PWGSC

Quality in Environmental Services

PHASE II ENVIRONMENTAL ASSESSMENT OF THE CALEY 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

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EXECUTIVE SUMMARY

A phase II environmental assessment was conducted at the Caley abandoned mine site (64^0 18'08" N, 140^0 11'34" W) in July, 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 possible 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 there is no health and safety, environmental or aesthetic concerns at the Caley site. There is a low potential for the generation of acid rock drainage in the future from the nearly 230,000 tonnes of waste rock. Sampling of the receiving waters showed no impacts from previous mine activities. Since the mine operations used open excavation, there are no underground openings on site. The excavation cut is physically stable. No building or waste materials have been left on site.

Based on the findings of this investigation, no further action is required.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

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 - creek	minor environmental risk	No Action
5. Waste Rock Disposal Areas		
Large waste pile	minor environmental risk	No Action
6. Mine Openings		
Large Excavation	None	No Action
7. Tailings		
None		

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1.0 INTRODUCTION AND BACKGROUND

In 1993, phase I 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 findings of the phase I investigation of the Caley exploration site, revealed possible environmental impacts as a result of previous mining activities. The potential areas of concern were the physical and chemical stability of the waste rock piles and open pit left on site. No rock, tailings, soil or water samples were collected in this assessment.

In light of these preliminary findings, Indian and Northern Affairs Canada has determined that further investigation is warranted. Environmental Services, Public Works and Government Services Canada was retained to conduct an environmental assessment of the Caley 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

Caley exploration site is located at 64° 18' 08"N latitude and 140° 11' 34"W longitude. The site is located approximately 47 km northwest of the community of Dawson, the nearest community to the site. The site is approximately 600m above sea level, approximately 7km west of the Cassiar Dome and above Cassiar Creek.

1.2 OVERVIEW OF SITE DEVELOPMENT

The following work history of the site has been compiled from DIAND minfile records (DIAND, 1994):

The first claim in this area was the Isabelle Marion claim staked by F. Purdy in December, 1930. In 1956 the property was optioned to Conwest Exploration Ltd. which explored with trenching. In 1958 Conwest assigned the option to Cassiar Asbestos Corporation Ltd. which explored with more trenching and 360m of drifting in two adits.

