

Supporting Document Q4

**Environmental Impact Matrix - Draft
(SRK, SENES, July 2007)**

Environmental Impact Matrix

DRAFT

Report Prepared for
Giant Mine Remediation Project Team

**Department of Indian Affairs
and Northern Development**

Report Prepared by



July 2007

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Giant Mine Remediation Project Team

Department of Indian Affairs and Northern Development

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1 Introduction

An environmental impact matrix has been prepared to document potential impacts of the proposed remediation of the Giant Mine. The matrix focuses on environmental effects and impacts associated with the proposed work program and associated activities. The report presented below has three main sections:

- Details of the process used to develop the matrix
- Summary of the main findings from the process
- Detailed table displaying the full environmental matrix of impacts.

2 Process and Approach

2.1 Objective

The objective of preparing the environmental impact matrix is to ensure that all the activities, likely effects, and possible impacts before and after mitigation are identified. Presentation of the results in the form of a matrix ensures transparency and allows verification that all potential impacts have been considered.

2.2 Methodology

The comprehensive environmental impact matrix was developed using the Leopold matrix methodology. The following are the specific steps used to complete the matrix:

- Identify all remediation tasks and activities associated with the project
- Identify components of the physical, chemical, ecological, aesthetic and cultural, and socioeconomic environments likely to be affected by the project
- Identify and describe all possible impacts of the remediation tasks on the environmental components before mitigation and assign a significance value
- Define mitigation measures that will address the environmental effects of the activities
- Re-evaluate possible impacts after mitigation measures are applied – this is the residual impact.

The conventional Leopold impact significance ranking scale was simplified to the system described in Table 1. In this system, impacts are scored as no impact (0) or into three levels of negative impact (1, 2, 3). Impact level 1 is generally regarded as activities that are having an effect but where the size of the associated impact is not greater than what would occur naturally due to normal environmental variability. Impacts rated as 2 or 3 are regarded as having significance. Positive impacts were included in this matrix to allow reviewers to assess the tolerability of short term negative impacts as a means to achieve positive outcomes in the long term. The significance of impacts was evaluated before and after mitigation to ensure that the effectiveness of any mitigation measures could be demonstrated.

Table 1: Description of the Impact Significance Scale used in the Impact Matrix

Symbol	Impact Scoring Description
P	Positive impact Potential to change ecosystem or activity in a localised manner or more for any length of time or permanently in a positive way beyond natural variability.
0	No impact No change to the ecosystem or activity in a localised area above natural variability.
1	Minor Potential to change ecosystem or activity in a localised area for a short time, with good recovery potential. Similar scale of effect to existing variability. It is not generally possible to measure impacts in this range although it is recognised that activities are causing a disturbance.
2	Moderate Potential to change ecosystem or activity for up to 2 years, with reasonable recovery potential. Impacts are measurable.
3	Major Potential to change ecosystem or activity leading to medium or long term (+2 years) damage with low or no recovery potential. Impacts are measurable.

2.3 Participation

The Technical Advisor prepared the skeleton of the matrix and based the work packages on the proposed project implementation plan. The work packages were then reordered by a group of participants involved in the project to reflect the order of the work as it is presented in previous reports to ensure consistency and traceability. The following group facilitated by Mark Vendrig of SRK described the activities, effects and assigned the impact significance:

- **Bill Mitchell:** Manager, Giant Mine Project Team, INAC
- **Mark Cronk:** Senior Project Manager, Environmental Services, Western Region Public Works and Government Services, Canada (PWGSC)
- **Jennifer Dalman Sanders:** Policy Analyst, Contamination and Remediation Directorate INAC
- **James Lariviere:** Head, Technical and Environmental Services, Giant Mine Remediation Project, INAC.

The matrix was also reviewed by SRK and SENES staff familiar with the project. The review has focussed on the process of matrix development and ensuring consistency in assigning significance and description of impacts.

3 Summary of Activities and Mitigations

After the matrix was completed, the content was reviewed and a consolidated list of the main activities involved with the remediation project developed (Table 2). The list of activities is not exhaustive but indicative of the main activities only. In consolidating results in this way there is a risk that resolution can be lost, so this table should be used with caution. The complete tables are presented in the following section.

