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Quality in Environmental Services

PHASE II ENVIRONMENTAL ASSESSMENT OF THE TINTINA 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 Tintina abandoned mine site (61° 33' 26 " N, 132° 09 '08" 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 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 the mine adit, at the exploration camp, is in an unstable condition but does not pose a risk to the public due to its very remote access. Five buildings and several other camp structures, left at the camp site, present health and safety hazards. An assessment of the acid rock drainage potential shows that the risk to the environment due to the presence of waste rock and adits is minor at this time. Twenty 205 litre barrels, containing liquid hydrocarbons discovered at the camp site are in fair shape and presents an environmental risk. Based on the sampling results, the barrel contents are suitable for incineration. A small quantity of hazardous material discovered at the camp location is an environmental and health and safety risk. Aesthetic concerns arise from miscellaneous debris scattered though out the site.

Using applicable federal and territorial criteria, background characteristics, as well as northern mine reclamation guidelines, it is recommended that the mine opening be secured from human and animal access for health and safety reasons. The adit does not require further work. It is recommended that all buildings be burned. Waste material that is non-hazardous combustible may be burned on site. The Core Library at the Yukon chamber of mines may be notified of the core inventory existing on-site. Waste petroleum hydrocarbons on site should immediately be removed from the site and disposed appropriately. It is recommended that barrel contents be incinerated. This may be done using a portable incinerator by air transporting the barrels to a central disposal location. If the incineration is conducted along with a regional cleanup, the barrel contents may be incinerated at a temporary barrel incineration facility established for the purpose of incinerating waste hydrocarbons at several mine sites in the area. It is recommended that hazardous wastes on site be properly packaged, labeled, transported and disposed at an approved hazardous waste disposal facility in accordance with the Transportation of Dangerous Goods Act. Miscellaneous site debris should be collected and buried on-site for aesthetic reasons.

Should further development occur on the site, regulatory agencies should ensure that an acid drainage prevention plan is developed which includes detailed measures for handling and disposal of mineralized waste rock.

Summary of Conclusions and Recommendations

ASSESSMENT COMPONENT	RISK	RECOMMENDATION
1. Building, Infrastructure, Equipment		
5 Buildings	Health and Safety	Burn
3 tentpads - wood	Health and Safety	Burn
track - upper site	Aesthetic	None
2. Non-Hazardous Waste Material		
Large quantity of wood, plastic and metal debris (<100m^3)	Aesthetic	Collect and burn
Large quantity of Core samples	Aesthetic	None
2 woods piles of timbers (<30m^3) - upper site	Aesthetic	None
5 empty barrels scattered throughout lower site	Aesthetic	None
3. Hazardous Materials		
20 barrels full and partially full - lower site	Environmental	Remove and incinerate
4. Water Quality		
Mine Seepage - upper adit	Minor environmental risk	None
Site Drainage - upper site	Minor environmental risk	None
Receiving Waters - stream	Minor environmental risk	None
5. Waste Rock Disposal Areas		
1 small pile - 763 tonnes	Minor environmental risk	No Action
6. Mine Openings		
1 adit - upper site	Health and Safety	No Action
7. Tailings		
None		

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1.0 INTRODUCTION AND BACKGROUND

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 in 1993. These assessments were intended to provide a general overview of historical activities, describe site infrastructure, workings and wastes, describe possible environmental or safety concerns on each site, and provide recommendations for follow-up work.

The phase I investigation of the Tintina abandoned mine site revealed that there exists an unsealed and collapsing adit, five building structures, rock core, numerous full and partly full barrels, and waste rock.

In light of these findings, Indian and Northern Affairs Canada determined that further investigation is warranted. Environmental Services of Public Works and Government Services Canada was retained to conduct a phase II environmental assessment of the Tintina abandoned mine site. The goals of this assessment are to a) identify specific environmental and human safety risks; b) provide cleanup recommendations; and c) provide a Class "D" (± 25%) cost estimate for mitigation of these risks.

1.1 LOCATION

Tintina mine site is located at 61° 08' 57"N latitude and 131° 09' 38"W longitude (Figure 1). It is located in a very remote location approximately 125km north of the Alaska Highway near the headwaters of the Liard River. The site is approximately 1600m above sea level on an unnamed peak of the St. Cyr Range of the Pelly Mountains.

The Tintina mine site is composed of an exploration and camp site. The exploration site is above the tree line at approximately 1600 m elevation and the camp site is located at approximately 1300 m elevation just at the tree line.

1.2 OVERVIEW OF SITE DEVELOPMENT

The history of development of the site is compiled in the Minfile record 105G 03-1 and is summarized here. The property was first staked in 1961 as the Eagle claims by Conwest and Central Patricia Gold Mining Ltd. The joint venture, called Tintina Silver Mining Ltd., completed 558m of drifting, 191 m of surface drilling in 6 holes, and 975m of underground drilling in 22 holes. The company also completed a

