



Appendix 3

Analysis of Environmental Risks

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A3.1 INTRODUCTION

Risk is the chance of something happening that will have an impact upon the objectives or the task which, in this case, is the safe and environmentally responsible construction and operation of the Project. Risk is measured in terms of consequence (severity) and likelihood (probability) of the event happening. The allocation of a qualitative consequence ranking of the potential impact(s) occurring for each risk source was based on the definitions defined **Table A3.1** whilst the qualitative likelihood or probability ranking was defined in accordance with **Table A3.2**. The risk ranking was established based upon the matrix presented in **Table A3.3**. These tables have been developed generally in accordance with Standards Australia “HB 203:2012 Managing environment-related risk”.

It is noted that the analysis of risks focused on those aspects of the Project that do not form a component of the existing and approved TGO operations. That is, the risk analysis focused on the changed risks associated with the proposed activities.

Table A3.1
Qualitative Consequence Ratings

Level	Descriptor	Description
1	Catastrophic	The potential to cause regional environmental impact/ecosystem damage or human health impact with impacts causing mine or business closure, e.g. major off-site release of a contaminant with long-term detrimental effects.
2	Major	The potential to cause substantial regional/local environmental damage or human health impacts which could result in major financial loss and/or prosecution, e.g. off-site release of a contaminant resulting in local ecosystem damage.
3	Moderate	The potential to cause substantial temporary or minor long-term damage, e.g. a minor water or large hydrocarbon off-site release with outside clean-up assistance required. May potentially result in a legal non-compliance.
4	Minor	The potential for a temporary or minor damage. No legal breach but may be non-compliant with internal environmental target, e.g. minor hydrocarbon spill.
5	Insignificant (I)	No detrimental effect, negligible environmental impact.

Table A3.2
Qualitative Likelihood Ranking

Level	Descriptor	Description
A	Almost Certain	Is expected to occur in most circumstances.
B	Likely	Will probably occur in most circumstances.
C	Possible	Could occur.
D	Unlikely	Could occur but not expected.
E	Rare	Occurs only in exceptional circumstances.



Table A3.3
Risk Rankings

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





 Low	 Medium	 High	 Extreme
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Table A3.4 presents the identified risk sources and the potential consequences of the identified risk and the risk rankings assuming standard controls together with the location of the proposed management and control measures identified within Section 6 of the EIS. In a number of cases, the standard controls would be appropriate to achieve an acceptable level of impact whereas for some cases, additional project or site-specific controls are required to achieve the required level of impact.

The four risk rankings are defined as follows.

- Low (L):** requiring a basic assessment of proposed controls and residual impacts. Any residual impacts are unlikely to have any major impact on the local environment or stakeholders.
- Medium (M):** requiring a medium level assessment of proposed controls and residual impacts. It is unlikely to preclude the development of the Project but may result in impacts deemed unacceptable to some local or government stakeholders.
- High (H):** requiring in-depth assessment and high level documentation of the proposed controls and mitigation measures. Ultimately, this level of risk may preclude the development of the Project.
- Extreme (E):** requiring in-depth assessment and high level documentation of the proposed controls and mitigation measures and possible preparation of a specialised management plan. Unless considered to be adequately managed by the controls and/or management plan, this level of risk is likely to preclude the development of the Project.



Table A3.4
Analysis of Environmental Risks

Risk Source	Consequence / Hazard	Risk with Standard Control Measures	Proposed Control Measures EIS Section Ref.	Residual Risk
TRAFFIC AND TRANSPORT				
Realigned public roads.	Realigned public roads fail to comply with required design standards.	11 (E1) ALARP	6.2.4	11 (E1) ALARP
	Realigned public roads fail to comply with required construction standards, thereby requiring additional maintenance compared with the existing road network.	12 (D2)		12 (D2)
	Realigned public roads result in additional travel time for motorists compared with the existing road network.	15 (A5) ALARP		15 (A5) ALARP
Site establishment and construction traffic.	Temporary intersections and traffic control operations result in increased safety risks.	11 (E1) ALARP		11 (E1) ALARP
	Disruption to motorists as a result of construction operations.	10 (A4)		10 (A4)
Operational traffic on the public road network.	Additional operational traffic results in increased safety risks for motorists.	11 (E1) ALARP		11 (E1) ALARP
	Additional operational traffic results in increased travel time for motorists.	22 (C5)		22 (C5)
	Deterioration of road condition and serviceability as a result of increased traffic.	18 (C4)		18 (C4)
VISIBILITY				
Construction of the SAR Waste Rock Emplacement and Residue Storage Facility 2.	Amenity impacts through the operation of machinery within sections of the Project Site visible from nearby privately-owned residences and the local public road network.	14 (B4)	6.3.4	21 (D4)
	Amenity impacts through the temporary and permanent change in content and composition of views from nearby privately-owned residences and the local public road network.	6 (A3)		15 (A5) ALARP
Construction of the SAR Waste Rock Emplacement and operation of equipment within the SAR Mine Site.	Distraction of motorists using the Newell Highway and Kyalite Road and resulting road accident	11 (E1) ALARP		