Table 2: Main Activities Identified for the various Remediation Tasks

Main Activities Identified	Description of Activities
On site monitoring	Monitoring of variables such as frozen ground. Requires vehicle movement activities.
Asbestos removal	Seal, remove, bag asbestos material typically using isolation tents and negative pressure.
Area cleaning	Sweeping, washing, bagging of contaminated material.
Cessation of pumping	Stopping underground pumping activities.
Local earthworks	Excavating, dumping, spreading, at work and soil remediation areas (Only some soil is arsenic contaminated).
Materials transport	Loading, hauling to different area, dumping. (Only some material is arsenic contaminated).
General construction	Concrete work, hammering, welding, grinding, washing, sweeping, crane hoisting, waste generation.
Road construction	Grading, compaction, spraying, tarmac/chip sealing.
Revegetation	Planting of new vegetation to stabilise or screen areas.
Loading	Flatbed transport, crane lifting activities.
Freeze plant operation	Active freezing operations with freezing units run off power grid.
Thermosyphon operation	Passive maintenance freezing done with heat exchangers.
Blasting	Drilling of rock, placing of charge and detonation.
Drilling	Drilling into rock with drill rigs and placing of casing.
Fencing	Surrounding areas requiring exclusion of people and animals with fence.

Note: that not all material on the site is contaminated and that materials transport and local earthworks have therefore been split to identify when contaminated material is being dealt with.

The main proposed mitigation measures (Table 3) have also been extracted into a consolidated list. The main potential impacts of the proposed remediation project are associated with contaminated and non-contaminated dust caused by local earthworks, materials transport, vehicle movement and blasting. It follows then that the main mitigation measures are focussed on limiting the extent of the potentially contaminated dust generation. In consolidating data in this way there is a risk that resolution can be lost so this table should also be used with caution.

Table 3: Main Mitigation Activities required to Manage Impacts

Main Proposed Mitigation Measures	Description
Monitoring	To decide if mitigation is required. Although not a mitigation measure in its own right monitoring to trigger mitigation measure use =follows the precautionary principle and encourages efficiency.
Settling pond and sediment control plan	Run off from all work areas will be collected in settling ponds, and water treated before release. All sediments collected will be removed and safely disposed of in suitable locations on site.
Screening vegetation	Vegetation which is planted to disrupt the viewing of developments or particular features. Screening can be placed close to receivers of or the source of the visual intrusion. Vegetation grows slowly in this area so it is considered a long term mitigation measure.
Standard asbestos controls	Negative pressure, isolation, bagging.
Flight coordination to avoid blast periods	To eliminate the possibility of air over pressure or noise, vibration shock or flying debris affecting aircraft blasting should be coordinated with air traffic so that it occurs when no planes are within a predetermined distance.
Road closures during blast periods	To keep vehicles clear of blast areas and potential flying debris.
Sound proofing	Static equipment can be sound proofed. Mobile equipment can only make use of built in mufflers.
Blasting mats	Blasting mats placed over the rock to be blasted arrests much of the flying debris. Best used in conjunction with limited charge size.
Dust suppression with water	Moistening of surfaces and excavation activities to minimise dust and escape of dust. Fine mist sprays can be used to capture dust near source.
Dust suppression with chemicals	Mainly used on roads and large areas requiring dust suppression.
Vehicle wheel and undercarriage washing when leaving high contamination areas	On leaving the site and specifically when leaving the contaminated areas the vehicle sides, undercarriage and wheels are washed down to remove any contaminated material that may be carried off the site. Wash water is sent for treatment.
Wash and waste water collection and treatment	Collection of waste water and contaminated water from any operations on site and treating it to remove contamination.
Haulage vehicle sealing/tarping	The covering of haul vehicle loads to prevent loss of material during vehicle movement.
Drill cutting and sludge collection, removal and safe disposal	The material that is produced during drill operations which can be wet or dry is to be managed at the drilling site and removed and disposed of in an appropriate area.

4 Residual Impacts

Although considerable effort can be made to control or manage the extent of the impacts it is often not possible to eliminate them entirely and many of the impacts are only reduced to 1, which is in the realm of natural variability. Furthermore even with the best efforts some impacts cannot be reduced below 2 or in some cases 3. The table of potential impacts with a residual of 2 or 3 is presented in Table 4.

