated water Ongoing monitoring of existing groundwater bores	E	2	23	Low	High probability that seepage contained within site Based on historical data management and engineering designs.
E12	Pit and underground dewatering exposing PAF and causing AMD.	Decreases in onsite water quality and potential exceedance of SSTVs if discharged. Adverse impacts on downstream water quality, aquatic environment, and downstream users.	Water captured within the pit/underground will be transferred to the water treatment plant and then stored onsite in the proposed WSD. The water may be discharged to the Mt Bundey Creek or passed on to a third party (i.e. pastoralist). The water treatment will ensure quality is within SSTVs.	C	2	18	Moderate	Sump below underground decline to reclaim contaminated water Implementation of AMD Management Plan including ore and waste rock controls and tailings controls. Treatment of pit and underground water to within SSTV criteria. Groundwater monitoring program Upgrading of site drainage measures Visual inspection of pit walls to identify locations and volumes of acid producing material	E	2	23	Low	High certainty that AMD affected pit water retained for treatment. Thus not escaping to the surrounding environs.

E13	Recovered products from water treatment process being released to the environment	Contamination of soil and surface water. Creation of contaminated laden dust.	Recovered products from the water treatment process will result in saleable products. The recovered products will be trucked offsite for on-sale.	D	2	21	Low	Establish markets before production/treatment occurs. Regular removal of the products to prevent large stockpiles If recovered products cannot be removed from site, they will be placed in pit.	E	2	21	Low	High level of certainty that product removed based on current trial plants in South Australia.
E14	Indiscriminate use of existing waste rock for construction. Storage of waste rock outside of pit footprint.	AMD, leading to contamination of surface water and groundwater systems.	The WRDs will not be used at any time during the recommencement of the TGU Project. Controlled drainage and runoff management measures will be the only activities associated with the WRD and rehabilitation at closure.	D	3	17	Moderate	No disturbance to WRDs during all phases of TGU Project Implementation of AMD Management Plan and Water Management Plan and Project EMP On-going and regular inspections of project areas Inductions to inform WRD are not to be utilised for any purposes.	E	2	23	Low	High probability that the WRD are not disturbed and waste stays within footprint integrated into operational plan and management.
E15	Erosion of site infrastructure leading to sedimentation	Reduces surface water quality in Mount Bundey Creek with increased sedimentation in creek bed. AMD in downstream ecosystems.	Risks include contamination of waterways or the groundwater table caused by embankment failure or overtopping and subsequent uncontrolled release. Poor management of clearing across site. .	B	3	9	High	Implementation of Erosion and Sediment Control Plan (ESCP) On-going and regular (weekly) inspections of project areas and after rainfall events Avoid land clearing during wet season Minimise concentrated flow of surface water and ponding (drain lines, sediment bunds, liners etc.)	E	3	20	Moderate	High level of certainty sediment maintained Based on management to direct the extend and timing of clearing
E16	Off-site release of low quality water from bores dewatering new underground workings	Inundation of vegetation and flora. Increased potential for biting insect breeding grounds. Water unsuitable for livestock consumption. Surface water contamination.	Pit dewatering is required to enable access to the underground workings. The pit water quality currently does not meet the quality requirements to enable it to be released. Water from the pit will be pumped (and treated) to the new WSD. Uncontrolled release of this water prior to being treated is possible if pumps break down or pipes burst/leak.	C	3	13	High	Implementation of Water Management Plan, Waste Discharge Licence Discharge Plan Management of general site water balance and dam freeboard Undertake bore test pumping Select appropriate water treatment option to ensure water quality will meet livestock consumption requirements and SSTVs Regular site inspections of dam freeboards, pumps, pipelines and drainage infrastructure	E	2	23	Low	Moderate level of certainty that dewatering waiter treated.as standalone water treatment plant
E17	Storage, handling and transport of hazardous materials.	Groundwater or surface water contamination from leaks and/or spills. Localised soil contamination.	Diesel, oil and lubricants as well as processing chemicals (cyanide etc.) will be the principle dangerous goods transported and stored. Transport accidents and failure of tanks or storage containers is possible.	C	3	13	High	Design, storage and handling of hazardous materials to Australian Standards and regulations. Regular maintenance of storage facilities. Ensure containment bunding, secure MDSDs, available spill kits Diesel in bunded storage tanks, waste oil in stored bunded tanks Weekly inspections of storage areas, tanks, containers Develop Emergency Response Plan and include in inductions	E	3	20	Moderate	Highly unlikely for major spill as well tested industry standards used.
2.0 Biodiversity		**Consequence**	**Discussion**	**Prob**	**Cons**	**Risk**	**Risk**	**Controls**	**Prob**	**Cons**	**Risk**	**Risk**	**Certainty**
E18	Construction and operational activities (incl. vegetation clearing) result in introduction of new weeds and spread of existing weeds into new areas.	Impact on native vegetation. Increased fire risk.	Annual weed mapping has documented seven weed species. One of the species recorded is listed under Schedule 2 of the Weed Management Act as Class A noxious weeds (Gamba Grass) and three species are listed under Schedule 3 of the Weed Management Act as Class B noxious weeds (Hyptis, Flannel weed, and Sicklepod). Red Natal Grass, Bush Passionfruit and Calopo were also recorded on site. There is minimal additional clearing required for the Project other than borrow pits and WSD, therefore existing weed infestations should be able to be managed through Weed Management Plan. Spread of new weed infestations is likely with movement of vehicles and machinery around site.	B	2	14	High	Annual weed mapping (by June each year) to understand nature of the spread of weeds and plan weed control activities accordingly Conduct seasonal weed control activities in consultation with local landholder as necessary and in accordance with the site Weed Action Plan (grazing control as option). Implementation of the Biodiversity MP Project EMP (incorporating fire management Weed hygiene procedures - including inspection and wash down of all vehicles and machinery entering site.	D	2	21	Low	Certainty high of weed control as mitigation measures have been used successfully for weed management.
E19	Increased density of weed infestations or introduction of new weed species.	Decline in fauna habitat quality. Increased fire risk.	Annual weed mapping has documented seven weed species. One of the species recorded is listed under Schedule 2 of the Weed Management Act as Class A noxious weeds (Gamba Grass) and three species are listed under Schedule 3 of the Weed Management Act as Class B noxious weeds (Hyptis, Flannel weed, and Sicklepod). Red Natal Grass, Bush Passionfruit and Calopo were also recorded on site.	B	2	14	High	Annual weed mapping (by June each year) to understand nature of the spread of weeds and plan weed control activities accordingly Conduct seasonal weed control activities in consultation with local landholder as necessary and in accordance with the site Weed Action Plan (grazing control as option). Implementation of the Biodiversity MP Project EMP (incorporating fire management Weed hygiene procedures - including inspection and wash down of all vehicles and machinery entering site.	D	2	21	Low	Certainty high of weed control as mitigation measures have been used successfully for weed management.

