

**ARCTIC GOLD AND SILVER MINE TAILINGS POND  
DISCHARGE EVALUATION  
FOR THE CARCROSS TAGISH FIRST NATION**

A Water Contaminants Evaluation under the Walk in Project

November 1997

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File 9590-2-11**

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Water Resources Division  
Northern Affairs Program  
345 - 300 Main St.  
Whitehorse, Yukon Y1A 2B5**

**November 1997**

## **BACKGROUND**

The Arctic Gold and Silver tailings pond site is associated with a mine of the same name which has been mined from 1905. The tailings pond is located 4 kilometres south of Carcross and was created in 1968 by a new company called Arctic Gold and Silver Mines Ltd. The mill at this site was officially opened on August 10 of that year with the new Minister for DIAND, Jean Chretien, in attendance as a special guest. The mine operated until either October 1969 or early 1970, depending on the reference. The mill mined 150 tons (136 metric tonnes) per day of ore and deposited an estimated 20,000 tons (18,134 metric tonnes) of tailings. The tailings pond originally decanted into a marsh of some size. The original drainage out of the marsh is blocked and the water now decants over the top of a beaver dam from the large pond behind it, into the head water of Tank Creek. Tank Creek flows into Bennett Lake. The beaver pond is fed by a few small creeks, the only named one being McDonald, which enters from the south end of the beaver pond. The mill and tailings site is currently abandoned and within the selected lands of the Carcross Tagish First Nation. Both DIAND and Environment Canada have monitored the site since it was constructed and there are records of water sampling efforts made from time to time over the years. An excellent report was produced in 1976 by Environment Canada which summarized the sampling to date.

### **Site Evaluation**

DIAND staff visited the site on two occasions in October of this year and conducted both a visual and sampling survey of the site. The tailings pond was found to be disturbed by some trenching, but the containment structure appeared sound. A decant was observed from the west side of the site into the beaver pond through a small drainage channel (photo page 4). The drainage channel appears stable and has experienced much higher flows in the past. Samples were collected from this discharge channel and an estimation made of the rate of flow. A set of water samples were collected from the area above the tailings pond and from the decant of the beaver pond.

## **RESULTS**

The chemical analysis of samples collected at the Arctic Gold and Silver site are collected in Appendix A. A selection of metal ions whose concentration are high is represented in Table 1. An evaluation of the sample analysis is as follows:

**TABLE 1. TAILINGS POND DISCHARGE SAMPLE RESULTS  
TOTAL METALS**

<b>PARAMETER</b>	<b>AGS (water) ppm*</b>	<b>AGS (soil) ppm*</b>	<b>AQUATIC GUIDELINE ppm*</b>	<b>DRINKING WATER GUIDELINE ppm*</b>
aluminum	37	16300	0.1	10
arsenic	3.57	41800	0.05	0.02
cadmium	0.06	3.2	0.002	0.005
copper	0.60	51.4	0.004	1.0
iron	700	97000	0.3	0.3
lead	0.07	2340	0.001	0.01
nickel	0.24	0.6	0.15	10
silver	0.002	116	0.0001	N/A**
zinc	17.0	66.0	0.03	5.0
ph	3.4	2.7	6.5-9.0	6.5-8.5

\* - parts per million

\*\* - not applicable

The first sample set in Appendix A are the "AGS" samples. These are samples collected from the drainage channel below the tailings pond, above where it flows into the beaver pond. There is a water and a sediment (referred to as "soil") sample. In Table 1, the values for aluminum, arsenic, cadmium, copper, iron, lead, nickel, silver, and zinc levels from this sample are shown. They are all higher than those recommended for aquatic life (Appendix B). While there are no fish in the beaver pond, the aquatic guidelines are used because they are conservative. The rate of discharge, when observed, was between 6 and 10 litres per hour. It is unlikely that the rate of discharge changes much except for when the snow melts in the spring or after a heavy rainfall. In those instances the values for the metals listed in Tables 1. and 2., should be lower because of dilution. Sampling would have to be done, during these events, to be certain. The 1976 Environment Canada report noted that flows from the tailings area were between 120 and 300 litres per hour.

