FINAL REPORT
ON

ECOLOGICAL RISK EVALUATION FOR ANVIL RANGE MINING COMPLEX

LEVEL 1 CUSTODIAL INPUT SECTION

Prepared for:

Department of Indian Affairs and Northern Development

Prepared by:

SENES Consultants Limited
121 Granton Drive, Unit 12
Richmond Hill, Ontario
L4B 3N4

November 2003

STEP 1 SUMMARY SITE DESCRIPTION: WORKSHEET

Section A) Contact Information

Contact Name:	
Signature:	
Date of Completion:	
Position:	
Address/Phone No.:	

Site Visited?	Yes / No

Section B) Site Information

Site No.:	
Site Name:	**Anvil Range Mining Complex**
Province/Territory:	**Yukon Territory**
Custodial Department:	**Department of Indian Affairs and Northern Development**
Site Location (latitude and longitude):	**(Approximately 62°N, 132-133°W) 200 km north-northeast of Whitehorse and 15 km northeast of the town of Faro.**

Provide a brief description of the site:
Site of mine operations from 1969-1998, producing lead and zinc concentrates. Consists of Faro Mine and Vangorda Plateau Mine sites, approximately 10 km apart. Site features include open pits, waste rock dumps, tailings impoundments, dams, diversion works and mine and mill facilities. Dominant vegetation types include tall and medium shrubs, moss, lichen and some trees. Moose, caribou, black and grizzly bears, Fannin sheep and a variety of game birds and small mammals have been observed at the site.

Describe the current land use: (e.g. Ag/Res/Com/Ind)	**Abandoned Mine Site**
Describe the future or potential land use:	**Natural Habitat**

FCSSAP (Federal Contaminated Site Accelerated Action Plan) NCS Scoring:

Provide the Total FCSSAP National Classification System Score for the Site:	
Provide the Total Score for Category III Receptors: Section B Environment:	/16
Score for Category III B1: Known Adverse Impact:	/16
Score for Category III B2: Potential fore Impact:	/16
Score for Category III B3: Special Considerations:	/5

Section C) Studies completed and Outcomes

List the reports or resources pertaining to the property used in the Ecological Risk Assessment (ERA) evaluation:

Report Title	Date
Gartner Lee Limited. *Anvil Range Mine Complex 2002 Baseline Environmental Information*. Volume 2.	**MAY 2002**
Gartner Lee Limited. *Metals in Vegetation and Soils Study at the Anvil Range Mine Complex in 2002*.	**MARCH 2003**

Has a screening level ERA been completed at the site? If yes, complete: **YES**

Study Title	Study Outcomes
SENES Consultants Limited 2003*. Draft Report on Ecological and Human Health Screening Level Risk Assessment for the Anvil Range Mine Closure Plan Development.* March.	**The results suggested that there were a number of aquatic and terrestrial species potentially at risk from exposure to elevated metals in the aquatic and terrestrial environments. Information on metal levels in the terrestrial environment was not available for assessment but has since been collected.**

Has a Tier 2/3 ERA; Preliminary or Detailed Quantitative Risk Assessment been completed at the site? If yes, provide a list:

Study Title	Study Outcomes

Has the Study been peer-reviewed? Yes/**No**; Comments: _____**NO**_____

Is the site under specific regulatory obligations? If yes provide a list:

Section D) High Risk Sites Statement

D1) Adverse Impact

If the response to question 1 or 2 or 3 is yes, automatically rate the site as high risk:

1) Is the site contamination known to have caused significant adverse impact or physical stress on the environment or highly valued species? **YES**
2) Could the imminent failure of a physical structure at this site have the potential to result in significant adverse effects? **YES**
3) Has an ecological risk assessment reported a risk or potential adverse impact to ecological receptors? **YES**

Significant adverse impacts would be defined as those which affect the population of a species or portion thereof in such a way as to cause a decline or change in abundance or distribution of the population over one or more generations; the impact may be localized; natural recruitment may not re-establish the population to its original level.

An insignificant impact is one that affects the population of a species in a localized area for a short period of time in a manner similar to natural variation, and would have no measureable effect on the integrity of the population as a whole.

Rating a site as high risk provides an additional qualitative indicator for Departments reviewing the site to consider when providing a final score for the site.

D2) Impact Summary

List impacted habitats/receptors:
Potential impacts on aquatic organisms, small terrestrial animals, birds and a variety of mammalian wildlife, including moose, caribou, bears and Fannin sheep.
List chemicals of concern:
Metals
List exposure pathways:
Drinking water, soil/sediment intake, food intake (e.g. aquatic and terrestrial plants).

Section E) Data Requirements Checklist

1. Are data requirements provided as per Step 2, the "**Data Requirements Checklist Form"**? **Yes**

Section F) Level 1 Risk Evaluation

	ROSE CREEK / FARO **MINE SITE = 94.5**
1. Complete the Level 1 Worksheets (Step 3) and indicate final Custodial Department input worksheets score:	**VANGORDA PLATEAU** **MINE SITE = 96.5**

Comments

Step 2 Data Requirements Checklist

Information Review	Yes/No	Comments
Has a description of the site historical activities been completed?	**Yes**	
Have chemicals of concern at the site been identified?	**Yes**	**Testing for metal contaminants was performed.**
Were the approximate size of site and quantity of contaminants provided?	**Yes**	**Areas of tailings, dumps and pits provided. Volumes of contaminated soil have not been estimated.**
Are the site assessment data collected representative of the site contamination?	**Yes**	
Are the QA/QC (quality assurance / quality control) data acceptable?	**Yes**	**QA/QC assessments of soil and vegetation data were discussed in the reference. QA/QC on historic water quality data questionable.**
Have the chemicals of concern been analyzed for in all potentially impacted media (*i.e.,* groundwater, surface soil, surface sediments, surface water, liquid phase product) or exposure pathways?	**Yes**	**All four media analyzed for metals only.**
Has the extent of contamination been delineated (*i.e.,* horizontal and vertical contamination) in all significantly impacted media?	**Soil: Yes** **Groundwater: No** **Surface Water: Yes** **Sediment: Yes**	**Soil samples collected from a number of horizontal transects and vertical depths.**
Have background concentrations been evaluated and identified for chemicals of concern?	**Soil: Yes** **Groundwater: No** **Surface Water: Yes** **Sediment: Yes**	**Background concentrations evaluated for metals in surface water, soil and sediment.**

Information Review	Yes/No	Comments
Were the following items defined on a regional and local basis: a) Surface drainage pattern? b) Surficial and bedrock geology? c) Groundwater flow regimes, gradients, and velocities? d) Aquifer types? e) Groundwater and surface water use in the local area? f) Grain size analyses (if proposing fine-grained soil criteria)?	**Yes** **Yes** **No** **No** **No** **No**	**Surface drainage patterns, and an overview of surficial and bedrock geology are provided in the references.**
Were the ecological uses of adjacent water resources evaluated and identified?	**Yes**	**Several aquatic resource studies have been performed.**
Were potential habitats identified, evaluated and defined: a) On-site? b) Off-site?	**On-Site: Yes** **Off-Site: Yes**	**Habitat of fish, moose and Fannin sheep have been studied.**
Is the data set for chemicals of concern appropriate and well founded, considering the attributes of the habitats?	**Yes**	**Well founded based on past use of site, not the attributes of the habitats.**

Notes: Appendix A provides details on the site.

- **Reference documents:**
  1. Gartner Lee Limited 2002. *Anvil Range Mine Complex 2002 Baseline Environmental Information. Volume 2.* March.
  2. Gartner Lee Limited 2003. *Metals in Vegetation and Soils Study at the Anvil Range Mine Complex in 2002*. May.

- **Reference documents not attached to submission.**

Worksheet 1 Ecological Habitat Screen – FARO MINE SITE AND VANGORDA MINE SITE

Ecological Habitat Screen **Determine the absence or presence of the following habitat within 1 km of the contaminated site:**			
	YES (Score 5)	**POSSIBLE (Score 2)**	**NO (Score 0)**
Category 1: Freshwater or Marine habitats such as wetlands, marshes, swamps, tidal flats, beaches, rivers, oceans, lakes or streams. **(Habitats identified are underlined)**	✔		
Category 2: Forested habitats and/or Grass land habitats	✔		
Category 3: Provincial/National Parks, ecological reserve; area of high biodiversity; sensitive arctic environments			✔
Category 4: Habitat supporting rare, threatened, endangered or significant (local / regional) species – **Fannin sheep are a rare local species.**	✔		
Category 5: Sensitive habitat for wildlife or migratory species (including breeding or spawning areas).		✔	
Score: Please total score. A score of 20 points is the maximum total for this worksheet. If the total is greater than 20, please score 20 for this worksheet.	**SUM = 17** **SCORE = 17**		
If the answer is No (Score 0) for all the above habitats, then no potential habitat at risk is identified and no further evaluation is required.			