E20	Cumulative impacts of clearing, dust, noise, artificial light associated with construction and/or operation of the mine site.	Disrupt lifecycle processes of fauna and or impact on the size of the populations.	The TGU project has been in operation on and off for over 10 years. The likelihood of fauna inhabiting the project area is highly unlikely. However the clearing and construction for the new WSD poses higher risks to fauna habitat and species. However the clearing will not impact species at a population scale, but rather at individual scale. One threatened fauna species, Merten's water monitor (Varanus mertensi), was recorded during the May 2017 fauna survey. Four near threatened species were recorded during the May 2017 survey; yellow-rumped manikin (Lonchura flaviprymma), bush stone-curlew, Arnhem sheath-tailed bat and orange leaf-nosed bat. All species (except the water monitor) are bird species and therefore unlikely to be significantly impacted by the clearing for the dam.	B	2	14	High	Implementation of Project EMP (incorporating fire and dust management measures) Implementation of Biodiversity MP (incorporating dust mitigation and artificial lighting mitigation measures) Site planning to minimise clearing activities, and avoid clearing on significantly windy days Comply with approved vegetation clearance Ground Disturbance Permit (GDP) procedure to be adhered to. Operations in line with noise regulations.	D	2	17	Low	High certainty that project will not greatly effect threatened species in the localised area.
E21	Poor water quality released from site during wet season.	Habitat modification and/or lifecycle disruption and/or impact on the size of a population (flora and/or terrestrial fauna). Decrease in fish populations and species richness	Pit dewatering is required to enable access to the underground workings. The pit water quality currently does not meet the quality requirements to enable it to be released. Other than during extreme rainfall events, the likelihood of water overtopping tailings material or water storage facilities is unlikely, particularly when regular inspections and monitoring of volumes will be undertaken. Stored mine water will be treated	C	4	8	Extreme	Compliance with the Waste Discharge Licence Implementation of Water Management Plan All water storage facilities geotechnically stable and engineered Water Storage Dam design (to ANCOLD guidelines) Water quality monitoring program including annual sediment and macroinvertebrate monitoring Weekly inspections of freeboard, structural integrity and pipelines. Water monitoring program implemented and results within SSTV	D	2	21	Low	Highly unlikely as water quality and volumes monitored with controlled discharge.
E22	Vegetation clearing for water storage dam.	Loss of 16 ha of habitat. Fragmentation of a population and/or habitat modification and/or lifecycle disruption and/or impact on the size of a population for flora and terrestrial fauna.	Approximately 16 ha of clearing proposed for the water storage dam. The vegetation survey determined that the vegetation existing within the WSD footprint is 1a/l - native eucalypt woodlands (Stringybark, woolybutt and Ironwood species) (GHD 2015d). This vegetation type is widely distributed beyond the disturbance footprint and thus habitat will be maintained beyond the WSD. Pre-disturbance walk over prior to clearing to avoid fauna injury with the help of wildlife specialist.	B	2	9	High	Adhere to buffer widths recommended by the Northern Territory Land Clearing Guidelines with regard to riparian vegetation in drainage lines Avoid land clearing during the Wet Season (Dec-May) Clearly mark limits of clearing Have a trained fauna spotter on site during clearing operations Make use of already disturbed areas where possible. Limit construction and clearing to times of the year when fauna are least vulnerable (e.g. avoiding breeding period). Surveys completed across the area.	D	2	21	Low	Low chance of habitat fragmentation due to vegetation widespread and field surveys.
E23	Groundwater drawdown.	Impact to any groundwater dependent ecosystems including aquatic ecosystems that are dependent on groundwater to provide dry season refugee.	A baseline aquatic ecology survey was undertaken to characterise the existing aquatic health and condition of the receiving environment (GHD 2015a). Mount Bundey Creek is approximately 30 km long with 13 km upstream of the mine site. The creek has several tributaries upstream of the TGU Project site. Downstream from the mine site it drains into Hardies Creek, and then the Mary River. The operation of the TGU Project needs to take into account the need to avoid impacts on water quality associated with low pH, i.e. leachates from WRDs and pits seeping into creek and/or low pH releases. It also needs to consider managing releases such that the operation does not contribute to reduced DO levels (i.e. impacting on environmental flows and release of hypoxic water) (GHD 2015a).	D	3	17	Moderate	Hydrogeological assessment indicated that minimal connection of groundwater to Mount Bundey Creek Water MP No documented drawdown impacts from previous operations	E	2	23	Low	Unlikely impact as minimal connectivity with discrete fracture zones.
E24	Clearing of native vegetation	Fragmentation of conservation significant / threatened fauna species or native fauna species	A flora and fauna survey of the Toms Gully mine site was undertaken by Low Ecological Services in November 2016 and May 2017 to assess fauna presence in the late dry season and assess diversity in the early dry season. One threatened fauna species, Merten's water monitor (Varanus mertensi), was recorded during the May 2017 survey. Four near threatened species were recorded during the May 2017 survey; yellow-rumped manikin (Lonchura flaviprymma), bush stone-curlew, Arnhem sheath-tailed bat and orange leaf-nosed bat. Seven introduced fauna species were recorded. Proposed clearing is only required for the WSD (and only if necessary, a purpose built TSF). The clearing is not extensive and much of the habitat on site is well represented outside of the disturbance area	A	2	10	High	Adherence to Ground Disturbance Procedures Progressive clearing and rehabilitation Only clearing what is absolutely necessary Implementation of Biodiversity Management Plan Clearly mark limits of clearing Have a trained fauna spotter on site during clearing operations Make use of already disturbed areas where possible.	C	2	14	Moderate	High clearing minimised as far as practical and will be marked out prior to any clearing activities. Communication with employees and contractors.
E25	Leak or spill of stored hydrocarbons and chemicals	Contamination of soil and vegetation leading to degradation of fauna habitat. Fauna potentially ingesting stored chemicals or hydrocarbons.	Hydrocarbons will be stored on site for refuelling as well as servicing of vehicles and machinery. Process chemicals will also be stored on site. It is unlikely that these hazardous materials will have significant impacts on fauna as they will be stored on previously cleared areas and will be bunded. Unless a major spill occurs and seeps into surrounding vegetated areas.	C	3	13	High	Storage of hazardous materials in accordance with Australian standards (including bunded storage) Weekly inspections of storage areas for leaks or damages Spill kits available around the site and procedures and training for the cleaning up of hazardous spills Implementation of hazardous materials management plan Training for emergency response Cyanide management and storage will be aligned to the International Cyanide Management Code for the Gold Mining Industry.	D	3	17	Moderate	High certainty large spills highly unlikely. Based on previous operations at TGU. Weekly inspections will ensure any minor leaks or spills are contained and cleaned up preventing larger spills

E26	Contamination of surface water bodies	Reduce the terrestrial fauna species diversity. Fragment or damage terrestrial fauna habitat for the conservation of biological diversity.	Altered hydrology is not expected to impact on any population size (only species level). Potential impact if species come into contact with contaminated water.	C	3	13	High	Water storage tanks stored in containment bunding Pipelines, pumps and tanks selected for appropriate water capacity Engineering standards for equipment Drainage to processing area sump Pumps operated in accordance to operating manual	D	3	17	Moderate	Containment of process fluids and mine affected water.
