FINAL REPORT
ON

ECOLOGICAL RISK EVALUATION FOR MOUNT NANSEN MINE SITE

LEVEL 1 CUSTODIAL INPUT SECTION

Prepared for:

Department of Indian Affairs and Northern Development

Prepared by:

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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:	**Mt Nansen Mine site**
Province/Territory:	**Yukon Territory**
Custodial Department:	**Department of Indian Affairs and Northern Development**
Site Location (latitude and longitude):	**(UTM: 19200 N; 19000E) 60 km West of Carmacks, 180 km NNW of Whitehorse.**

Provide a brief description of the site:
A former open pit gold-silver mine operated from 1996 to 1999. Placer and exploration mining has been ongoing over an area of 5300 ha since 1917. The mine site proper is approximately 63 ha. **Mine consisted of one open pit and small underground mine workings (4 adits), mill, and a 250,000 tonne dammed tailings facility. The pit is steep, flooded and unstable. Tailings dam is seeping considerably and is considered to be unstable. The tailings are leaching metals, including arsenic, copper, and zinc. Numerous chemicals, reagents, and hydrocarbons have been abandoned on site.** **The site is within the Dawson Range Ecosystem, characterized as a lowland forest home to woodland caribou, moose, black bear, timer wolf, and possibly woodland bison. Most mine development is near or above treeline, limiting impacted vegetation to shrubs and groundcover.**

Describe the current land use: (e.g. Ag/Res/Com/Ind)	**Abandoned Mine Site**
Describe the future or potential land use:	**Placer exploration/mineral extraction**

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
Conor Pacific Environmental Technologies Inc., 2000. *Mount Nansen Historical Review, Site Assessment, and Field Sampling Program.* Prepared for the Department of Indian and Northern Affairs, Canada. February 2000.	**FEBRUARY 2000**
Kwong, J.Y.T., A. Kapoor, and J-F. Fiset 2002. *Assessment of Chemical Stability of Impounded Tailings at Mount Nansens, Yukon Territory*. Prepared for Water Resources Division, Indian and Northern Affairs, Whitehorse, Canada. CANMET Report MMSL 02-011(CR). Project No. 602345. June 2002.	**JUNE 2002**

Has a screening level ERA been completed at the site? If yes, complete: **NO**

Study Title	Study Outcomes

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: _____

Is the site under specific regulatory obligations? If yes provide a list: **NO**

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? **NO**

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 terrestrial vegetation, terrestrial mammals, and aquatic receptors.
List chemicals of concern:
Metals, cyanide derivatives, hydrocarbons, and PCBs.
List exposure pathways:
drinking water, soil/sediment intake, food intake.

Section E) Data Requirements Checklist

1. Are data requirements provided as per Step 2, the "**Data Requirements Checklist Form"**? **Yes, however data is incomplete (ie: no groundwater).**

Section F) Level 1 Risk Evaluation

1. Complete the Level 1 Worksheets (Step 3) and indicate final Custodial Department input worksheets score: **97**

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**	
Were the approximate size of site and quantity of contaminants provided?	**Size of Site: Yes** **Quantity of Contamiants: Yes**	**Estimated volume of contaminated soil was not determined.**
Are the site assessment data collected representative of the site contamination?	**Yes**	
Are the QA/QC (quality assurance / quality control) data acceptable?	**No**	**None reported in documentation.**
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?	**Groundwater: No** **Surface soil: Yes** **Sediment : Yes** **Surface Water : Yes**	**No groundwater samples collected** **Analyzed for metals, PCBs, and hydrocarbons.** **Analyzed for metals.** **Analyzed for metals and cyanide products.**
Has the extent of contamination been delineated (*i.e.,* horizontal and vertical contamination) in all significantly impacted media?	**No**	
Have background concentrations been evaluated and identified for chemicals of concern?	**Yes**	**Background concentrations were only evaluated for metals and cyanide products in surface water and for metals in 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 pattern and bedrock geology.** **Surficial geology, groundwater flow, aquifer types, water use, and grain-size analysis not provided.**
Were the ecological uses of adjacent water resources evaluated and identified?	**No**	**Only historic qualitative surveys have been conducted.**
Were potential habitats identified, evaluated and defined: a) On-site? b) Off-site?	**On-Site: No** **Off-Site: Yes**	**Only historic qualitative surveys have been conducted.**
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 more detail on the site.

- **Reference document**

1. Conor Pacific Environmental Technologies Inc., 2000. *Mount Nansen Historical Review, Site Assessment, and Field Sampling Program.* Prepared for the Department of Indian and Northern Affairs, Canada. February 2000.