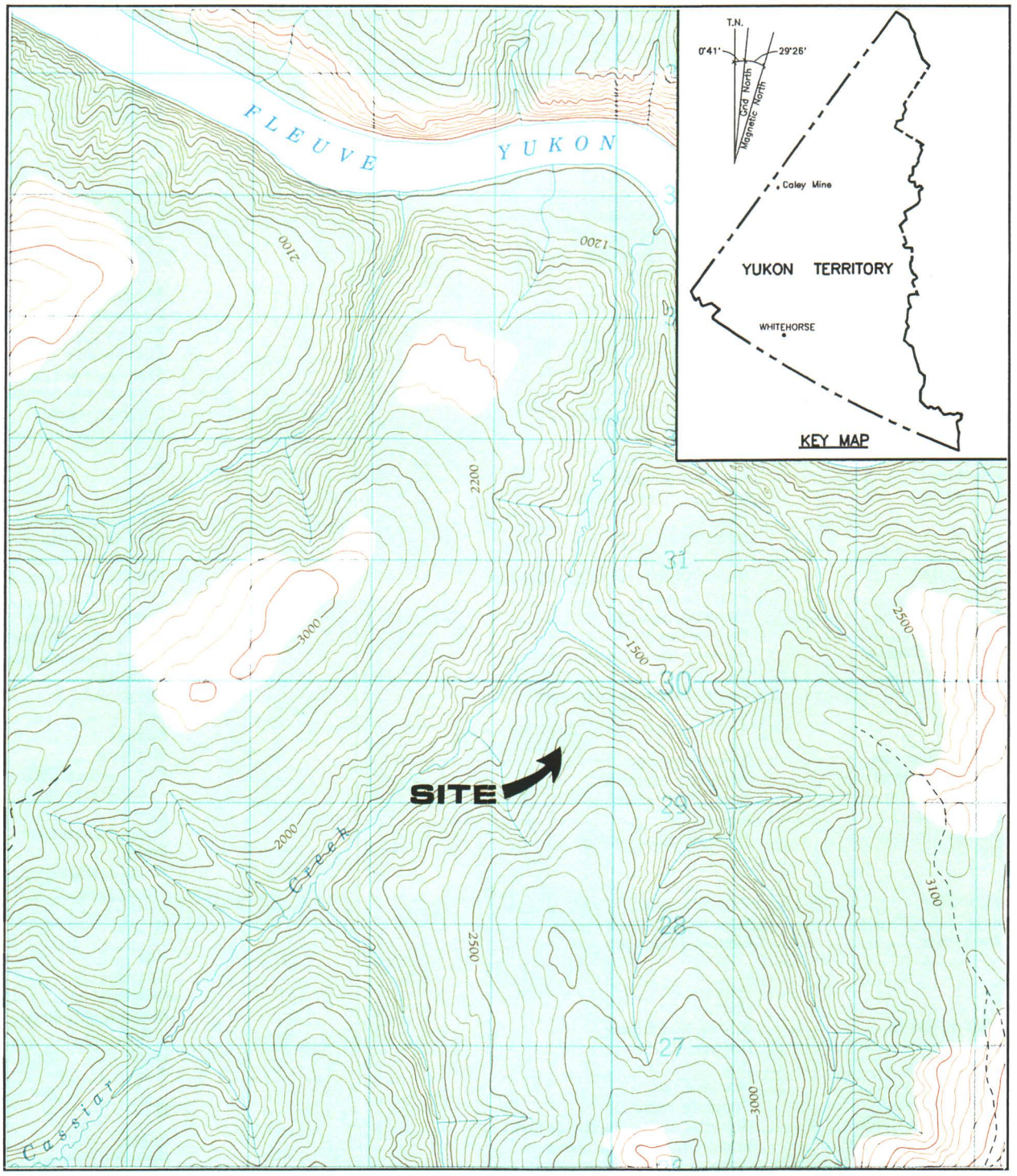

Figure 1. Location of Caley Mine - 1:50,000, NTS-116 C/8 [Energy Mines and Resources Canada: 1991]

[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 Caley 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:

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.

In 1963 the property was optioned to Johns-Mannville Co. Ltd. which drilled 609.6m of diamond drill holes from 12 holes. The property was then sold to Anglo Western Minerals Ltd. in 1972. Anglo Western conducted additional trenching in a joint venture with Branta Exploration Ltd.

In 1978, R. Gillespie mined 229,073 tonnes of asbestos and sold the ore to Cassiar Asbestos Corp. Ltd. In 1980, dozer trenching was conducted.

Cominco Ltd. obtained the claims in 1992 but allowed them to lapse.

1.3 SITE ACCESS

The Caley mine site is located approximately 47 km north of Dawson City, and is accessible via the Top of the World Highway and a dirt road to the old Clinton Creek mine site.

2.0 PURPOSE AND SCOPE OF WORK

The following assessment activities were completed, where appropriate:

- 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 an 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

The following assessment criteria were used for the Becker Cochran abandoned mine site:

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 the results of upstream (background) water quality.
CCME:	Remediation Criteria for Water - Freshwater Aquatic Life guideline for river and stream water quality

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 and 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

The commodity of interest at the Caley deposit was asbestos. The dark to apple green asbestos is present in sub-horizontal, sheet-like serpentinite bodies with peripheral zones of carbonate quartz and talc (Janes, 1964). In the main deposit area visited by the assessment team, the rock consisted almost exclusively of serpentine and asbestos. The asbestos fibres range from 0.6 cm to 3.8 cm.