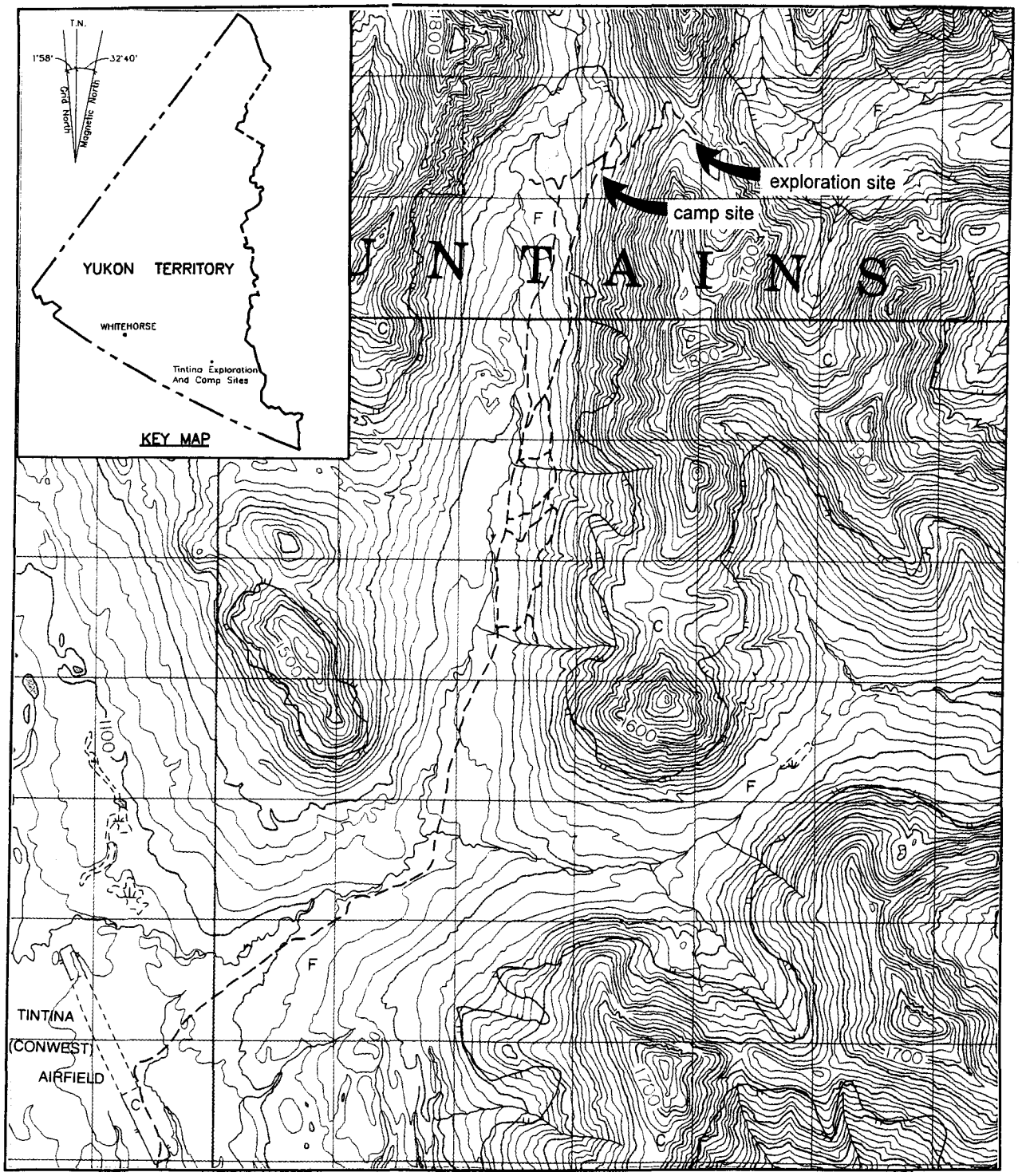

Figure 1. Location of Tintina Mine - 1:50,000, NTS-105F/9 [Energy Mines and Resources Canada: 1971]

33.5km winter road from Mile 780 on the Alaska Highway. In 1976, the company drilled 11 holes for 1230m. The property was optioned to a couple of other companies before Tintina Silver drilled an additional 15 holed (1712m) in 1987.

1.3 SITE ACCESS

The mine site is accessed by air only. A road in good condition leads from an airfield 8 kilometers south-southwest of the camp site and a further one kilometer northwest up 300 metres to the exploration camp. Alternatively, the site can be accessed by helicopter.

2.0 PURPOSE AND SCOPE OF WORK

The following assessment activities were completed:

- 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.

Barrel Clean Up Protocol (INAC, 1992)

See Appendix E for protocol on testing and cleaning of barrels and contents.

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 Tintina 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

[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. Barrel Clean Up

INAC:	Barrel Clean Up Protocol

D. 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 Tintina 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.

Hazardous Materials were inventoried and sampled for analyses of contaminant

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 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 is hosted in a series of interbedded Cambrian limestones and argillites intruded by a Jurassic-Cretaceous stock. The focus of exploration activities was a 90m long zone of massive to disseminated sphalerite (ZnS), galena (PbS), and tetrahedrite ($Cu_{12}Sb_4S_{13}$) (DIAND, 1994).

Th major commodities at the Tintina site are silver, lead, and zinc with minor copper and cadmium.

4.2 SURFACE HYDROLOGY

Both the site and regional drainage are to the west draining into an unnamed southerly moving stream (see Figure 1). The headwaters of the stream are in the lakes of the St. Cyr Range of Pelly Mountains Range and ultimately drains to the eastward moving Liard River.

Flow from the adit before mixing with the stream was approximately 0.1 L/sec at the time of the site visit. Combined with the surrounding runoff the stream was flowing approximately 3 L/sec. Upon reaching the treeline, the stream infiltrated the groundwater system towards an unnamed stream flowing through the prominent valley and into Liard River.

4.3 CLIMATE

The closest climatological information is from the town of Ross River, 61° 59' N, 132° 27' W; 698m above sea level (Environment Canada, 1980). Total annual precipitation is 263.5 mm. This consists of 152.1mm of rainfall and 105.8mm of snowfall. Highest levels of rainfall occur in July and highest levels of snowfall occur in January. Temperatures range from -28.6° C in January to 12.8° C in July. The mean annual temperature is -5.7° C.

4.4 VEGETATION

Tintina minesite occurs within the Pelly Mountains ecoregion. Much of the ecoregion lies above the treeline, and is dominated by treeless tundra vegetation including lichens, dwarf ericaceous shrubs, birch and willows. Wetter sites are occupied by grasses, sedges, cottongrass and mosses. Subalpine regions are characterized by open stands of black and white spruce and alpine fir. Valleys and lower elevation slopes are occupied by aspen and scrub birch. Disturbed areas at the mine opening and along the access road are dominated by fireweed.