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

Worksheet 1 Ecological Habitat Screen

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 **(woodland caribou and woodland bison)**		✔	
Category 5: Sensitive habitat for wildlife or migratory species (including breeding or spawning areas) **(woodland caribou migration route, Arctic grayling fishery)**	✔		
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.	**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

Source Matrix	Chemical Testing Performed (Yes or No)	Chemical Category	Circle Yes or No	Comments
Surface Water	**Yes**	Metals	(Y) N	
	No	PAHs	Y N	
	No	PHC	Y N	**Based on 20 surface water sampling locations collected 09/2000. Elevated Al, As, Ba, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Se, Si, Sr, ammonia, and thiocyanate.**
	No	VOCs	Y N	
	No	Pesticides	Y N	
	No	PCBs	Y N	
	No	Soluble inorganics	Y N	
	Yes	Others **(cyanide products)**	(Y) N	
Surface Sediment	**Yes**	Metals	(Y) N	
	No	PAHs	Y N	
	No	PHC	Y N	**Based on nine sediment sampling locations collected 09/2000. Elevated Sb, As, Cd, Cr, Cu, Pb, Mn, Mo, Si, and Sn.**
	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	**Five soil samples were taken at the mine site 09/2000. Elevated Sb, As, Cu, Pb, Mo, and Zn.**
	No	PAHs	Y N	
	Yes	PHC	(Y) N	**All five soil samples contained measurable PHCs.**
	Yes	VOCs	(Y) N	
	No	Pesticides	Y N	
	Yes	PCBs	(Y) N	**Two of five soil samples were measured for PCBs. One of the two contained detectible levels.**
	No	Soluble inorganics	Y N	
	No	Others	Y N	
Groundwater	**No**	Metals	Y N	
	No	PAHs	Y N	
	No	PHC	Y N	
	No	VOCs	Y N	**No groundwater sampling was conducted at this site.**
	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

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:**		
	Barium	**No**	**0**
	Cobalt	**Yes**	**0.5**
	Lithium	**No**	**0**
	Manganese	**Yes**	**0.5**
	Strontium	**No**	**0**
	Titanium	**Yes**	**0.5**
	Cyanide Products:		
	Cyanide – WAD	**Yes**	**0.5**
	Thiocyanate	**Yes**	**0.5**
Sediment	**Metals:**		
	Aluminum	**No**	**0**
	Antimony	**Yes**	**0.5**
	Barium	**No**	**0**
	Beryllium	**No**	**0**
	Cobalt	**No**	**0**
	Iron	**Yes**	**0.5**
	Lithium	**No**	**0**
	Manganese	**Yes**	**0.5**
	Molybdenum	**Yes**	**0.5**
	Nickel	**No**	**0**
	Silver	**Yes**	**0.5**
	Strontium	**No**	**0**
	Tin	**Yes**	**0.5**
	Titanium	**No**	**0**
	Vanadium	**No**	**0**
Surface Soil*	**Metals:**		
	Aluminum	**No Background Available**	
	Bismuth		
	Iron		
	Manganese		
	Strontium		
	Titanium		
	Uranium		

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)
Groundwater	**Not Measured**		
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 = 5.5** **SCORE = 5**		

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

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:**	CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life	
	Aluminum		**5**
	Arsenic		**5**
	Cadmium		**5**
	Chromium		**1**
	Copper		**5**
	Iron		**5**
	Nickel		**1**
	Silver		**5**
	Zinc		**0**
	Cyanide Products:		
	Ammonia		**2**
	Nitrate		**0**
	Nitrite		**0**
Sediment	**Metals:**	CCME Canadian Sediment Quality Guidelines for the Protection of Aquatic Life	
	Arsenic		**5**
	Cadmium		**5**
	Chromium		**1**
	Copper		**5**
	Lead		**5**
	Zinc		**5**
Surface Soil	**Metals:**	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)**	
	Antimony		**5**
	Arsenic		**5**
	Barium		**1**
	Beryllium		**0**
	Cadmium		**0**
	Chromium		**1**
	Cobalt		**0**
	Copper		**1**
	Lead		**1**
	Molybdenum		**5**
	Nickel		**0**

Source Matrix	Chemical Category and Parameter (please list)	Evaluation Criteria	Score (Please score each parameter in each category listed – See scoring guide below)
	Silver **Tin** **Vanadium** **Zinc** **Organics:** **PCBs** **Benzene** **Xylenes** **TPH (C6-C10) F1** **TPH (C10-C19) F2** **TPH (C19-C32) F3**	**For TPH: Canada-Wide Standard for Petroleum Hydrocarbons in Soil – Ecological Soil Contact from CCME 2001 residential land use.**	**0** **0** **0** **2** **0** **0** **0** **0** **5** **5**
Groundwater	**Not Measured**	CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life X 10 (account for dilution of groundwater discharging to surface water)	
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 = 91** **SCORE = 20**

Worksheet 2D Non-Chemical - Physical Impact Screen

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
Tailings dam is unstable and open pit is flooding and has unstable walls. **Some buildings generally in fair condition with some damage due to weathering, including the mill and former site. Numerous barrels and various items of debris were found around the site.**	**1. Tailings dam failure or pit wall failure.** **2. Debris, dangerous structure, surface openings.**	**1. Failure of tailings dam or of overhanging pit wall (while pit flooded) could impact large areas downstream of the site.** **2. Failure of structures or workings could pose hazard to wildlife.**	**1. high** **2. low**	**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 = 6** **SCORE = 5**			

Worksheet 2E Scale of Impact

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	**2**
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 = 25** **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

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 – 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 – 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 – Barium	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	**3.5**
	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		
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 – 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 – Iron	**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		

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	**2.5**
	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 – Molybdenum	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	**1.5**
	0.5		0.5		0.5		0.5		**0.5**		
	0		**0**		**0**		0		0		
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 – 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 – 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		
Cyanide Products - Ammonia	**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		

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
Cyanide Products – Cyanide (WAD)	**1**	High Low	1	High Low	0	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		
Cyanide Products – Thiocyanate	**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		
Hydrocarbons – TPH (C10-C19) F2	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		
Hydrocarbons – TPH (C19-C32) F3	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		

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 = 42

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

Category	Score
Ecological Habitats – Apply Score from Worksheet 1	**17**
Chemical/Physical Hazards - Apply total of scores from Worksheet 2B 5/5 2C 20/20 2D 5/5	**30**
Scale of Impact – Apply score from Worksheet 2E	**25**
Operable Pathways and Exposure Assessment - Apply score from Worksheet 3	**25**
Total Score	**97**

APPENDIX A

SITE CHARACTERIZATION AND PHYSICAL HAZARDS

SITE CHARACTERIZATION AND PHYSICAL HAZARDS

This section provides a brief description of the Mount Nansen Mine site and physical characteristics associated with the site.