Table 4: The Main Residual Impacts (after mitigation impacts, scoring 2 or 3 based on the significance ranking scheme used in the matrix)

Remediation Task	Activity	Environmental Effect	Mitigation Measures	Residual Impact
Build roads and pads	<ul style="list-style-type: none"> Earthmoving Materials transport Road construction 	<ul style="list-style-type: none"> Earthmoving dust and blasting noise. Materials transport dust and noise. Blasting noise and dust and spent explosive residue. Potential for blast debris material to enter the Creek. Power line in area of work. 	<ul style="list-style-type: none"> Dust suppression with water Dust suppression with chemicals Wheel and undercarriage washing Haulage vehicle sealing/tarping Wash and waste water collection and treatment 	<ul style="list-style-type: none"> Noise (2)
Drill and install from-surface freeze pipe casing (2-6 years)	<ul style="list-style-type: none"> Local earthworks Materials transport Drilling General construction Loading Fencing 	<ul style="list-style-type: none"> Drilling produces dust, slimes night lighting and noise Potential for hydrocarbon spillage Drilling operations could disturb surface soil with arsenic content 	<ul style="list-style-type: none"> Dust suppression with water Dust suppression with chemicals Wheel and undercarriage washing Haulage vehicle sealing/tarping Wash and waste water collection and treatment Screening vegetation Drill cutting and sludge collection, removal and safe disposal 	<ul style="list-style-type: none"> Noise (2) Sound quality (2) Built environment (3)
Flood to ~200 Level (below A2 Pit). Pumping will be restarted as needed to maintain water at this level.	<ul style="list-style-type: none"> Cessation of pumping (maintenance pumping still required). 	<ul style="list-style-type: none"> Reduces extent of drawdown cone, which could lead to ground water leaving the mine site. Water underground in mine workings may become stratified chemically. Arsenic might be mobilised, as well as other contaminants. Reduced power usage Reduced water volumes coming from mine and water treatment plant use. 	<ul style="list-style-type: none"> Monitoring to decide if mitigation is required 	<ul style="list-style-type: none"> Geochemical stability (2) Hydrogeology and underground mine water (2)
Brook & B4 Pits - backfill	<ul style="list-style-type: none"> Materials transport Earthmoving 	<ul style="list-style-type: none"> Backfilling with existing waste rock from site. Brook pit has a quartz vein with visible gold that could be used as educational tool. Backfilling will occur to level of vein, but due to loose material above this there is a danger of rock fall and it may be backfilled completely. 	<ul style="list-style-type: none"> Dust suppression with water Dust suppression with chemicals Wheel and undercarriage washing Haulage vehicle sealing/tarping Wash and waste water collection and treatment Decide if structures can be left in place that will allow vein to remain visible. 	<ul style="list-style-type: none"> Archaeology and heritage (3)
Build and use access roads to new borrow source and quarry areas)	<ul style="list-style-type: none"> Earthmoving Materials transport Drilling Blasting 	<ul style="list-style-type: none"> Noise, dust. Hydrocarbon spillage. Vibration. Potential sedimentation in creek from run off and working near water. Dust from travelling on roads. Calcium chloride/water used for dust suppression which could cause run off contamination. 	<ul style="list-style-type: none"> Dust suppression with water Dust suppression with chemicals Wheel and undercarriage washing Haulage vehicle sealing/tarping Drill cutting and sludge collection, removal and safe disposal Wash and waste water collection and treatment Blasting mats Flight coordination to avoid blast periods Road closures during blast periods Screening vegetation 	<ul style="list-style-type: none"> Soils and terrain (2)
Open borrow source	<ul style="list-style-type: none"> Earthmoving 	<ul style="list-style-type: none"> Noise, dust. 	<ul style="list-style-type: none"> Dust suppression with water 	<ul style="list-style-type: none"> Soils and terrain (2)

