PWGSC

Quality in Environmental Services

PHASE II ENVIRONMENTAL ASSESSMENT OF THE CONNAUGHT ABANDONED MINE SITE

prepared for:

Action on Waste Program
Indian and Northern Affairs Canada

prepared by:

Environmental Services
Public Works and Government Services Canada

March 1997

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

Canada

Printed on recycled paper

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EXECUTIVE SUMMARY

A phase II environmental assessment was conducted at the Connaught abandoned mine site (63° 55'20" N, 140° 32'52" W) in August, 1996 by Environmental Services, Public Works and Government Services Canada for the Action on Waste Program, Indian and Northern Affairs Canada. Based on the findings of the Phase I investigation performed in 1993 by DIAND Technical Services, a phase II assessment was conducted to a) identify potential environmental and human health risks associated with the present condition of the mine site, and b) provide recommendations and preliminary cost estimates for remediation of those risks.

A field investigation of the abandoned mine site was conducted to evaluate environmental and human safety concerns with respect to: mine openings and workings; buildings and infrastructure; waste disposal areas; waste rock disposal areas; surface water (including adit and waste rock seepage, and receiving waters); and hazardous and non-hazardous materials on the site.

The results of the investigation concluded that environmental risks from the Connaught Mine site are low. An assessment of the acid rock drainage potential shows that the risk to the environment due to the presence of exposed rock is currently insignificant. There are not any health and safety or aesthetic concerns on the site since all equipment, buildings or mine openings have been removed.

Using applicable federal and territorial criteria as well as northern mine reclamation guidelines, the recommendation is that no additional work be conducted on this site. Natural revegetation has reclaimed much of the site and leveling of trenches would provide only marginal benefit over the generally flat area while disturbing this vegetative cover .

Table 1: Summary of Potential Hazards at the Connaught Mine Site

Assessment Component	Risk	Recommendation
1. Building, Infrastructure, Equipment		
None		
2. Non-Hazardous Waste Material		
None		
3. Hazardous Materials		
None		
4. Water Quality		
Mine Seepage	None	
Site Drainage	None	
Receiving Waters	None	
5. Waste Rock Disposal Areas		
None		
6. Mine Openings		
3 trenches	None	None
7. Tailings		
None	None	

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1.0 INTRODUCTION AND BACKGROUND

In 1993, assessments of 49 abandoned Yukon mine exploration and development sites were completed under the Arctic Environmental Strategy - Action on Waste program by DIAND Technical Services. These assessments were intended to provide a general overview of historical activities, describe site infrastructure, workings and wastes, describe existing environmental or safety concerns on each site, and provide general recommendations for remediation or mitigation work, as appropriate.

The 1993 report for the Connaught abandoned mine site identified numerous trails and trench locations of various sizes over the area. No rock, soil or water samples were collected in this assessment.

In light of these preliminary findings, Indian and Northern Affairs Canada determined that further investigation was warranted. Environmental Services, Public Works and Government Services Canada was retained to conduct an environmental assessment of the Connaught abandoned mine site to a) identify specific environmental and human safety risks; b) provide clean-up recommendations; and c) provide a Class "D" cost estimate for remediation or mitigation of those risks.

1.1 LOCATION

The Connaught abandoned mine site is located at 63^0 55'20" N latitude and 140^0 32'52" W longitude approximately 70 km west of the community of Dawson and is accessible by road via the Top of the World Highway and through the Sixty Mile area. The site is approximately 1200 - 1225m above sea level on a low lying ridge approximately 5 km west of Mount Hart and between Butler Gulch and Huot Gulch.

1.2 OVERVIEW OF SITE DEVELOPMENT

Development of the property was detailed in DIAND (1993) and is summarized here. The property was first staked as the CCL claims by J. Lerner and M. Chefkoi in August of 1965. The claims were optioned by A. Moisey who enlarged the property and conducted geochemical sampling and trenching. In 1966, Sixty Mile Mining Co. Ltd. conducted additional trenching and a shipment of approximately 20 tonnes of hand-cobbed ore was sent to the Trail smelter (Price, 1987).

In 1968, Connaught Mining Ltd. optioned the property and conducted mapping, geochemical sampling, extensive dozer trenching and 318.8m of drilling from six