4.5 WILDLIFE RESOURCES

Typical mammals in the ecoregion include grizzly and black bear, moose, caribou, beaver fox, wolf and hare. Typical bird species include rock and willow ptarmigan, raven and golden eagle.

4.6 SITE TOPOGRAPHY AND SOIL

The regional and site topography are mountainous, with a relief of about 900 metres at the Liard River to 2,000 metres at some of the higher peaks. The mountains, though steep, are rounded with few cliffs and rock outcrops and can be easily traversed.

Much of the ecoregion is covered by a thin layer of eutric brunisolic soils. A blanket

not here

of recent volcanic ash 10-30cm thick covers most of the region. Turbic cryosols occur sparsely in poorly drained areas.

Topography above the mine site exhibits typical upper-alpine features such as stone nets and felsenmeer interspersed with hummocky tundra. Steep upper slopes are covered with talus or scree material contributed by freeze-thaw fracturing of sedimentary rock. The slope is uniformly covered with talus; at lower elevations, fractured shale outcrops are interspersed with hummocky flats and gentle slopes.

4.7 PERMAFROST

Tintina Hill 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, and EQUIPMENT

Table 1 lists all buildings and structures on site by size, construction, and contents. The camp buildings are in fair shape and appear to have been left abandoned for eventual recommissioning. In total, there are 5 buildings and three tentpads at the camp site. At the exploration site there is one building and ore car rails.

5.2 NON-HAZARDOUS WASTE MATERIALS

The non-hazardous waste materials observed in and around the site are listed in Table 2. Non-hazardous waste debris was observed at both the exploration and camp sites. The debris is primarily wooden timbers, steel tracks, and empty barrels.

5.3 HAZARDOUS MATERIALS

The description of hazardous materials observed during the site inspection is listed in Table 3. All hazardous materials were present at the camp site. Very little soil staining was observed. Five representative barrel samples were analyzed for potential incineration and are presented in Table 4. The results indicate that all barrel contents are suitable for incineration.

Table 1 Buildings, Infrastructure, and Equipment

ITEM	Size	MATERIALS	CONTENTS
Bunkhouse	4'x3'x3'	wood (2x4 construct.), fiberglass insulation	-3 wood frame beds - small quantity wood debris
Shower House	3.5'x3'x2.5'	wood (2x4 construct.)	- copper/plastic piping - 1 - 2 basin sink - 1 plastic shower stall - 10 gall. empty barrel - 4" diam. tin piping (1.5m)
Mess Hall	5'x4'x3'	wood (2x4 construct.), Asphalt paper roof	- 3 wood benches, wood box, table - electrical equipment - 1 full can oil - metal grates, cans
Mainten. Shop	6'x15'x4', extension - 3'x3'x3'	wood (2x4 construct.), Asphalt paper roof, no floor, 22 joists, plastic sheeting as interior covering	- shovels, wiring (100 ft.'), wood & metal debris, wood stove, kerosine furnace - steel piping, 4 - 10' sections - 10 - 4' sections tin piping - 288 of (1.5m, 4 row) cores - wooden bench & shelves - small quantity of hazmat - varsol, paint, gas, oil, glycol, 2 ballasts, 2/3 full 10 gall. Barrel
Kitchen	5'x4'x3'	wood (2x4 construct.), Aspahlt paper roof	- double sink, shelving - pots, pans, utensils, kitchen supplies, food - fire extinguisher (ABC)
Toilet	3'x2'x3'	wood (2x4 construct.)	- none
Shed (explor. site)	4'x6.5'x3'	wood (2x4 construct.), Aspahlt paper roof	- none
Track & ties (explor. site)	300 metres	steel and wood	N/A
Tentpad (3)	5'x5'x0.5'	wood	N/A

Table 2 Non-Hazardous Waste Materials

Waste Material	Number/Volume	Location	Comments
Logs	approx. 3000 m^3	exploration site	stacked in 4 piles
Rails	approx. 150 m^3	exploration site	stacked in 4 piles
Rails	approx. 55 m^3	camp site	stacked near Bunkhouse
Empty Barrels		3 at exploration site 5 scattered west of camp site	no visible staining
Debris	< 25 m	scattered throughout camp site	metal, wood, and plastic

Table 3 Hazardous Materials

Hazardous Waste	Number/Vol.	Location	Comments
Hydro-carbons	1. 1 - 205 L (1/4f) 2. 1 - 205 L (3/4f) 3. 1 - 205 L (full)	300 m south of main camp site	1. sample #3, sealed, dirty, jet fuel 2. clear, jet fuel 3. clear, jet fuel
Hydro-carbons	1. 13 - 205 L (full) 2. 1- 45 L (full) 3. 1 - 205 L (full)	200 m south of main camp site	1. Sample 4, diesel, open 2. 3. Sample 5, oil, sealed small (<2') stain observed
Hydro-carbons	1. 1 - 45 L (1/2f) 2. 1 - 205 L (3/4f)	Maintenance Shop	1. sample #1, waste oil, sealed 2. sample #2, gas, open
Fire extinguisher	1	kitchen	ABC, charged
Miscell. Domestic waste	< 50 L	Maintenance shop	varsol, paint, gas, oil, glycol, 2 ballasts

Table 4 Results of Barrel Sampling for Incineration

Parameter	Barrel Clean Up Criteria (ppm)	#1 (ppm)	#2 (ppm)	#3 (ppm)	#4 (ppm)	#5 (ppm)
Cadmium	2	< 1	N/A	< 1	< 1	< 1
Chromium	10	< 1	N/A	< 1	< 1	< 1
Lead	100	297	N/A	14.1	510	43.1
Total Organic Halides	1000	< 2	< 2	5	48	16
PCBs	2	N/R	N/R	< 0.3	< 0.3	< 2

Note: N/R - not required as TOX analysis is less than 2 ppm, N/A - not available

5.4 SURFACE WATER QUALITY

Two water samples were collected: one at the edge of the snow that covered the mouth of the adit (TINT-WQ-A1-1), and another approximately 150 m downstream of the adit (TINT-WQ-STR1-1).