The water samples listed in Appendix A have two sets of values. The first column lists a "dissolved" value and the second has a "total" value. "Dissolved" metal is the amount of metal which is normally in the water after any sediment has been removed. "Total" metal is the amount of metal in the water when you include the sediment suspended in it. If a sample is taken directly from the water and analysed, then it is a "total" metal sample. If you filter the water, then it will give you a "dissolved" metal value.

The sample identified as "AGS soil" is a sample of sediment from the bottom of the drainage channel in the area where the "AGS" water sample was taken. In Table 1., you can see the similarity of the chemistry between the "AGS water" and the "AGS soil" sample. This would be the material which makes up the stained area of the pond visible in the photo on page 4. It is unknown how much metal this sediment is leaking into the water. The sediment has formed from metals leaving the water and settling on the bottom of the channel. The stained area in the beaver pond would contain similar material. In this form it may be stable and stay as a solid on the bottom.

There are three water samples whose analysis is grouped together in Appendix A. The two samples "AGS US" and "AGS-BPD" are surface water samples from upstream and downstream of the tailings pond discharge, respectively. The middle one labelled "ART" is well water from the community well at Tagish and is here for comparison. They are represented in Table 2., with the same parameters as in Table 1., for comparison.

The AGS-US sample is from upstream of the tailings pond, in an area where water flows around the material pushed up to make part of the tailings dam. This is ground water that comes up near the road and then runs around the tailings area and into the beaver pond through the marsh on the pond's edge. In the photo, (page 4), it would run along the top of the tailings pond area where you see the strip of bright green vegetation. This water is of drinking water quality and none of the metals are above the aquatic life guidelines (Table 2.).

The AGS-BPD sample is from the beaver pond, above the old road down to the Lake. It is off the left side of the photo (page 4), in the middle of the beaver pond. This water is also of drinking water quality and again within the aquatic life guidelines (Table 2.). In the "total" metals analysis, Iron in the AGS-BPD sample, has a value of 0.476 and the guideline is 0.3. These values can be considered to be equal for water quality purposes.

The 1976 report by Environment Canada noted some low levels (0.1 to 0.2 parts per billion) of natural mercury in a creek draining into the marsh and in Tank Creek itself. These levels are within the drinking water guidelines and no sampling for mercury was done during this evaluation.



**Arctic Gold and Silver Mill Site and Tailings Pond - August 1997**

**TABLE 2. SURFACE WATER SAMPLE RESULTS  
TOTAL METALS**

PARAMETER	AGS-US (water) ppm*	ART (water) ppm*	AGS-BPD (water) ppm*	AQUATIC GUIDELINE ppm*	DRINKING WATER GUIDELINE ppm*
aluminum	0.024	0.0	0.009	0.1	10
arsenic	0.0	0.0	0.0	0.05	0.02
cadmium	0.0	0.0	0.0	0.002	0.005
copper	0.002	0.071	0.005	0.004	1.0
iron	0.088	0.0	0.233	0.3	0.3
lead	0.0	0.0	0.0	0.001	0.01
nickel	0.0	0.003	0.004	0.15	10
silver	0.0	0.0	0.0	0.0001	N/A**
zinc	0.002	0.031	0.004	0.03	5.0
ph	7.8	8.2	8.0	6.5-9.0	6.5-8.5

\* - parts per million

\*\* - not applicable

**CONCLUSIONS**

In summary; there is no measurable environmental impact on the water quality of the beaver pond and Tank Creek from the tailings site discharge. This is based on recent sampling and confirms the 1976 Environment Canada report. That 1975 study by DOE was extensive in evaluating the aquatic life in the marsh, Tank Creek, and the creeks around the tailings pond and found no measured effect.

The tailings pond itself contains levels of metals which are hazardous to aquatic life but which have not been released in enough volume to affect the water quality down stream. The evaluation of the site as a physical risk to persons and the environment was not considered within this report but should be addressed as a separate issue.

**APPENDIX A**

**WATER QUALITY ANALYSIS**





**NORWEST  
LABS**

To: NORTHERN AFFAIRS PROGRAM  
WATER LABORATORY  
#345-300 Main St.  
Whitehorse, Yukon  
Y1A 2B5

Workorder: 1313  
Received : 03-Oct-97  
Completed: 09-Oct-97

Attn: Pat Roach

Re: Water Sample

**ANALYSIS  
OF  
ENVIRONMENTAL SAMPLES**

**METHODOLOGY**

Samples were analysed using procedures detailed in publications of the American Public Health Association, U.S Environmental Protection Agency, B.C. Ministry of the Environment, and Environment Canada - Conservation and Protection.