Worksheet 2 Chemical Identification

Worksheet 2A Chemical Identification – Data Only: No Scoring – ROSE CREEK / FARO MINE SITE

Source Matrix	Chemical Testing Performed (Yes or No)	Chemical Category Circle Yes or No			Comments
Surface Water	**Yes**	Metals	(Y)	N	**Several metals exceeded CCME guidelines in Rose Creek surface water.**
	No	PAHs	Y	N	
	No	PHC	Y	N	
	No	VOCs	Y	N	
	No	Pesticides	Y	N	
	No	PCBs	Y	N	
	No	Soluble inorganics	Y	N	
	No	Others	Y	N	
Surface Sediment	**Yes**	Metals	(Y)	N	**Several metals exceeded CCME guidelines in Rose Creek sediment. Baseline sediment concentrations were not available.**
	No	PAHs	Y	N	
	No	PHC	Y	N	
	No	VOCs	Y	N	
	No	Pesticides	Y	N	
	No	PCBs	Y	N	
	No	Soluble inorganics	Y	N	
	No	Others	Y	N	
Surface Soil	**Yes**	Metals	(Y)	N	**Most metals exceed CCME guidelines in soil.**
	No	PAHs	Y	N	
	No	PHC	Y	N	
	No	VOCs	Y	N	
	No	Pesticides	Y	N	
	No	PCBs	Y	N	
	No	Soluble inorganics	Y	N	
	No	Others	Y	N	
Groundwater	**Yes**	Metals	(Y)	N	**Groundwater concentrations of all metals tested exceed CCME guidelines. Baseline groundwater concentrations were not available.**
	No	PAHs	Y	N	
	No	PHC	Y	N	
	No	VOCs	Y	N	
	No	Pesticides	Y	N	
	No	PCBs	Y	N	
	No	Soluble inorganics	Y	N	
	No	Others	Y	N	

Worksheet 2A Chemical Identification – Data Only: No Scoring – VANGORDA MINE SITE

Source Matrix	Chemical Testing Performed (Yes or No)	Chemical Category	Circle Yes or No		Comments
Surface Water	**Yes**	Metals	(Y)	N	**Some metals exceeded CCME guidelines in Vangorda Creek surface water.**
	No	PAHs	Y	N	
	No	PHC	Y	N	
	No	VOCs	Y	N	
	No	Pesticides	Y	N	
	No	PCBs	Y	N	
	No	Soluble inorganics	Y	N	
	No	Others	Y	N	
Surface Sediment	**Yes**	Metals	(Y)	N	**Only three metals tested (copper, lead and zinc). All three exceed CCME guidelines in Vangorda Creek sediment.**
	No	PAHs	Y	N	
	No	PHC	Y	N	
	No	VOCs	Y	N	
	No	Pesticides	Y	N	
	No	PCBs	Y	N	
	No	Soluble inorganics	Y	N	
	No	Others	Y	N	
Surface Soil	**Yes**	Metals	(Y)	N	**One metal (selenium) exceeded CCME guidelines in soil.**
	No	PAHs	Y	N	
	No	PHC	Y	N	
	No	VOCs	Y	N	
	No	Pesticides	Y	N	
	No	PCBs	Y	N	
	No	Soluble inorganics	Y	N	
	No	Others	Y	N	
Groundwater	**Yes**	Metals	(Y)	N	**Groundwater concentrations of five metals were tested. Of these, three exceed CCME guidelines. Baseline groundwater concentrations were not available.**
	No	PAHs	Y	N	
	No	PHC	Y	N	
	No	VOCs	Y	N	
	No	Pesticides	Y	N	
	No	PCBs	Y	N	
	No	Soluble inorganics	Y	N	
	No	Others	Y	N	

Worksheet 2B – Chemical Screen – for Chemicals without Environmental Quality Criteria – ROSE CREEK / FARO MINE SITE

Source Matrix	Chemical Category (list) and Chemical Parameters (list)	Is concentration >2 x mean background/reference location Yes/No	Score (Please score 0.5 for each Yes - Score each parameter in each category listed)
Surface Water	**Metals – Boron** **- Barium** **- Beryllium** **- Cobalt** **- Manganese** **- Antimony** **- Tin** **- Strontium** **- Titanium** **- Vanadium** **- Tungsten**	**No** **No** **Yes** **No** **Yes** **Yes** **Yes** **No** **No** **Yes** **No**	**0** **0** **0.5** **0** **0.5** **0.5** **0.5** **0** **0** **0.5** **0**
Sediment	**Metals – Molybdenum** **- Nickel** **- Selenium**	**Background concentrations not available.**	
Surface Soil	**None**		
Groundwater	**None**		
Score:	**SUM = 2.5** **SCORE = 2.5**		

Worksheet 2B – Chemical Screen – for Chemicals without Environmental Quality Criteria – VANGORDA MINE SITE

Source Matrix	Chemical Category (list) and Chemical Parameters (list)	Is concentration >2 x mean background/reference location Yes/No	Score (Please score 0.5 for each Yes - Score each parameter in each category listed)
Surface Water	**Metals – Boron** **- Barium** **- Beryllium** **- Cobalt** **- Manganese** **- Antimony** **- Tin** **- Strontium** **- Titanium** **- Vanadium** **- Tungsten**	**Yes** **No** **Yes** **Yes** **Yes** **Yes** **Yes** **Yes** **Yes** **Yes** **No**	**0.5** **0** **0.5** **0.5** **0.5** **0.5** **0.5** **0.5** **0.5** **0.5** **0**
Sediment	**None**		
Surface Soil	**None**		
Groundwater	**None**		
Score: Please total score. A score of 5 points is the maximum total for this worksheet. If the total is greater than 5, please score 5 for this worksheet.	**SUM** **SCORE**	**4.5** **4.5**	

Note: Environmental data summaries are provided in Appendix B.

Worksheet 2C Chemical Hazard Screen – Exceeding Environmental Quality Criteria and Degree of Exceedance – ROSE CREEK / FARO MINE SITE

Source Matrix	Chemical Category and Parameter (please list)	Evaluation Criteria	Score (Please score each parameter in each category listed – See scoring guide below)
Surface Water	**Metals – Silver** **- Aluminum** **- Arsenic** **- Cadmium** **- Chromium** **- Copper** **- Molybdenum** **- Nickel** **- Lead** **- Selenium** **- Zinc**	CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life	**5** **5** **1** **5** **5** **2** **0** **0** **2** **2** **1**
Sediment	**Metals - Arsenic** **- Cadmium** **- Chromium** **- Copper** **- Lead** **- Zinc**	CCME Canadian Sediment Quality Guidelines for the Protection of Aquatic Life	**2** **2** **1** **2** **5** **5**
Surface Soil	**Metals- - Silver** **- Arsenic** **- Cadmium** **- Chromium** **- Copper** **- Mercury** **- Nickel** **- Lead** **- Selenium** **- Zinc**	CCME Canadian Soil Quality Guidelines for the Protection of Environmental Health - SQGe **(Ecological component was used if available, otherwise, the generic CCME soil quality guidelines for residential/parkland were used)**	**1** **2** **0** **1** **2** **1** **2** **5** **5** **5**

Source Matrix	Chemical Category and Parameter (please list)	Evaluation Criteria	Score (Please score each parameter in each category listed – See scoring guide below)
Groundwater	**Metals - Arsenic** **- Copper** **- Nickel** **- Lead** **- Zinc**	CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life X 10 (account for dilution of groundwater discharging to surface water)	**5** **5** **5** **5** **5**
Score: Please total score. A score of 20 points is the maximum total for this worksheet. If total is greater than 20, please score 20 for this worksheet. Scoring Guide: Score 1 if exceedance is > 1 to 5 fold over guideline. Score 2 if exceedance is > 5 to 10 fold over guideline. Score 5 if exceedance is > 10 fold over guideline.			**SUM = 94** **SCORE = 20**

Worksheet 2C Chemical Hazard Screen – Exceeding Environmental Quality Criteria and Degree of Exceedance – VANGORDA MINE SITE

Source Matrix	Chemical Category and Parameter (please list)	Evaluation Criteria	Score (Please score each parameter in each category listed – See scoring guide below)
Surface Water	**Metals – Silver** **- Aluminum** **- Arsenic** **- Cadmium** **- Chromium** **- Copper** **- Molybdenum** **- Nickel** **- Lead** **- Selenium** **- Zinc**	CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life	**1** **5** **2** **5** **5** **5** **0** **5** **5** **5** **2**
Sediment	**Metals - Copper** **- Lead** **- Zinc**	CCME Canadian Sediment Quality Guidelines for the Protection of Aquatic Life	**1** **5** **2**
Surface Soil	**Metals- - Silver** **- Arsenic** **- Cadmium** **- Chromium** **- Copper** **- Mercury** **- Nickel** **- Lead** **- Selenium** **- Silver** **- Zinc**	CCME Canadian Soil Quality Guidelines for the Protection of Environmental Health - SQGe **(Ecological component was used if available, otherwise, the generic CCME soil quality guidelines for residential/parkland were used)**	**0** **0** **0** **0** **0** **0** **0** **0** **1** **0** **0**

Source Matrix	Chemical Category and Parameter (please list)	Evaluation Criteria	Score (Please score each parameter in each category listed – See scoring guide below)
Groundwater	**Metals --Aluminum** **- Arsenic** **- Cadmium** **- Chromium** **- Copper** **- Molybdenum** **- Nickel** **- Lead** **- Selenium** **- Silver** **- Zinc**	CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life X 10 (account for dilution of groundwater discharging to surface water)	**5** **0** **5** **5** **1** **0** **1** **2** **2** **0** **0**
Score: Please total score. A score of 20 points is the maximum total for this worksheet. If total is greater than 20, please score 20 for this worksheet. Scoring Guide: Score 1 if exceedance is > 1 to 5 fold over guideline. Score 2 if exceedance is > 5 to 10 fold over guideline. Score 5 if exceedance is > 10 fold over guideline.			**SUM = 70** **SCORE = 20**

Worksheet 2D Non-Chemical - Physical Impact Screen – ANVIL RANGE MINE SITE (FARO AND VANGORDA MINE SITES)

Site Conditions	Non –Chemical Stressor (please list)	Physical Impact to Environment (please specify)	Degree of Hazard / Impact (low[1] or high[2])	Score: low = 1 high = 5
Dam failure a major concern for this site. Buildings generally in fair condition.	**1. Dam failure a major concern.** **2. Waste rock piles may be slumping and have potential for failure.** **3. Degradation of diversion work and canals.** **4. High pit walls.** **5. Surface structures (buildings, maintenance facilities).**	**1. Dam failure could cause breach of downstream dams, and release significant amount of contaminated tailings and water into aquatic environment.** **2. If disturbed (by climbing), waste rock piles could collapse** **3. Diversions affect pit stability and could increase Faro Pit flooding if failure.** **4. High pit walls may collapse.** **5. If not maintained, buildings pose a potential physical hazard.**	**1. High** **2. Low** **3. High** **4. High** **5. Low**	**5** **1** **5** **5** **1**
Score: Please total score. A score of 5 points is the maximum for this worksheet. If total is greater than 5, please score 5 for this worksheet.	**SUM = 17** **SCORE = 5**			