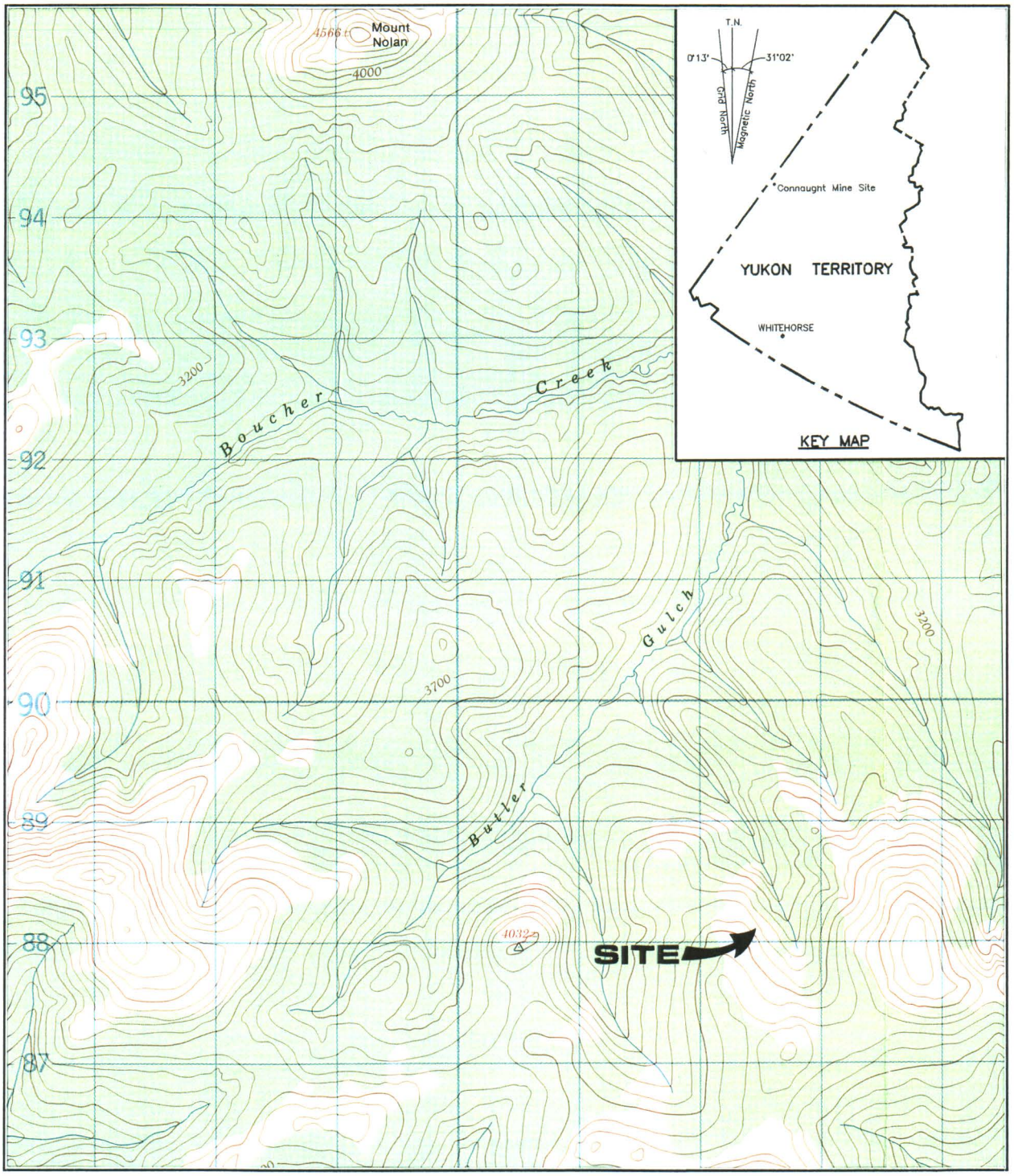

Figure 1. Location of Connaught Mine - 1:50,000, NTS-115N/15 [Energy Mines and Resources Canada: 1971]

holes. In 1976, J. Lerner mined and shipped approximately 27 tonnes of ore from the No. 1 vein.

The claims were restaked as the PRA claims by Croesus Resources Inc. in April, 1987. Croesus performed geochemical sampling and dozer trenching, then optioned the property to Red Fox Mines Ltd. who drilled eight holes in 1988. An additional 411m hole was drilled in May, 1989 by Walhalla Exploration Ltd.

Finally, Tombstone Exploration Ltd. optioned the property and conducted dozer trenching and geochemical sampling in 1990.

1.3 SITE ACCESS

The site is accessible by road off the Top of the World Highway and through the Sixty Mile area.

2.0 PURPOSE AND SCOPE OF WORK

The following assessment activities were completed, where appropriate, during site investigations:

- Inspection of mine openings and workings, buildings and infrastructure, and waste disposal areas;
- Photo documentation and mapping of relevant site features;
- Sampling of waste rock disposal areas, stained soils, surface water (including adit and waste rock seepage, and receiving waters) and barrel contents;
- Identification and inventory of hazardous and non-hazardous materials on the site;
- Identification of potential or actual environmental pathways and receptors for site contaminants; and
- Assessment of human safety hazards and potential for accidental or deliberate access to hazardous areas.

Upon completion of these activities, preliminary cost estimates were generated to meet the following remediation/mitigation requirements:

- Physical stabilization of waste rock disposal areas;
- Chemical stabilization of the waste rock disposal areas as appropriate to local and background conditions, taking into account impact, on-site resources, and accessibility;

- Sealing of all mine openings;
- Consolidation and landfill of all non-hazardous, non-combustible solid wastes;
- Remediation or removal and disposal of contaminated soils as required to meet the more stringent of: Yukon Government's Contaminated Sites Regulations (1996) Schedule 1; and Canadian Council of Ministers of the Environment's Interim Canadian Environmental Quality Criteria for Contaminated Sites (1991) Commercial/Industrial criteria for soils;
- Removal and disposal of hazardous solid wastes;
- Draining, cleaning and disposal of drums or other containers containing petroleum products or other liquid hazardous wastes;
- Onsite flaring or removal and off-site disposal of petroleum products and other liquid hazardous wastes; and
- Demolition of buildings and infrastructure to foundation level and burning of combustible non-hazardous materials in approved location

3.0 SITE ASSESSMENT METHODOLOGY

3.1 ASSUMPTIONS

The assessment was limited to the area specifically developed or occupied for exploration or mining purposes, and adjacent areas and resources believed to be affected by these activities. Water samples were taken off-site to determine potential impact to surface water bodies due to mining activities. Access roadways to mine sites were not included in the assessments.

3.2 ASSESSMENT CRITERIA

3.2.1 Criteria and Guidelines

Metal Mining Liquid Effluent Regulations and Guidelines (Environmental Protection Service, Environment Canada, 1977)

The intent of the requirements defined in this document is to limit the discharge of deleterious substances from base-metal, uranium and iron ore mines. These requirements are uniformly applied national standards and intended to provide protection for fish and other aquatic life.

Interim Canadian Environmental Quality Criteria for Contaminated Sites (Canadian Council of Ministers of the Environment, 1992)

The Canadian Council of Ministers of the Environment (CCME) Interim Canadian Environmental Quality Criteria for Contaminated Sites are numerical limits for contaminants in soil and water intended to protect, maintain or improve environmental quality and human health at contaminated sites in general.