Table A3.4 (Cont'd)
Analysis of Environmental Risks

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Risk Source	Consequence / Hazard	Risk with Standard Control Measures	Proposed Control Measures EIS Section Ref.	Residual Risk
VISIBILITY (CONT'D)				
Lighting or sky glow impacts after dusk.	Visual intrusion or a reduction in scenic quality due to direct/indirect lighting or sky glow after dusk at nearby privately-owned residences.	18 (C4)	6.3.4	23 (E4)
	Impacts on astronomical operations at the Siding Spring Observatory and local observatories due to night sky brightness above the observatories created by the Project lighting.	25 (E5)		25 (E5)
NOISE AND BLASTING				
Site establishment and construction activities within the SAR Mine Site together with ongoing TGO activities.	Noise emissions exceeding the relevant criteria at residential receptors – daytime.	18 (C4)	6.4.5	21 (D4)
	Noise emissions exceeding the relevant criteria at residential receptors – evening and night.	9 (B3)		21 (D4)
Mining-related operations within the SAR and TGO Mine Sites.	Noise emissions exceeding the relevant criteria at residential receptors – daytime.	14 (B4)		21 (D4)
	Noise emissions exceeding the relevant criteria at residential receptors – evening and night.	9 (B3)		18 (C4)
Night-time Open Cut mining-related operations.	Noise emissions resulting in sleep disturbance at residential receptors.	8 (C2)		23 (E4)
Offsite transportation operations.	Noise emissions exceeding the relevant criteria at residential receptors along the transportation routes.	25 (E5)		25 (E5)
Road traffic noise from the realigned Newell Highway.	Relocation of existing highway traffic approximately 1km to the west of the current alignment results in increased noise emissions at residences to the west of the SAR Mine Site.	18 (C4)		21 (D4)
Ground vibration and airblast from Open Cut blasting activities.	Blasting emissions exceeding the relevant criteria at residential receptors.	21 (D4)		21 (D4)
	Blasting emissions exceeding the relevant criteria for surrounding infrastructure.	25 (E5)		25 (E5)
Rock propelled outside the Blast Management Zone.	Damage to nearby privately-owned property.	16 (E2)		





Table A3.4 (Cont'd)
Analysis of Environmental Risks

Risk Source	Consequence / Hazard	Risk with Standard Control Measures	Proposed Control Measures EIS Section Ref.	Residual Risk
AIR QUALITY AND GREENHOUSE GAS				
Emissions of TSP/PM ₁₀ /PM _{2.5} / Deposited dust from site establishment and construction activities within the SAR Mine Site together with ongoing TGO activities.	Health and/or amenity impacts on occupants within the nearby privately-owned residences and other sensitive receptors.	17 (D3)	6.5.5	20 (E3)
Emissions of TSP/PM ₁₀ /PM _{2.5} / Deposited dust from mining-related operations within the SAR and TGO Mine Sites.	Health and/or amenity impacts on occupants within the nearby privately-owned residences and other sensitive receptors.	13 (C3)		17 (D3)
Generation of gaseous emissions and blasting fumes.	Health and/or amenity impacts on occupants within the nearby privately-owned residences and other sensitive receptors.	23 (E4)		23 (E4)
Generation of gaseous cyanide emissions.	Health and/or amenity impacts on occupants within the nearby privately-owned residences and other sensitive receptors.	No Change		
Emissions of metals attached to particulate emissions and crystalline silica as a component of particulate emissions.	Health and/or amenity impacts on occupants within the nearby privately-owned residences and other sensitive receptors.	25 (E5)	6.5.5	25 (E5)
Scope 1 – additional on-site generation of Greenhouse Gas (GHG) emissions.	Climate change impacts from the Project, locally, regionally, and worldwide.	19 (B5)		19 (B5)
Scope 2 – additional off-site generation of GHG emissions associated with construction and mining operations.	Climate change impacts from the Project, locally, regionally, and worldwide.	25 (E5)		25 (E5)
Scope 3 – additional off-site impacts of GHG emissions associated with use of the produced gold.	Climate change impacts from the Project, locally, regionally, and worldwide.	25 (E5)		25 (E5)
SURFACE WATER				
Construction of SAR Mine components within natural catchments.	Loss of catchment and reduction in flows downstream of Mine Site.	15 (A5) ALARP	6.6.4	15 (A5) ALARP
Diversion of surface water around the SAR Open Cut.	Concentration of overland flows in areas that previously received lower flows, resulting in increased erosion or flooding risks.	14 (B4)		14 (B4)
	Diversion of overland flows from areas that previously received flows, resulting in reduced water availability for agricultural operations and changes in ecological processes.	15 (A5) ALARP		15 (A5) ALARP