Worksheet 2E Scale of Impact – ROSE CREEK / FARO MINE SITE

Habitat	Score (Range 25)
Terrestrial Contaminated Area Score 0 if no chemical impact Score 2 if <10 hectares Score 5 if >10 to 25 hectares Score 10 is >25 hectares	**10**
Aquatic Contaminated Area Score 0 if no chemical impact Score 2 if <1 hectare **OR** <50 metres downstream in a flowing watercourse Score 5 if >1 to 5 hectares **OR** >50 - <100 metres downstream Score 10 if >5 hectares **OR** > 100 metres downstream	**10**
Physical Impact on Terrestrial Area Score 0 if no physical impact Score 1 if <10 hectares Score 2 if >10 to 25 hectares Score 5 is >25 hectares	**5**
Physical Impact to Aquatic Area Score 0 if no physical impact Score 1 if <1 hectare **OR** <50 metres downstream in a flowing watercourse Score 2 if >1 to 5 hectares **OR** >50 - <100 metres downstream Score 5 if >5 hectares **OR** > 100 metres downstream	**5**
Score: Please total score. A score of 25 points is the maximum for this worksheet. If total is greater than 25, please score 25 for this worksheet.	**SUM = 30** **SCORE = 25**

Area of Contamination definition:

- the area or volume of contaminated media (soil, sediment, groundwater and surface water) that exceeds appropriate environmental quality criteria (including modified generic; risk-based site specific criteria and site specific toxicity testing).

Physical Impact definition:

- A non-chemical impact originating from a site that affects the quality of the environment or poses a potential or existing ecological risk (*e.g.*, a slope that is failing; a structure that could fail).

Worksheet 2E Scale of Impact – VANGORDA MINE SITE

Habitat	Score (Range 25)
Terrestrial Contaminated Area Score 0 if no chemical impact Score 2 if <10 hectares Score 5 if >10 to 25 hectares Score 10 is >25 hectares	**10**
Aquatic Contaminated Area Score 0 if no chemical impact Score 2 if <1 hectare **OR** <50 metres downstream in a flowing watercourse Score 5 if >1 to 5 hectares **OR** >50 - <100 metres downstream Score 10 if >5 hectares **OR** > 100 metres downstream	**10**
Physical Impact on Terrestrial Area Score 0 if no physical impact Score 1 if <10 hectares Score 2 if >10 to 25 hectares Score 5 is >25 hectares	**5**
Physical Impact to Aquatic Area Score 0 if no physical impact Score 1 if <1 hectare **OR** <50 metres downstream in a flowing watercourse Score 2 if >1 to 5 hectares **OR** >50 - <100 metres downstream Score 5 if >5 hectares **OR** > 100 metres downstream	**5**
Score: Please total score. A score of 25 points is the maximum for this worksheet. If total is greater than 25, please score 25 for this worksheet.	**SUM = 30** **SCORE = 25**

Area of Contamination definition:

- the area or volume of contaminated media (soil, sediment, groundwater and surface water) that exceeds appropriate environmental quality criteria (including modified generic; risk-based site specific criteria and site specific toxicity testing).

Physical Impact definition:

- A non-chemical impact originating from a site that affects the quality of the environment or poses a potential or existing ecological risk (*e.g.*, a slope that is failing; a structure that could fail).

Worksheet 3 Operable Pathway and Exposure Assessment – for Chemicals Scoring in Worksheets 2B and 2C – ROSE CREEK / FARO MINE SITE

Chemical Category and Parameter (Please list – Examples Provided Below)	Surface Water Exposure Pathway		Sediment Exposure Pathway		Soil & Direct Surface Contact Exposure Pathway		Groundwater Exposure Pathway		Other Exposure Pathway[1] - provide specifics		Additive Score
	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Totals
Metals – Silver	**1**	High Low	1	High Low	**1**	High Low	1	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Aluminum	**1**	High Low	1	High Low	1	High Low	1	High Low	1	High Low	**1.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Arsenic	**1**	High Low	**1**	High Low	**1**	High Low	**1**	High Low	1	High Low	**4.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Antimony	**1**	High Low	1	High Low	1	High Low	1	High Low	1	High Low	**1.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Beryllium	**1**	High Low	1	High Low	1	High Low	1	High Low	1	High Low	**1.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Cadmium	**1**	High Low	**1**	High Low	1	High Low	1	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		**0**		0		0		

Chemical Category and Parameter (Please list – Examples Provided Below)	Surface Water Exposure Pathway		Sediment Exposure Pathway		Soil & Direct Surface Contact Exposure Pathway		Groundwater Exposure Pathway		Other Exposure Pathway[1] - provide specifics		Additive Score
	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Totals
Metals – Chromium	**1**	High Low	**1**	High Low	**1**	High Low	1	High Low	1	High Low	**3.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Copper	**1**	High Low	**1**	High Low	**1**	High Low	**1**	High Low	1	High Low	**4.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Manganese	**1**	High Low	1	High Low	1	High Low	1	High Low	1	High Low	**1.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Mercury	1	High Low	1	High Low	**1**	High Low	1	High Low	1	High Low	**1.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Nickel	**1**	High Low	1	High Low	**1**	High Low	**1**	High Low	1	High Low	**3.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		**0**		0		0		0		
Metals – Lead	**1**	High Low	**1**	High Low	**1**	High Low	**1**	High Low	1	High Low	**4.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		

Chemical Category and Parameter (Please list – Examples Provided Below)	Surface Water Exposure Pathway		Sediment Exposure Pathway		Soil & Direct Surface Contact Exposure Pathway		Groundwater Exposure Pathway		Other Exposure Pathway[1] - provide specifics		Additive Score
	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Totals
Metals – Selenium	**1**	High Low	1	High Low	**1**	High Low	1	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Tin	**1**	High Low	1	High Low	1	High Low	1	High Low	1	High Low	**1.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Vanadium	**1**	High Low	1	High Low	1	High Low	1	High Low	1	High Low	**1.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		**0**		0		0		0		
Metals - Zinc	**1**	High Low	**1**	High Low	**1**	High Low	**1**	High Low	1	High Low	**4.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		

Score: Please total score. A score of 25 points is the maximum for this worksheet. If total is greater than 25, please score 25.

Scoring Guide:
Score 1: Confirmed or measured open or operable pathway to receptor that results in an exposure
Score 0.5: Possible or Potential pathway to receptor
Score 0: No open or operable pathway

If the exposure pathway is open for any number of chemicals within a given chemical category (Scores 1), please indicate whether the potential for exposure from this pathway is high or low, for an ecological receptor group (e.g. aquatic life; soil invertebrates, etc).

SUM = 43

SCORE = 25

[1] Other exposure pathway: this may include upper trophic level consumption pathways (i.e., mink eating contaminated fish from a lake or stream, or eagles eating contaminated small mammals of fish from a site, etc.), or other small exposure pathways, such as inhalation of air/dust from a contaminated site.

Worksheet 3 Operable Pathway and Exposure Assessment – for Chemicals Scoring in Worksheets 2B and 2C – <u>VANGORDA MINE SITE</u>

Chemical Category and Parameter (Please list – Examples Provided Below)	Surface Water Exposure Pathway		Sediment Exposure Pathway		Soil & Direct Surface Contact Exposure Pathway		Groundwater Exposure Pathway		Other Exposure Pathway[1] - provide specifics		Additive Score
	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Totals
Metals – Silver	**1**	High Low	1	High Low	1	High Low	1	High Low	1	High Low	**1.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		**0**		**0**		0		
Metals – Aluminum	**1**	High Low	1	High Low	1	High Low	**1**	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Arsenic	**1**	High Low	1	High Low	1	High Low	1	High Low	1	High Low	**1.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		**0**		**0**		0		
Metals – Antimony	**1**	High Low	1	High Low	1	High Low	**1**	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Boron	**1**	High Low	1	High Low	1	High Low	**1**	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Beryllium	**1**	High Low	1	High Low	1	High Low	**1**	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		

Chemical Category and Parameter (Please list – Examples Provided Below)	Surface Water Exposure Pathway		Sediment Exposure Pathway		Soil & Direct Surface Contact Exposure Pathway		Groundwater Exposure Pathway		Other Exposure Pathway[1] - provide specifics		Additive Score
	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Totals
Metals – Cadmium	**1**	High Low	1	High Low	1	High Low	**1**	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		**0**		0		0		
Metals – Chromium	**1**	High Low	1	High Low	1	High Low	**1**	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		**0**		0		0		
Metals – Cobalt	**1**	High Low	1	High Low	1	High Low	**1**	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Copper	**1**	High Low	**1**	High Low	1	High Low	**1**	High Low	1	High Low	**3.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		**0**		0		0		
Metals – Manganese	**1**	High Low	1	High Low	1	High Low	**1**	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Nickel	**1**	High Low	1	High Low	1	High Low	**1**	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		**0**		0		0		