Work at the Cassiar mine indicated a reserve of approximately 900,000 tonnes grading 4% to 6% cement grade asbestos fibre. The ore mined in 1978 is estimated to have an average grade of 8% fibre but because the shipment was blended with other material, this is not an exact figure (Minfile 116C 033).

4.2 SURFACE HYDROLOGY

Both the site and regional drainage are to the northwest draining 500 metres into Cassier Creek and subsequently 3500 metres into the Yukon River (see Figure 1).

Hydrological and water quality data are not available for the Caley Stream.

No seepage from the waste rock piles was detected, however the site topography lends itself to seepage through the waste rock piles as a result of site drainage and surface infiltration from precipitation.

4.3 CLIMATE

The closest climatological information is from Clinton Creek, 64° 28' N, 140° 44' W; 576 m above sea level (Environment Canada, 1980). Total annual precipitation is 370.4 mm. This consists of 212.6 mm of rainfall and 145.3 mm of snowfall. Highest levels of rainfall occur in August and highest levels of snowfall occur in December. Temperatures range from -27.1° C in January to 14.9° C in July. Data on the mean annual temperature is unavailable.

4.4 VEGETATION

Caley mine site occurs within the Klondike Plateau ecoregion. Warmer boreal zones within the area are characterized by open stands of black and white spruce with some aspen and occasionally lodgepole pine. Vegetation on slopes underlain by permafrost include black spruce and paper birch. In valley areas, scrub birch and willow form large stands, while balsam poplar is found along floodplains.

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.

4.6 SITE TOPOGRAPHY AND SOILS

The soil development in this ecoregion is dominated by turbic cryosols and eutric brunisols with eutric regosols occurring on floodplains.

4.7 PERMAFROST

Caley is in a discontinuous permafrost zone. No attempt was made to establish the presence or absence of permafrost at this site.

5.0 SITE DESCRIPTION AND FINDINGS

5.1 BUILDING, INFRASTRUCTURE, EQUIPMENT

No buildings 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

To identify possible contribution of metals by the Caley exploration site, two water samples were collected on Cassiar Creek, one upstream from the Caley deposit (CLWQ/STR1/1) and one at the mouth of the creek where it empties into the Yukon River (CLWQ/STR1/2). The downstream sample was collected approximately 2 kilometres from the site due to access constraints.

Complete results of water quality analyses are presented in Appendix B and summarized in Table 1. The quality of water both upstream of the Caley site and

at the mouth of Cassiar Creek are similar. Both samples had pH values above 8, conductivity greater than 500 µs/cm, and sulphate concentrations of approximately 136 mg/L. Metal concentrations were generally low. The iron concentration in the upstream sample was <0.03 mg/L compared to 0.09 mg/L in the downstream sample. The strontium concentration in the two samples was approximately 0.4 mg/L.

Table 1 Surface Water Samples - Significant Laboratory Results

Sample ID	Sample Location	pH	Conductivity (µs/cm)	Metallic Parameters
CLWQ/STR1/1	upstream	8.04	535	low
CLWQ/STR1/2	downstream	8.17	548	low

5.5 WASTE ROCK DISPOSAL AREAS

Approximately 230,000 tonnes of waste rock was deposited at the site as a result of the open cut operation. This material was composed primarily of asbestos and serpentine. The adits were not identified on site and it is assumed that these were consumed in 1978 when the site was mined and the open cut was formed.

Because of the homogeneity of the serpentinite, only one test pit was dug and one rock sample collected. The sample (CLWR/P1/1) was composed almost exclusively of asbestos fibres. This sample was submitted for Acid Base Accounting (ABA) tests and determination of metals by Inductively Coupled Plasma - Atomic Emission Spectrophotometry (ICP-AES).

Results of these analyses are presented in Table 2. The laboratory pH (9.0) was higher than that measured in the field (7.4) but both indicated that the waste was not currently generating acid. The material had a total sulphur concentration of 0.02% and an NP/AP of 705, indicating that it is acid consuming.