SITE DESCRIPTION

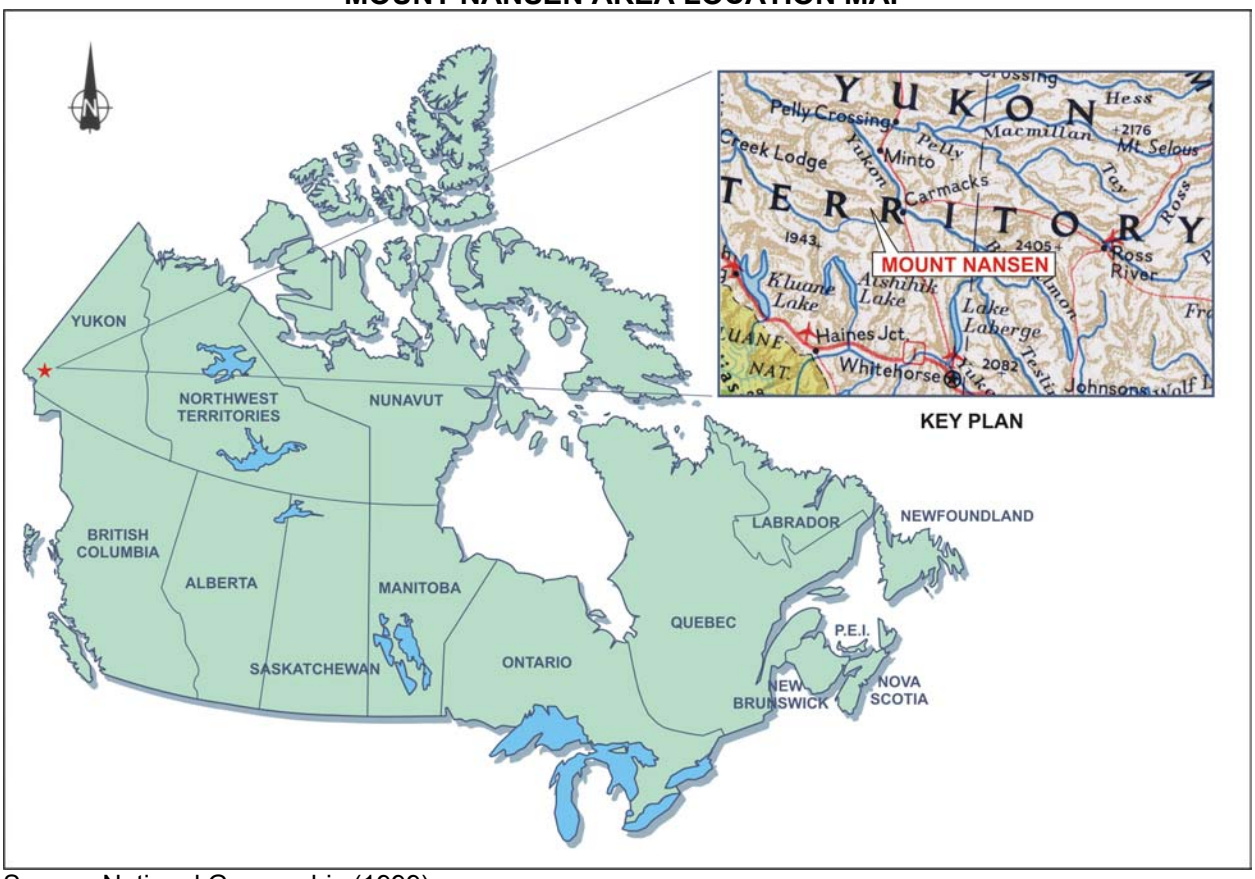
The Mount Nansen Mine is located in the remote Dawson Range in southeast Yukon, as shown in Figures A.1 and A.2. The Mount Nansen Area or Property refers to the 247 mineral claims and 30 mineral leases covering 5,300 ha within the Little Salmon/Carmacks First Nations traditional territory (Conor Pacific 2000). This area has been subjected to intermittent hard rock and extensive placer and trenching exploration since 1917. In the late 1960's, over 1 km of underground workings was developed in the area. The majority of activity in the area, however, occurred in the late 1990's at the Mount Nansen Mine site, which includes an open pit and mill, as shown in Figure A.3. The open pit mine and mill were operated from 1997 to 1999, and produced approximately 258,000 m^3 of tailings and approximately 300,000 m^3 of waste rock. This area, the Mount Nansen Mine site proper, is the focus of the SLRA discussed in this report.