Chemical Category and Parameter (Please list – Examples Provided Below)	Surface Water Exposure Pathway		Sediment Exposure Pathway		Soil & Direct Surface Contact Exposure Pathway		Groundwater Exposure Pathway		Other Exposure Pathway[1] - provide specifics		Additive Score
	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Totals
Metals – Lead	**1**	High Low	**1**	High Low	1	High Low	**1**	High Low	1	High Low	**3.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		**0**		0		0		
Metals – Selenium	**1**	High Low	1	High Low	**1**	High Low	**1**	High Low	1	High Low	**3.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Strontium	**1**	High Low	1	High Low	1	High Low	**1**	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Titanium	**1**	High Low	1	High Low	1	High Low	**1**	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Tin	**1**	High Low	1	High Low	**1**	High Low	**1**	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals – Vanadium	**1**	High Low	1	High Low	1	High Low	**1**	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		0		0		0		
Metals - Zinc	**1**	High Low	**1**	High Low	1	High Low	1	High Low	1	High Low	**2.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		0		**0**		**0**		0		

Chemical Category and Parameter (Please list – Examples Provided Below)	Surface Water Exposure Pathway		Sediment Exposure Pathway		Soil & Direct Surface Contact Exposure Pathway		Groundwater Exposure Pathway		Other Exposure Pathway[1] - provide specifics		Additive Score
	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Pathway	Exposure	Totals
Score: Please total score. A score of 25 points is the maximum for this worksheet. If total is greater than 25, please score 25. Scoring Guide: Score 1: Confirmed or measured open or operable pathway to receptor that results in an exposure Score 0.5: Possible or Potential pathway to receptor Score 0: No open or operable pathway If the exposure pathway is open for any number of chemicals within a given chemical category (Scores 1), please indicate whether the potential for exposure from this pathway is high or low, for an ecological receptor group (e.g. aquatic life; soil invertebrates, etc).											**SUM = 48.5** **SCORE = 25**

[1] Other exposure pathway: this may include upper trophic level consumption pathways (i.e., mink eating contaminated fish from a lake or stream, or eagles eating contaminated small mammals of fish from a site, etc.), or other small exposure pathways, such as inhalation of air/dust from a contaminated site.

Worksheet 4 – Risk Summary Score – ROSE CREEK / FARO MINE SITE

Category	Score
Ecological Habitats – Apply Score from Worksheet 1	**17**
Chemical/Physical Hazards - Apply total of scores from Worksheet 2B 2.5/5 2C 20/20 2D 5/5	**27.5**
Scale of Impact – Apply score from Worksheet 2E	**25**
Operable Pathways and Exposure Assessment - Apply score from Worksheet 3	**25**
Total Score	**94.5**

Worksheet 4 – Risk Summary Score – VANGORDA MINE SITE

Category	Score
Ecological Habitats – Apply Score from Worksheet 1	**17**
Chemical/Physical Hazards - Apply total of scores from Worksheet 2B 4.5/5 2C 20/20 2D 5/5	**29.5**
Scale of Impact – Apply score from Worksheet 2E	**25**
Operable Pathways and Exposure Assessment - Apply score from Worksheet 3	**25**
Total Score	**96.5**

APPENDIX A

SITE CHARACTERIZATION AND PHYSICAL HAZARDS

SITE CHARACTERIZATION AND PHYSICAL HAZARDS

This section provides a brief description of the Anvil Range Mines and their physical characteristics.

SITE DESCRIPTION

The Anvil Range Mining Complex is located in the Yukon Territory, approximately 200 km northeast of Whitehorse (see Figure A.1). The Anvil Range site includes the Faro Mine site (in production from 1969 to 1992) and the Vangorda Plateau Mine site (in production from 1986 to 1998), as shown in Figure A.2. The operation produced lead and zinc concentrates. The site is accessible by road from the town of Faro, and a haul road links the Faro and Vangorda Plateau Mine sites.

The Faro Mine site is 15 km north of the town of Faro and contains mill and tailings facilities. Figure A.3 provides an overview of the Faro Mine site. The Vangorda Plateau Mine site is 9 km northeast of the town of Faro and includes two open pits and associated mine facilities, as shown in Figure A.4.

The Faro Mine site is located within the Rose Creek watershed, which is a tributary of the Anvil Creek watershed, and the Vangorda Plateau Mine site is located within the Vangorda Creek watershed. Both watersheds empty into the Pelly River. The Faro Pit and associated dumps are located north of the mainstem, just west of the north fork. As seen in Figure A.3, Faro Creek has been diverted around the Faro pit to enter the north fork rather than the mainstem. Several other modifications have also been made to the Rose Creek watershed, including diversion of the mainstem around the Rose Creek tailings and diversion of the lower north fork (Gartner Lee 2002). The Vangorda pit and dump are located on the east side of the east fork, upslope of Shrimp Creek. The Grum pit and dump are located between the two branches, over Grum Creek. A portion of Vangorda Creek has been diverted around Vangorda Pit (Gartner Lee 2002).

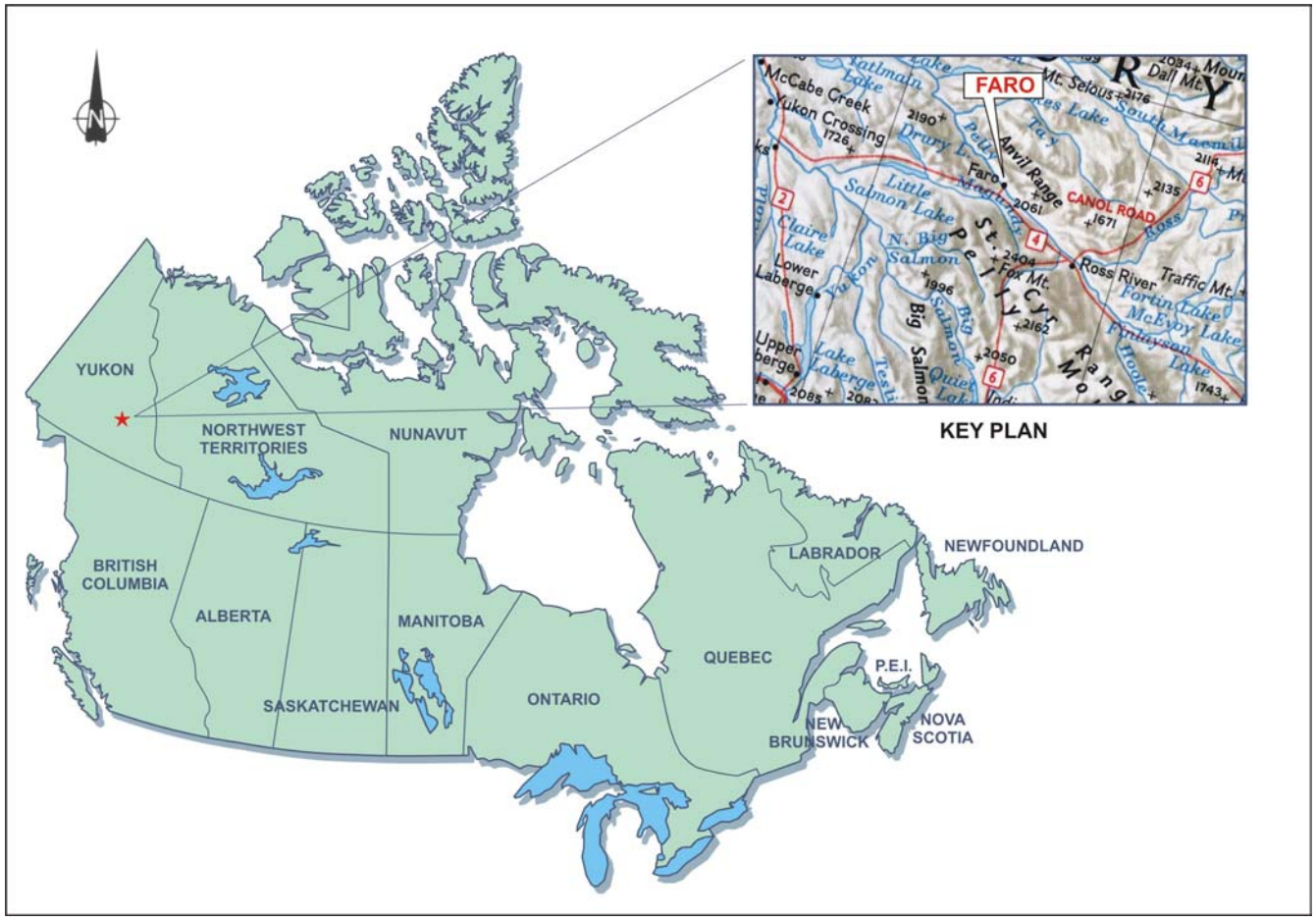
Milling operations and tailings deposition have occurred at the Faro Mine site, but never at the Vangorda Plateau Mine site.

Mill tailings were deposited in three separate surface impoundments at the Faro Mine site between 1969 and 1992 (Gartner Lee 2003). The original impoundment was initially a waste rock starter dyke, which breached in 1975. A study conducted by DIAND following the breach, estimated that approximately 247,000 m^3 of frozen slurry containing 12,300 m^3 of tailing solids had been deposited between the impoundment and the mouth of Rose Creek (Gartner Lee 2002).