E27	Production of domestic waste	Increase in pest fauna (rats/mice) and feral/predator species (dingoes, cats) causing reduction in native population.	Onsite operations will require a landfill site and dustbins etc. Creating opportunities for feral fauna species. The landfill site will be buried.	B	2	14	High	Secure dustbin lids. Weekly inspections of landfill and general tidiness of site. Trapping for vermin Burial of landfill (non-contaminating) waste	C	1	22	Low	Low probability as inert rubbish continually managed
E28	Unplanned bushfire	Reduce the area of occupancy for terrestrial fauna. Long term decrease in size of population. Fragmentation of habitat. Interference with recovery of species.	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 habitat areas.	C	2	13	Moderate	Implementation of fire management plan. Maintenance of firebreaks and active fire management during cool season. Adherence to hot works permits	D	2	17	Low	High. Low probability of fires starting
E29	Vehicle/machinery interaction with terrestrial fauna	Loss of life or injury to fauna species.	Many marsupials are nocturnal in the TGU project region. Therefore night shift operations have higher risk of fauna and vehicle interaction.	C	2	18	Moderate	Vehicle speed restrictions on site Vehicles not to park on vegetation areas (to prevent hot engines causing wildfire) Vehicles to remain on designated tracks Inductions include information regarding fauna species	D	2	21	Low	High. Driving behaviour enforced
3.0 Rehabilitation and Closure		**Consequence**	**Discussion**	**Prob**	**Cons**	**Risk**	**Risk**	**Controls**	**Prob**	**Cons**	**Risk**	**Risk**	**Certainty**
E30	Unfinished/unsuccessful rehabilitation of Project due to inadequate funds.	Site not rehabilitated to required standards. Increased potential for offsite impacts from AMD, erosion and sedimentation.	Potential legacy issues.	D	4	12	High	Progressive rehabilitation of unused areas Implementation of detailed mine closure plan Early planning and financial provision for closure works	D	3	17	Moderate	Implement closure planning into mine plan.
E31	Unfinished/unsuccessful rehabilitation due to natural disaster (e.g. cyclone).	Site not rehabilitated to required standards. Increased potential for offsite impacts from AMD, erosion and sedimentation.	An un-rehabilitated site can result in the compromisation of natural functioning ecosystems. Early closure planning needs to be undertaken and where possible rehabilitation trials to understand the most effective methods for successful rehabilitation.	D	4	12	High	Infrastructure design to withstand extreme events Ongoing management of levels in water infrastructure Improve site drainage controls Financial provisioning for closure implementation	E	3	20	Moderate	Site operated to accommodate natural disasters
E32	Unplanned closure	Incomplete rehabilitation reducing biodiversity in region. Decline in species and or species habitat.	An unrehabilitated site can result in the compromisation of natural functioning ecosystems. Early closure planning needs to be undertaken and where possible rehabilitation trials to understand the most effective methods for successful rehabilitation.	C	4	8	Extreme	Financial provisioning for closure implementation Early implementation of rehab trials to determine successes or failures Adherence to mine closure commitments and schedules Stakeholder engagement with surrounding landholders	D	3	17	Moderate	Closure planning integrated into life of mine planning.
E33	Geotechnical instability - failure of pit wall, WRD or TSFs	Land degradation (loss of flora and fauna habitat and AMD contamination). Public injury.	Ongoing management of as built structures. Pit wall currently stood up for 20 yrs. TSF stood up to date.	D	4	12	High	Construction of abandonment bund and signage preventing public entry Geotech assessment prior to closure Annual post-closure monitoring and inspections of site. New waste in pit dumping.	E	2	23	Low	Geotechnically assessed against industry best practice.
E34	Pit lake becomes a groundwater source.	Gradual development of plume of contaminated groundwater	The pit and underground workings will be used for long term storage of waste rock. Once the pit fills at closure - options will be investigated for an insitu natural sulphate reducing bacterium system. The pit will be located in livestock exclusion zone.	C	3	13	High	Investigate in pit water treatment options Contaminant transport modelling further refined Limit pit catchment post closure to reduce inflow Ongoing groundwater monitoring program	D	3	17	Moderate	Focus to maintain good water quality
E35	Long term positive water balance and AMD issues from WRDs.	Need for long term treatment of contaminated water. Inability to meet environmental obligations and objectives.	Close out structures to be water shedding to reduce water build up across site. Reduce and minimise contact water contact with AMD forming material.	C	4	8	Extreme	Improve and maintain site drainage infrastructure Review options for WRD Rehabilitation Implementation of Mine Closure Plan and adherence to commitments Closure Plan updated and refined throughout mining operations including life of mine closure planning and contingency planning Financial provisioning for closure implementation	D	4	12	High	Focus to maintain good water quality
E36	Not being able to establish native vegetation by local provenance species with resultant cover comparable to nearby areas	Completion criteria and environmental outcomes unable to be met	Areas to be cleared of vegetation shall have any useful materials (seed, timber) salvaged, before vegetation is pushed aside, topsoil (notionally 10 cm) and other useful growth media or construction materials are stockpiled for later use. Rehabilitation monitoring shall be completed in the first wet season and any remedial actions identified and implemented by the next wet season.	C	3	13	High	Financial provisioning for closure implementation Rehabilitation trials to determine effective methods Rehabilitation monitoring.	D	3	17	Moderate	Effective use of topsoil and growth mediums.
E37	Lack of rehabilitation materials leads to inadequate tailings closure and poor quality site rehabilitation.	Completion criteria and environmental outcomes unable to be met	Areas to be cleared of vegetation shall have any useful materials (seed, timber) salvaged, before vegetation is pushed aside, topsoil (notionally 10 cm) and other useful growth media or construction materials are stockpiled for later use. Rehabilitation monitoring shall be completed in the first wet season and any remedial actions identified and implemented by the next wet season.	A	3	6	Extreme	Financial provisioning for closure implementation Recover topsoil from water supply dam footprint Progressively rehabilitating the mine Clearing and Topsoil Procedures Implementation of Mine Closure Plan In-pit storage of waste material	D	3	17	Moderate	Implement manage of rehabilitation resources as part of mine scheduling
4.0 Cultural Heritage		**Consequence**	**Discussion**	**Prob**	**Cons**	**Risk**	**Risk**	**Controls**	**Prob**	**Cons**	**Risk**	**Risk**	**Certainty**

E38	Disturbance of sites/objects of heritage significance heritage items or places and sacred sites.	Damage, destruction or removal of heritage item, place or sacred site	A search of the NT Heritage Register and Archaeological database shows that there are no nominated, provisional or declared heritage places located within the area of NT Portion 4937 (Old Mount Bundey Station) that contains the former Toms Gully Mine footprint. The area has already been subject to surveys and is unlikely to contain heritage sites.	D	2	21	Low	Survey over the Project area with the AAPA regarding Aboriginal Sacred Sites. Undertake consultation with the Heritage Group of DLPE with regards to potential heritage sites in the area. Project EMP Adherence to ground disturbance/clearing procedures	E	2	23	Low	High. Based on database searches, and AAPA certificate.