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Risk Source		Consequence / Hazard		Risk with Standard Control Measures	Proposed Control Measures EIS Section Ref.	Residual Risk
SURFACE WATER (CONT'D)						
Release of sediment-laden water to downstream watercourses.	Impacts on aquatic ecosystem function.	18 (C4)	6.6.4	18 (C4)		
Release of chemical water to downstream watercourses.	Adverse impacts on aquatic ecosystem function and limitations upon use by current water users.	12 (D2)		12 (D2)		
Release of salt-laden groundwater to downstream watercourses.	Adverse impacts on aquatic ecosystem function and limitations upon use by current water users.	17 (D3)		17 (D3)		
Failure of Residue Storage Facility.	Damage to infrastructure and impacts on watercourse and aquatic ecosystem function.	11 (E1) ALARP		11 (E1) ALARP		
GROUNDWATER						
Interception and take of groundwater by open cut and underground mining.	Reduced groundwater levels and availability for existing groundwater users.	21 (D4)	6.7.5	23 (E4)		
	Reduced baseflow contribution to Gundong or Bulldog Creeks or the Bogan River impacting on streamflow and aquatic ecosystem health.	25 (E5)		23 (E4)		
Contaminated discharge/groundwater to fractured rock/deep aquifers.	Reduced groundwater quality for existing groundwater users.	23 (E4)		23 (E4)		
	Impacts to groundwater dependent ecosystems.	23 (E4)		23 (E4)		
Contaminated discharge/groundwater to alluvial aquifers. from contaminated water storage structures or the Residue Storage Facilities.	Reduced groundwater quality for existing groundwater users.	20 (E3)		20 (E3)		
	Impacts to groundwater dependent ecosystems.	20 (E3)		20 (E3)		
Discharge of contaminated groundwater into the natural drainage	Reduced water quality in surrounding watercourses.	13 (C3)		20 (E3)		
LAND AND SOILS						
Inappropriate soil stripping.	Incorrect/degraded soil stripped, resulting to less successful rehabilitation and increased rehabilitation costs and maintenance.	17 (D3)	6.8.5 and 6.9.5	20 (E3)		
	Inadequate soil stripped leading to a shortfall in soil resources, less successful rehabilitation and increased rehabilitation costs and maintenance.	20 (E3)		20 (E3)		
Inappropriate soil stockpiling.	Degradation of soil in stockpiles leading to less successful rehabilitation and increased rehabilitation costs and maintenance.	17 (D3)		20 (E3)		
	Erosion and loss of materials from soil stockpiles.	20 (E3)		20 (E3)		



Table A3.4 (Cont'd)
Analysis of Environmental Risks

Risk Source	Consequence / Hazard	Risk with Standard Control Measures	Proposed Control Measures EIS Section Ref.	Residual Risk
LAND AND SOILS (CONT'D)				
Inappropriate soil spreading.	Poor soil handling or inappropriate amelioration leading to less successful rehabilitation and increased rehabilitation costs and maintenance.	17 (D3)	6.8.5 and 6.9.5	20 (E3)
Changes to land uses impacting soil and land resources.	Reduction of the land and soil capability class within the SAR Mine Site.	6 (A3)		15 (A5)
BIODIVERSITY				
Planned clearing of vegetation communities within the SAR Mine Site.	Significant localised impacts upon habitat for listed fauna species (or the species themselves), threatened or rare native vegetation, vegetation communities or biodiversity values.	18 (C4)	6.10.5	18 (C4)
	Direct injuries to native fauna during clearing / earthworks.	21 (D4)		21 (D4)
Site establishment and mining operations.	Indirect impacts to fauna communities due to light / noise / blasting, etc.	18 (C4)		18 (C4)
Inappropriate maintenance/management of weeds and pest species.	Weeds and/or pests propagating from the Project Site impact the productivity of surrounding agricultural land or the biodiversity values of retained native vegetation communities.	21 (D4)		21 (D4)
	Weeds and/or pests impede successful rehabilitation.	21 (D4)		21 (D4)
Biodiversity offsetting.	Failure to adequately offset anticipated biodiversity impacts	17 (D3)		17 (D3)
ABORIGINAL CULTURAL HERITAGE				
Destruction of known Aboriginal artefacts during salvage and storage.	Loss of Aboriginal cultural heritage values and reduction of archaeological record.	15 (A5) ALARP	6.11.7	15 (A5) ALARP
Inadvertent removal or destruction of known Aboriginal sites and/or artefacts.	Loss of Aboriginal cultural heritage values and reduction of in situ archaeological record.	17 (D3)		17 (D3)
Removal or destruction of currently unidentified Aboriginal sites and/or artefacts.	Loss of Aboriginal cultural heritage values and reduction of in situ archaeological record.	20 (E3)		20 (E3)
HISTORIC HERITAGE				
Unauthorised destruction of known historic heritage sites.	Loss of heritage items displaying features of previous agricultural, commercial, residential or mining operations.	24 (D5)	6.12.6	24 (D5)
Unauthorised destruction of unknown historic heritage sites within approved disturbance areas.	Loss of heritage items displaying features of previous mining operations.	25 (E5)		25 (E5)