Remediation Task	Activity	Environmental Effect	Mitigation Measures	Residual Impact
areas and extract material	<ul style="list-style-type: none"> • Materials transport • Drilling • Blasting 	<ul style="list-style-type: none"> • Hydrocarbon spillage. • Potential sedimentation in creek from run off and working near water. • Dust from travelling on roads. • Water used for dust suppression which could cause run off contamination. • Removal of vegetation and soil. 	<ul style="list-style-type: none"> • Dust suppression with chemicals • Haulage vehicle sealing/tarping • Drill cutting and sludge collection, removal and safe disposal • Wheel and undercarriage washing • Settling pond and sediment control plan • Wash and waste water collection and treatment • Blasting mats • Flight coordination to avoid blast periods • Road closures during blast periods • Screening vegetation • Reclamation of the borrow pits and haul roads 	
Hazardous buildings (arsenic and asbestos preferred disposal in chamber 15 and low contamination building material in B1)	<ul style="list-style-type: none"> • Asbestos removal • Contaminated materials transport • Contaminated earthmoving • Loading • Area cleaning 	<ul style="list-style-type: none"> • Arsenic contaminated asbestos material, • Dust, noise, • waste and hazardous waste • Traffic volumes to disposal sites. 	<ul style="list-style-type: none"> • Standard asbestos controls • Dust suppression with water • Dust suppression with chemicals • Wheel and undercarriage washing • Haulage vehicle sealing/tarping • Wash and waste water collection and treatment 	<ul style="list-style-type: none"> • Waste production (2)
Non Hazardous buildings (may still contain asbestos and contamination assessment needed)	<ul style="list-style-type: none"> • Asbestos removal • Contaminated materials transport • Contaminated earthmoving • Loading • Area cleaning • Materials transport • Earthmoving 	<ul style="list-style-type: none"> • Little or no arsenic contamination • Some asbestos material, • Dust, noise • waste and hazardous waste • Traffic volumes to disposal sites. 	<ul style="list-style-type: none"> • Standard asbestos controls • Dust suppression with water • Dust suppression with chemicals • Wheel and undercarriage washing • Haulage vehicle sealing/tarping • Wash and waste water collection and treatment 	<ul style="list-style-type: none"> • Waste production (2)
A-Shaft (heritage society would like to retain this and the compressor house in addition to the museum)	<ul style="list-style-type: none"> • Asbestos removal • Contaminated materials transport • Contaminated earthmoving • Loading • Area cleaning • Materials transport • Earthmoving 	<ul style="list-style-type: none"> • Little or no arsenic contamination • Some asbestos material, • Dust, noise • waste and hazardous waste • Traffic volumes to disposal sites. 	<ul style="list-style-type: none"> • Standard asbestos controls • Dust suppression with water • Dust suppression with chemicals • Wheel and undercarriage washing • Haulage vehicle sealing/tarping • Wash and waste water collection and treatment • Decide if structures are safe and if they can be stripped of hazardous material to leave a heritage asset 	<ul style="list-style-type: none"> • Waste production (2) • Archaeology and heritage (3)

5 Conclusion

The environmental impact matrix helps to identify potential impacts and mitigation measures and residual impacts. Further development of the mitigation measures and further examination of the impacts are needed before any final conclusions can be drawn.

A weakness of the Leopold methodology is that it deals with activities and impacts in isolation. Depending on the final project schedule, some of those activities could overlap. Assessment of cumulative impacts is also needed before final conclusions can be drawn.

6 Complete Impact Matrix

Table 5: Complete Impact Matrix

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			Possible Environmental Impact Before Mitigation Measures are Applied																	Possible Residual Impacts after Mitigation Measures are Applied (Orange Cells)																															
			Mainly Construction Short Term						Mainly Long Term											Mainly Construction Short Term						Mainly long term																									
			Physical Chemical						Ecological			Aesthetics and Culture				Socio-economic				Physical Chemical						Ecological			Aesthetics and Culture				Socio-economic																		
Project Work Package	Activity	Environmental Effect	Air Quality	Noise	Light	Soils and Terrain	Geochemical Stability	Waste Production	Hydrogeology under-ground mine water	Hydrology/Water	Quality of Fish & Fish Habitat	Aquatic Ecosystems	Vegetation & Wetlands	Avifauna Wildlife and Wildlife Habitat	Archaeology Heritage	Visual	Sound Quality	Life Quality	Built Environment	Economic	Societal	Public Health & Safety	Regional Development	Effects of the Environment on the Project	Proposed Mitigation Measures	Air Quality	Noise	Light	Soils and Terrain	Geochemical Stability	Waste Production	Hydrogeology under-ground mine water	Hydrology/Water	Quality of Fish & Fish Habitat	Aquatic Ecosystems	Vegetation & Wetlands	Avifauna Wildlife and Wildlife Habitat	Archaeology Heritage	Visual	Sound Quality	Life Quality	Built Environment	Economic	Societal	Public Health & Safety	Regional Development	Plans	Effects of the Environment on the Project			
Relocate UG arsenic distribution pipes (pipes will remain UG)	Materials transport	No effects anticipated as all operations will be below ground by skilled operators.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	P	0	P	0	0	Short term refers to impacts associated with activities Long term refers to the impacts/ consequences of the completed the activity. Where the term 'arsenic' is used below it includes the following suite of contamination arsenic, antimony, chromium, copper, zinc, lead, nickel, vanadium Proposed Mitigation Measures Does not include Health and Safety measures which will be required for all site personnel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	P	0	P	0	0	Monitor air vented from mine to determine if mitigation is required
Freeze plant installation and operation (excludes drilling and casing (assumed to be using NH3))	Local earthworks Materials transport General construction Loading Fencing	Noise from installation of and chiller operation. There could be a loss of containment of ammonia. Dust could be created during construction, possible arsenic content in dust - to be confirmed.	1	1	1	1	0	1	0	0	0	0	0	0	0	0	2	0	0	0	P	0	P	0	0	Short term refers to impacts associated with activities Long term refers to the impacts/ consequences of the completed the activity. Where the term 'arsenic' is used below it includes the following suite of contamination arsenic, antimony, chromium, copper, zinc, lead, nickel, vanadium Proposed Mitigation Measures Does not include Health and Safety measures which will be required for all site personnel	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	P	0	P	0	0	Dust suppression with water Dust suppression with chemicals Settling pond and sediment control plan Wheel and undercarriage washing Haulage vehicle sealing/tarping Wash and waste water collection and treatment Sound proofing