Dissolved metals were determined in a filtered (0.45 um) & acidified sample aliquot by UNICP-AES (EPA Method 200.15).

Total metals were determined in a sample aliquot which was acid digested in a closed teflon vessel in a microwave oven (EPA Method 3015). The digest was analyzed by UNICP-AES (EPA Method 200.15).

**ACCREDITATION**

Norwest Labs is accredited by the Canadian Association of Environmental Analytical Laboratories (CAEAL), by the Standards Council of Canada (SCC), and by Washington State Department of Ecology for specific tests. Norwest Labs is also registered in the B.C. Ministry of Environment Laboratory Registration Program.

To: NORTHERN AFFAIRS PROGRAM

W/O: 1313 Page 1

Sample type Identification	water AGS - WATER SAMPLE 1313-001	water AGS - WATER SAMPLE 1313-001
Lab Reference #	1313-001	1313-001
ICP - ULTRASONIC NEBULIZATION		
Method used	filt. 0.45u DISSOLVED	uwave HNO3 TOTAL
aluminum	34.	37.
antimony	< 0.02	< 0.02
arsenic	3.35	3.57
barium	0.0029	0.0042
beryllium	< 0.0002	< 0.0002
bismuth	< 0.02	< 0.02
cadmium	0.0565	0.0594
calcium	332.	349.
chromium	0.015	0.016
cobalt	0.430	0.452
copper	0.556	0.597
iron	600	700
lead	0.068	0.073
lithium	0.035	0.037
magnesium	69.7	73.1
manganese	26.2	27.6
molybdenum	0.008	0.010
nickel	0.226	0.235
phosphorus	< 0.06	< 0.06
potassium	4.0	4.0
selenium	< 0.02	< 0.02
silicon	27.8	29.6
silver	< 0.001	0.002
sodium	7.93	8.67
strontium	0.618	0.643
sulfur	820	865.
thorium	< 0.005	< 0.005
tin	< 0.005	< 0.005
titanium	0.003	0.003
uranium	< 0.06	< 0.06
vanadium	0.013	0.014
zinc	16.0	17.0
zirconium	0.005	0.005
Results in	mg/L	mg/L

Test results are for internal use only. Norwest liability is limited to the testing fee paid.

Approved:





**NORWEST  
LABS**

To: NORTHERN AFFAIRS PROGRAM  
WATER LABORATORY  
#345-300 Main St.  
Whitehorse, Yukon  
Y1A 2B5

Workorder: 1314  
Received : 03-Oct-97  
Completed: 10-Oct-97

Attn: Pat Roach

Re: PO# 337272 - Soil Sample

**ANALYSIS  
OF  
ENVIRONMENTAL SAMPLES**

**METHODOLOGY**

**PREPARATION**

Samples were dried at 55 degrees Celsius and pulverized in a non-contaminating ceramic grinder to pass a 100 mesh screen.

**DIGESTION**

A portion (0.5 grams) of the prepared sample was acid digested in a closed teflon vessel in a microwave oven (modified EPA Method 3051).

**ANALYSIS**

Metals were determined on the resulting solution by UNICP-AES (EPA Method 200.15).

**ACCREDITATION**

Norwest Labs is accredited by the Canadian Association of Environmental Analytical Laboratories (CAEAL), by the Standards Council of Canada (SCC), and by Washington State Department of Ecology for specific tests. Norwest Labs is also registered in the B.C. Ministry of Environment Laboratory Registration Program.

To: NORTHERN AFFAIRS PROGRAM

W/O: 1314 Page 1

Sample type	soil
Identification	AGS
Lab Reference #	OCT 1/97 1314-001
ICP - ULTRASONIC NEBULIZATION---	
Method used	uwave HNO3/H2O2 soluble
Amount analysed	0.502 g
aluminum	16300
antimony	230
arsenic	41800
barium	144.
beryllium	< 0.1
bismuth	25.
cadmium	3.2
calcium	646.
chromium	11.0
cobalt	0.3
copper	51.4
iron	97000
lead	2340
lithium	4.7
magnesium	1110
manganese	37.7
molybdenum	43.
nickel	0.6
phosphorus	408.
potassium	11800
selenium	< 2.
silicon	632.
silver	116.
sodium	370.
strontium	23.
sulfur	14800
thorium	8.
tin	< 1.
titanium	158.
uranium	< 5.
vanadium	10.
zinc	66.0
zirconium	5.5
Results in	ug/dry g

Test results are for internal use only. Norwest liability is limited to the testing fee paid.