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Risk Source	Consequence / Hazard	Risk with Standard Control Measures	Proposed Control Measures EIS Section Ref.	Residual Risk
HAZARDS AND RISKS				
Sodium cyanide or cyanide solution spill and/or leak event within the Mine Site.	Impacts to the biophysical environment including impacts on human health, aquatic life, birds, plants and animals.	No change		
Sodium cyanide loss of containment events during transport.	Impacts to the biophysical environment including impacts on human health, aquatic life, birds, plants and animals.	No change		
Unplanned initiation of blasting agent.	Off-site impacts to surrounding infrastructure and human health.	20 (E3)	6.13.1.3	20 (E3)
Fire initiated off site.	Threat to operations and impacting on-site stock and infrastructure.	17 (D3)	6.13.2.3	17 (D3)
Fire initiated on site.	Threat to Mine Site operations.	17 (D3)		17 (D3)
	Fire spreading off site and impacting on privately owned stock and infrastructure.	17 (D3)		17 (D3)
ECONOMIC				
Downturn in gold price or increase in operating costs.	Project becomes uneconomic and closes prematurely resulting in more challenging rehabilitation.	12 (D2)	6.14.5	12 (D2)
Amenity impacts from construction and operations.	Localised impacts negatively affect the property market and lead to decreases in land prices.	21 (D4)		21 (D4)
Increase employment and population reduce available housing stock.	Property values increase and housing markets become constrained leading to rent increases.	21 (D4)		21 (D4)
Utilisation of resources (natural and human) for the construction and operation of the Project.	Mining operations leads to a reduction in resources / increased cost of operation for other industries within surrounding areas.	21 (D4)		21 (D4)
SOCIAL				
Construction and operation of the Project.	Changes to existing visual amenity for residents of surrounding properties that reduces social amenity.	6 (A3)	6.15.4	18 (C4)
	Creation of noise, vibration and dust that reduces social amenity.	13 (C3)		21 (D4)
	Impacts on ecosystem services including water use / availability and biodiversity that is valued by the community.	22 (C5)		22 (C5)
Land acquisitions.	Loss of community and generational properties resulting in changes in way of life.	6 (A3)		15 (A5) ALARP





Table A3.4 (Cont'd)
Analysis of Environmental Risks

Risk Source	Consequence / Hazard	Risk with Standard Control Measures	Proposed Control Measures EIS Section Ref.	Residual Risk
SOCIAL (CONT'D)				
Population increase associated with employment growth.	Changes in way of life.	13 (C3)	6.15.4	21 (D4)
	Reduced housing availability and associated increased housing costs.	17 (D3)		21 (D4)
	Inability of existing community services (i.e. health, education and childcare) in surrounding towns to accommodate additional demand.	17 (D3)		23 (E4)
	Poor relationships between existing community and mine workers / new arrivals.	17 (D3)		17 (D3)
CLOSURE, REHABILITATION AND FINAL LANDFORM AND FINAL LAND USE				
Closure	Unplanned closure as a result of economic or other factors.	16 (E2)	3.14	16 (E2)
Rehabilitation and final landform.	Failure to shape final landform as designed results in suboptimal final landform.	16 (E2)		16 (E2)
	Failure to spread topsoil as designed results in suboptimal rehabilitation and erosion of the final landform.	17 (D3)		17 (D3)
	Failure to spread seed of the appropriate species results in suboptimal rehabilitation and erosion of the final landform.	17 (D3)		17 (D3)
	Failure to undertake rehabilitation progressively results in inability to optimise rehabilitation procedures and increased risk of suboptimal rehabilitation.	12 (D2)		17 (D3)
	Failure to undertake appropriate rehabilitation maintenance and remediation (as required) results in erosion of growth medium and suboptimal rehabilitation.	17 (D3)		17 (D3)
Final land use	Failure to establish the nominated final land use results in suboptimal agricultural productivity or ecological improvements.	17 (D3)		17 (D3)



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