The second impoundment was a second dam built around the perimeter of the original dam, constructed in part by using spilled tailings. A third dam, the intermediate impoundment, built downstream of the second, collected tailings from 1986 to 1992. The Cross Valley Pond Dam

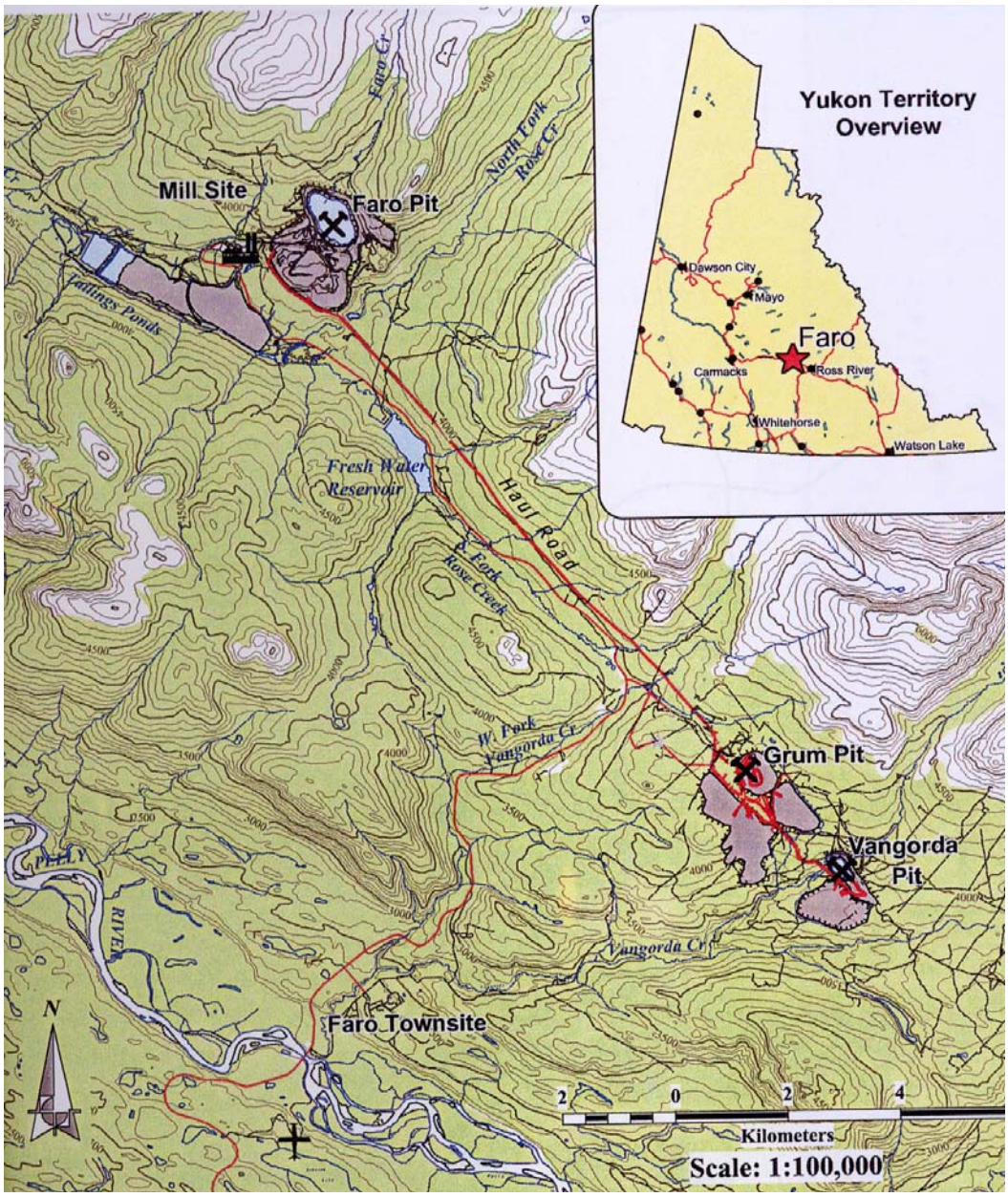
was constructed to create a polishing pond for water discharged from the intermediate impoundment prior to release into Rose Creek. The pond contains lime treatment sediments, but does not hold tailings. The Faro Main Pit Tailings Impoundment was used between 1992 and shutdown in 1998. Since 1998, the pit has undergone a seasonal dewatering program to maintain water levels within an acceptable range (Gartner Lee 2002).

FIGURE A.1
ANVIL RANGE MINE GENERAL LOCATION



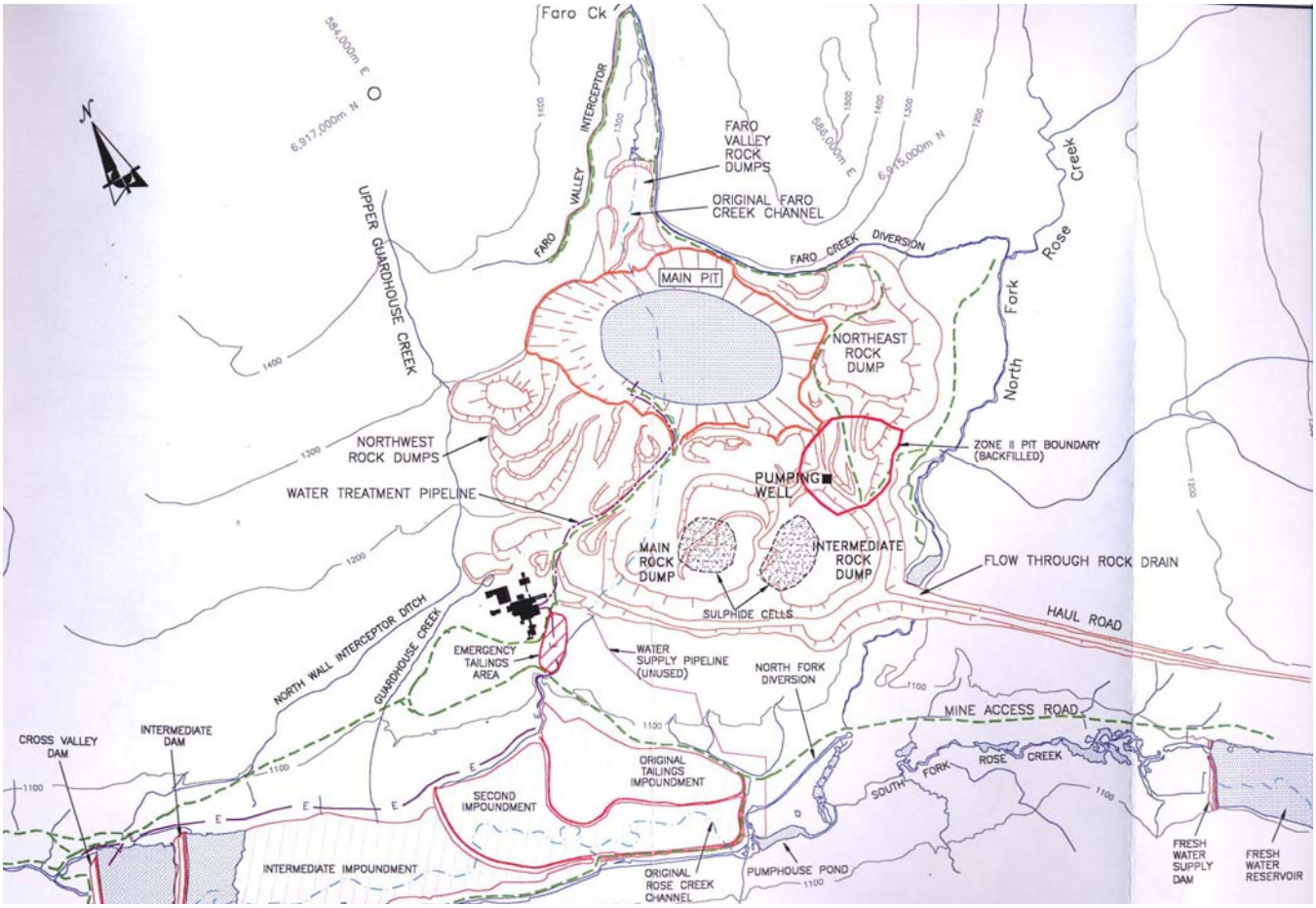
Source (inset): National Geographic (1999).

FIGURE A.2
ANVIL RANGE MINE SITE MAP



Source: Gartner Lee (2002).

FIGURE A.3
FARO MINE SITE OVERVIEW



Source: Gartner Lee (2002).

FIGURE A.4
VANGORDA PLATEAU MINE SITE OVERVIEW

Source: Gartner Lee (2002).

PHYSICAL FEATURES

Physical Hazards at Mine Sites

Typically, there are numerous physical hazards associated with an abandoned mine site. The nature of these physical hazards depends on whether the mine was an open pit or underground mining operation. The following paragraphs describe the most important hazardous features of abandoned mine sites.

Shaft Openings

An open shaft is a vertical opening that may be hundreds of feet deep. A shaft may be visible or it may be hidden by debris or vegetation. Internal seepage and periodic storms or flashfloods may create deep water at the base of such shafts. In addition to the direct risk from drowning, the presence of water can accelerate the decay of support structures, leading to cave-ins and collapses.

Adits

Adits are horizontal openings that lead to underground mine workings. Adits provide a variety of dangers, including unstable rock ceilings and walls and decayed structures that may collapse, causing a rock fall.

Open Pits

Not all mines are underground. Often large areas of the surface have been disturbed to access the minerals near the surface, altering the original contours and creating dangerous surface features. These features include open pits and/or vertical cliffs (highwalls) that are prone to collapse and unstable ground. When approached from the top, the vertical edge of a highwall may not be seen in time or may crumble, leading to a fatal fall.

Open pits can be partially filled with water, which in turn, can be highly acidic or laden with harmful chemicals. Drowning in open pits has been found to claim more lives than any of the other hazardous features of abandoned mine sites.

Waste Rock Piles

Waste rock piles are typically created at mine sites by dumping from haulage trucks or conveyor systems. The side slopes, which form at the natural angle of repose of the material, are generally unstable and thus, are subject to failure when disturbed. Hence, mine site visitors who may choose to climb these piles are at risk of serious injury.

Tailings Basins

Mining operations that featured ore processing on-site usually have surface tailings impoundments. The impoundments generally are created by constructing one or more dams at low points and placement of the tailings behind the dams as a slurry. Hence, tailings impoundments characteristically contain a pond of water. Without ongoing care and maintenance, tailings dams deteriorate and are subject to failure and the subsequent release of tailings pond water and tailings solids. Because site visitors are naturally attracted to these impoundments, as they are usually easily accessible on foot or motorized vehicle, they are at risk of injury when crossing the dams or tailings surfaces.