			Possible Environmental Impact Before Mitigation Measures are Applied																	Possible Residual Impacts after Mitigation Measures are Applied (Orange Cells)																																
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Project Work Package	Activity	Environmental Effect	Air Quality	Noise	Light	Soils and Terrain	Geochemical Stability	Waste Production	Hydrogeology under-ground mine water	Hydrology/Water	Quality of Fish & Fish Habitat	Aquatic Ecosystems	Vegetation & Wetlands	Avifauna Wildlife and Wildlife Habitat	Archaeology Heritage	Visual	Sound Quality	Life Quality	Built Environment	Economic	Societal	Public Health & Safety	Regional Development	Effects of the Environment on the Project	Proposed Mitigation Measures	Air Quality	Noise	Light	Soils and Terrain	Geochemical Stability	Waste Production	Hydrogeology under-ground mine water	Hydrology/Water	Quality of Fish & Fish Habitat	Aquatic Ecosystems	Vegetation & Wetlands	Avifauna Wildlife and Wildlife Habitat	Archaeology Heritage	Visual	Sound Quality	Life Quality	Built Environment	Economic	Societal	Public Health & Safety	Regional Development	Plans	Effects of the Environment on the Project				
Drill and install from-surface freeze pipe casing (2-6 years)	Local earthworks Materials transport Drilling General construction Loading Fencing	Drilling produces dust, slimes night lighting and noise Potential for hydrocarbon spillage Drilling operations could disturb surface soil with arsenic content	2	2	1	2	0	1	1	1	1	1	1	1	0	3	2	0	3	P	0	0	0	0	Short term refers to impacts associated with activities Long term refers to the impacts/ consequences of the completed the activity. Where the term 'arsenic' is used below it includes the following suite of contamination arsenic, antimony, chromium, copper, zinc, lead, nickel, vanadium	Does not include Health and Safety measures which will be required for all site personnel	1	2	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	2	0	3	P	0	0	0	0
Drill and install from-Ug freeze pipe casing (2-6 years) Horizontal pipes below chambers. Activities will occur primarily underground.	Drilling Materials transport Loading	Drilling produces dust and slimes underground. Potential for hydrocarbon spillage. Highly contaminated water and dust could be encountered when drilling below chambers	1	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	P	0	0	0	0	Short Term: Dust and noise impacts similar to road and pad construction activities (as above). Hydrocarbons could be lost from drilling equipment and slimes from drilling could result in soil contamination and potential contamination of surface and groundwater. Surface runoff water could enter streams and thereby distribute arsenic and impact on animals and people. Drilling will be a continuous operation and lighting will be required at night causing light pollution. The lighting will generally be away from roads (particularly if rerouted) so is unlikely to have much direct human safety impact. Local business is expected to benefit from provision of goods and services. Some construction and drilling waste is expected. Long Term: Installation of casings and freezing pipe structures will change the visual landscape of the area. As the pipes are intended to be left in place this is scored as '3' to indicate a permanent change.	Dust suppression with water Dust suppression with chemicals Settling pond and sediment control plan Wheel and undercarriage washing Haulage vehicle sealing/tarping Wash and waste water collection and treatment Screening vegetation Drill cutting and sludge collection, removal and safe disposal	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	P	0	0	0	0				
Distribution line from freeze plant to freeze pipe collars and casings installation and operation	Local earthworks Materials transport General construction Fencing Freeze plant operation Road construction	Surface disturbance and dust creation. Insulation wrapping waste and general construction waste. Restriction of surface access and movement. Fencing off of piped areas. Construction of access road creating dust and water flow effects. Loss of containment of coolant is possible through leaks.	1	1	1	1	0	1	0	0	0	0	0	2	0	2	1	0	0	P	0	0	0	0	Short Term: Dust from construction activities may enter air and water systems. Waste will be generated during construction that will need safe disposal. Local business is expected to benefit from provision of goods and services. Long Term: The area will be crossed by distribution pipes which will be fenced restricting access to and across the site. Animals such as moose, bear, coyote and fox will now be forced to move around the site.	Dust suppression with water Dust suppression with chemicals Settling pond and sediment control plan Wheel and undercarriage washing Haulage vehicle sealing/tarping Wash and waste water collection and treatment Screening vegetation	1	1	1	1	0	1	0	0	0	0	0	0	1	0	1	0	0	P	0	0	0	0				