Approved:



DATE 16 OCT 97 08:18

P.O. NO. 30139

W.O. NO. 2 142244

PAGE 1

EDMONTON PH. (403) 438-5522 FAX (403) 438-0396  
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 LETHBRIDGE PH. (403) 329-8288 FAX (403) 327-8527  
 WINNIPEG PH. (204) 982-8630 FAX (204) 275-6019

NORWEST LABS-LANGLEY  
 203-20771 LANGLEY BYPASS  
 LANGLEY, BC  
 V3A 5E8

NORTHERN AFFAIRS

WATER ANALYSIS REPORT

SAMPLE	1	2	3
	ID AGS - US	ID ART OCT 10/97	IC AGS-BPD OCT 3/97


TRACE ICP, DISS

ALUMINUM	mg/L	0.024	<0.008	0.009
ANTIMONY	mg/L	<0.005	<0.005	<0.005
ARSENIC	mg/L	<0.01	<0.01	<0.01
BARIUM	mg/L	0.0146	0.0668	0.0073
BERYLLIUM	mg/L	<0.0005	<0.0005	<0.0005
BISMUTH	mg/L	<0.007	<0.007	<0.007
BORON	mg/L	0.003	0.002	0.005
CADMIUM	mg/L	<0.0005	<0.0005	<0.0005
CALCIUM	mg/L	17.4	77.1	8.92
CHROMIUM	mg/L	0.0013	<0.0008	<0.0008
COBALT	mg/L	<0.0007	<0.0007	<0.0007
COPPER	mg/L	0.002	0.071	0.005
IRON	mg/L	0.088	<0.003	0.233
LEAD	mg/L	<0.002	<0.002	<0.002
LITHIUM	mg/L	0.00058	0.00361	<0.00006
MANGANESE	mg/L	0.0088	0.0049	0.0117
MAGNESIUM	mg/L	3.29	22.0	2.05
MOLYBDENUM	mg/L	<0.001	0.003	<0.001
NICKEL	mg/L	<0.001	0.003	0.004
PHOSPHORUS	mg/L	<0.006	0.008	0.009
POTASSIUM	mg/L	1.04	2.31	<0.60
SELENIUM	mg/L	<0.003	<0.003	<0.003
SILICON	mg/L	6.47	5.27	4.07
SILVER	mg/L	<0.001	<0.001	<0.001
SODIUM	mg/L	2.43	10.6	1.72
STRONTIUM	mg/L	0.0751	0.470	0.0400
SULPHUR	mg/L	0.690	9.16	1.31
THALLIUM	mg/L	<0.004	<0.004	<0.004
TIN	mg/L	0.003	0.009	<0.003
TITANIUM	mg/L	<0.0004	<0.0004	<0.0004
VANADIUM	mg/L	<0.001	<0.001	<0.001
ZINC	mg/L	0.0019	0.0310	0.0042

TRACE ICP, TOTAL

ALUMINUM	mg/L	0.045	0.025	0.062
ANTIMONY	mg/L	<0.005	<0.005	<0.005
ARSENIC	mg/L	<0.01	<0.01	<0.01
BARIUM	mg/L	0.0060	0.0575	<0.0002

Lab Manager:



DATE 16 OCT 97 08:18

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PAGE 2

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NORWEST LABS-LANGLEY  
 203-20771 LANGLEY BYPASS  
 LANGLEY, BC  
 V3A 5E8