CCME criteria include two types of benchmarks for soil and water quality - assessment criteria and remediation criteria. Assessment criteria are approximate background concentrations or approximate analytical detection limits for contaminants in soil and water, and remediation criteria are used as clean-up benchmarks based upon intended land use. Remediation criteria do not address site-specific conditions. They are considered generally protective of human and environmental health for specified uses of soil and water at contaminated sites. The remediation criteria for soil are classified by three land uses:

1) Agricultural,
2) Residential/Parkland, and
3) Commercial/Industrial.

Remediation criteria for water are classified by four uses of water likely of concern at contaminated sites:

1) Freshwater aquatic life,
2) Irrigation,
3) Livestock watering, and
4) Drinking water.

Contaminated Sites Regulations (draft) (Yukon Government, 1996)

According to these draft regulations a site is contaminated if it used for agricultural, commercial, industrial, parkland, or residential land use and contains a substance in concentration greater than or equal to:

(I) the generic numerical soil standard of Schedule 1, or
(ii) the matrix (pathway specific) numerical soil standards of Schedule 2

and, surface or groundwater used for aquatic life, irrigation, livestock, or drinking water which exceeds a concentration greater than or equal to:

(I) the generic numerical water standard of Schedule 3, or
(ii) the local background concentration of that substance in the soil, surface water, or groundwater.

Below 3 metres of the surface, commercial land use criteria is applicable.

Mine Reclamation in Northwest Territories and Yukon (INAC, 1992)

This report defines factors which are to be considered in reclamation of abandoned mine sites operating in northern climates. Factors include:

- open pit and underground mines;
- special mines such as uranium, sand and gravel, and coal;
- waste rock and tailings disposal;
- acid generation and leaching; and
- estimating cleanup costs.

3.2.2 Application of Criteria and Guidelines

For the Connaught abandoned mine site assessment the following criteria were used:

A. Soils:

CCME:	Remediation Criteria for Soil - Commercial/Industrial standard
YUKON RENEWABLE RESOURCES:	Draft Contaminated Sites Regulations - used for hydrocarbon screening parameters

B. Water:

ENVIR. CANADA:	Metal Mining Liquid Effluent Regulations and Guidelines - are compared to seepage from mine openings, and river/stream water quality
BACKGROUND:	Downstream water quality results of rivers and streams are compared to results of upstream (background) water quality
CCME:	Remediation Criteria for Water - Freshwater Aquatic Life guideline for river and stream water quality

[Note: In this screening assessment of water quality, analytical results are primarily compared to background values which may more accurately characterize the local environment.]

C. Mine Clean-Up and Reclamation:

INAC: Mine Reclamation in Northwest Territories and Yukon

3.3 METHODS

3.3.1 Background Information

Available background information was consolidated from the Yukon Chamber of Mines mine records, Whitehorse Public Library, Yukon Archives holdings, and records and reports from the Yukon Renewable Resources Library, Yukon Water Board, DIAND Lands Branch, DIAND Water Resources, and DIAND Library. INAC (1994) provided an overview assessment of the Connaught abandoned mine site to that date. Other published information sources were examined for site or regional information as applicable. On the basis of available information, knowledge gaps regarding existing or potential safety and environmental risks at the site were identified and a site assessment plan was developed.

3.3.2 Site Assessment Components

A site assessment was conducted to identify existing or potential safety and environmental risks on the site. The assessment included the following components, as applicable:

Waste Rock disposal areas were inspected and sampled by a professional geologist to assess acid rock drainage potential by:

- Identifying waste rock mineralization with potential to release acidic and/or metal-contaminated drainage
- Mapping and logging waste rock, tailings, pit walls and rock faces
- Collecting and field testing representative samples of mine wastes

Mine Openings were inspected and documented to identify closure requirements.

Non-Hazardous Site Debris was inventoried.

Contaminated Soil Areas were measured and sampled to determine the degree and type of contamination and estimate soil volumes for remediation.

Hazardous Materials were inventoried and sampled for analyses of contaminant constituents, as necessary.

Buildings and other Structures were inspected for hazardous materials and assessed for stability.

Borrow Sources were identified and assessed for accessibility and approximate quantity and type of granular material as applicable.

Scale site plans were prepared to identify the dimensions and locations site structures, mine workings and adits, waste rock disposal areas, on-site sampling locations, and any other pertinent information.

3.3.3 Sampling Methods and Quality Assurance

Test Pit Sampling

Test pits were excavated to a depth of about 0.3 to 1.0 m. Horizons in the test pit walls were logged, noting colour/weathering, rock composition, primary and secondary mineralization, particle size distribution, paste pH and paste conductivity, and moisture content. The test pit was photographed and its location was marked on the field map.

Approximately 2 kg of rock was collected at each sample site. For test pits showing a homogeneous wall face, a plastic sheet was placed at the bottom of the test pit and the pit wall was cut vertically down with a cleaned shovel. All rock larger than 75 mm in size was discarded. The sample was coned and quartered, discarding opposite quarters, until a 2 kg sample was obtained.

For test pit walls showing clearly-distinguishable horizons (distinguishable by the sulphide and carbonate contents), the horizons were sampled individually.

Water Sampling

Samples were collected from surface streams upstream and downstream of mine related flows, and from representative seeps emanating from waste rock, tailings, pit walls, and/or adits.

250 ml water samples were collected by hand, facing upstream, ensuring that the sample is not contaminated by disturbed sediment, debris and other floating materials. Sample bottles were rinsed three times with water from the sample stream prior to collecting the sample.

2 ml of HNO_3 were immediately added to water samples destined for metals analyses. For analyses of non-metallic parameters, water samples were brim-filled to minimize head space, placed in a cooler, and maintained at 4° C until delivery to the laboratory.