5.0 Miscellaneous Risks		**Consequence**	**Discussion**	**Prob**	**Cons**	**Risk**	**Risk**	**Controls**	**Prob**	**Cons**	**Risk**	**Risk**	**Certainty**
E39	Ineffective operational implementation of site environmental management system, plans and procedures.	Environmental incidents. Reputational damage. Work or schedule delays.	Ensure appropriate levels of resourcing and integrate into operation plans	C	3	13	High	Corporate commitment to EMS implementation via policy Environmental Management System and various management plans (EMP, WMP, AMD MP, MMP etc.). All events/incidents to be reported and managed through to resolution via event/incident reporting procedures. All personnel will be inducted into the area and informed of the hazards and relevant management protocols of the areas. All personnel will be trained in the appropriate management practices as is relevant to their position.	D	2	21	Low	Moderate. Based on similar conditions.
E40	Fire impacts on Project or nearby infrastructure, personnel and local environment.	Loss of infrastructure. Loss of habitat and local fauna populations. Potential for loss of human lives.	Bushfires commonly occur in the dry season within the region. Primary will need to implement a Fire Management Plan to ensure that bushfires are not started as a result of the TGU operations.	C	3	13	High	Liaise with Bushfires NT regarding regional (and site) fire break scheduling and implementation Project EMP Hot works procedures in place Regular inspections of generators and other sources of heat/power Fire extinguishers available around site and on all vehicles and machinery Training and inductions include Emergency Response Plan	D	3	17	Moderate	Moderate. Based on similar conditions.
E41	Creation of biting insect breeding grounds.	Increase in biting insect populations. Increase potential for biting insect borne diseases	Biting insects can become a nuisance for site workers and have the potential to transmit diseases.	C	2	18	Moderate	Implementation of Project EMP Minimise surface water ponding Regular site inspections for potential breeding grounds Monitor complaints register	D	2	21	Low	Moderate. Based on similar conditions.
E42	Inappropriate liquid and solid waste disposal.	Production of leachate leading to the contamination of groundwater. Localised soil contamination	Generation of waste oils, lubricants and solid waste such as batteries, scrap metal and oily rags etc. need to be disposed of in an appropriate manner such as waste oil bins and taken off site. If this is managed properly, it is unlikely that waste should cause impacts to the surrounding environment.	D	3	17	Moderate	Manage disposal of wastes in accordance with the Project EMP (including bunded waste oil bins) Hazardous materials stored in accordance with Australian standards Spill kits available around site and spill clean-up procedures implemented Employees and contractors trained in clean up procedures	E	2	23	Low	Low probability of occurrence as inert rubbish continually managed
E43	Chemical spills and leaks.	Seepage of liquids into groundwater leading to contamination of the aquifer. Localised soil contamination. Surface water contamination.	Processing chemicals (cyanide etc.) will be the principle dangerous goods stored on site (other than hydrocarbons). It is possible that chemicals may spill and leak if stored inappropriately.	C	3	13	High	Chemical and hydrocarbon storage facilities bunded and managed in accordance with the Hazardous Materials Management Plan and the Project EMP. Minimal storage of chemicals on site at all times. Weekly inspections of storage areas for any potential leaks Cyanide management and storage will be aligned to the International Cyanide Management Code for the Gold Mining Industry. Appropriate training and inductions for the management of cyanide on site	D	3	17	Moderate	High chance of no major spills. Based on historical basis.
E44	Dust emissions.	Dust emissions impact upon neighbours or Arnhem Highway. Creating safety issue during operations.	Dust is not expected to be a significant issue during operations. Periodically there will be higher levels of dust during clearing. Clearing will be undertaken on the least windy forecast days and dust suppression will be implemented via a water cart.	A	1	15	High	Dust suppression around site Implementation of Dust Management Plan Progressive clearing and progressive rehabilitation Avoid clearing on windy days Visual monitoring of emissions	C	1	19	Low	Moderate. Based on standard industry practice & similar conditions prevailing during previous mining phases at TGU.
E45	Noise and vibration emissions from blasting or traffic.	Noise levels impact upon surrounding landholders or employees on site.	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.	C	2	18	Moderate	All mining underground Project EMP Noise levels within noise regulations limits Monitor complaints register	D	2	21	Low	Moderate. Based on standard industry practice & similar conditions prevailing during previous mining phases at TGU.
E46	Visual amenity impacts	Viewscape from Arnhem Highway impacted	There is no new planned infrastructure as part of the recommencement of operations at TGU facing the Arnhem Highway. The only additional infrastructure is the WSD and the embankment lift of the TSF. The TSF will be raised by 6 m. It is unlikely that this will create impacts to visual amenity.	D	2	21	Low	If necessary, vegetation for screening Detailed engineering design of infrastructure Monitor complaints register	E	2	23	Low	Moderate. Based on standard industry practice & similar conditions prevailing during previous mining phases at TGU.
E47	Sterilising gold resources.	Reduces future options	The geology of the TGU project has been and will continue to be assessed in great detail to determine the nature of the ore body.	D	4	12	High	Resource model, exploration drilling, mine design Accurate post-closure survey	E	4	16	High	High. Based on testing and modelling.

Table 10: Health and Safety Risk Assessment

Inherent Risk									Residual Risk				
Risk #	Source of Impact	Consequence	Discussion	Prob	Cons	Risk	Risk	Mitigation & Monitoring	Prob	Cons	Risk	Risk	Certainty and Justification of Residual Risk Rating
1.0 Exploration/Environmental /Survey		Consequence	Discussion	Prob	Cons	Risk	Risk	Controls	Prob	Cons	Risk	Risk	Certainty and Justification of Residual Risk Rating
H1	Aircraft Operations	Crash of aircraft leading to Injury/mortality of personnel or resultant bushfire.	Aircraft may at times be used to do aerial surveys. There is no flying in or out of site, accommodation will be offsite and employees will drive in and drive out.	E	5	11	High	All aviation work to be conducted following a risk assessment and only by reputable, competent operator. Operator to obey all air traffic control regulations Emergency training and satellite phone / EPIRB equipment	E	5	11	High	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully. Administrative Controls. The likelihood of an aircraft crash is extremely rare, however the consequence of a crash is significant and therefore a residual risk rating of 11 is justified.