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Fence/Berm Pits	Fencing Local earthworks Materials transport Loading	Prevent inadvertent access. Dust and noise generated from activities.	1	1	0	1	0	0	0	1	1	0	1	1	0	2	1	0	0	P	0	P	0	0	Short term refers to impacts associated with activities Long term refers to the impacts/ consequences of the completed the activity. Where the term 'arsenic' is used below it includes the following suite of contamination arsenic, antimony, chromium, copper, zinc, lead, nickel, vanadium	Does not include Health and Safety measures which will be required for all site personnel	1	1	0	1	0	0	0	1	1	0	1	0	0	P	0	P	0	0	Short Term: Dust and noise from activities may have an impact on plants and animals. Dust is likely to impact plants. Noise will scare animals form the site. Fencing will restrict but not eliminate human and animal passage across the site. Local business is expected to benefit from provision of goods and services. Long Term: Fencing and berms will leave permanent structures in the landscape which may be perceived as a visual impact. Public health and safety will be improved by the elimination of access.	Dust suppression with water Dust suppression with chemicals Settling pond and sediment control plan Wheel and undercarriage washing Haulage vehicle sealing/tarping Wash and waste water collection and treatment Screening vegetation				
B1 Pit - backfill & cover Building a platform for drilling. Hydrocarbon contaminated material goes into pit.	Contaminated local earthworks Contaminated materials transport Local earthworks Materials transport	Noise and dust. Moving and potential fugitive loss of highly arsenic contaminated material.	2	1	0	P	P	0	P	P	P	P	P	0	0	1	0	0	P	0	P	0	0	Short Term: Dust and noise from activities may have an impact on plants and animals. Dust is likely to impact plants. Dust is likely to contain arsenic so air quality will be reduced during dry dusty conditions and may pose a public health and safety impact in the short term. Noise will scare animals form the site on a temporary basis. Local business is expected to benefit from provision of goods and services. Long Term: Perception and public health improved. Soil contamination source removed and plants, animals and people will have lower impact risk profiles. With the source of potential surface and ground water contamination removed positive impacts are expected in the longer term as less material will be able to enter into environmental pathways.	Dust suppression with water Dust suppression with chemicals Settling pond and sediment control plan Wheel and undercarriage washing Haulage vehicle sealing/tarping Wash and waste water collection and treatment	1	1	0	P	P	0	P	P	P	P	P	0	0	1	0	0	P	0	P	0	0	Short Term: Dust and noise from activities may have an impact on plants and animals. Dust is likely to impact plants. Dust is likely to contain arsenic so air quality will be reduced during dry dusty conditions and may pose a public health and safety impact in the short term. Noise will scare animals form the site on a temporary basis. Local business is expected to benefit from provision of goods and services. Long Term: Perception and public health improved. Soil contamination source removed and plants, animals and people will have lower impact risk profiles. With the source of potential surface and ground water contamination removed positive impacts are expected in the longer term as less material will be able to enter into environmental pathways.	Dust suppression with water Dust suppression with chemicals Settling pond and sediment control plan Wheel and undercarriage washing Haulage vehicle sealing/tarping Wash and waste water collection and treatment		
A1, A2, & C1 Pits, mine out fill, and stabilize slopes	Materials transport Local earthworks	Dust from local earthworks operations of primarily clay overburden and rock material	1	1	0	0	0	0	0	0	0	0	0	0	P	1	0	0	P	0	P	0	0	Short Term: Dust and noise from activities may have an impact on plants and animals. Dust is likely to impact plants. Noise will scare animals form the site on a temporary basis. Local business is expected to benefit from provision of goods and services. Long Term: The visual landscape and public health will be improved by stabilising slopes and removing loose rock material.	Dust suppression with water Dust suppression with chemicals Settling pond and sediment control plan Wheel and undercarriage washing Haulage vehicle sealing/tarping Wash and waste water collection and treatment	1	1	0	0	0	0	0	0	0	0	0	0	0	P	1	0	0	P	0	P	0	0	Short Term: Dust and noise from activities may have an impact on plants and animals. Dust is likely to impact plants. Noise will scare animals form the site on a temporary basis. Local business is expected to benefit from provision of goods and services. Long Term: The visual landscape and public health will be improved by stabilising slopes and removing loose rock material.	Dust suppression with water Dust suppression with chemicals Settling pond and sediment control plan Wheel and undercarriage washing Haulage vehicle sealing/tarping Wash and waste water collection and treatment	
Brock & B4 Pits - backfill	Materials transport Local earthworks	Backfilling with existing waste rock from site. Brock pit has a quartz vein that could be used as educational tool. Backfilling will occur to level of vein, but due to loose material above this there is a danger of rock fall and it may be backfilled completely.	1	1	0	0	0	P	0	0	0	0	0	0	3	P	1	0	0	P	0	P	0	0	Short Term: Dust and noise from activities may have an impact on plants and animals. Dust is likely to impact plants Noise will scare animals form the site on a temporary basis. Local business is expected to benefit from provision of goods and services. Long Term: If the vein is left exposed and the wall stabilised and loose material removed then the '3' on heritage will become a 'P'. If the vein is closed this is considered a permanent loss of heritage	Dust suppression with water Dust suppression with chemicals Settling pond and sediment control plan Wheel and undercarriage washing Haulage vehicle sealing/tarping	1	1	0	0	0	P	0	0	0	0	0	0	3	P	1	0	0	P	0	P	0	0	Short Term: Dust and noise from activities may have an impact on plants and animals. Dust is likely to impact plants Noise will scare animals form the site on a temporary basis. Local business is expected to benefit from provision of goods and services. Long Term: If the vein is left exposed and the wall stabilised and loose material removed then the '3' on heritage will become a 'P'. If the vein is closed this is considered a permanent loss of heritage	Dust suppression with water Dust suppression with chemicals Settling pond and sediment control plan Wheel and undercarriage washing Haulage vehicle sealing/tarping