Carmacks, with a population of approximately 500, is the nearest community to the mine site, and is located approximately 60 km east (Wiatzka 2003). Whitehorse is located approximately 180 km south-southeast. Placer miners and recreation users frequent the site during the warmer summer months (Wiatzka 2003). The majority of users access the area by a road that runs adjacent to the open pit and near the mill site, as shown in Figure A.4. An abandoned airfield may provide access to the site; however its current condition is unknown.

The main water bodies within the Mount Nansen Mine site include Pony and Dome Creeks. The Dome Creek watershed contains the Mount Nansen mill and tailings area (Figure A.4). Pony Creek is influenced by seepage water from the Pony Creek Adit, which may be connected to the Brown-McDade Pit, as shown in Figure 2.4.

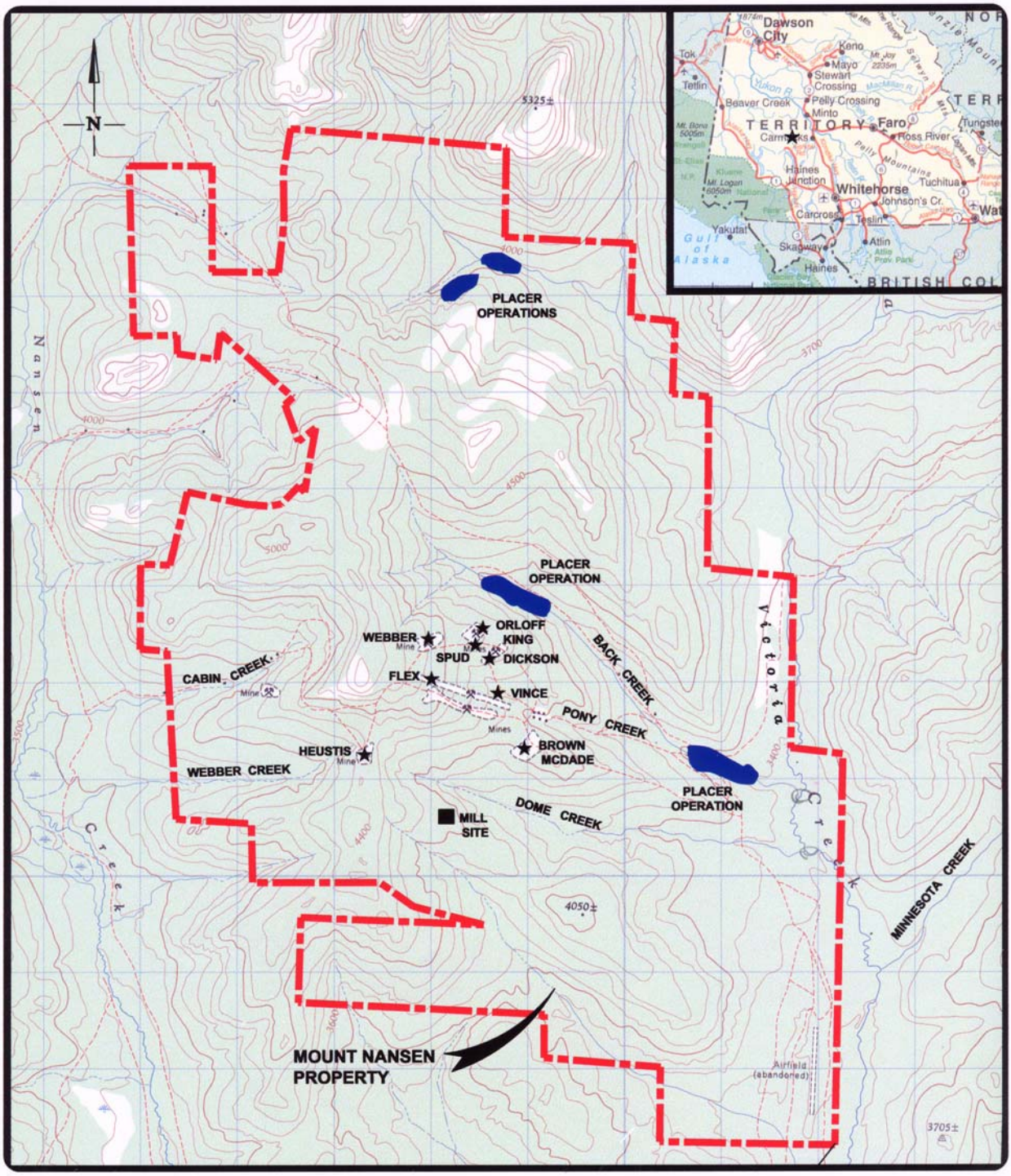
The area around the site, which is sparsely vegetated provides habitat for moose, woodland caribou, and possibly mountain sheep.

FIGURE A.1
MOUNT NANSEN AREA LOCATION MAP



Source: National Geographic (1999).

FIGURE A.2
MOUNT NANSEN AREA SITE MAP



Source: Conor Pacific (2000).