H2	Lost / Stranded Personnel	Dehydration, starvation and exposure to the elements leading to Injury/mortality of personnel	Exploration or environmental personnel may require to work remotely when undertaking sampling or monitoring. Daily call in procedure in place	D	3	17	Moderate	Remote work procedure, environmental procedures, radio communications, and satellite phone requirements Pre-task risk assessment	E	2	23	Low	High. Historical basis - standard industry practice. Similar mitigation currently being used & previously used at Toms Gully.
H3	Slip, trip or fall into old workings.	Injury/mortality of personnel	The TGU project contains old underground workings that could pose risks to unaware site personnel. However, most of these would have been closed and blocked off.	D	4	12	High	Pre-task risk assessment Area survey and distribute maps and locations of old workings and block off areas Inductions raise awareness regarding old workings locations	E	2	23	Low	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H4	Manual handling of heavy equipment, chemicals or sharp objects	Injury (strains, burns, cuts) /mortality of personnel	Construction and operational work may require manual handling of gear and equipment	B	3	9	High	Manual handling awareness training Take 5 pre-task hazard assessment JHA process, work procedures, dedicated lifting equipment PPE	E	2	23	Low	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H5	Heat exposure	Heat stroke, dehydration or mortality of personnel	In the dry season, temperatures can rise to 40 degrees Celsius. This coupled with over exertion of physical exercise can result in severe dehydration or hyponatremia.	B	3	9	High	Hydration and heat exposure awareness training, site induction Fatigue management procedures and training PPE	D	3	17	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H6	Uncontrolled movement of equipment	Hit by or crushing by equipment leading to Injury/mortality of personnel	The TGU Project will involve numerous operational equipment, including haul trucks, excavators, drill rigs, light vehicles and underground equipment.	C	5	4	Extreme	Trained and licenced drill operators, specialised equipment operated by competent contractors, demarcated work areas, isolation procedure for maintenance. Pre-start inspections and pre-task risk assessment (take 5s) Licenced operators only for all equipment. U/g speeds max 30kph, surface speeds per signage up to 40kph	E	3	20	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H7	Compressed Air Release	Injury/mortality of personnel	Safety chains on air lines	D	4	17	High	Trained and competent operators, minimum equipment specifications, equipment pre-start checks, hose whip chains, hazard reporting. PPE Emergency Response Team (including site medic)	D	3	17	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H8	Crush Injury	Injury/mortality of personnel		C	5	4	Extreme	Compliance to regulations re machine guarding, workplace inspections, trained and competent maintenance personnel, isolation procedures. Training for emergency response team	D	3	17	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H9	Fall from Heights	Injury/mortality of personnel	The requirement to work from heights at the TGU Project is not often required. Only trained personnel will undertake such work.	D	4	7	High	Handrails, fall prevention procedures, working at height procedures and training, maintenance procedures, trained and competent operators and maintainers Training for emergency response team	E	4	16	High	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H10	Rotating Equipment	Injury/mortality of personnel	Guards around all rotating equipment and drill strings	D	4	8	High	Trained drill operators, specialised equipment operated by competent contractors, demarcated work areas, isolation procedure for maintenance, machinery guarding and limit switches Training for emergency response team	E	3	20	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H11	Chemical Handling	Injury/mortality of personnel	Hazardous material will be transported and stored on site. This includes chemicals for processing as well as hydrocarbons such a fuel, oils and lubricants.	B	3	9	High	Specialised contractor, site induction, hazardous material training (as appropriate), MSDS, first aid, emergency response, Take 5 pre-task risk assessment, Hazardous Materials Management Plan Training for emergency response team (including site medic) Weekly inspections of storage areas.	C	2	18	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H12	Drilling into Workings old and/or new	Injury/mortality of personnel		D	4	12	High	Survey control, all work requires a signed plan. Pre-task risk assessment Inductions include old site workings awareness Only trained and licenced operators	E	3	20	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.

H13	Fire on site can cause toxic gases or explosion of ammonium nitrate. Natural bushfire risk	Poisoning or Injury/mortality of personnel	Bushfires can occur during the dry season. PG will ensure appropriate hot work procedures and implement a fire management plan to ensure fires are not caused as a result of operations.	C	3	13	High	Equipment specifications and maintenance system, fire extinguishers on equipment, evacuation procedures, emergency response team training Hot work procedures Maintenance of firebreaks and undertaking controlled burning in cool season Appropriate storage of hazardous materials. Explosives stored an appropriate distance away from site	D	3	17	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
2.0 Surface Mining		**Consequence**	**Discussion**	**Prob**	**Cons**	**Risk**	**Risk**	**Controls**	**Prob**	**Cons**	**Risk**	**Risk**	**Certainty Justification of Residual Risk Rating**
H14	Light Vehicle – Equipment Collision	Injury/mortality of personnel or pedestrians	Traffic will increase on the Arnhem Highway during recommissioning and operational phases. Particularly since the nature of work is drive in and drive out. Traffic will also be of a high level around the mine site during peak operations.	B	5	2	Extreme	Traffic management plan, Mobile equipment standard / procedures, operating procedures, driver's license required, 4 x 4 (where required), radios in vehicles and heavy equipment, heavy equipment operator training, demarcation of pedestrian areas, where practicable segregation of heavy and light vehicles, road rules and signs aligned to public roads (as far as reasonably practicable) Positive communication to operators at all time.	D	4	12	High	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully. Administrative & Engineering controls.
H15	Heavy Equipment Collision	Injury/mortality of personnel	Heavy machinery such as haul trucks, drill rigs and earthworks will be in operation on site but speeds of this equipment are approx 10kph	D	3	17	Moderate	Traffic management plan, Road design construction and maintenance, competent operators, competency based training, site inductions and training processes, demarcation of HV/ LV & Pedestrians where appropriate, minimum equipment standards, preventative maintenance program, hazard reporting process Positive communication with operators at all times.	E	2	23	Low	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully. Administrative & Engineering controls.
H16	Dust or Noise related Health Hazards and/or Health issues	Injury/mortality of personnel		B	3	9	High	Operating procedures, enclosed dust collection systems, hearing protection, health monitoring, dust suppression, PPE where required, noise suppression, personal risk assessment, water monitoring procedures, minimum equipment specifications	C	2	18	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully. Administrative & Engineering controls.
H17	Slips/Trips due to ground instability	Injury of personnel		A	2	10	High	Site and area inductions, housekeeping standards, workplace inspections, Take 5 hazard assessment, appropriate construction	C	2	18	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully. Administrative & Engineering controls.