Soil Sampling

Soil lithology was recorded from observations of the side walls of the test pit, and soil samples for both field and laboratory testing were collected. Observations were recorded for each soil sample site, including soil particle size, consistency, colour, moisture, discoloration, stratification, odour, and any other observations of significance.

Samples were collected at depth intervals selected on the basis of stratigraphic observations and anticipated or apparent contamination. The lab samples were collected using disposable latex gloves and decontaminated stainless steel sampling utensils. All samples intended for organic analyses were stored in laboratory-cleaned 250 ml glass jars; samples intended for metals analyses were placed in new "Whirl-Pak" bags. All samples were placed in a cooler for shipment to the laboratory.

Barrel, Pail, and Above-Ground Storage Tank Sampling

Barrels and pails containing hydrocarbons were sampled with 1.2 m clean hollow glass rods ("drum thieves"), capable of extracting up to 25 ml of product. The rods were inserted into the drum or pail, and the uppermost open tip was sealed to maintain the sample within the rod as it was extracted from the drum or pail. The sampled hydrocarbon was then drained into a 40-ml laboratory-cleaned vial. The extractions were repeated until at least 20-30 ml of product was obtained. The vial was then sealed and placed in a container for shipment to the laboratory. Each used drum thief rod was subsequently destroyed to prevent accidental re-use.

One Above-Ground Storage Tank (AST) was sampled with a stainless steel Bacon bomb sampler. A plunger at the tip of the sampler depressed when contact with the tank bottom was made, allowing petroleum product to enter the body of the sampler. When the sampler was raised, the plunger closed to seal the sampler and allow

removal of the sample from the AST. The sampled hydrocarbon was then drained into a 40-ml laboratory-cleaned vial which was then sealed and placed in a container for shipment to the laboratory. The bomb sampler was cleaned with laboratory-grade detergent between sampling events.

Since hydrocarbon samples were collected only for analyses of Total Halides and metals, no cooling or other preservative was required.

Quality Assurance

Quality Assurance (QA) is a set of procedures for ensuring that the results of chemical analyses are, and can be shown to be, accurately representative of field conditions. A complete QA program includes both a field component and a laboratory component.

In addition to the standard sample collection methods outlined above, the field QA measures that were implemented for this assessment study include:

- chain of custody procedures and forms;
- a sample labeling and sample location identification scheme;
- laboratory preparation of all sampling containers;
- laboratory defined sample preservation and shipping procedures; and
- regular maintenance (including re-calibration) and cleaning of field equipment.

Laboratory QA measures included replicate analyses of selected soil and water samples. Replicate analytical results were submitted with each analytical report.

4.0 ENVIRONMENTAL SETTING

4.1 MINERALIZATION

Mineralization at the site occurs in quartz-galena veins that cross-cut Klondike Schist and Pelly Gneiss (Price, 1989). The main vein contains galena lenses up to 17 inches wide and trends northeast and dips steeply to the southeast. No other sulphides were identified in the site visit although minor arsenopyrite, sphalerite, tetrahedrite, and boulangerite are reported (DIAND, 1989). Iron oxide staining is common in the area around the vein whereas manganese oxides are more common peripheral to the veins in the metamorphic rocks.

The major commodities at the site are silver and lead, with gold and zinc as minor commodities.

4.2 SURFACE HYDROLOGY

Both site and regional drainage are to the east, draining into a valley leading towards Boucher Creek and, subsequently, the Sixty Mile and Yukon Rivers (see Figure 1). Hydrological and water quality data are not available for streams in the area of Connaught mine. The mine itself sits on a flat, broad ridge above the treeline and is dry with no streams cutting the area.

4.3 CLIMATE

The closest climatological information is from the town of Dawson, 64° 3' N, 139° 26' W; 320m above sea level (Environment Canada, 1980). Total annual precipitation is 306.1 mm. This consists of 182.7mm of rainfall and 137.1mm of snowfall. Highest levels of rainfall occur in July and highest levels of snowfall occur in December. Temperatures range from -30.7° C in January to 15.6°C in July. The mean annual temperature is -5.1° C.

4.4 VEGETATION

Connaught mine site occurs within the Klondike Plateau ecoregion. The site is above the treeline and vegetation is limited to short shrubs and bushes. At an elevation of between 1200 and 1225m above sea level, the area is characterized by alpine vegetation consisting of lichens, moss and numerous low grasses and shrubs.

4.5 FISH AND WILDLIFE RESOURCES

Typical mammals in the area include grizzly and black bear, Dall's sheep, caribou, moose, wolf, beaver, fox and hare. Typical bird species include raven, rock and willow ptarmigan, and golden eagle. Given that the mine occurs above the treeline, the area can be expected to be typically low in species number and diversity.

4.6 SITE TOPOGRAPHY AND SOILS

Characteristic terrain features include smooth, unglaciated, rolling plateau topography with moderate to deeply incised valleys.

The soil development in this ecoregion is dominated by turbic cryosols and eutric

brunisols with eutric regosols occuring on floodplains.

4.7 PERMAFROST

Connaught is in an area of discontinuous permafrost. No evidence of permafrost was discovered during the site visit.

5.0 SITE DESCRIPTION AND FINDINGS

5.1 BUILDING, INFRASTRUCTURE, EQUIPMENT

No buildings, infrastructure or equipment were left on site.

5.2 NON-HAZARDOUS WASTE MATERIALS

No non-hazardous waste material was left on site.

5.3 HAZARDOUS MATERIALS

No hazardous materials were observed at the site.

5.4 SURFACE WATER QUALITY

Because the site is located on a broad flat ridge, no streams cut the area and there is no mine surface water. Therefore, no water samples were collected.

5.5 WASTE ROCK DISPOSAL AREAS

There is no waste rock at the site. Activity has been limited to bulldozed trenches and flat-lying scars, and any mining conducted has been by hand-cobbling (high-grading). The trenches and the berms created by trenching are fairly well vegetated, and, therefore, were not sampled. The scar is a more recent disturbance, however, and two grab rock samples were collected in that area: a composite sample across the largest vein and a sample of the altered metamorphic rocks located west of the vein.