Decayed Support Structures

Unstable equipment, scrap metal and lumber, and deteriorated buildings pose great danger to visitors of abandoned mine sites.

Underground Mines

Within a mine, the condition of structures and supports is harder to see. In many cases, shifting rock, caving walls, water and humidity cause wood to deteriorate much faster than wooden structures on the surface. With deterioration of support structures, the fractured roof or walls of a mine tunnel eventually collapse in response to vibrations and the force of gravity.

A few metres from the entrance, the mine becomes very dark. A person can easily become disoriented and lost. With a failed light source, the chances of getting out of an extensive mine, honeycombed with miles of workings, in absolute darkness, are remote.

Abandoned mines are also not ventilated. Gases such as methane, hydrogen sulphide and carbon dioxide (CO_2) occur naturally in some mines, particularly in coal mines. Pockets of carbon dioxide or other deadly gases displace oxygen with no visible sign. This is a deadly trap for the visitors of abandoned mine sites.

Explosives and Toxic Chemicals

Explosives and chemicals used in mining are often left behind when an operation is abandoned. Explosives such as dynamite and blasting caps become very unstable over time and can explode if disturbed. Storage containers, boxes, barrels and drums deteriorate, allowing toxic chemicals to leak or to combine into highly dangerous mixtures.

Physical Hazards at Anvil Range Site

Table A.1 summarizes some of the main physical features of the site.

TABLE A.1
PHYSICAL FEATURES OF THE ANVIL RANGE MINE SITES

Physical Parameter	Key Features	Characteristics	Description
Rose Creek Tailings (Faro)		General Information	Surface impoundment was built in four stages and contains three interior dam/dykes and one external cross valley dam. Tailings spill in 1975 is still visible downstream.
		Dates of Tailings Deposition	1969 - 1975; 1975 -1982; 1986 - 1992
		Tailings Volume	28.6 million m^3
		Tailings Surface Area	195.7 ha
		Tailings Average Depth	Approximately 14.5 m (25 m max)
		Avg Depth to Water Table	Unknown
		Physical Stability	Unknown
		Geochemical Characteristics, Acid Base Accounting (ABA)	Unknown. Zinc and arsenic are the primary concerns. Zinc concentrations in surface water quality have recently risen substantially (avg >12 mg/L). Average zinc seepage concentrations are 43 mg/L.
		Groundwater Seepage Rate	Unknown. The tailings facility is located above an unconfined aquifer running along the length of Rose Creek. Deep groundwater wells have documented groundwater contamination below the impoundment.
		Surface Discharge Rate	Unknown
		Cover Type	None
		Vegetation	Unknown
		Erosion	Unknown
		Accessibility	Unknown
	Original Dam	General Information	Began as a 7.5 - 9 m waste rock starter dyke. Raised using uncompacted waste rock and does not contain an impervious core. Dyke raising continued yearly until a breach occurred in 1975 (12,300 m^3 tailings spilled into Rose Creek).
		Dimensions	Estimated 1500 m long
		Type of Construction	Presumably downstream (dyke raised annually with un-compacted waste rock).
		Discharge Structure	Unknown
		Seepage	Unknown
		Erosion	Unknown
		Stability	Unknown
		Additional Information	Emergency tailings area has old Faro Creek channel running below it. Creek emerges from under rock dumps with zinc concentrations of approx. 1100 mg/L.

TABLE A.1 (Cont'd)
PHYSICAL FEATURES OF THE ANVIL RANGE MINE SITES

Physical Parameter	Key Features	Characteristics	Description
Rose Creek Tailings (Faro)	**Second Dam**	General Information	Constructed 1974-1975. Built as a perimeter dam around the original dam. Used in part spilled tailings. West Dam is 27 m high; East Dam is 4.3 m high.
		Dimensions	Unknown
		Type of Construction	Unknown
		Discharge Structure	Surface decant spillway at right abutment of West Dam.
		Seepage	Unknown
		Erosion	Unknown
		Stability	Unknown
		Additional Information	
	Intermediate Dam	General Information	Constructed in 1981 and raised in 1988, 1989 and 1991 to a height of 34.4 m. Tailings deposited from NE corner of impoundment. Water level controls saturation level of tailings.
		Dimensions	Unknown
		Type of Construction	Upstream and downstream slopes of 2H:1V. The downstream slope also includes a 20 m wide toe bench with an overall slope of 2.1H:1V at maximum section.
		Discharge Structure	Siphons and riprap-lined spillway overflow (est. 100 m^3/s) from the Intermediate Pond to polishing pond, retained by Cross Valley Dam.
		Seepage	Unknown. Visual seepage observed at the toe of the south abutment.
		Erosion	Unknown
		Stability	Unknown. Cracking observed on the crest due to frost and heavy precipitation. Thermistors and pneumatic piezometers are monitored biannually.
		Additional Information	
	Cross Valley (Final) Dam	General Information	Constructed in 1980 and 1981, 500 m downstream of Intermediate Dam. Dam creates a polishing pond (up to 1.4 million m^3 of water) for discharge water from the tailings impoundment. Holds lime treatment sediments, but does not contain tailings.
		Dimensions	Max height 19 m. Crest width 6 m.
		Type of Construction	Zoned earthfill with low permeability core founded on permeable sands and gravels. An upstream till blanket controls seepage. Upstream and downstream slopes of 2H:1V.

TABLE A.1 (Cont'd)
PHYSICAL FEATURES OF THE ANVIL RANGE MINE SITES

Physical Parameter	Key Features	Characteristics	Description
Rose Creek Tailings (Faro)	**Cross Valley (Final) Dam**	Discharge Structure	Syphon pipes and riprap lined spillway (up to 100 m^3/s) overflow into Rose Creek. Granular toe drain added in 1991.
		Seepage	Unknown, however seepage is significant and is collected from the north (highest), central, and south areas. Granular toe drain added in 1991.
		Erosion	Unknown
		Stability	Unknown. Cracking observed on the crest due to frost. Thermistors and pneumatic piezometers are monitored bi-annually.
		Additional Information	
Freshwater Supply Dam and Reservoir		General Information	Original mine structure built in 1969, upstream of the tailings impoundment. A small toe berm was added shortly after construction due to seepage and cracking at the toe.
		Dimensions	Approx. 410 m long, 20 m high, 6 m wide at crest.
		Type of Construction	Zoned earthfill dam; 2.5H:1V upstream slope; 2H:1V downstream slope; low permeability core with upstream blanket and cutoff trench.
		Discharge Structure	Overflow concrete spillway on the dam crest and a low-level outlet pipe through the base of the dam.
		Seepage	Unknown
		Erosion	Unknown
		Stability	Significant longitudinal cracking (frost?). Dam meets static stable conditions, but does not meet minimum required Factors of Safety based on recommended Peak Ground Acceleration (earthquake) values for the region.
		Additional Information	The failure of this dam would result in significant environmental impacts, including the breach and possible failure of both the downstream Intermediate and Cross Valley tailings dams, resulting in the release of contaminated water and tailings into the aquatic environment.
Faro Main Pit		General Information	
		Volume	Unknown
		Depth	Up to 335 m
		Surface Area at grade level	1.06 km^2

TABLE A.1 (Cont'd)
PHYSICAL FEATURES OF THE ANVIL RANGE MINE SITES

Physical Parameter	Key Features	Characteristics	Description
Faro Main Pit		Contents of Pit	Allowed to flood in 1992 (water depth is at least 100 m). Tailings were deposited from 1992 - 1998 (volume unknown). Seasonal dewatering is conducted to maintain water levels below critical elevation.
		Depth to Watertable	Approx. 15 m (controlled by pumping)
		Groundwater Seepage Rate	Unknown (est. 40 - 55 L/s pumping rate from pit during operations from 1986 to 1990)
		Surface Discharge Rate	Controlled by pumping to surface.
		Slopes	Unknown
		Stability	Unknown. Note, however, that Faro Creek drains steeply toward the pit and may cause erosion, stability and flood concerns over time.
		Accessibility (fenced?)	Unknown
		Underground Workings In Pit	None
		Additional Information	Avg pH and total zinc from 1996 - 2001 were 7.5 and 7.2 mg/L, respectively.
Faro Zone 2 Pit		General Information	
		Volume	Est. 1.6 million m^3
		Depth	Up to 100 m
		Surface Area at grade level	0.27 km^2
		Contents of Pit	Backfilled with waste rock (not covered)
		Depth to Watertable	Unknown. Naturally overflows to N. Fork Rose Creek. Water level maintained below overflow by pumping to Main Pit.
		Groundwater Seepage Rate	Unknown (est. 13 L/s groundwater seepage into pit during operations)
		Surface Discharge Rate	Controlled: pumped to Main Pit.
		Slopes	Unknown
		Stability	Unknown
		Accessibility (fenced?)	Unknown
		Underground Workings In Pit	None
		Additional Information	Zinc concentrations ranged from 4.6 - 104 mg/L with an overall increasing trend.
Vangorda Pit		General Information	Poorest water quality of the three pits at Anvil. Wall rocks are mineralized. Surface water is diverted in an open culvert, perched on the pit wall that is not stable in the long-term.
		Volume	Unknown
		Depth	Up to 150 m

TABLE A.1 (Cont'd)
PHYSICAL FEATURES OF THE ANVIL RANGE MINE SITES

Physical Parameter	Key Features	Characteristics	Description
Vangorda Pit		Surface Area at grade level	Approx. 0.2 km^2
		Contents of Pit	Backfilled with waste rock (50,000 to 70,000 tonnes) and flooded.
		Depth to Watertable	Unknown
		Groundwater Seepage Rate	Unknown (est. 0.14 L/s groundwater seepage into pit during operations)
		Surface Discharge Rate	Unknown
		Slopes	Unknown
		Stability	Wall failures documented in northwest end of pit. Vangorda Creek drains steeply to the pit and could cause erosion and stability problems in the event of a flood.
		Accessibility (fenced?)	Unknown
		Underground Workings In Pit	Unknown
		Additional Information	Water level in the pit is to be maintained by pumping to surface. Acid rock drainage (ARD) appears to be problem on exposed pit walls.
Grum Pit (Vangorda)		General Information	Pit is connected to underground exploration workings, creating a direct hydraulic connection. Pit still contains ore as only one of two phases was completed. In general, this pit has the best stability and water quality of the three pits at the Anvil Site.
		Volume	Unknown
		Depth	Unknown
		Surface Area at grade level	Unknown
		Contents of Pit	Flooded.
		Depth to Watertable	Unknown
		Groundwater Seepage Rate	Unknown
		Surface Discharge Rate	Unknown
		Slopes	Unknown
		Stability	Well-developed slope failure on the northeast till wall has slumped to the pit bottom.
		Accessibility (fenced?)	Unknown
		Underground Workings In Pit	Yes. Connected to exploration workings (flooded).
		Additional Information	Grum Interceptor Ditch diverts surface water around the pit.