The waste contained significant concentrations of arsenic (52 mg/L), chromium (229 mg/L), cobalt (89 mg/L), mercury (0.64 mg/L) and nickel (1930 mg/L).

Table 2 Summary Acid/Base Accounting Test Results

Sample ID	Sample Location and Description	Discussion of Results
CLWR/P1/1	Located on northeast end of waste rock pile. Dark to apple green asbestos fibres with minor serpentine.	Non-acid generating (NP/AP=705); high Ni, As, Cr, Co.

5.6 MINE OPENINGS AND EXCAVATIONS

The exploration site consists of an open cut into the hillside. The slope and rocks are stable. There are no mine openings.

5.7 TAILINGS

No milling of ore was done on site. Therefore, no tailings are present.

6.0 CONCLUSIONS

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

6.1 HEALTH AND SAFETY

There are no safety issues at the site, since there are no mine openings, the highwall at the back of the open cut is relatively stable, and there is no building or infrastructure at the site.

6.2 ENVIRONMENTAL RISKS

The waste rock at the Caley exploration site is not currently generating acid and has low potential for acid generation in the future (i.e. NP/AP=705). The waste rock contains significant concentrations of chromium and nickel. However, comparison of water quality from above and below the site indicates that constituents from Caley are not impacting Cassiar Creek.

6.3 AESTHETIC CONCERNS

The site has been left in an orderly fashion and no debris or waste materials have been left on site. The waste rock piles are beginning to revegetate.

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 the recommendation provided herein.

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APPENDIX A

Site Photographs

CALEY
Photographic Record

August 13, 1996

Photos	Description
C. # 1	Overview of Caley Mine from the east
C. # 2	View of Main Excavated Terrace
C. # 3	View of Overgrown Access Road to Site from south
C. # 4	Waste Rock (note discoloration at base of pile)
C. # 5	Upstream Water Quality Sample Location
C. # 6	Downstream Water Quality Sample Location

Photo 1: Overview of Caley Mine from the east

Photo 2: View of main excavated terrace

Photo 3: View of overgrown access road to site from south

Photo 4: Waste rock (note discoloration at base of pile)

Photo 5: Upstream water quality sample location

Photo 6: Downstream water quality sample location

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

CANADA'S 50 BEST MANAGED PRIVATE COMPANIES

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).