Paste pH and conductivity were measured in the field, and the samples were analyzed for Acid Base Accounting (ABA) and metals concentrations by Inductively Coupled Plasma - Atomic Emission Spectrophotometry (ICP-AES). Sample

locations are shown on the site map. Sample descriptions and a summary of analytical results are presented in Table 2. Complete analytical results are listed in Appendix B.

TABLE 2 Summary of Acid/Base Accounting Test Results

Sample ID	Sample Location and Description	Discussion of Results
CNWR/P1/1	Grab sample across large quartz-galena vein	Potentially acid generating (NP/AP=0.12); high As, Cu, Pb, Zn.
CNWR/P2/1	Grab sample west side of the trench in altered biotite granite.	Potentially acid generating (NP/AP=1.14); high As, Cu, Pb, Zn.

Laboratory paste pH values for the two samples were 5.4 and 5.7, indicating that the rock is slightly acid generating. However, paste conductivity measurements below 60 µS/cm indicate that the lack of oxidation products stored in the rock. The exposed rock has the potential to generate acid (NP/AP = 0.12 and 1.14) but the total sulphur concentrations are low (0.52% and 0.14%).

The rock samples contain high concentrations of arsenic, copper, lead, and zinc, with lesser concentrations of molybdenum.

5.6 MINE OPENINGS

There were no mine openings at the site.

5.7 TAILINGS

Ore mined from the property was shipped off site for milling. Therefore, no tailings are present at the site.

6.0 CONCLUSIONS

In general, there were no significant health, safety, environmental or aesthetic concerns discovered at the Connaught mine site.

6.1 HEALTH AND SAFETY

There are no safety issues at the site since there are no mine openings and no buildings.

6.2 ENVIRONMENTAL RISKS

Environmental risks from the Connaught mine site are low. Although rock at the site has the potential to generate acid, the amount of rock exposed to weathering conditions is minimal since it is only material exposed through trenching. There are no waste piles on site. Furthermore, there is no water flow to the potentially acid generating material other than rainfall. As a result, there does not appear to be a significant risk to the environment at this time.

6.3 AESTHETIC CONCERNS

The site has been left in an orderly manner with no equipment, barrels or buildings. Revegetation of the site is occurring naturally. The older trenches are almost fully covered in low grasses and bushes, and vegetation is encroaching at the edges of the most recent dozer scar.

7.0 RECOMMENDATIONS

Since there are no concerns at this site, no action is required.

8.0 COST ESTIMATES TO IMPLEMENT RECOMMENDATIONS

There are no costs associated with the recommendation provided herein.

REFERENCES

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APPENDIX A

Site Photographs

CONNAUGHT

Photographic Record

August 13, 1996

Photos	Description
C. # 1	Overview of Connaught Mine from Air
C. # 2	Overview of Surface Stripped Area
C. # 3	View from Centre of Stripped Area looking West
C. # 4	North-South Ridge within Stripped Area
C. # 5	Location of Waste Rock Sample CNWR/P1/1
C. # 6	View of Stripped Area looking East

Photo # 1 - Overview of Connaught Mine from Air

Photo # 2 - Overview of Surface Stripped Area

Photo # 3 - View from Centre of Stripped Area looking West

Photo # 4 - North-South Ridge within Stripped Area

Photo # 5 - Location of Waste Rock Sample CNWR/P1/1

Photo # 6 - View of Stripped Area looking East

APPENDIX B

Analytical Results

1988 Triumph Street, Vancouver, B.C., Canada V5L 1K5

analytical service laboratories ltd.

FAX: (604) 253-6700 TEL: (604) 253-4188

CHEMICAL ANALYSIS REPORT

Date: September 13, 1996

ASL File No. G4225

Report On: Soil And Water Analysis

Report To: **Public Works & Gov't Services**
Environmental Services
204-1166 Alberni Street
Vancouver, BC
V6E 3W5

Attention: **Mr. Tim Sackmann**, Manager, Contaminated Sites

Received: August 19, 1996

ASL ANALYTICAL SERVICE LABORATORIES LTD.
per:

Heather A. Ross, B.Sc.
Project Chemist

Frederick Chen, B.Sc.
Supervisor, Trace Metals Lab

REMARKS

File No. G4225

The Acid Base Accounting of the rock samples were subcontracted to BC Research Inc. Please refer to the attached subconsultants report for details.

RESULTS OF ANALYSIS - Sediment/Soil[1]

File No. G4225

		CN-WR-P1-1	CN-WR-P2-1	CL-WR-P1-1	SC-WR-P1-1	CA-WR-P1-1
		96 08 13	96 08 13	96 08 13	96 08 14	96 08 11
Physical Tests						
Moisture	%	9.5	8.7	7.6	7.4	4.1
Total Metals						
Antimony	T-Sb	48	61	<20	<20	<20
Arsenic	T-As	871	2050	52.1	63.9	44.5
Barium	T-Ba	50	161	22	127	14
Beryllium	T-Be	0.6	0.8	<0.5	<0.5	<0.5
Cadmium	T-Cd	4	2	<2	<2	<2
Chromium	T-Cr	3	6	229	22	20
Cobalt	T-Co	5	7	89	12	110
Copper	T-Cu	588	407	3	94	737
Lead	T-Pb	5270	3870	<50	<50	<50
Mercury	T-Hg	0.099	0.054	0.640	0.225	0.025
Molybdenum	T-Mo	127	101	<4	14	<4
Nickel	T-Ni	<2	3	1930	56	2140
Selenium	T-Se	<20	<20	<20	<20	<20
Silver	T-Ag	5	21	<2	2	<2
Tin	T-Sn	<30	<30	<30	<30	<30
Vanadium	T-V	18	32	<2	34	34
Zinc	T-Zn	491	254	5	222	90

Remarks regarding the analyses appear at the beginning of this report.
< = Less than the detection limit indicated.
[1]Results are expressed as milligrams per dry kilogram except where noted.