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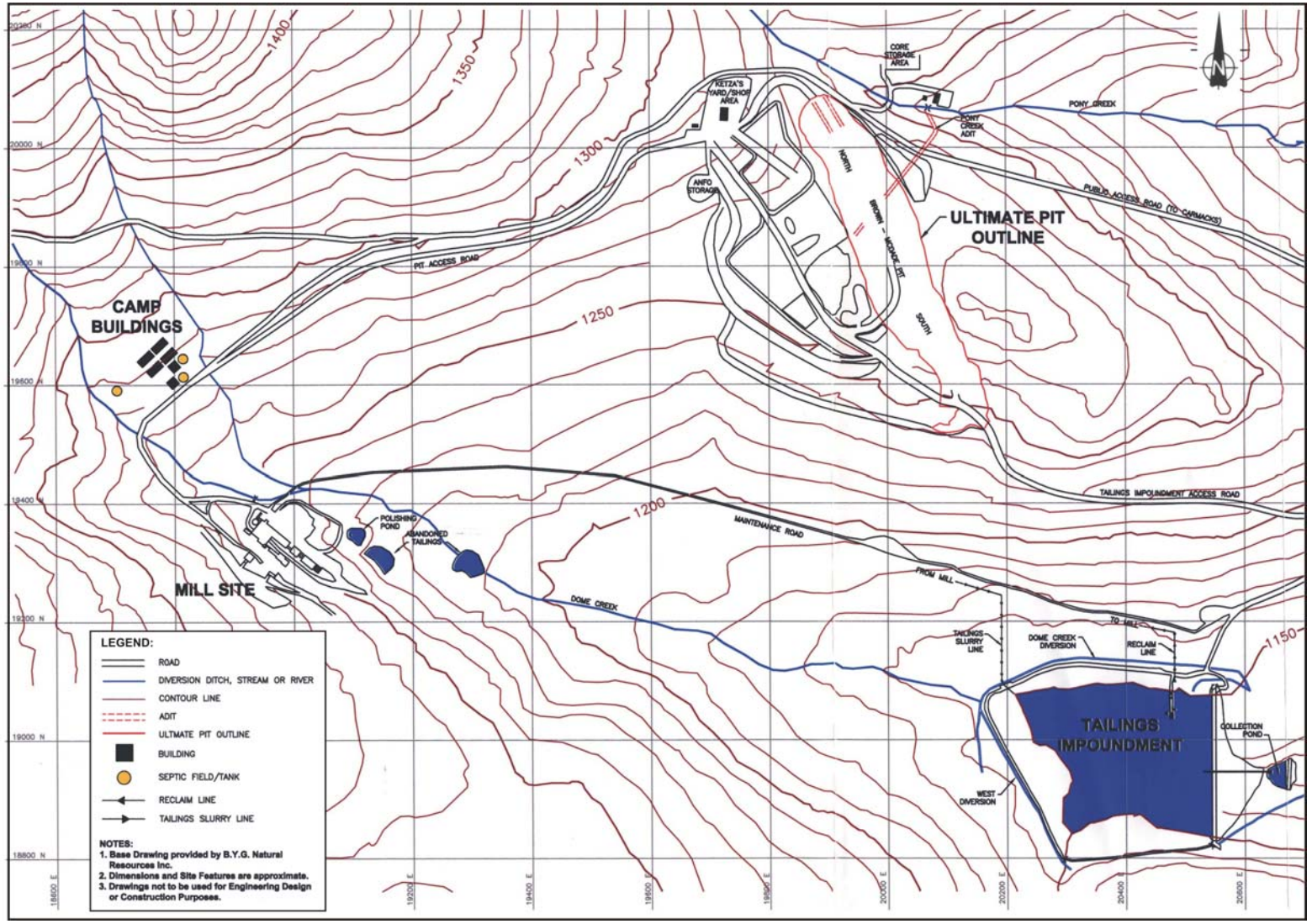
FIGURE A.3
MOUNT NANSEN MINE PLAN



Source: Conor Pacific (2000).

PHYSICAL FEATURES

Physical Hazards at Mine Sites

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

Table A.1 summarizes some of the main physical features of the Mount Nansen Mine. It is noted that there were limited data available to characterize and quantify the remaining mine

waste on the sites (tailings and waste rock). Tailings are mostly underwater and not acid producing; however, tailings may be a source of aluminum, ammonia, antimony, arsenic, copper, iron, lead, nickel, thiocyanate, and zinc to the receiving environment. Furthermore, waste rock material has not been thoroughly characterized and may be potentially acid and/or metal leach generating.

TABLE A.1
PHYSICAL FEATURES OF THE MOUNT NANSEN MINE SITE

Physical Parameter	Key Features	Characteristics	Description
Tailings Impoundments		General Information	The main tailings impoundment is located in the Dome Creek drainage, downstream of the mill.
		Dates of Tailings Deposition	October 1996 to February 1999.
		Tailings Volume	250,000 tonnes (approx. 95,000 m^3)
		Tailings Surface Area	estimated 60,000 m^2
		Tailings Average Depth	estimated 1.5 meters (max depth approx. 10 m)
		Avg Depth to Water Table	mostly saturated (water cover)
		Physical Stability	Wet, saturated, unstable.
		Geochemical Characteristics, Acid Base Accounting (ABA)	Detailed assessment done by Kwong (2002); avg AP (sample #): 67 (8), 63 (10), 39 (3); avg NP (sample #): 24 (8), 24 (10), 16 (3); avg NNP (sample #): -43 (8), -39 (10), -23 (3). Tailings are reportedly moderately acid generating and are relatively chemically stable. Although thiocyanate and ammonia levels are of concern for the medium term, they are expected to improve with time *if the tailings remain under water cover*. If tailings dam were to fail, or water cover were removed, elevated levels of Ag, As, Cu, CN, Pb, Sb, and Zn along with increased acidity may be released to the environment.
		Groundwater Seepage Rate	Not determined
		Surface Discharge Rate	Not determined
		Cover Type	Not determined
		Vegetation	Not determined
		Erosion	Not determined
		Accessibility	Not determined
		Additional Information	Approx. 41,000 tonnes of tailings from previous mill operations are disposed of underwater in a small pond near the mill site. No additional information was provided.
	Dams	General Information	A single dam contains the tailings at Mt. Nansen
		Dimensions	Not determined
		Type of Construction	The dam is composed of 100,000 m^3 of silty, fine - medium grained sand, and was built on a foundation of frozen ice-rich, silty-sandy valley fill.
		Discharge Structure	Emergency spillway documented. Details unknown.
		Seepage	Modelling suggested less than 1 L/s; however observations demonstrate it is significantly higher. A seepage collection pond has since been built.