H18	Subsidence / Voids	Injury/mortality of personnel		D	5	7	Extreme	Mine design, survey control, void monitoring if required, pit slope design, geotechnical control / oversight as required, bunding	E	3	20	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully. Administrative & Engineering controls.
H19	Equipment accidents on waste dump/over edge	Injury/mortality of personnel	Reverse bunds in place. Dumps checked and tidied daily.	D	3	17	Moderate	All edges bunded minimum 1/2 height of wheel, competent operators, supervision, hazard awareness training, hazard reporting process, equipment operating procedures, procedure for dump operation,	E	3	20	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully. Administrative, Engineering controls & Substitution (underground and in- pit dumping only).
H20	Explosives incident	Injury/mortality of personnel	in hole delivery by independent supplier from offsite	E	3	20	Moderate	Explosives management plan, trained and competent operators, explosives handling procedures, explosives inventory procedures, supervision, auditing, workplace inspections, magazine control procedures, delegated magazine keeper, minimum equipment specifications	E	2	23	Low	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully. Administrative controls.
H21	Tyre/Fires/Explosions	Injury/mortality of personnel	u/g tyre fires causing toxic environment but refuge chambers in use	E	3	20	Moderate	Tyre management procedures, emergency response, tyre fire risk training, equipment operator training includes risk and actions required, trained and competent maintenance personnel, minimum standards for tyres and tyre fitting, trained and competent tyre fitters, third party engagement as required to monitor standards/ procedures/ compliance.	E	3	20	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully. Administrative controls.
H22	Fatigue / Fitness for Work	Injury/mortality of personnel	Daily breath testing	B	3	9	High	Fitness for work procedures, fit for work assessment, health monitoring (as appropriate), drug and alcohol testing /procedures/ and awareness training, fatigue awareness training,	C	1	22	Low	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully. Administrative controls.
3.0 Mining Underground		**Consequence**	**Discussion**	**Prob**	**Cons**	**Risk**	**Risk**	**Controls**	**Prob**	**Cons**	**Risk**	**Risk**	**Certainty and Justification of Residual Risk Rating**
H23	Rock falls	Injury/mortality of personnel	Ground control plans in place	C	3	12	High	Geotechnical engineering, ground control management plan, minimum ground support standards, ground support installation procedures, ground monitoring procedures, survey standards, work procedures and training, competent operators, bunding/fencing/signage	C	2	12	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully. Administrative & Engineering controls.
H24	Ground Support Failure / Inadequate Support Design Injury/mortality of personnel	Injury/mortality of personnel		B	5	2	Extreme	Geotechnical engineering, ground control management plan, minimum ground support standards, ground support installation procedures, ground monitoring procedures, survey standards, work procedures and training, competent operators, bunding/fencing/signage	E	5	11	High	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully. Administrative & Engineering controls.

H25	Seismicity/ rock burst	Injury/mortality of personnel	Shallow mine. Engineered pillars	D	3	17	Moderate	Geotechnical engineering, ground control management plan, minimum ground support standards, ground support installation procedures, ground monitoring procedures, survey standards, work procedures and training, competent operators, backfilling of mined areas as required	D	2	23	Low	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully. Administrative & Engineering controls.
H26	Working around stope brows / rock fall / backfill	Injury/mortality of personnel	not relevant for R&P method but around vent rise risky	E	2	21	Low	Specific procedure for working around a brow or open hole, demarcation / sign standards, backfill procedure, trained and competent operators, JHS & Take 5	D	2	23	Low	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully. Administrative & Engineering controls.
H27	Uncontrolled break through (fly rock, blast percussion etc.)	Injury/mortality of personnel	multiple close breakthroughs in R&P	C	5	4	Extreme	Minimum standards for drill and blast procedures, survey procedures, specific "breakthrough" procedure including minimum exclusion distances, evacuation before blast, barricade	D	1	24	Low	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully. Administrative, engineering & Eliminating controls.
H28	Blasting	Injury/mortality of personnel		C	5	4	Extreme	Explosives management plan, trained and competent operators, explosives management and handling procedures, explosives inventory procedures, supervision, auditing, workplace inspections, magazine control procedures, delegated magazine keeper, reactive ground assessment prior to recommencement of mining, evacuation prior to blast, barricade area	D	2	21	Low	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully. Administrative, Engineering & Eliminating controls.
H29	Hazards with entry into Open Stope	Injury/mortality of personnel	not relevant in R&P method	E	2	23	Low	Geotechnical engineering, ground control management plan, minimum ground support standards, ground support installation procedures, ground monitoring procedures, survey standards, work procedures and training, competent operators, barricades.	E	2	23	Low	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H30	Remote Bogging (Hit by)	Injury/mortality of personnel	High traffic Around multiple breakthroughs	D	5	7	Extreme	Tele remote loaders, trained and competent operators, demarcated areas, pedestrian exclusion zone, proximity detection hardware (or procedures), Deadman controls,	E	2	23	Low	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H31	Hazards with re-entry to old workings	Injury/mortality of personnel		D	5	7	Extreme	Underground ground control standard, ground control management plan, minimum ventilation requirements, gas monitoring, ground control inspection procedures, trained and competent operators and supervisors, re-entry procedure, barricades	D	2	21	Low	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H32	Ventilation failure / Fuming	Injury/mortality of personnel		B	3	9	High	Minimum standards for mine ventilation, delegated trained and competent ventilation officer, mine ventilation design, hazard reporting and action processes, supervision, legislative requirements, vent failure warning system, barricades	D	2	21	Low	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H33	Intersecting Gas	Injury/mortality of personnel	no records for past 20yrs	B	3	9	High	Specialised drilling contractor, site induction, gas management procedure, gas detection, various ventilation risk controls	E	2	23	Low	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H34	Electrical Equipment Failure	Injury/mortality of personnel		B	3	9	High	Electrical equipment minimum specifications, competent and qualified electrical personnel, electrical maintenance processes and procedures, minimum standards for electrical installations and infrastructure,	C	2	18	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H35	Entrapment of Personnel	Injury/mortality of personnel	Use of refuge chambers and procedure.	D	4	12	High	Emergency response procedures, training, emergency drills, second means of egress, ground control management systems and processes, mobile equipment management and maintenance processes, Emergency and Crisis Management Plan	E	3	20	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
5.0 Process Plant		**Consequence**	**Discussion**	**Prob**	**Cons**	**Risk**	**Risk**	**Controls**	**Prob**	**Cons**	**Risk**	**Risk**	**Certainty and Justification of Residual Risk Rating**
H36	Working in Confined space	Injury/mortality of personnel		B	5	2	Extreme	Confined space procedures, gas testing and monitoring, confined space survey, signage for all confined spaces, confined space entry training and competency assessment,	D	3	17	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H37	Lifting and Slinging, equipment falling	Injury/mortality of personnel		B	5	2	Extreme	Work procedures, JHA process, trained and certified riggers and crane operators, kickboards on walkways/ work areas where required, demarcation and signage procedures, minimum equipment specifications	C	2	18	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H38	High Voltage contact	Injury/mortality of personnel		D	5	7	Extreme	Electrical installations as per AS, qualified and certified electricians, isolation procedures, regular testing and tagging of equipment, specific procedures for HV management	E	5	11	High	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H39	Slope Stability / wall failure - Tailings Dam/ water storage dams	Injury/mortality of personnel		D	5	7	Extreme	Tailings dam and water storage dams engineer designed, site management of tails dam, monitoring and management of all water storage dams	E	3	20	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H40	Molten Metal Handling	Injury/mortality of personnel	Gold room procedures	C	3	13	High	Gold room operator competency based training, PPE, Gold room work procedures, hazard identification and action management process	D	3	17	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H41	Uncontrolled Digging / Excavations	Injury/mortality of personnel		B	3	9	High	Permit to dig procedure, hazard identification, take 5 pre-task hazard assessment, JHAs,	C	2	18	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.