RESULTS OF ANALYSIS - Sediment/Soil[1]

File No. G4225

		SD-WR-P4-1	SD-WR-P3-1	SD-WR-P2-1	SD-WR-P1-1	CA-WR-P2-1
		96 08 15	96 08 15	96 08 15	96 08 15	96 08 11
Physical Tests						
Moisture	%	17.7	21.4	22.6	13.7	7.4
Total Metals						
Antimony	T-Sb	<20	<20	<20	<20	<40
Arsenic	T-As	7.14	8.28	6.95	21.9	17.7
Barium	T-Ba	27	25	38	111	17
Beryllium	T-Be	1.5	4.2	1.5	1.0	<1
Cadmium	T-Cd	<2	<2	<2	<2	<4
Chromium	T-Cr	2	6	3	52	19
Cobalt	T-Co	<2	3	3	21	158
Copper	T-Cu	9	14	11	43	2590
Lead	T-Pb	<50	<50	<50	<50	<100
Mercury	T-Hg	0.150	0.077	0.234	1.26	0.052
Molybdenum	T-Mo	<4	<4	<4	<4	<8
Nickel	T-Ni	13	19	16	90	6510
Selenium	T-Se	<20	<20	<20	<20	<20
Silver	T-Ag	<2	<2	<2	<2	<4
Tin	T-Sn	<30	<30	<30	<30	<60
Vanadium	T-V	15	17	14	52	32
Zinc	T-Zn	15	22	40	135	342

Remarks regarding the analyses appear at the beginning of this report.
< = Less than the detection limit indicated.
[1]Results are expressed as milligrams per dry kilogram except where noted.

Appendix 1 - QUALITY CONTROL - Replicates

File No. G4225

Sediment/Soil[1]		SD-WR-P2-1	SD-WR-P2-1
		96 08 15	QC # 70641
Physical Tests			
Moisture	%	22.6	24.1
Total Metals			
Antimony	T-Sb	<20	<20
Arsenic	T-As	6.95	5.14
Barium	T-Ba	38	50
Beryllium	T-Be	1.5	1.9
Cadmium	T-Cd	<2	<2
Chromium	T-Cr	3	4
Cobalt	T-Co	3	3
Copper	T-Cu	11	15
Lead	T-Pb	<50	<50
Mercury	T-Hg	0.234	0.296
Molybdenum	T-Mo	<4	<4
Nickel	T-Ni	16	20
Selenium	T-Se	1.2	1.1
Silver	T-Ag	<2	<2
Tin	T-Sn	<30	<30
Vanadium	T-V	14	17
Zinc	T-Zn	40	54

Remarks regarding the analyses appear at the beginning of this report.
< = Less than the detection limit indicated.
[1]Results are expressed as milligrams per dry kilogram except where noted.

RESULTS OF ANALYSIS - Water[1]

File No. G4225

			CL-WQ-STR-1	SD-WQ-STR1-1	CL-WQ-STR-2	SD-WQ-STR1-2
			96 08 13	96 08 15	96 08 13	96 08 15
Physical Tests						
Conductivity (umhos/cm)			535	281	548	270
pH			8.04	8.02	8.17	8.33
Dissolved Anions						
Acidity		CaCO3	4.4	4.4	<1.0	<1.0
Alkalinity - Total		CaCO3	143	134	148	132
Sulphate	SO4		135	18.9	138	18.2
Total Metals						
Aluminum	T-Al		<0.2	<0.2	<0.2	<0.2
Antimony	T-Sb		<0.2	<0.2	<0.2	<0.2
Arsenic	T-As		<0.2	<0.2	<0.2	<0.2
Barium	T-Ba		0.06	0.06	0.06	0.06
Beryllium	T-Be		<0.005	<0.005	<0.005	<0.005
Bismuth	T-Bi		<0.1	<0.1	<0.1	<0.1
Boron	T-B		<0.1	<0.1	<0.1	<0.1
Cadmium	T-Cd		<0.01	<0.01	<0.01	<0.01
Calcium	T-Ca		69.5	34.1	66.1	33.6
Chromium	T-Cr		<0.01	<0.01	<0.01	<0.01
Cobalt	T-Co		<0.01	<0.01	<0.01	<0.01
Copper	T-Cu		<0.01	<0.01	<0.01	<0.01
Iron	T-Fe		<0.03	0.16	0.09	0.17
Lead	T-Pb		<0.05	<0.05	<0.05	<0.05
Lithium	T-Li		<0.01	<0.01	<0.01	<0.01
Magnesium	T-Mg		26.0	12.4	27.5	11.9
Manganese	T-Mn		0.005	0.036	0.008	0.025
Molybdenum	T-Mo		<0.03	<0.03	<0.03	<0.03
Nickel	T-Ni		<0.02	<0.02	<0.02	<0.02
Phosphorus	T-P		<0.3	<0.3	<0.3	<0.3
Potassium	T-K		<2	<2	2	<2
Selenium	T-Se		<0.2	<0.2	<0.2	<0.2
Silicon	T-Si		3.02	2.80	2.93	2.77
Silver	T-Ag		<0.01	<0.01	<0.01	<0.01
Sodium	T-Na		3	6	4	5
Strontium	T-Sr		0.402	0.305	0.379	0.303
Thallium	T-Tl		<0.1	<0.1	<0.1	<0.1
Tin	T-Sn		<0.03	<0.03	<0.03	<0.03
Titanium	T-Ti		<0.01	<0.01	<0.01	<0.01
Vanadium	T-V		<0.03	<0.03	<0.03	<0.03

Remarks regarding the analyses appear at the beginning of this report.
< = Less than the detection limit indicated.
[1]Results are expressed as milligrams per litre except for pH and Conductivity (umhos/cm).