Project Work Package	Activity	Environmental Effect	Possible Environmental Impact Before Mitigation Measures are Applied																	Possible Residual Impacts after Mitigation Measures are Applied (Orange Cells)																																											
			Mainly Construction Short Term							Mainly Long Term										Mainly Construction Short Term							Mainly long term																																				
			Physical Chemical							Ecological			Aesthetics and Culture				Socio-economic						Physical Chemical							Ecological			Aesthetics and Culture				Socio-economic																										
			Air Quality	Noise	Light	Soils and Terrain	Geochemical Stability	Waste Production	Hydrogeology under-ground mine water	Hydrology/Water	Quality of Fish & Fish Habitat	Aquatic Ecosystems	Vegetation & Wetlands	Avifauna Wildlife and Wildlife Habitat	Archaeology Heritage	Visual	Sound Quality	Life Quality	Built Environment	Economic	Societal	Public Health & Safety	Regional Development	Effects of the Environment on the Project	Proposed Mitigation Measures	Air Quality	Noise	Light	Soils and Terrain	Geochemical Stability	Waste Production	Hydrogeology under-ground mine water	Hydrology/Water	Quality of Fish & Fish Habitat	Aquatic Ecosystems	Vegetation & Wetlands	Avifauna Wildlife and Wildlife Habitat	Archaeology Heritage	Visual	Sound Quality	Life Quality	Built Environment	Economic	Societal	Public Health & Safety	Regional Development	Plans	Effects of the Environment on the Project															
Cover settling and polishing ponds	Local earthworks Materials transport Revegetation	Local earthworks and dust generation. May have some remaining water which has to be pumped into Creek. Revegetation.	1	1	0	P	0	0	P	P	0	P	P	P	0	P	1	0	0	P	0	P	P	1	Short term refers to impacts associated with activities Long term refers to the impacts/ consequences of the completed the activity. Where the term 'arsenic' is used below it includes the following suite of contamination arsenic, antimony, chromium, copper, zinc, lead, nickel, vanadium	Does not include Health and Safety measures which will be required for all site personnel	1	1	0	P	0	0	P	P	0	P	P	P	0	P	1	0	0	P	0	P	P	P	0	P	1	0	0	P	0	P	P	P	0	P	P	P	1
Cover all ponds	Drilling Blasting Local earthworks Materials transport Revegetation	Dust and noise. Revegetation.	1	1	1	P	P	0	P	P	0	P	P	P	0	P	1	1	0	P	0	P	P	1	Same as above	Dust suppression with water Dust suppression with chemicals Settling pond and sediment control plan Wheel and undercarriage washing Haulage vehicle sealing/tarping Drill cutting and sludge collection, removal and safe disposal Wash and waste water collection and treatment Blasting mats Flight coordination to avoid blast periods Road closures during blast periods	1	1	1	P	P	0	P	P	0	P	P	P	0	P	1	1	0	P	0	P	P	P	0	P	1	1	0	P	0	P	P	P	0	P	P	P	1