Significant results of analysis of the water samples are presented in Table 5. The laboratory measurements of pH and TDS on the adit sample were similar to the field measurements. Laboratory pH and TDS were 7.8 and 122 µS/cm, respectively, compared to a pH of 8.4 and TDS of 80 µS/cm measured in the field. The sulphate concentration was 2 mg/L and alkalinity was 60 mg/L.

The adit water contained significant concentrations of calcium (25 mg/L) and magnesium (3.8 mg/L) as a result of dissolution of the limestone hosting the deposit. The water also contained nearly 2 mg/L aluminum, 1.5 mg/L iron, and 0.074 mg/L zinc. These concentrations are within the Metal Mine Liquid Effluent (MMLE, 1977) guidelines for these elements but are above the Canadian Water Quality Guidelines (CCME, 1987) for fresh water aquatic life. Concentrations of arsenic, copper, lead and selenium were below the detection limits for the analytical method used. However, the detection limits were above the CCME guidelines for these elements.

Water collected approximately 150 metres downstream was of poorer quality. The laboratory pH of this water was 3.3 and the TDS was 1340 µS/cm. The sulphate concentration was 739 mg/L and alkalinity was less than 1.0 mg/L.

Calcium and manganese concentrations were greater than those in the adit water sample. Aluminum, cadmium, cobalt, copper, iron, nickel, and zinc concentrations were also higher. For example, the iron concentration was 44 mg/L compared to 1.5 mg/L in the adit water.

Table 5 Surface Water Samples - Significant Results

Sample ID	Sample Location	pH	Conductivity (μs/cm)	MetallicParameters
TINT-WQ-A1-1	mouth of the adit	7.8	122	moderate Al, Fe, Zn
TINT-WQ-STR1-1	150 m downstream of the adit	3.3	1340	high Al, Cd, Co, Cu, Fe, Ni, Zn

5.5 WASTE ROCK DISPOSAL AREAS

Waste rock was deposited outside and downstream of the adit. Roughly 775 tonnes (850 tons) of waste rock is present on site, most of which was deposited by end-dumping from a wooden trestle. As a result of this type of deposition, coarser material is found at base of dump. No seeps or iron oxide staining was seen on or around the waste pile.

The surface of the pile has formed a 2 cm thick resistant pavement (or crust) composed primarily of limestone with rare quartz veins. The underlying waste rock is composed primarily of gray limestone, argillite, and vein quartz, and is generally sand to pebble sized material with few cobbles.

- One sample (TINTWR/P1) was collected from a pit excavated into the waste rock pile beneath the trestle and submitted for analysis.

The waste rock sample had a field paste pH value of 8.5 and a paste conductivity of 84µS/cm. These values indicate that the material is not currently generating acid and that it contains few stored oxidation products. The total sulphur concentration was 0.8% with 0.6% of this present as sulphate. In addition, the material contains abundant Neutralizing Potential (NP) and the NP/AP is 86. Thus, the waste has a low potential for acid generation.

The waste contains >15 ppm calcium and high concentrations of manganese (295 ppm) and strontium (487 ppm), indicative of the limestone. The material also contains 249 ppm arsenic and 93 ppm lead.

Table 4 Summary Acid/Base Accounting Test Results

Sample #	Paste pH	Total S (%)	SO4 (%)	NP/AP
TINTWR/P1	8.5	0.8	0.6	86.00

5.6 MINE OPENINGS AND EXCAVATIONS

One adit is present and is located at the exploration site on the north facing slope of an unnamed mountain. The entrance to the adit was partly blocked by snow at the time of the visit. The opening left exposed was not secured. The opening structure is composed of rotting timbers and is in unstable condition.

5.7 TAILINGS

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

6.0 CONCLUSIONS

6.1 HEALTH AND SAFETY RISKS

The adit is in unstable condition, however due to the remote access to the site, the risk to humans is considered low.

Seven building structures are on site and present a safety hazard to the public if left unmaintained. Most buildings contain waste debris and are easily accessed. A small quantity of domestic hazardous waste, including flammables and combustibles, is stored in the maintenance shop and is a potential health hazard.

The rails and trestles in front of the adit are physically unstable and also pose a health and safety hazard to humans visiting the site.

6.2 ENVIRONMENTAL RISKS

Acid Rock Drainage:

The waste was not acid generating and, except for moderate concentrations of arsenic and lead, contained generally low metal concentrations.

Water flowing from the adit (TINTWQ/A1) was good quality with a neutral pH and low conductivity (122 µS/cm). Metal concentrations were generally low. The quality of the water deteriorated downstream, however, as a result of seeps entering the stream from the country rock. Approximately 100 metres downstream from the adit entrance, the stream water became cloudy with aluminum hydroxide precipitates and white-gray foam of these precipitates was observed on the east side of the drainage just above the water level. The pH at this location was 5.5 and the conductivity was 460 µS/cm. Seeps entering the stream from the siltstones to the east appear to be lowering the pH and raising the conductivity. The decrease in pH is causing the precipitation of aluminum hydroxides (probably gibbsite). Limestone waste rock lining the stream on the west buffers the low pH water from siltstones and keeps the pH of the water from decreasing further. At approximately 150 m downstream of the adit, dark orange-brown seeps enter the creek from the platy siltstones. One seep had a pH of 3.5 and a TDS greater than 1990 µS/cm. Several dark or ange-brown seeps enter the creek from the platy siltstones at this location, abundant precipitation of iron oxides is seen which continues downstream for more than 100 metres.