TABLE A.1 (Cont'd)
PHYSICAL FEATURES OF THE ANVIL RANGE MINE SITES

Physical Parameter	Key Features	Characteristics	Description
Underground (Exploration) Workings (Vangorda)		General Information	Underground exploration program conducted from 1975 – 1977.
	Number and Types of Openings	General Information	Twin declines followed ore zone for approx. 700 m. Enabled extensive drilling of ore zone.
		Volume	Unknown
		Depth	Unknown (portals enter at elevation of approx. 1265 m)
		Contents of Workings	Unknown
		Depth to Watertable	Unknown, controlled by Grum Pit water level/
		Groundwater Seepage Rate	Unknown
		Surface Discharge Rate	Unknown (outflow to Grum Pit).
		Stability	Unknown
		Accessibility	Unknown
		Ventilation/Gases	Unknown
		Additional Information	
Waste Rock Piles (Faro)		General Information	Approximately 31 waste rock dumps and stockpiles exist at the Faro Mine Site. These dumps were constructed over a period from 1968 to 1998 around the Main Faro Pit. The Faro waste rock is discussed as a whole below.
	Faro Waste Rock Piles	General Information	
		Location	Surrounding Main Pit.
		Volume	Total volume est. 129 million m^3 (including over 1 million m^3 of stockpiled ore)
		Surface Area	3.3 million m^2
		Height/Depth	Highest pile: Zone II (backfilled pit) East at 137 m
		Depth to Water Table	Unknown
		Geochemical Characteristics, Acid Base Accounting (ABA)	Unknown. Average pH and zinc from monitored seeps: Faro Valley rock dump - 7.3, 12.8 mg/L; NE dumps 7.7, 2.8 to 7.1 mg/L; Main/Intermediate Dump - 6.8, 30 - 960 mg/L. Monitored seepage from the Main Dump shows decreasing pH and increasing sulphate and zinc over time with erratic increases in zinc concentrations.
		Groundwater Seepage Rate	Unknown
		Surface Discharge Rate	Unknown
		Cover (water, soil, sand, none, etc.)	None Identified
		Vegetation	Unknown
		Sloped/Graded Surfaces	Unknown
		Erosion	Unknown

TABLE A.1 (Cont'd)
PHYSICAL FEATURES OF THE ANVIL RANGE MINE SITES

Physical Parameter	Key Features	Characteristics	Description
Waste Rock Piles (Faro)	**Faro Waste Rock Piles**	Physical Stability	Valley dump is slumping into north end of Faro Pit (Faro Creek diversion channel impacts further stability of the pile); the Main and Intermediate dumps overlooking the N. Fork of Rose Creek may compromise the rock drain due to creep or failure.
		Additional Information	
Waste Rock Piles (Vangorda)	**Vangorda Rock Dump**	General Information	
		General Information	Located on topographic high, sloping west to Shrimp Creek and northwest toward Vangorda Creek. Constructed from 1990 to 1998, the waste rock pile contains glacial till overburden and waste rock. Sulphides were segregated into a sulphide cell.
		Location	Southwest of the Vangorda Pit.
		Volume	16 million tonnes (3 million tonnes sulphides).
		Surface Area	Estimated 270,000 m^2.
		Height/Depth	Unknown
		Depth to Water Table	Unknown - the majority of the piles appear to be well above the water table.
		Geochemical Characteristics, Acid Base Accounting (ABA)	No data, however both "sulphide" and "phyllite" waste rock types are reported to be potentially acid generating.
		Groundwater Seepage Rate	Unknown - may be considerable.
		Surface Discharge Rate	Unknown - may be considerable.
		Cover (water, soil, sand, none, etc.)	None
		Vegetation	None Identified.
		Sloped/Graded Surfaces	Resloped in 1994.
		Erosion	Unknown
		Physical Stability	Appears to be stable.
		Additional Information	Dump contains 225,000 tonnes of "oxidized fines" from the ore body that could not be processed in the mill. This material has been shown to generate and release substantial concentrations of contaminants. In 1994 the rock slopes were recontoured and the seepage collection system was upgraded. Seepage is collected in Little Creek Pond.
	Grum Main Dump	General Information	Composed of phyllites and sulphides. Constructed as seven 30 m tall lifts.
		Location	South of the Grum Pit.
		Volume	108 million tonnes (3.8 million tonnes sulphides).

TABLE A.1 (Cont'd)
PHYSICAL FEATURES OF THE ANVIL RANGE MINE SITES

Physical Parameter	Key Features	Characteristics	Description
Waste Rock Piles (Vangorda)	**Grum Main Dump**	Surface Area	Unknown
		Height/Depth	Est. 0.56 million m^2
		Depth to Water Table	Unknown, although the majority of the waste rock pile appears to be above the water table.
		Geochemical Characteristics, Acid Base Accounting (ABA)	Unknown, although the pile contains approx. 15.9 million tonnes carbonaceous phyllite and 3.8 million tonnes of sulphidic waste rock.
		Groundwater Seepage Rate	Unknown
		Surface Discharge Rate	Unknown
		Cover Type	None
		Vegetation	Unknown
		Sloped/Graded Surfaces	Unknown
		Erosion	Unknown
		Physical Stability	Unknown
		Additional Information	Sulphidic waste was segregated and placed into the central area of the rock dump into the "sulphide cell" overlying 10 m of phyllite.
	Grum Southwest Dump	General Information	Composed of calcareous phyllite.
		Location	Southwest of the Grum Pit.
		Volume	20 million m^3
		Surface Area	Uncertain
		Height/Depth	Uncertain
		Depth to Water Table	Uncertain, however the majority of the waste rock pile appears to be above the water table.
		Geochemical Characteristics, Acid Base Accounting (ABA)	Unknown, however the dump reportedly contains no sulphides.
		Groundwater Seepage Rate	Unknown
		Surface Discharge Rate	Unknown
		Cover Type	None
		Vegetation	Unknown
		Sloped/Graded Surfaces	Unknown
		Erosion	Unknown
		Physical Stability	Unknown
		Additional Information	
	Grum Ore Transfer Pad	General Information	Used as ore transfer point to the Faro mill.
		Location	North of Grum Pit.
		Volume	Unknown - residual quantities of various ore grades.
		Surface Area	Unknown
		Height/Depth	Unknown

TABLE A.1 (Cont'd)
PHYSICAL FEATURES OF THE ANVIL RANGE MINE SITES

Physical Parameter	Key Features	Characteristics	Description
Waste Rock Piles (Vangorda)	**Grum Ore Transfer Pad**	Depth to Water Table	Unknown
		Geochemical Characteristics, Acid Base Accounting (ABA)	Unknown - presumably acid generating.
		Groundwater Seepage Rate	Unknown
		Surface Discharge Rate	Unknown
		Cover Type	None
		Vegetation	Unknown
		Sloped/Graded Surfaces	Unknown
		Erosion	Unknown
		Physical Stability	Unknown
		Additional Information	The ore pad was built over calcareous phyllite.
	Grum Overburden Dump	General Information	Composed of glacial till. Built in five 15 m lifts.
		Location	Southeast of the Grum Pit.
		Volume	24 million tonnes.
		Surface Area	Estimated 338,000 m^2.
		Height/Depth	Unknown
		Depth to Water Table	Unknown
		Geochemical Characteristics, Acid Base Accounting (ABA)	Unknown - glacial till
		Groundwater Seepage Rate	Unknown
		Surface Discharge Rate	Unknown
		Cover Type	None
		Vegetation	Unknown
		Sloped/Graded Surfaces	Unknown
		Erosion	Unknown
		Physical Stability	Appears to be stable, as the lifts were set back to accommodate easy resloping to a 3H:1V slope. The northeast slope was resloped by Anvil Range Mining Corporation.
		Additional Information	This material may be suitable cover material.
Infrastructure		General Information	The mine site facilities, including the mill, have remained unchanged following mine closure in 1998. As of 2002, some facilities have remained in use for active water treatment and maintenance.
		Date of Construction	post 1968
		Number of Buildings	Numerous, including mill, shops, offices, warehouses, etc.
		Type of Construction	Various.
		Condition/Stability	Assumed to be in relatively good condition as the mine was closed in 1998.