Settling pond and sediment control plan

<p>A shaft (heritage society would like to retain this and the compressor house in addition to the museum)</p>	<p>Asbestos removal Contaminated materials transport Contaminated local earthworks Loading Area cleaning Materials transport Local earthworks</p>	<p>Little or no arsenic contamination Some asbestos material, Dust, noise waste and hazardous waste Traffic volumes to disposal sites.</p>	1	1	1	1	0	2	0	1	0	0	0	0	0	0	3	P	1	P	P	P	0	P	P	0	<p>Short Term: The removal of the shaft structures would remove a potential hazard and also potentially asbestos and arsenic contaminated material. The removal process will create dust and noise with similar impacts as noted above. Local business is expected to benefit from provision of goods and services.</p> <p>Long Term: The removal of the buildings which in some instances are currently in a state of poor repair and which have areas of exposed asbestos cladding represents a positive impact on the visual environment, public health and safety and the overall removal of contaminated material will improve the perception of life quality. If the building is to be kept then there will be a need to render the structure safe and to remove asbestos material. To leave potentially harmful material in place will increase the risk of possible future health and safety impacts. Leaving the structure in place will however capture some of the mine heritage.</p>	<p>Standard asbestos controls Dust suppression with water Dust suppression with chemicals Settling pond and sediment control plan Wheel and undercarriage washing Haulage vehicle sealing/tarping Wash and waste water collection and treatment Decide if structures are safe and if they can be stripped of hazardous material to leave a heritage asset</p>	1	1	1	1	0	2	0	1	0	0	0	0	0	0	3	P	1	P	P	P	0	P	P	0
Clean-up of Existing Waste Storage Areas																																																				
<p>General non hazardous waste disposal Recycling or dispose on site.</p>	<p>Local earthworks Materials transport Loading</p>	<p>Waste -tyres, scrap metal, general junk, cable and spare parts haulage trucks on site may affect noise, dust, traffic</p>	1	1	0	P	0	P	0	0	0	0	P	P	0	P	1	P	P	P	0	P	P	0	<p>Short Term: Recycling of materials is seen as positive impacts. Local business is expected to benefit from provision of goods and services. There is also likely to be a temporary increase of heavy haulage vehicles in the area to remove recyclable waste and this may create a public safety impact in the short term. The number of heavy haulage vehicles is however expected only to be a small percentage of the traffic that occurs normally.</p> <p>Long Term: The removal of wastes and discard materials is regarded as a positive impact in the long term for virtually all environmental components.</p>	<p>Dust suppression with water Dust suppression with chemicals Settling pond and sediment control plan Wheel and undercarriage washing Haulage vehicle sealing/tarping Wash and waste water collection and treatment</p>	1	1	0	P	0	P	0	0	0	0	0	P	P	0	P	1	P	P	P	0	P	P	0			
<p>Hazardous Waste Disposal Almost all off site disposal to Alberta (check transboundary issue)</p>	<p>Local earthworks Materials transport Loading</p>	<p>Batteries, waste oil, reagents, other hydrocarbons,</p>	1	1	0	P	0	P	0	0	0	0	P	P	0	P	1	P	P	P	0	P	P	0	<p>Short Term: Local business is expected to benefit from provision of goods and services. As existing and discarded on site equipment is taken out of service there will some waste generation as not all materials will be recyclable. There is also likely to be a temporary increase of heavy haulage vehicles in the area to remove recyclable waste and this may create a public safety impact. The number of heavy haulage vehicles is however expected only to be a small percentage of the traffic that occurs normally.</p> <p>Long Term: The removal of wastes and materials such oils and batteries with chemical contents that may be liberated over time as structures decay is regarded as a positive impact in the long term for environmental components such as Geohydrology and soils as well as from an aesthetic perspective.</p>	<p>Dust suppression with water Dust suppression with chemicals Settling pond and sediment control plan Wheel and undercarriage washing Haulage vehicle sealing/tarping Wash and waste water collection and treatment</p>	1	1	0	P	0	P	0	0	0	0	0	P	P	0	P	1	P	P	P	0	P	P	0			