This small stream survey in the area below the adit indicates that the decrease in water quality results from weathering of the bedrock in the vicinity of the exploratory workings rather than from the workings themselves.

Petroleum Hydrocarbons:

A significant environmental risk exists as a result the storage of petroleum hydrocarbons on site. In total, there are 18 - 205 L barrels and 2 - 45 L left abandoned at the camp site. Most are in fair to poor shape and, in some cases, are exposed to the environment where the drum has been left open. Approximately 10 of the barrels are sealed and have not been opened.

Analyses of representative samples taken from five barrels indicates that local incineration is an acceptable disposal option. These barrels may be incinerated locally in a regional clean-up effort.

Other:

A small quantity of hazardous materials is stored mostly in the maintenance shop and in the kitchen. These substances present a moderate environmental risk to humans and animals visiting the site.

6.3 AESTHETIC CONCERNS

Although the site is very remote and is accessed primarily by air, there are a substantial amount of buildings, infrastructure and waste debris scattered throughout both the exploration and camp sites.

7.0 RECOMMENDATIONS

Recommended remediation and management actions are compliant with applicable federal or territorial regulations and criteria, are reliant upon available technology, and are intended to be appropriate for local conditions and sensitivities.

Recommendation 1.

It is recommended that the mine opening be left as it is and no further work is required.

Recommendation 2.

It is recommended that all buildings be burned. This is provided that all mining activity has ceased and that the facilities are no longer being used. Waste material that is non-hazardous combustible may be burned on site.

Recommendation 3.

Considering that the acidic drainage at the site results from the exploration workings, and into account the remoteness of the site, it is recommended that waste rock at the site be left as it is.

Recommendation 4.

Waste petroleum hydrocarbons on site should be immediately removed from the

site and disposed appropriately. It is recommended that barrel contents be incinerated. This may be done using a portable incinerator by air transporting the barrels to a central disposal location. If incineration is conducted along with a regional cleanup, the barrel contents may be incinerated at a temporary barrel incineration facility established for the purpose of incinerating waste hydrocarbons at several mine sites in the area.

Recommendation 5.

It is recommended the domestic hazardous wastes stored on site be properly packaged, labeled, transported and disposed at an approved hazardous waste disposal facility.

Recommendation 6.

It is recommended that the miscellaneous non-hazardous and combustible debris be collected and burned, where possible, for aesthetic reasons.

8.0 COST ESTIMATES TO IMPLEMENT RECOMMENDATIONS

A cost estimate of expected site remediation costs to an accuracy of 25% is provided under a separate cover. The cost estimate includes contractor and project management costs and contingency.

REFERENCES

Canadian Council of Ministers of the Environment, 1991. Interim Canadian Environmental Quality Criteria for Contaminated Sites. The National Contaminated Sites and Remediation Program.

DIAND Technical Services, 1993. Assessment Report, 105G-03-1, Tintina Abandoned Mine Assessment. Prepared for Indian and Northern Affairs Canada.

Ecological Stratification Working Group, November, 1996. A National Ecological Framework for Canada. Produced by Centre for Land and Biological Resources Research and Research Branch, Agriculture and Agri-Food Canada; and, State of the Environment Directorate, Environmental Conservation Service, Environment Canada.

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Environment Canada Atmospheric Environment Service. Canadian Climate Normals. 1961-1990.

Environment Canada Atmospheric Environment Service. Canadian Climate Normals. 1951-1980.

Environmental Protection and Assessment Branch, June 1996. Draft, Contaminated Sites Regulations. Yukon Renewable Resources.

Indian and Northern Affairs Canada, 1992, Barrel Clean Up Protocol

MMLE, 1977. Metal Mining Liquid Effluent Regulations. Canada Gazette part II, Vol. III, No. 5.

Omni Resources Inc. 1987. Project Overview of Omni Resources Inc's Skukum Creek Project.

Steffen, Robertson, and Kirsten (B.C.), 1992. Mine Reclamation in Northwest Territories and Yukon. Prepared for Northern Water Resource Studies, Northern Affairs Program, DIAND. Report No. QS-8476-000-EF-A1, Minister of Supply and Services Canada.

Yukon Minfile, 105O 057.

APPENDIX A

Determination of Acid Rock Drainage Potential

P118105

TINTINA
ACID ROCK DRAINAGE
ASSESSMENT REPORT

TABLE OF CONTENTS

LIST OF TABLES

P118105

TINTINA
ACID ROCK DRAINAGE
ASSESSMENT REPORT

1.0 INTRODUCTION

This site specific report has been prepared in conjunction with a *Phase II Environmental Assessment of the Tintina Abandoned Mine Site*, prepared by Environmental Services, Public Works and Government Services Canada (PWGSC). The reader is directed to that report for a comprehensive environmental assessment of the Tintina site.

The Tintina exploration site is located approximately 125 km north of the Alaska Highway, near the headwaters of the Liard River. The site is on an unnamed peak of the St. Cyr Range of the Pelly Mountains and is approximately 1600 metres above sea level. An airstrip constructed during exploration approximately 8 km south of the site is now covered by vegetation. In addition, a road that was constructed from the Alaska Highway to the site is now impassable because it is overgrown and requires crossing of several large streams. Currently, the site is only accessible by helicopter.

Mine related disturbances observed during the site assessment consist of one adit and one waste rock pile. No mill site or tailings pond is present at the site.

The exploration area is located primarily on bedrock. The surrounding area is covered by alpine vegetation, including moss campion, lichens, arctic heather, and short alpine grasses.

This report reviews the existing, and the potential for, acid rock drainage (ARD) conditions at the Tintina site, and provides recommendations for remediation. This site specific report is part of the *Acid Rock Drainage Review Report, Yukon Abandoned Mine Site Assessments*, prepared by Steffen, Robertson and Kirsten (SRK). The reader is directed to that report for detail regarding the scope of work, site assessment

methodology, ARD remediation options, and the evaluation of potential remediation options.