NORTHERN AFFAIRS

WATER ANALYSIS REPORT

SAMPLE	1	2	3
	ID AGS - US	ID ART OCT 10/97	IC AGS-BPD OCT 3/97

TRACE ICP, TOTAL

BERYLLIUM	mg/L	<0.0005	<0.0005	<0.0005
BISMUTH	mg/L	<0.007	<0.007	<0.007
BORON	mg/L	<0.002	0.003	<0.002
CADMIUM	mg/L	<0.0005	<0.0005	<0.0005
CALCIUM	mg/L	16.3	72.6	8.68
CHROMIUM	mg/L	0.0012	<0.0008	<0.0008
COBALT	mg/L	<0.0007	<0.0007	<0.0007
COPPER	mg/L	0.001	0.117	0.002
IRON	mg/L	0.113	0.004	0.476
LEAD	mg/L	<0.002	<0.002	0.002
LITHIUM	mg/L	0.00051	0.00372	<0.00006
MANGANESE	mg/L	0.0062	0.0047	0.0122
MAGNESIUM	mg/L	3.07	20.5	1.83
MOLYBDENUM	mg/L	<0.001	0.005	<0.001
NICKEL	mg/L	0.002	0.005	0.001
PHOSPHORUS	mg/L	0.013	0.172	0.023
POTASSIUM	mg/L	3.05	<0.60	<0.60
SELENIUM	mg/L	0.003	<0.003	0.004
SILICON	mg/L	6.12	4.99	3.92
SILVER	mg/L	<0.001	<0.001	<0.001
SODIUM	mg/L	2.21	10.6	1.55
STRONTIUM	mg/L	0.0688	0.433	0.0356
SULPHUR	mg/L	0.689	8.72	1.20
THALLIUM	mg/L	<0.004	<0.004	<0.004
TIN	mg/L	<0.003	<0.003	0.003
TITANIUM	mg/L	<0.0004	<0.0004	0.0016
VANADIUM	mg/L	<0.001	<0.001	<0.001
ZINC	mg/L	0.0046	0.0594	0.0129

Lab Manager: \_\_\_\_\_



<b>INORGANIC PARAMETERS</b>	<b>DRINKING WATER (7,11)*</b>	<b>FRESHWATER AQUATIC LIFE (11)***</b>	<b>IRRIGATION WATER (11)***</b>	<b>LIVESTOCK WATER (11)***</b>
Aluminum (total)	(10)	0.005-0.1 (5)	5.0	5.0
Ammonia (total)	(13)	1.37-2.2 (2)		
Antimony	(10)			
Arsenic (total)	0.025 (8)	0.05 (10)	0.1 (10)	0.5-5.0 (10)
Barium	1.0			
Beryllium	(10)		0.1	0.1
Boron (total)	5.0 (8)		0.5-6.0	5.0
Cadmium (total)	0.005	0.0002-0.0018 (1) (10)	0.01	0.02
Calcium	(13)	0.00006		1000
Chloride (total)	≤ 250		100-700	
Chlorine (total residual)	(10)	0.002		
Chromium (total)	0.05	0.002-0.02	0.1	1.0
Cobalt (total)	(10)		0.05	1.0
Copper (total)	≤ 1.0	0.002-0.004 (1)	0.2-1.0 (4)	0.5-5.0
Cyanide	0.2 (total) (10)	0.005 (free CN)		
Fluoride (total)	1.5 (10)	(10)	1.0 (10)	1.0-2.0 (10)
Iron (total)	≤ 0.3	0.3	5.0	
Lead (total)	0.01	0.001-0.007 (1)	0.2	0.1
Lithium (total)			2.5	
Manganese (total)	≤ 0.05		0.2	
Mercury (total)	0.001	0.0001		0.003
Molybdenum (total)			0.01-0.05	0.5
Nickel (total)	(10)	0.025-0.15 (1)	0.2	1.0
Nitrate	45.0 (12)	Avoid prolific weed growth		
Nitrate and nitrite				100
Nitrite	3.2 (12)	0.06		10.0
Oxygen (dissolved)		5.0-9.5		
Selenium (total)	0.01	0.001	0.02-0.05	0.05
Silver (total)	(13)	0.0001		
Sodium	≤ 200		Refer to CWQG	
Sulphate	≤ 500			1000
Sulphide (as H <sub>2</sub> S)	≤ 0.05			
Total dissolved solids	≤ 500		500-3500	3000
Uranium (total)	0.1 (10)		0.01	0.2
Vanadium (total)			0.1	0.1
Zinc (total)	≤ 5.0	0.03	1.0-5.0 (3)	50.0

## REFERENCES

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Weagle, K., W. Robson and K. Gullen. 1976. Water quality and biological survey at Arctic Gold and Silver Mines Ltd., Yukon Territory, summer, 1975. Environment Canada, West Vancouver, BC., Environmental Protection Report No. EPS 5-PR-76-10, 18 p.