RESULTS OF ANALYSIS - Water[1]

File No. G4225

		CL-WQ-STR-1	SD-WQ-STR1-1	CL-WQ-STR-2	SD-WQ-STR1-2
		96 08 13	96 08 15	96 08 13	96 08 15
Total Metals					
Zinc	T-Zn	<0.005	<0.005	<0.005	<0.005

Remarks regarding the analyses appear at the beginning of this report.
< = Less than the detection limit indicated.
[1]Results are expressed as milligrams per litre except for pH and Conductivity (umhos/cm).

Outlines of the methodologies utilized for the analysis of the samples submitted are as follows:

Moisture

This analysis is carried out gravimetrically by drying the sample to constant weight at 103 C.

Metals in Sediment/Soil

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 Method 3050 or Method 3051, published by the United States Environmental Protection Agency (EPA). The procedures involve a digestion using a 1:1 ratio of nitric acid and hydrochloric acid, along with hotplate or microwave heating. Instrumental analysis is by atomic absorption spectrophotometry (EPA Method 7000) and/or inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010).

Method Limitation: The stated acid digestion will provide excellent results for total recoverable metals; however, it is only partially effective on mineralized or non-environmentally available metals.

Conventional Parameters in Water

These analyses are carried out in accordance with procedures described in "Methods for Chemical Analysis of Water and Wastes" (USEPA), "Manual for the Chemical Analysis of Water, Wastewaters, Sediments and Biological Tissues" (BCMOE), and/or "Standard Methods for the Examination of Water and Wastewater" (APHA). Further details are available on request.

Metals in Water

This analysis is carried out in accordance with procedures described in "Standard Methods for the Examination of Water and Wastewater" 19th Edition 1995 published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion or filtration (EPA Method 3005), followed by instrumental analysis by atomic absorption spectrophotometry (EPA Method 7000), inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010), and/or inductively coupled plasma - mass spectrometry (EPA Method 6020).

End of Report

APPENDIX

RESULTS OF SUBCONTRACTED ANALYSES

BCRI

September 9, 1996
File: 2-21-900

Mr. Fred Chen
ASL Ltd.
1988 Triumph St.
Vancouver, B.C.
V6C 2V6

Dear Fred:

Subject: ***Results of Acid Base Accounting of Soil Samples.***

Below are the results of acid base accounting of 10 soil samples received August 21, 1996. Samples G4225-1, G4225-5, G4225-6, G4225-7, G4225-8 and G4225-10 are potential net acid producers. All remaining samples are net acid consumers.

Results of Acid Base Accounting:

Sample ID	Paste pH	Total Sulphur (Wt. %)	Maximum Potential Acidity (kg $CaCO_3$/tonne)	Neutralization Potential (kg $CaCO_3$/tonne)	Net Neutralization Potential (kg $CaCO_3$/tonne)
G4225-1	5.7	0.52	16.3	2.0	-14.3
G4225-2	5.4	0.14	4.4	5.0	0.6
G4225-3	9.0	0.02	0.6	422.8	422.2
G4225-4	8.1	0.17	5.3	71.4	66.1
G4225-5	5.4	1.17	36.6	3.7 / 3.2*	-32.9
G4225-6	3.2	0.74	23.1	-20.8	-43.9
G4225-7	4.8	0.30/0.30*	9.4	-3.4	-12.8
G4225-8	4.1	0.62	19.4	-16.9	-36.3
G4225-9	7.7	0.11	3.4	37.2	33.8
G4225-10	5.6	2.22	69.4	19.5	-49.9

*Duplicate analysis.

The analysis were carried out according to Sobek A. et al., EPA-600/2-78-054, March, 1978. Total cost for this work is $700.00, based on our price of $70 per sample. Please find enclosed our invoice for $700.00 plus GST. Thank you for using BCRI.

Sincerely,
BCRI

Tim O'Hearn, P.Eng.
Mine Waste & Drainage
Environmental Services and Technology

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC
Canada V6S 2L2

Canada
Tel: (604) 224-4331
Fax: (604) 224-0540

USA
Tel: (360) 738-0958
Fax: (360) 733-3590

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

Specialists in Environmental Chemistry
analytical service laboratories ltd.
1988 Triumph Street
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TOLL FREE: (800) 665-0243

CLIENT Public Works Canada PAGE 1 OF 2

ASL CONTACT

CLIENT PROJECT #

PH/FAX# 403-497-3846/497-3996 PO #

CONTACT Ed Doumyan DATE SUBMITTED Aug 16/96

SAMPLED BY " " RESULTS REQUIRED BY

ANALYSIS REQUESTED

LAB USE	SAMPLE IDENTIFICATION	SAMPLE TYPE	DATE/TIME SAMPLED (Y M D)	FIELD PRESERVATION	Metals by ICP	ABA acid-base	TM	IMM	COMMENTS
	CN-WR-P1-1	Rock	96 08 13	NO	✓	✓			
	CN-WR-P2-1	"	96 08 13	NO	✓	✓			
	CL-WR-P1-1	"	96 08 13	"	✓	✓			
	SC-WR-P1-1	"	96 08 14	"	✓	✓			
	CA-WR-P1-1	"	96 08 11	"	✓	✓			
	SD-WR-P4-1	"	96 08 15	"	✓	✓			
	SD-WR-P3-1	"	96 08 15	"	✓	✓			
	SD-WR-P2-1	"	96 08 15	"	✓	✓			
	SD-WR-P1-1	"	96 08 15	"	✓	✓			
	CA-WR-P2-1	"	96 08 11	"	✓	✓			
	CL-WQ-STR-1 (IMM)	Water	96 08 13	HNO3				✓	
	CL-WQ-STR-1 (TM)	"	96 08 13	Nitric Acid			✓		
	SD-WQ-STR1-1 (IMM)	"	96 08 15	None				✓	
	SD-WQ-STR1-1 (TM)	"	96 08 15	Nitric Acid			✓		