2.0 GEOLOGY AND MINERALIZATION

The mineralization is hosted in a series of interbedded Cambrian limestones and argillites intruded by a Jurassic-Cretaceous stock. The focus of exploration activities was a 90m long zone of massive to disseminated sphalerite ((Zn,Fe)S), galena (PbS), and tetrahedrite ($(Cu,Fe)_{12}Sb_4S_{13}$)) (DIAND, 1994).

3.0 WASTE ROCK DISPOSAL AREAS

3.1 Description

The Tintina site was explored from an adit, the entrance to which was blocked by snow during the site visit. Waste rock was deposited outside and downstream of the adit. Roughly 775 tonnes (850 tons) of waste rock is present on site, most of which was deposited by end-dumping from a wooden trestle. As a result of this type of deposition, coarser material is found at base of the pile. No seeps or iron oxide staining was seen on or around the pile.

The surface of the pile has formed a 2 cm thick resistant hardpan composed primarily of limestone with rare quartz veins. The underlying waste rock is composed primarily of gray limestone, argillite, and vein quartz, and is generally sand to pebble sized material with few cobbles.

The adit is located at the head of a small stream that runs down the ridge that comprises the exploration site. Below the adit, the stream is bounded on either side by black, very fine grained siltstone, some of which are coated with red-brown iron oxide staining.

3.2 Sampling

One rock sample (TINTWR/P1) was collected from a pit excavated into the waste rock pile beneath the trestle.

Two water samples were collected: one at the edge of the snow that covered the mouth of the adit (TINTWQ/A1); and another approximately 150 m downstream of the adit (TINTWQ/STR1). Flow from the adit was <1 L/min. Flow at the downstream sample site was approximately 2 L/min (visual estimate). Sample locations are shown on the site map, Drawing 2.

3.3 Analytical Results

Results of geochemical analyses of waste rock samples are provided in Table 2 and the analytical results for the water samples are provided in Table 3.

Paste Parameters

The waste rock sample had a field paste pH value of 8.5 and a paste conductivity of 84 µS/cm. These values indicate that the material is not currently generating acid and that it contains little stored oxidation products.

Acid Base Accounting

The total sulphur concentration was 0.8%, with 0.6% of this present as sulphate. In addition, the material contains abundant Neutralizing Potential (NP) and the NP:AP ratio is 86. Thus, the mine rock is not considered to be potentially acid generating.

Metals Concentrations

The material contains 249 ppm arsenic and 93 ppm lead. Other elements of concern are present at very low concentrations.

Water Quality

Laboratory measurements of pH and conductivity on the adit sample were 7.8 and 122 µS/cm, respectively, and were similar to field measurements. The sulphate concentration was 2 mg/L and alkalinity was 60 mg/L.

The adit water contained 25 mg/L of calcium and 3.8 mg/L of magnesium as a result of dissolution of the limestone hosting the deposit. Aluminum was present at almost

2 mg/L, however, at the prevailing pH, it is believed to be present as suspended matter, as the solubility of aluminum is well below this concentration. Iron (1.5 mg/L) and zinc (0.074 mg/L) concentrations exceed CCME freshwater aquatic life criteria, but are within the Metal Mining Liquid Effluent (MMLE, 1977) criteria.

Water collected approximately 150 metres downstream was of poorer quality than the adit discharge water. The laboratory pH was 3.3 and the conductivity was 1340 µS/cm. The sulphate concentration was 739 mg/L and alkalinity was less than 1.0 mg/L. Calcium and manganese concentrations were higher than those in the adit water sample. Concentrations of aluminum, cadmium, cobalt, copper, iron, nickel, and zinc were at least seven times that in the adit water sample and exceeded CCME criteria for freshwater aquatic life. For example, the iron concentration was 44 mg/L compared to 1.5 mg/L in water from the adit.

4.0 EXISTING OR POTENTIAL ACID ROCK DRAINAGE CONDITIONS

The limestone rich waste rock was not acid generating and, except for moderate concentrations of arsenic and lead, contained generally low metal concentrations.

Water flowing from the adit (TINTWQ/A1) had a neutral pH and low conductivity (122 µS/cm). Metal concentrations were generally low. However, approximately 100 metres downstream of the adit, the stream water was cloudy, and white-gray aluminium oxides were precipitated on the streambed. The pH at this point was 5.5. Another 50 metres further downstream, the pH was 4.9 and the conductivity was 1220 µS/cm. The streambed at this location was covered with yellow to re-brown iron oxide precipitates. The reason for the change in the stream waster chemistry is the addition of seeps from the siltstone country rock. One such seep had a pH of 3.5 and conductivity > 1990 µS/cm, and was dark red-brown in colour. Therefore, acidic drainage at the site is a result of oxidation of naturally occurring material rather than the mining activity.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Contaminated drainage from the site is not a result of mining related activities. The poor water quality downstream of the adit results from oxidation of natural bedrock. It is considered that there are no feasible or cost effective remediation options to reduce acid generation from the natural bedrock.

5.2 Recommendations

It is recommended that no action be taken at the site with regard to the waste rock.

6.0 REFERENCES

Canadian Council of Ministers of the Environment, 1991. Interim Canadian Environmental Quality Criteria for Contaminated Sites. The National Contaminated Sites and Remediation Program.

Carlson, G.G. and Hilker, R.G., 1974. Geological Report of the 1974 Diamond Drill Program, Eagle Claim Group. Prepared for Tintina Silver Mines, Ltd. Toronto, Ontario.

DIAND Technical Services, 1994. Assessment Report 105F-09-1, Stump Abandoned Mines Assessment. Indian and Northern Affairs Canada.