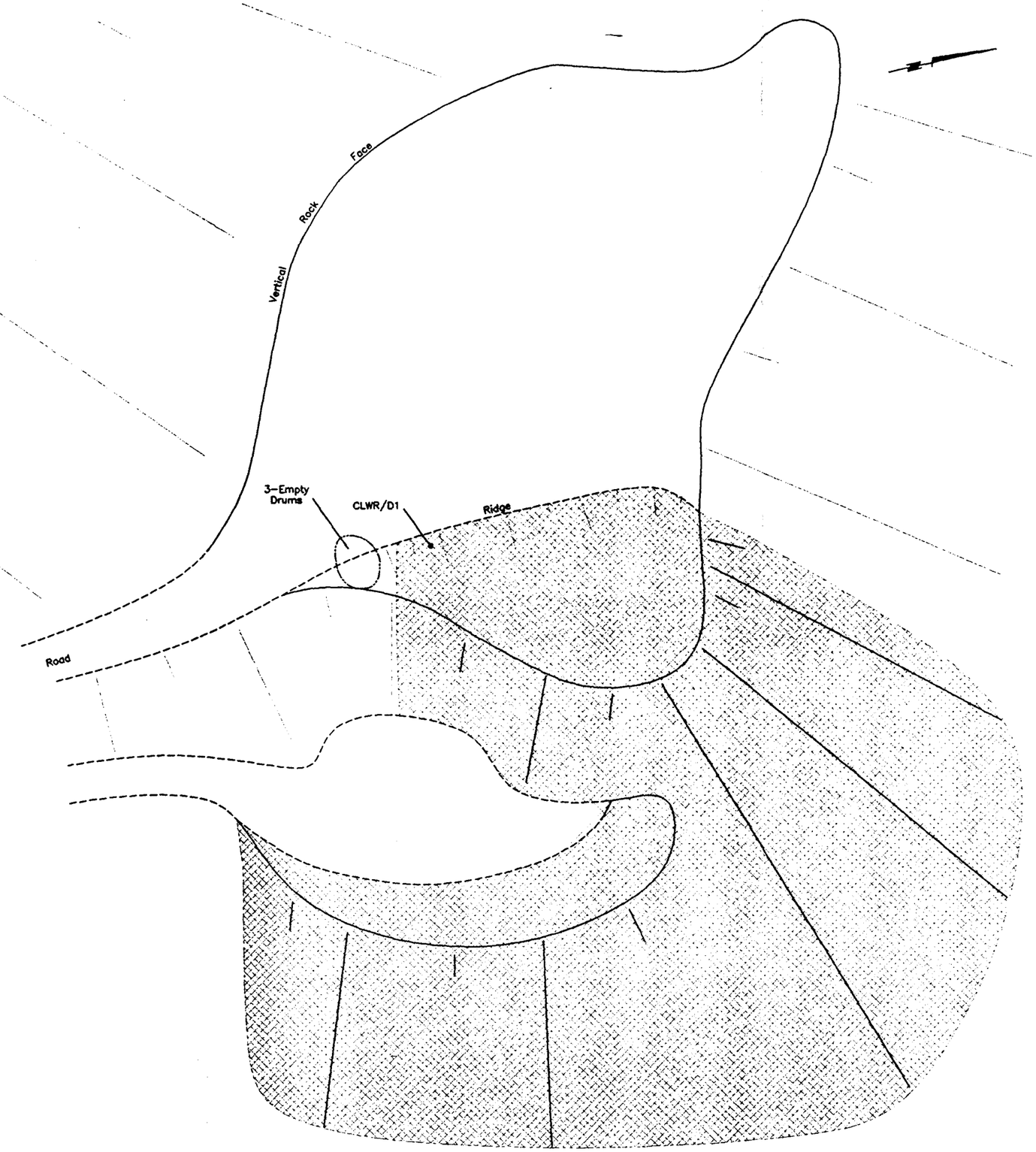
End of Report

CALEY WASTE ROCK

Parameter	Units	Sample Number
		CL-WR-P1-1
Field pH	units	7.4
Field conductivity	µS/cm	20
Lab pH	units	9.0
Sulfur, total	%	0.02
AP		0.6
NP		422.8
Net NP		422.2
NP/AP		705
Aluminum, total	mg/L	<20
Arsenic, total	mg/L	52.1
Barium, total	mg/L	22
Beryllium, total	mg/L	<0.5
Cadmium, total	mg/L	<2
Chromium, total	mg/L	229
Cobalt, total	mg/L	89
Copper, total	mg/L	3
Lead, total	mg/L	<50
Mercury, total	mg/L	0.64
Molybdenum, total	mg/L	<4
Nickel, total	mg/L	1930
Selenium, total	mg/L	<20
Silver, total	mg/L	<2
Tin, total	mg/L	<30
Vanadium, total	mg/L	<2
Zinc, total	mg/L	5

APPENDIX C

DRAWINGS



Legend

- Road
- Extent Of Waste Rock
- • CLWR/D1 — Waste Rock (site designation)
- Slope Down
- Green Serpentine Waste Rock With Asbestos
- Extent of Debris, Timber, Cable, Pipe, etc.

Approx. Scale: 1:1000

PLOT: 1=1
CAD FILE: INVEN-96\CALEY\CALEY-1

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

Architectural & Engineering Services
Western Region

Drawing title / Titre du dessin:

Caley Mine
Site Development & Geological Information
Yukon Territory

Designed by:	date:
Drawn by:	
Checked by:	
Approved by:	
Recommended by:	
Revisions	
Project no. / No. du projet: 626967	Dwg. no. / Dessin no.: 1 of 1