NOTES/COMMENTS

CONDITION RECEIVED
FROZEN
COLD
AMBIENT
TOTAL PACKAGES

RELINQUISHED BY		
AFFILIATION		
RECEIVED BY	Y M D	Y M D
AFFILIATION	: AM PM	: AM PM

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

analytical service laboratories ltd.
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1988 Triumph Street
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CLIENT Public Works Canada

PAGE 2 OF 2

ASL CONTACT

CLIENT PROJECT #

PO #

PH/FAX# (403) 497-3846 / 497-3796

CONTACT Ed Domjan

DATE SUBMITTED Aug 16/96

SAMPLED BY Ed Domjan

RESULTS REQUIRED BY

ANALYSIS REQUESTED

LAB USE	SAMPLE IDENTIFICATION	SAMPLE TYPE	DATE/TIME SAMPLED (Y M D)	FIELD PRESERVATION	TM	TMM	COMMENTS
	CL-WQ-STR-2 (TMM)	Water	96 08 13	None		✓	
	CL-WQ-STR-2 (TM)	"	96 08 13	Nitric Acid	✓		
	SD-WQ-STR1-2 (TMM)	"	96 08 15	None		✓	
	SD-WQ-STR1-2 (TM)	"	96 08 15	Nitric Acid	✓		

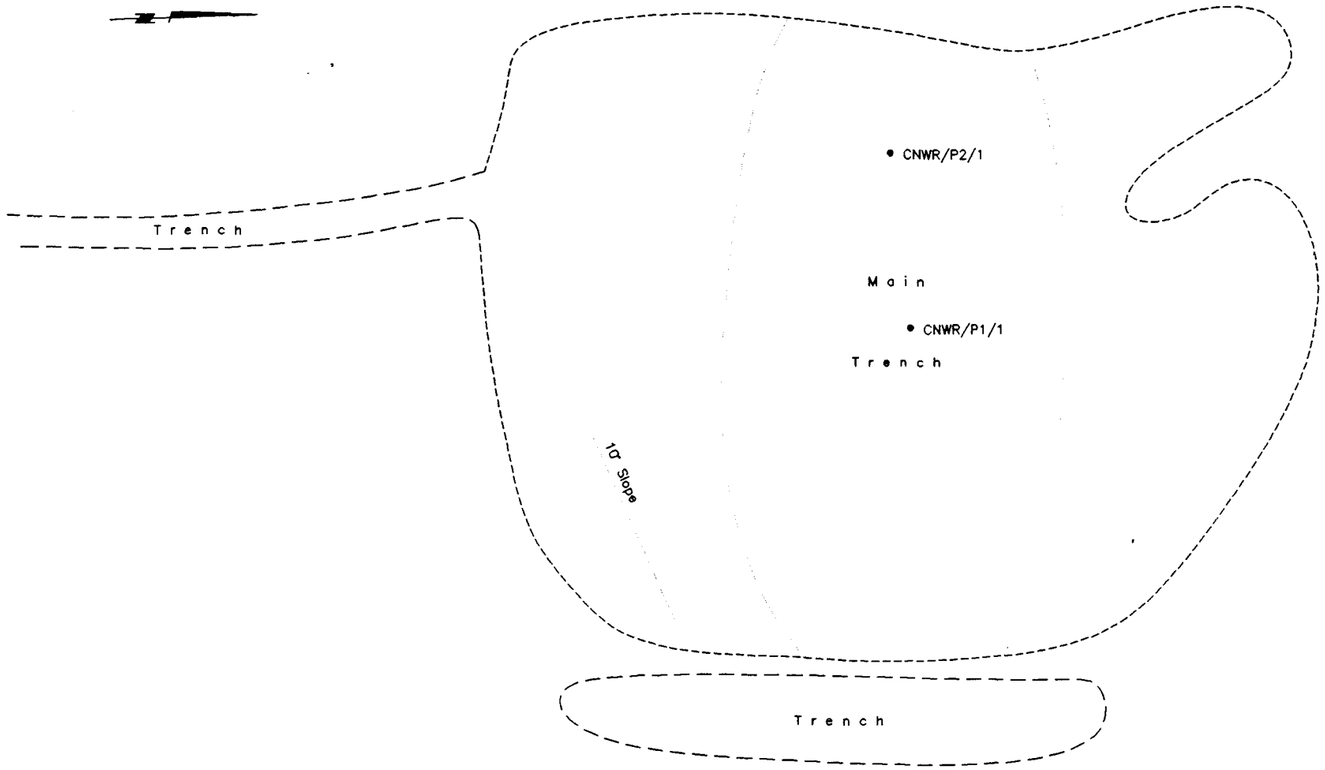
NOTES/COMMENTS

CONDITION RECEIVED
FROZEN
COLD
AMBIENT
TOTAL PACKAGES

RELINQUISHED BY		
AFFILIATION		
RECEIVED BY	Y M D	Y M D
AFFILIATION	: AM PM	: AM PM

APPENDIX C

Drawings



Legend

- Outcrop Boundry
- W/R — Waste Rock
- Road
- Extent Of Waste Rock
- CNWR/P1/1 — Waste Rock (site designation)
- Slope Down

Approx. Scale: 1:1000

PLOT: 1=1
CAD FILE: INVEN-96\CONAUGHT\CONAUG-1

Public Works And Government Services Canada / Travaux publics et Services gouvernementaux Canada
Architectural & Engineering Services
Western Region

Connaught Mine Site Development & Geological Information
Yukon Territory

626967

1 of 1