H42	Structural Failure	Injury/mortality of personnel		E	5	11	High	Fixed plant inspection and maintenance processes, mill / infrastructure review prior to commencement, barricades	E	1	25	Low	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H43	Radiation Source risks	Injury/mortality of personnel		D	4	12	High	Appointment of trained and competent radiation officer, radiation source management procedures, legislative requirement compliance, workplace inspections, signage, demarcation as required / appropriate	E	4	16	High	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
6.0 Services (Other)		**Consequence**	**Discussion**	**Prob**	**Cons**	**Risk**	**Risk**	**Controls**	**Prob**	**Cons**	**Risk**	**Risk**	**Certainty and Justification of Residual Risk Rating**
H44	Dangerous Goods Transport, Storage, Handling, spillage etc. either on or off site (e.g. cyanide, fuel, etc.)	Impact to human health through contact with hydrocarbons and/or chemicals. Injury/mortality of personnel safety	Hydrocarbons (fuel, oil and lubricants) as well as processing chemicals will be transported and stored on site. Procedures as per regs.	D	3	17	Moderate	DG legislation, minimum equipment specifications, equipment pre-start checks, hazard reporting, maintenance systems and procedures, fire suppression on mobile equipment, fire extinguishers, emergency response training and procedures, emergency exits, fire response training, Hazardous Materials Management Plan Transport and storage of hazardous materials aligned to Australian standards	D	3	17	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H45	Equipment / goods fall from storage racks/ area within the stores	Injury/mortality of personnel safety	A store room will be managed by the stores manager which includes maintenance spares, equipment, oils and lubrications.	C	2	18	Moderate	Minimum standards for storage of goods, housekeeping standards, dedicated lifting equipment, hazard awareness training, Take 5 pre task risk assessment, Hazardous Materials Management Plan	D	2	21	Low	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H46	Livestock on Roads	Vehicle and livestock collision causing Injury/mortality of personnel and livestock	The TGU project is surrounded by a pastoral lease containing cattle.	B	4	5	Extreme	Trained and competent operators, NT Licence required for main roads, equipment pre-start checks, site induction, and LV permit, speed limits, Paddock and site boundary fence maintenance, Traffic Management Plan Regular stakeholder engagement with pastoralist	D	3	17	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H47	Snakes, wildlife, mosquitoes, spiders, crocodile attack	Injury/mortality of personnel	Several fauna species exist within the project area that can attack when feeling threatened. Including dogs, snakes, dingoes and crocodiles. Bites from some species including snakes and spiders can be fatal. However attacks by dogs and dingoes or crocodiles are unlikely unless the animal is injured or threatened. Other than environmental personnel undertaking water monitoring, crocodile attacks are highly unlikely.	C	4	8	Extreme	Emergency response procedures Training, inductions and hazard awareness regarding dangerous species Medical assistance on site, personnel trained in First Aid, ambulance on site PPE Emergency and Crisis Management Plan	D	3	17	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H48	Cyclone / infrastructure damage / people incidents/ lightning strikes	Injury/mortality of personnel	Cyclones can cause extreme weather such as high winds and lightning strikes causing infrastructure damage and human injury.	C	5	4	Extreme	Rated buildings, cyclone management plan, emergency response procedures and training, barricade & evacuate site, Emergency and Crisis Management Plan Stop work procedures in event of lightning strikes Training and inductions for evacuation plans and lightning procedures	C	3	13	High	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H49	Health hazards: bacteria / contaminants/ bugs in water or soil	Injury or illness or mortality of personnel	Potable water will be sourced either via haulage truck from off-site, or by re-establishing the existing reverse osmosis (RO) water treatment plant on-site. The RO plant is likely to be supplied with bore water from mine dewatering bores.	C	3	13	High	Water monitoring procedures, health monitoring (as appropriate), PPE, minimum equipment specifications Treatment of potable water as necessary Water management plan	D	3	17	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H50	Contact with Power Line	Injury/mortality of personnel, power lines can be knocked over during cyclones or extreme weather events.	Power lines run through the project for electricity purposes.	D	5	7	Extreme	Electrical installations as per Australian Standards, Qualified and certified electricians, isolation procedures, regular testing and tagging of equipment, minimum clearances, enhance visibility of lines Regular maintenance of power lines	E	3	20	Moderate	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
6.0 Workshop		**Consequence**	**Discussion**	**Prob**	**Cons**	**Risk**	**Risk**	**Controls**	**Prob**	**Cons**	**Risk**	**Risk**	**Certainty and Justification of Residual Risk Rating**
H51	Incorrect use of cranes / forklifts	Injury/mortality of personnel		C	4	8	Extreme	Site wide competency based training, inductions, trained and competent supervisors, equipment pre-start checks, audits and inspections, hazard reporting, pre-shift meetings Emergency response team training (include site medic)	D	4	16	High	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.
H52	Poor Maintenance Procedures	Injury/mortality of personnel due to equipment failure or equipment fire		C	4	8	Extreme	Trained and competent maintenance supervisors, equipment pre-start checks, audits and inspections, hazard reporting, pre-shift meetings Emergency response team training (including on site medic)	D	4	12	High	High. Historical basis - standard industry practice. Similar mitigation used previously at Toms Gully.