TABLE A.1 (Cont'd)
PHYSICAL FEATURES OF THE MOUNT NANSEN MINE SITE

Physical Parameter	Key Features	Characteristics	Description
Tailings Impoundments	**Dams**	Erosion	Not determined
		Stability	The impoundment dam has required repeated maintenance and repair. Cracking and differential thaw-settlement was mitigated in 1996 with a geosynthetic clay liner. Excessive seepage from the toe was remediated in 1997 with a toe berm to prevent piping. As of 1998, the dam foundation continued to show signs of thawing and seepage was at the upper limit of the design range.
		Additional Information	None identified at this time
	Dykes	General Information	None identified
Brown-McDade Pit		General Information	Pit walls are steep and unstable and the pit is flooding.
		Volume	Not determined
		Depth	Not determined
		Surface Area at grade level	Not determined
		Contents of Pit	Partially flooded
		Depth to Watertable	Not determined
		Groundwater Seepage Rate	Not determined
		Surface Discharge Rate	Not determined
		Slopes	Not determined
		Stability	Freeze-thaw action; rock fall; pit walls, overburden, and overlying waste rock are intensely fractured, weathered, and unstable; tension fractures exist along the upper edges of the pit.
		Accessibility (fenced?)	Unknown
		Underground Workings In Pit	4 adits within the pit, including the Pony Creek adit.
		Additional Information	None at this time
Pony Creek Underground Workings		General Information	Pony Creek underground workings are not well defined. These workings are presumably from early (pre-1940's) hard rock mining and later (post-1940's) exploration around the Brown-McDade vein. The locations of these workings is unknown, however they are assumed to be located in the Pony Creek drainage. These workings may have been removed upon excavation of the Brown-McDade Pit.

TABLE A.1 (Cont'd)
PHYSICAL FEATURES OF THE MOUNT NANSEN MINE SITE

Physical Parameter	Key Features	Characteristics	Description
Pony Creek Underground Workings	**Number and Types of Openings**	General Information	The number and type of opening(s) is unknown, however four (4) adits are shown in figures of the Brown-McDade Pit.
		Volume	Unknown
		Depth	609 m of drifting and cross-cutting in 1947; 552 m of drilling and 216 m of underground development in 1964. 976 m drifting in 1968.
		Contents of Workings	Not determined
		Depth to Watertable	Not determined
		Groundwater Seepage Rate	Not determined
		Surface Discharge Rate	Not determined
		Stability	Not determined
		Accessibility	Not determined
		Ventilation/Gases	Not determined
		Additional Information	None at this time
Heustis Underground Workings		General Information	The Heustis underground workings are referred to by name, however the location, size, nature, and type of workings is unknown. The workings are apparently located in the Dome Creek Drainage.
		Volume	Unknown
		Depth	Unknown
		Contents of Workings	Unknown
		Depth to Watertable	Unknown
		Groundwater Seepage Rate	Unknown
		Surface Discharge Rate	Unknown
		Stability	Unknown
		Accessibility	Unknown
		Ventilation/Gases	Unknown
		Additional Information	None at this time
Waste Rock		General Information	Waste rock dumps are located in two main areas northeast and west of the pit on top of gentle sideslopes on the north side of Dome Creek valley.
		Location	Northeast and west of the pit.
		Volume	Originally planned for estimated 620,000 tonnes (actual mass on surface remains unknown)
		Surface Area	Not determined
		Height/Depth	Not determined
		Depth to Water Table	Not determined