TABLE A.1 (Cont'd)
PHYSICAL FEATURES OF THE ANVIL RANGE MINE SITES

Physical Parameter	Key Features	Characteristics	Description
Infrastructure		Accessibility	Unknown.
		Additional Information	
Tank Farms		General Information	No available reporting documents describe the existence or non-existence of tank farms.
Fuels, Chemicals, PCBs		General Information	No available reporting documents describe the existence or non-existence of chemicals, PCB, fuels, etc. Fuel tanks and reagent sheds do exist on-site, however no information is provided as whether these facilities have been emptied or cleared.
Additional Physical Hazards		General Information	Numerous diversion ditches and diversion canals around the Faro Mine site require yearly maintenance and upkeep. Culverts are underdesigned and require de-icing in the winter. Degradation of these diversions could seriously impact tailings facility stability and Faro Pit stability and increase Faro Pit flooding. Grizzly and black bears are frequently observed on or near the mine sites.

As seen in Table A.1, the main areas of concern for the Anvil Range Mine site are:

Faro Mine

A number of diversion ditches and canals around the Faro site require annual maintenance and upkeep. Culverts are underdesigned and require de-icing in the winter. Degradation of these diversions could seriously impact tailings facility stability and Faro pit stability and increase;
Faro pit flooding;
Dam failure; and
Waste rock dumps-some are slumping or have potential for creep or failure.

Vangorda Mine

- Wall failures have been documented in the northwest end of the Vangorda Pit. Since Vangorda Creek drains steeply toward the pit, over time it may cause erosion, stability and flood concerns.

APPENDIX B

SUMMARY OF MAXIMUM MEASURED ENVIRONMENTAL DATA

ANVIL RANGE MINE MEASURED DATA - VANGORDA CREEK

Prepared by: Farrah Bhesania
Checked by: Mo-Ki Tai

Vangorda Creek - Soil Concentrations (ppm)

	Avg. Background		CCME	Measured	Score	
Contaminant	**Mean**	**2xMean**	**Guideline**	**Maximum**	**Background**	**CCME**
Ag	1.56	3.12	20	0.14	-	0
As	18.5	37	17	15	-	0
Cd	1.885	3.77	10	0.62	-	0
Cr	6.14	12.28	64	36.6	-	0
Cu	15.35	30.7	63	31.8	-	0
Hg	0.17	0.34	12	0.05	-	0
Ni	7.45	14.9	50	32	-	0
Pb	55.75	111.5	300	27.9	-	0
Se	3.5	7	1	2	-	1
Zn	84.95	169.9	200	88.1	-	0
SUM					**0**	**1**

CCME Soil Quality Guidelines based on ecological component where available.
Otherwise, generic residential/parkland guidelines were used.

Vangorda Creek - Surface Water Concentrations (ppm)

	Avg. Background		CCME	Measured	Score	
Contaminant	**Mean**	**2xMean**	**Guideline**	**Maximum**	**Background**	**CCME**
Ag	0.0015	0.003	0.001	0.005	-	1
Al	0.26	0.52	0.005	3.6	-	5
As	0.005	0.01	0.005	0.037	-	2
B	0.13	0.26		3.6	0.5	-
Ba	0.18	0.36		0.32	0	-
Be	0.0007	0.0014		0.003	0.5	-
Cd	0.0014	0.0028	0.000017	0.094	-	5
Co	0.008	0.016		0.28	0.5	-
Cr - assume all hexavalent	0.027	0.054	0.001	0.182	-	5
Cu	0.026	0.052	0.002	0.046	-	5
Mn	0.057	0.114		19.04	0.5	-
Mo	0.005	0.01	0.073	0.018	-	0
Ni	0.007	0.014	0.025	0.425	-	5
Pb	0.0095	0.019	0.001	0.06	-	5
Sb	0.017	0.034		0.1	0.5	-
Se	0.004	0.008	0.001	0.059	-	5
Sn	0.0086	0.0172		4.82	0.5	-
Sr	0.16	0.32		1.23	0.5	-
Ti	0.023	0.046		0.1	0.5	-
V	0.006	0.012		0.052	0.5	-
W	0.015	0.03		0.015	0	-
Zn	0.024	0.048	0.03	0.16	-	2
SUM					**4.5**	**40**

CCME Freshwater Guidelines for the Protection of Aquatic Life

ANVIL RANGE MINE MEASURED DATA - VANGORDA CREEK

Prepared by: Farrah Bhesania

Checked by: Mo-Ki Tai

Vangorda Creek - Sediment Concentrations (ppm)

	Background		CCME	Measured	Score	
Contaminant	**Mean**	**2xMean**	**Guideline**	**Maximum**	**Background**	**CCME**
Cu	33.4	66.8	35.7	129	-	1
Pb	40.8	81.6	35	2800	-	5
Zn	131	262	123	921	-	2
SUM					**0**	**8**

CCME Interim Sediment Quality Guidelines

Vangorda Creek - Groundwater Concentrations (ppm)

	Avg. Background		CCME	Measured	Score	
Contaminant	**Mean**	**2xMean**	**Guideline**	**Maximum**	**Background**	**CCME**
Ag	0.0015	0.003	0.01	0.005	-	0
Al	0.26	0.52	0.05	3.6	-	5
As	0.005	0.01	0.05	0.037	-	0
B	0.13	0.26		3.6	0.5	-
Ba	0.18	0.36		0.32	0	-
Be	0.0007	0.0014		0.003	0.5	-
Cd	0.0014	0.0028	0.00017	0.094	-	5
Co	0.008	0.016		0.28	0.5	-
Cr - assume all hexavalent	0.027	0.054	0.01	0.182	-	5
Cu	0.026	0.052	0.02	0.046	-	1
Mn	0.057	0.114		19.04	0.5	-
Mo	0.005	0.01	0.73	0.018	-	0
Ni	0.007	0.014	0.25	0.425	-	1
Pb	0.0095	0.019	0.01	0.06	-	2
Sb	0.017	0.034		0.1	0.5	-
Se	0.004	0.008	0.01	0.059	-	2
Sn	0.0086	0.0172		4.82	0.5	-
Sr	0.16	0.32		1.23	0.5	-
Ti	0.023	0.046		0.1	0.5	-
V	0.006	0.012		0.052	0.5	-
W	0.015	0.03		0.015	0	-
Zn	0.024	0.048	0.3	0.16	-	0
SUM					**4.5**	**21**

Based on surface water guidelines multiplied by a factor of 10

ANVIL RANGE MINE MEASURED DATA - ROSE CREEK

Prepared by: Farrah Bhesania
Checked by: Mo-Ki Tai

Rose Creek - Soil Concentrations (ppm)

	Avg. Background		CCME	Measured	Score	
Contaminant	**Mean**	**2xMean**	**Guideline**	**Maximum**	**Background**	**CCME**
Ag	0.46	0.91	20	22.2	-	1
As	9.71	19.43	17	126	-	2
Cd	0.99	1.98	10	7.45	-	0
Cr	1.56	3.12	64	302	-	1
Cu	7.13	14.26	63	404	-	2
Hg	0.13	0.27	12	12.2	-	1
Ni	1.89	3.77	50	279	-	2
Pb	12.20	24.40	300	20200	-	5
Se	4.29	8.57	1	23	-	5
Zn	72.30	144.60	200	3490	-	5
SUM					**0**	**24**

CCME Soil Quality Guidelines based on ecological component where available.
Otherwise, generic residential/parkland guidelines were used.

Rose Creek - Surface Water Concentrations (ppm)

	Avg. Background		CCME	Measured	Score	
Contaminant	**Mean**	**2xMean**	**Guideline**	**Maximum**	**Background**	**CCME**
Ag	0.001	0.002	0.001	0.022	-	5
Al	0.13	0.26	0.005	0.18	-	5
As	0.008	0.016	0.005	0.006	-	1
B	0.23	0.46		0.15	0	-
Ba	0.12	0.24		0.16	0	-
Be	0.0004	0.0008		0.0009	0.5	-
Cd	0.0006	0.0012	0.000017	0.0008	-	5
Co	0.0035	0.007		0.005	0	-
Cr - assume all hexavalent	0.0064	0.0128	0.001	0.0145	-	5
Cu	0.006	0.012	0.002	0.012	-	2
Mn	0.036	0.072		0.285	0.5	-
Mo	0.002	0.004	0.073	0.003	-	0
Ni	0.0023	0.0046	0.025	0.0077	-	0
Pb	0.0035	0.007	0.001	0.01	-	2
Sb	0.01	0.02		0.027	0.5	-
Se	0.0018	0.0036	0.001	0.0052	-	2
Sn	0.0034	0.0068		0.011	0.5	-
Sr	0.09	0.18		0.17	0	-
Ti	0.014	0.028		0.028	0	-
V	0.006	0.012		0.026	0.5	-
W	0.01	0.02		0.016	0	-
Zn	0.019	0.038	0.03	0.065	-	1
SUM					**2.5**	**28**

CCME Freshwater Guidelines for the Protection of Aquatic Life

ANVIL RANGE MINE MEASURED DATA - ROSE CREEK

Prepared by: Farrah Bhesania
Checked by: Mo-Ki Tai

Rose Creek - Sediment Concentrations (ppm)

	Background		CCME	Measured	Score	
Contaminant	**Mean**	**2xMean**	**Guideline**	**Maximum**	**Background**	**CCME**
As		0	5.9	47	-	2
Cd		0	0.6	3.9	-	2
Cr		0	37.3	80	-	1
Cu		0	35.7	182	-	2
Mo		0		8	-	-
Ni		0		350	-	-
Pb		0	35	788	-	5
Se		0		32	-	-
Zn		0	123	1600	-	5
SUM					**0**	**17**

CCME Interim Sediment Quality Guidelines

Rose Creek - Groundwater Concentrations (ppm)

	Avg. Background		CCME	Measured	Score	
Contaminant	**Mean**	**2xMean**	**Guideline**	**Maximum**	**Background**	**CCME**
As		0	0.05	5	-	5
Cu		0	0.02	1.6	-	5
Ni		0	0.25	787.9	-	5
Pb		0	0.01	5	-	5
Zn	0.0025	0.005	0.3	2130	-	5
SUM					**0**	**25**

Based on surface water guidelines multiplied by a factor of 10