Table 11: Social & Economic Risk Assessment

Inherent Risk									Residual Risk				
Risk #	**Source of impact**	**Consequence**	**Discussion**	**Prob**	**Cons**	**Risk**	**Risk**	**Mitigation & Monitoring**	**Prob**	**Cons**	**Risk**	**Risk**	**Certainty and Justification of Residual Risk**
1.0 Economic		**Consequence**	**Discussion**	**Prob**	**Cons**	**Risk**	**Risk**	**Controls**	**Prob**	**Cons**	**Risk**	**Risk**	**Certainty and Justification of Residual Risk Rating**
S1	Adverse Change in Au price	Project no longer financially viable.		C	3	13	High	Target Opex costs in lower quartile of Australian production costs combined with a forward gold price hedging strategy	D	3	17	Moderate	Moderate. Similar conditions. Similar mitigation used previously at Toms Gully.
S2	Adverse change in US$ FX rate	Project no longer financially viable.		C	3	13	High	Target Opex costs in lower quartile of Australian production costs. Consider FX hedge	D	3	17	Moderate	Moderate. Similar conditions. Similar mitigation used previously at Toms Gully.
S3	Adverse change in fuel prices	Project no longer financially viable as overheads increase.		C	3	13	High	Target Opex costs in lower quartile of Australian production costs. Consider and review any potential advantages of a diesel fuel price hedging strategy	D	3	17	Moderate	Moderate. Similar conditions. Similar mitigation used previously at Toms Gully.
S4	Extreme rainfall event	Water storage dams overflow, infrastructure failure, extended periods of no operations.	Cyclones or extreme rainfall events can cause operational work delays which result in schedule delays. Unaccounted for expenses to clean up and fix infrastructure damages.	C	4	8	Extreme	Ensure adequate freeboard and pumping capacity available at all times. Ensure availability of effective drainage which can be used during high rainfall events. Install and maintain effective water drainage control bunds around potential water ingress channels Design infrastructure to withstand PMF events Financial provisioning for cyclone events.	D	4	12	High	Moderate certainty. Similar mitigation used previously at Toms Gully. Residual risk ranking downgraded to Unlikely if early planning and detailed design are implemented.
S5	Adverse change in metallurgical recoveries of ore	Project no longer financially viable as overheads increase.		C	3	13	High	Metallurgical recovery testing of exploration samples on an appropriate density to undertake recovery modelling, monitor in production reconciliation studies	D	3	17	Moderate	Moderate certainty. Similar conditions. Similar mitigation used previously at Toms Gully.
S6	Major mechanical failure of processing plant	Major operational delays and unexpected expenses to fix damages.		D	3	17	Moderate	Ensure appropriate warranties in place and maintain appropriate critical mechanical spares inventory Regular maintenance and inspections of plant Engineer sign off before recommencement of plant	E	3	20	Moderate	Moderate certainty. Standard industry practice. Similar mitigation used previously at Toms Gully.
S7	Ore Reserve modelling estimation error	Project no longer financially viable.	**mining to date only in upper low grade areas**	C	2	21	Moderate	Grade control and mapping programmes combined with effective production reconciliation studies both present and historical	E	2	23	Low	Moderate. Standard industry practice. Similar mitigation used previously at Toms Gully.
S8	Serious Contractual Dispute	Operational delays. Project financial expenses raised. Reputational damage.	There is potential for disagreements with mining contractors (or drill and blast contractors) with Primary Gold.	D	3	18	Moderate	Use of Australian Standards for preparation of applicable and appropriate contract conditions; Conduct appropriate legal and commercial due diligence; Use only reputable established contract companies with record of successful completion	E	3	20	Moderate	Moderate. Standard industry practice. Similar mitigation used previously at Toms Gully.
S9	Skilled labour shortages	Potential draw of existing workers from other industries into better paying resource jobs leading to shortfalls in skilled labour.	The total number of personnel will peak at approximately 104. The TGU project is only 100 km from Darwin and thus shortages of skilled labour is not expected to be significant. The regions industry is mining and therefore an appropriately skilled workforce should be available.	C	2	18	Moderate	Work with local training providers to develop local training programs to provide unskilled people with opportunities to gain employment at the TGU project. Adoption of recruitment policies that allow for appropriate notice periods to be served for new employees	D	2	21	Low	Moderate. Similar conditions.
2.0 Social		**Consequence**	**Discussion**	**Prob**	**Cons**	**Risk**	**Risk**	**Controls**	**Prob**	**Cons**	**Risk**	**Risk**	**Certainty and Justification of Residual Risk Rating**
S10	Additional highway commuter traffic and associated road safety concerns.	Increase in road vehicle accidents. Increased maintenance of highway and access roads.	Drive in and drive out employees as well as increased service trucks to and from site.	B	3	9	High	Implement bus/coach transport on shift by shift basis to transport employees to work and home. Schedule delivery's at staged times so road is not inundated with trucks. Increase road safety signage.	D	3	17	Moderate	Moderate certainty. Similar conditions. Administrative Controls. Implementing thorough road safety planning and administration of traffic will reduce the risk of heavy traffic and accidents and therefore moderate residual risk is expected/
S11	Negative impact on housing availability and affordability	Increase in demand for accommodation, and reduction in affordability of rental housing leading to rent escalation and housing price inflation	The total number of personnel will peak at approximately 104. Accommodation will be off-site. Workers are expected to be primarily sourced locally. Some accommodation will be made available by Primary Gold via outsourcing to nearby accommodation facilities.	C	2	18	Moderate	Recruit locally from within existing labour pool	D	2	21	Low	High. Based on data. Administrative Controls.
S12	Negative impact on tourism	Visual amenity impacts. Contamination of surface water impacting Mary River Catchment and National Park.	Impacts to tourism from the TGU operations is unlikely to due distances from tourist areas.	D	2	21	Low	Lower visual impact of project site from highway using vegetation placement and good design Groundwater and surface water monitoring AMD management plan	E	2	23	Low	Moderate. Similar conditions. Administrative Controls.

S13	Negative impact on demand for NT provided services	Decline in services needed.	Majority of required services are already in place at the TGU project. Negative impacts on NT provided services is unlikely as the project will not take work away from established service providers.	D	2	21	Low	Acquire any additional services on commercial terms	E	2	23	Low	Moderate. Similar conditions. Administrative Controls.
S14	Negative impact on community cohesion and inclusion	Decline in community health, safety and wellbeing increase in incidence of anti-social behaviour impacts on vulnerable groups such as women and Indigenous groups.	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.	C	2	18	Moderate	Recruit locally from a demographic where mining is already significant proportion of industry of employment Establish a complaints and feedback register Establish clear mechanisms for ongoing stakeholder engagement	D	2	21	Low	Moderate. Similar conditions. Administrative Controls.
S15	Negative impact on other land users	Use of hazardous materials on site such as use of ammonium nitrate for blasting or cyanide for processing can be spilled during transportation, spread of weeds from vehicles and machinery. Contamination of surface water or groundwater from AMD.	Potential risks to pastoralist's livestock drinking water quality or land degradation on pastoralists land.	C	3	13	High	Operating service agreement and executed land use agreement in place	D	3	17	Moderate	High. Based on data. Administrative Controls.