DIAND, Exploration and Geological Services Division, 1991. Yukon Minfile No. 105F 056, Stump.

MMLE, 1977. Metal Mining Liquid Effluent Regulations. Canada Gazette Part II, Vol. III, No. 5. Regulations, codes and Protocols Report No. EPS 1-W-77-1, Ministry of Supply and Services Canada.

TABLE 1 Tintina Waste Rock Sample Descriptions

Sample ID	Sample Location and Description
TINTWR/P1	Located on east side of the waste pile underlying the trestle, approx. 40 m from adit. Waste is gray sand matrix among clast-supported pebbles; no FeOx.

TABLE 2 Tintina Waste Rock ABA and ICP Results

Parameter	Units	Sample Number
		TI\WR\P1-1
Field Conductivity	µS/cm	84
Field pH		8.47
Lab pH		8.65
Sulfur, total	%	0.82
Sulfate	%	0.57
AP		7.8
NP		669.5
Net NP		661.7
NP/AP		85.7
Aluminum, total	%	0.67
Antimony, total	ppm	6
Arsenic, total	ppm	249
Barium, total	ppm	29
Beryllium, total	ppm	0.3
Bismuth, total	ppm	<1
Cadmium, total	ppm	<0.1
Calcium, total	%	>15.00
Chromium, total	ppm	17
Cobalt, total	ppm	7
Copper, total	ppm	14
Gallium, total	ppm	<1
Iron, total	%	0.97
Lead, total	ppm	93
Lithium, total	ppm	15
Magnesium, total	%	1.06
Manganese, total	ppm	295
Molybdenum, total	ppm	6
Nickel, total	ppm	17
Phosphorus, total	ppm	380
Potassium, total	ppm	0.16
Silver, total	ppm	2.3
Sodium, total	%	0.02
Strontium, total	ppm	487
Titanium, total	%	<0.01
Thorium, total	ppm	<1
Tin, total	ppm	2
Tungsten, total	ppm	<1
Uranium, total	ppm	<1
Vanadium, total	ppm	8.0
Zinc, total	ppm	46

AP = Acid Potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material

NP = Neutralization Potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material

Net NP = Net Neutralization Potential = tonnes $CaCO_3$ equivalent per 1000 tonnes of material

na = no assay / analysis

< = lower detection limit

> = upper detection limit

Steffen Robertson and Kirsten
February, 1997

TABLE 3 Tintina Water Quality Results

Parameter	Units	Sample Number TINTWQ/	
		A1	STR1
Field pH		8.4	4.9
Field Conductivity	µS/cm	80	1220
Lab pH		7.76	3.28
Lab Conductivity	µS/cm	122	1340
Acidity ($CaCO_3$)	mg/L	2.1	395
Alkalinity ($CaCO_3$)	mg/L	60.2	<1.0
Sulfate	mg/L	2.3	739
Aluminum, total	mg/L	1.9	56.1
Antimony, total	mg/L	<0.2	<0.2
Arsenic, total	mg/L	<0.2	<0.2
Barium, total	mg/L	0.02	0.02
Beryllium, total	mg/L	<0.005	<0.005
Bismuth, total	mg/L	<0.1	0.1
Boron, total	mg/L	<0.1	<0.1
Cadmium, total	mg/L	<0.01	0.07
Calcium, total	mg/L	24.5	56.9
Chromium, total	mg/L	<0.01	<0.01
Cobalt, total	mg/L	<0.01	0.54
Copper, total	mg/L	<0.01	0.39
Iron, total	mg/L	1.5	44.2
Lead, total	mg/L	<0.05	<0.05
Lithium, total	mg/L	<0.01	0.21
Magnesium, total	mg/L	3.81	83.2
Manganese, total	mg/L	0.044	1.64
Molybdenum, total	mg/L	<0.03	<0.03
Nickel, total	mg/L	<0.02	1.4
Phosphorus, total	mg/L	<0.3	<0.3
Potassium, total	mg/L	<2	<2
Selenium, total	mg/L	<0.2	<0.2
Silicon, total	mg/L	2.72	4.67
Silver, total	mg/L	<0.01	<0.01
Sodium, total	mg/L	<2	4
Strontium, total	mg/L	0.067	0.148
Thallium, total	mg/L	<0.1	<0.1
Tin, total	mg/L	<0.03	<0.03
Titanium, total	mg/L	0.04	<0.01
Vanadium, total	mg/L	<0.03	<0.03
Zinc, total	mg/L	0.074	2.13