TABLE A.1 (Cont'd)
PHYSICAL FEATURES OF THE MOUNT NANSEN MINE SITE

Physical Parameter	Key Features	Characteristics	Description
Waste Rock		Geochemical Characteristics, Acid Base Accounting (ABA)	Unknown. Rock samples collected from pit walls (6) and from exploration samples (64) had an avg total sulphur of 0.6% and a range of NNP values between 100 and -400 with a mean value of 14.9. Previous studies suggest that ARD from waste rock was unlikely; however potential arsenic leaching was a concern.
		Groundwater Seepage Rate	Not determined
		Surface Discharge Rate	Not determined
		Cover (water, soil, sand, none, etc.)	Not determined
		Vegetation	Not determined
		Sloped/Graded Surfaces	Moderately steep to angle of repose.
		Erosion	Not determined
		Physical Stability	Appear to be unstable: tension fractures and drainage holes have been observed
		Additional Information	None at this time
Infrastructure		General Information	Buildings on site are in various states of condition. The mill and crusher have been damaged and many buildings are easily accessible. 2 floating barges in the tailings were in disrepair as of 2000.
		Date of Construction	Unknown, but majority is presumably post 1985.
		Number of Buildings	Numerous buildings. Exact number unknown.
		Type of Construction	Wood and steel.
		Condition/Stability	Varied
		Accessibility	Most buildings are insecure and open.
		Additional Information	The mill, loadout, crusher, and treatment buildings contain riggings, sumps, and misc. insecure hazards.
Tank Farms		General Information	None identified
Fuels, Chemicals, PCBs		General Information	Chemicals, reagents, and petroleum products have not been stored or disposed of safely at the site. Leaking containers, spilled powder, ripped bags, open barrels, and chemical spills have been documented. The various chemicals and estimated volumes are listed below. In addition, 275 empty barrels have been deposited throughout the site.
	Copper Sulphate	Contents and Volume	1000 kg
	Dense Soda Ash	Contents and Volume	324 bags (mass unknown)
	Hydrated Lime	Contents and Volume	18 bags (25 kg each)

TABLE A.1 (Cont'd)
PHYSICAL FEATURES OF THE MOUNT NANSEN MINE SITE

Physical Parameter	Key Features	Characteristics	Description
Fuels, Chemicals, PCBs	**Hydrochloric Acid**	Contents and Volume	11 drums
	Hydrogen Peroxide	Contents and Volume	38 drums
	Sodium Metabisulphite	Contents and Volume	392 bags (22.67 kg each)
	Sodium Hydroxide	Contents and Volume	Not determined
	Sulphur Dioxide	Contents and Volume	Not determined
	Borax Dehydrate	Contents and Volume	100 bags (22.67 kg each)
	Lead Nitrate	Contents and Volume	12 cans (25 kg each)
	Manganese Dioxide	Contents and Volume	36 pails (25 L or 32.67 kg each)
	Sodium Nitrate	Contents and Volume	20 bags (22.67 kg each)
	Soidum Cyanide	Contents and Volume	Unknown
	Ammonium nitrate	Contents and Volume	2 pallets (2000 kg each)
	Sulphur Dioxide Tank	Contents and Volume	Tank reportedly empty by site personnel (unconfirmed)
		Container Type and Number	One 36 m^3 tank railcar
		Condition of Containers	Good condition (2000)
		Evidence of Leakage/Spillage	None identified
		Documented Incidents or Spills	None identified
		Additional Information	Tank was to be emptied and purged with dry air at closure.
	Petroleum Products	Type of Contaminant	Petroleum products and solvents, including grease, lubricant, antifreeze, heating oil, motor oil, transmission oil, antiscalant compounds and other reagents.
		Volume	Over 70 drums and various 25 L pails and buckets
		Condition of Container	Varied condition. Some lids loose or open.
		Evidence of Leakage/Spillage	Yes. Majority are stored outside and are exposed to the elements.
		Documented Incidents or Spills	Undetermined
		Additional Information	Stored in various areas around the mine site, both inside and outside.
	Gasoline and Diesel Tanks	Type of Contaminant	Gasoline and diesel fuel
		Volume	5 tanks totalling over 75,000 litres
		Condition of Container	Good condition (2000)

TABLE A.1 (Cont'd)
PHYSICAL FEATURES OF THE MOUNT NANSEN MINE SITE

Physical Parameter	Key Features	Characteristics	Description
Fuels, Chemicals, PCBs	**Gasoline and Diesel Tanks**	Evidence of Leakage/Spillage	No, however slight hydrocarbon odour emanated from the soil of one tank at the Ketza yard.
		Documented Incidents or Spills	10,000 litres of diesel fuel spilled onto the ground from a broken fuel line in Sept 1996. Surface water and surface contamination was remediate, however no subsurface or groundwater remediation was conducted. Another diesel fuel spill occurred in May 1997; however details of the spill were not documented.
		Additional Information	None at this time
Additional Physical Hazards		General Information	Placer operations and extensive exploration trenching has caused enhanced erosion and gullying in places. These disturbances may be a hazard to unaware ATV and snowmobile users.
***Site data from Conor Pacific (2000) unless otherwise cited.**			

The main areas of concern for the Mount Nansen Mine site are:

- unstable open pit walls and surrounding waste rock and overburden;
- flooded open pit and workings;
- unstable tailings impoundment dam;
- unsealed mine entrances (including at least four adits);
- several ancillary and support buildings in advanced states of disrepair;
- numerous mine chemical and reagent supplies (PCBs, hydrocarbons, explosives, milling reagents, and assay chemicals);
- exposed tailings and tailings surface pond water;
- hydrocarbon impacted soils near the fuel tanks; and,
- an unknown quantity of submerged tailings.

Asbestos Containing Materials (ACM) in various forms exist at several of the sites assessed in this study. In most jurisdictions, ACM is defined as any material containing more than one percent (1%) asbestos. Based on this definition, most asbestos containing material found at the abandoned mine sites and former military sites (e.g. insulated piping, asbestos board) would be classified as ACM. Accidental or intentional disturbances of ACM can result in fibre release and consequently pose a health hazard to individuals handling the material. This particular health hazard has not been considered in these SLRAs.

APPENDIX B

SUMMARY OF MAXIMUM MEASURED ENVIRONMENTAL DATA

MT. NANSEN MEASURED DATA

Prepared by: Justin Stockwell

Mt. Nansen - Soil Concentrations (ppm) **Checked by: Mo-Ki Tai**

	Avg. Background		CCME	Measured	Score	
Contaminant	**Mean**	**2xMean**	**Guideline**	**Maximum**	**Background**	**CCME**
Al		0		40800	-	-
Sb		0	20	310	-	5
As		0	17	1240	-	5
Ba		0	500	530	-	1
Be		0	4	0.7	-	0
Bi		0		10	-	-
Cd		0	10	8.5	-	0
Cr		0	64	72.9	-	1
Co		0	50	12.9	-	0
Cu		0	63	255	-	1
Fe		0		92000	-	-
Pb		0	300	760	-	1
Mn		0		1850	-	-
Mo		0	10	13700	-	5
Ni		0	50	49.2	-	0
Se		0	1	2	-	-
Ag		0	20	11.9	-	0
Sr		0		130	-	-
Sn		0	50	2	-	0
Ti		0		1330	-	-
U		0		5	-	-
V		0	130	79	-	0
Zn		0	200	1790	-	2
VOCs						
Benzene	0	0	5	0.17	-	0
Xylene	0	0	1	0.42	-	0
PHCs						
TPH (C6-C10) F1	0	0	130	61	-	0
EPH (C10-C19) F2	0	0	450	54100	-	5
EPH (C19-C32) F3	0	0	400	50700	-	5
PCBs	0	0	1.3	0.12	-	0
SUM					**0**	**31**

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

MT. NANSEN MEASURED DATA

Prepared by: Justin Stockwell
Checked by: Mo-Ki Tai

Mt. Nansen - Surface Water Concentrations (ppm)

	Background		CCME	Measured	Score	
Contaminant	**Mean**	**2xMean**	**Guideline**	**Maximum**	**Background**	**CCME**
Al	0.135	0.27	0.005	2.45	-	5
Sb	0.4	0.8		0.02	-	-
As	0.4	0.8	0.005	0.18	-	5
Ba	0.104	0.208		0.103	0	-
Be	0.0004	0.0008		0.0002	-	-
Cd	0.001	0.002	0.000017	0.0015	-	5
Cr - assume all hexavalent	0.002	0.004	0.001	0.004	-	1
Co	0.002	0.004		0.1	0.5	-
Cu	0.018	0.036	0.002	4.82	-	5
Fe	0.36	0.72	0.3	11.3	-	5
Pb	0.01	0.02	0.001	0.005	-	-
Li	0.005	0.01		0.004	0	-
Mn	0.13	0.26		7.99	0.5	-
Hg	0.0002	0.0004	0.000026	0.0002	-	-
Mo	0.01	0.02	0.073	0.005	-	-
Ni	0.004	0.008	0.025	0.059	-	1
Se	0.03	0.06	0.001	0.02	-	-
Ag	0.002	0.004	0.00001	0.022	-	5
Sr	0.38	0.76		0.433	0	-
Sn	0.01	0.02		0.005	-	-
Ti	0.0028	0.0056		0.142	0.5	-
U	0.075	0.15		0.06	-	-
Zn		0	0.2	0.088	-	0
V	0.002	0.004		0.002	-	-
Ammonia[a]	0.05	0.1	1.54	11.8	-	2
Cyanide (WAD)	0.002	0.004		0.017	0.5	-
Nitrate as N	0.23	0.46	13	2.35	-	0
Nitrite as N	0.006	0.012	0.06	0.05	-	0
Thiocyanate	1.23	2.46		86.4	0.5	-
SUM					**2.5**	**34**

CCME Freshwater Guidelines for the Protection of Aquatic Life

a - Ammonia CCME Criteria:

Assuming pH 7.5 and Temperature of 20o C yields a guideline of 1.54 mg/L ammonia.

MT. NANSEN MEASURED DATA

Prepared by: Justin Stockwell
Checked by: Mo-Ki Tai

Mt. Nansen - Sediment Concentrations (ppm)

	Background		CCME	Measured	Score	
Contaminant	**Mean**	**2xMean**	**Guideline**	**Maximum**	**Background**	**CCME**
Al	35400.00	70800.00		57900	0	-
Sb	16.00	32.00		310	0.5	-
As	492.00	984.00	5.5	4480	-	5
Ba	381.33	762.67		669	0	-
Be	0.70	1.40		0.9	0	-
Cd	2.87	5.73	0.6	31.5	-	5
Cr	26.20	52.40	37.3	68.7	-	1
Co	14.83	29.67		21.7	0	-
Cu	106.87	213.73	35.7	1150	-	5
Fe	44333.00	88666.00		106000	0.5	-
Pb	422.33	844.67	35	4090	-	5
Li	15.67	31.33		23.6	0	-
Mn	2876.67	5753.33		6210	0.5	-
Mo	2.33	4.67		5	0.5	-
Ni	14.33	28.67		20.3	0	-
Se	2.00	4.00		2	-	-
Ag	4.07	8.13		98.9	0.5	-
Sr	62.67	125.33		93	0	-
Sn	1.33	2.67		4	0.5	-
Ti	1270.33	2540.67		2310	0	-
U	5.00	10.00		5	-	-
V	85.67	171.33		120	0	-
Zn	361.00	722.00	123	2070	-	5
SUM					**3**	**26**

CCME Interim Sediment Quality Guidelines

Measured value is below method detection limit and is assumed to be at the MDL. These values were not carried forward into the assessment.