< = lower detection limit

Steffen Robertson and Kirsten
February, 1997

APPENDIX B

Site Photographs

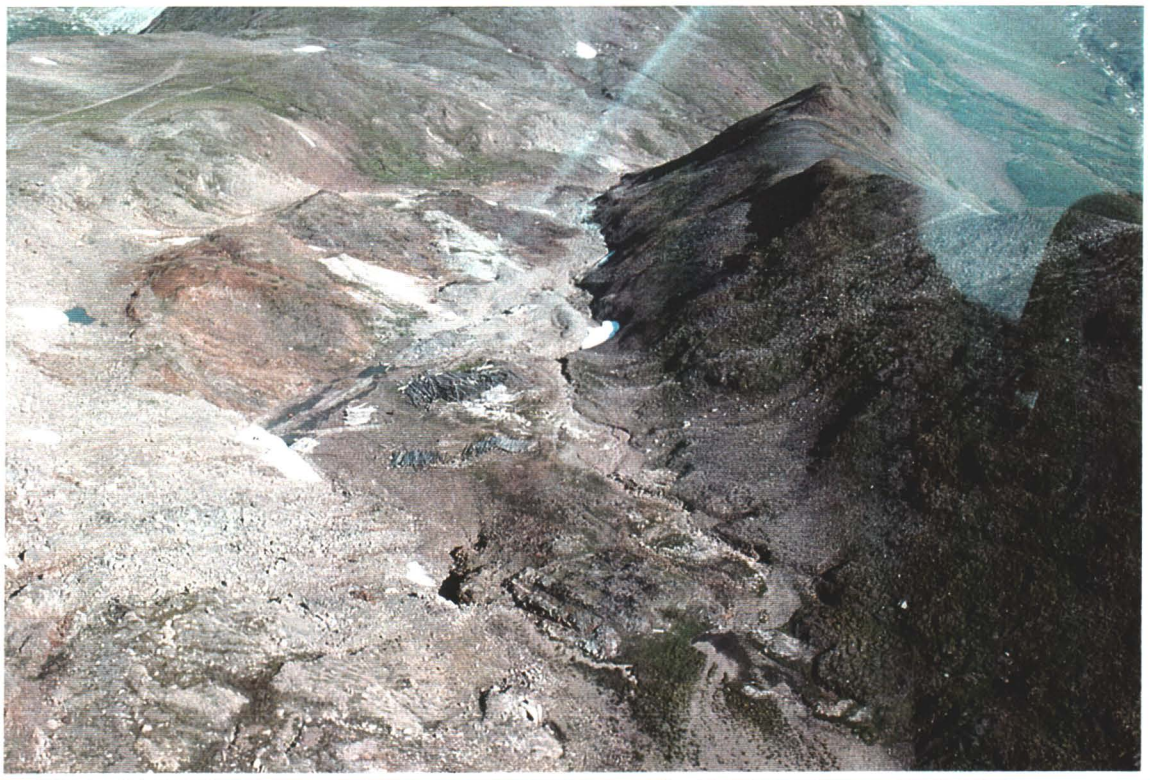
TINTINA

Photographic Record

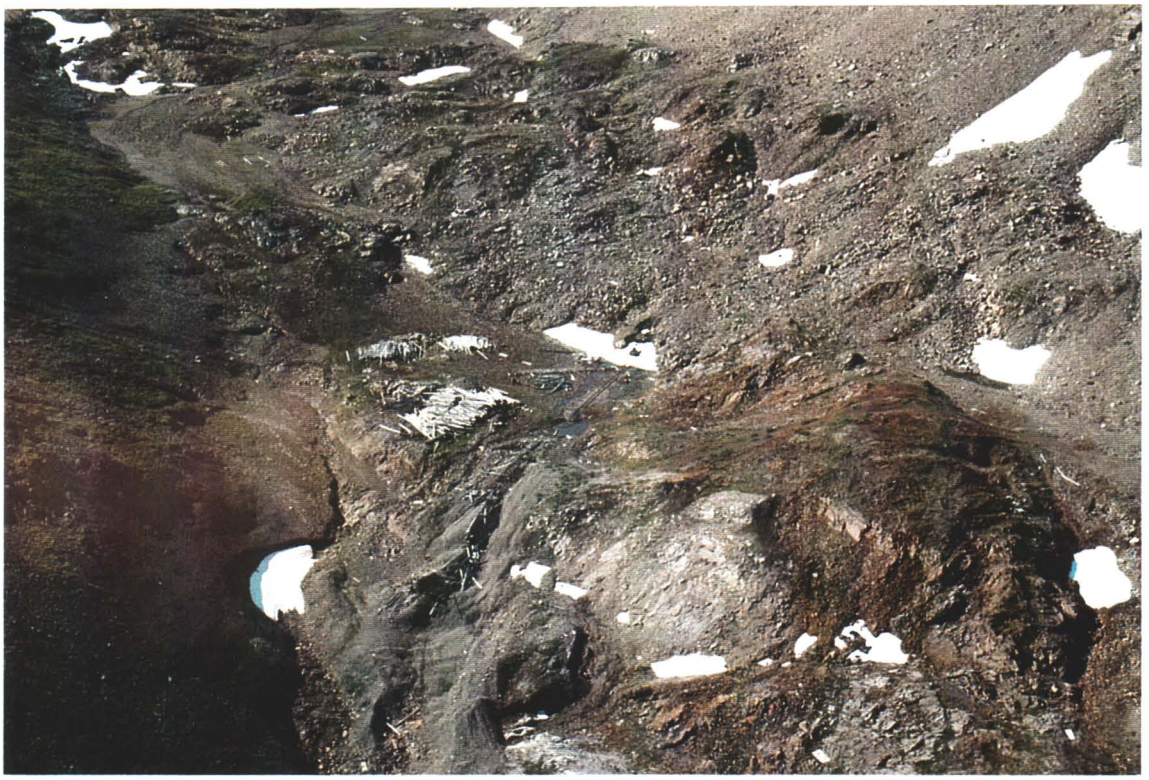
July 25, 1996

Photos	Description
T. # 1	Aerial View of the Exploration Site
T. # 2	Aerial View of the Exploration Site
T. # 3	Upper Adit and Drainage Coarse
T. # 4	Exploration Site Drainage
T. # 5	Iron Oxidation in Exploration Site Drainage
T. # 6	Aerial View of Camp Site
T. # 7	Aerial View of Camp Site
T. # 8	Maintenance Shop
T. # 9	Shower Facility
T. # 10	Kitchen and Mess Buildings
T. # 11	Mess Hall Interior
T. # 12	Maintenance Shop Interior
T. # 13	Core Storage in Maintenance Shop
T. # 14	Tent Pads
T. # 15	Barrels
T. # 16	Barrels

Photo# 1: Aerial View of the Exploration Site



Photo# 2: Aerial View of the Exploration Site



Photo# 3: Upper Adit and Drainage Coarse

Photo# 4: Exploration Site Drainage

Photo# 5: Iron Oxidation in Exploration Site Drainage

Photo# 6: Aerial View of Camp Site

Photo# 7: Aerial View of Camp Site

Photo# 8: Maintenance Shop

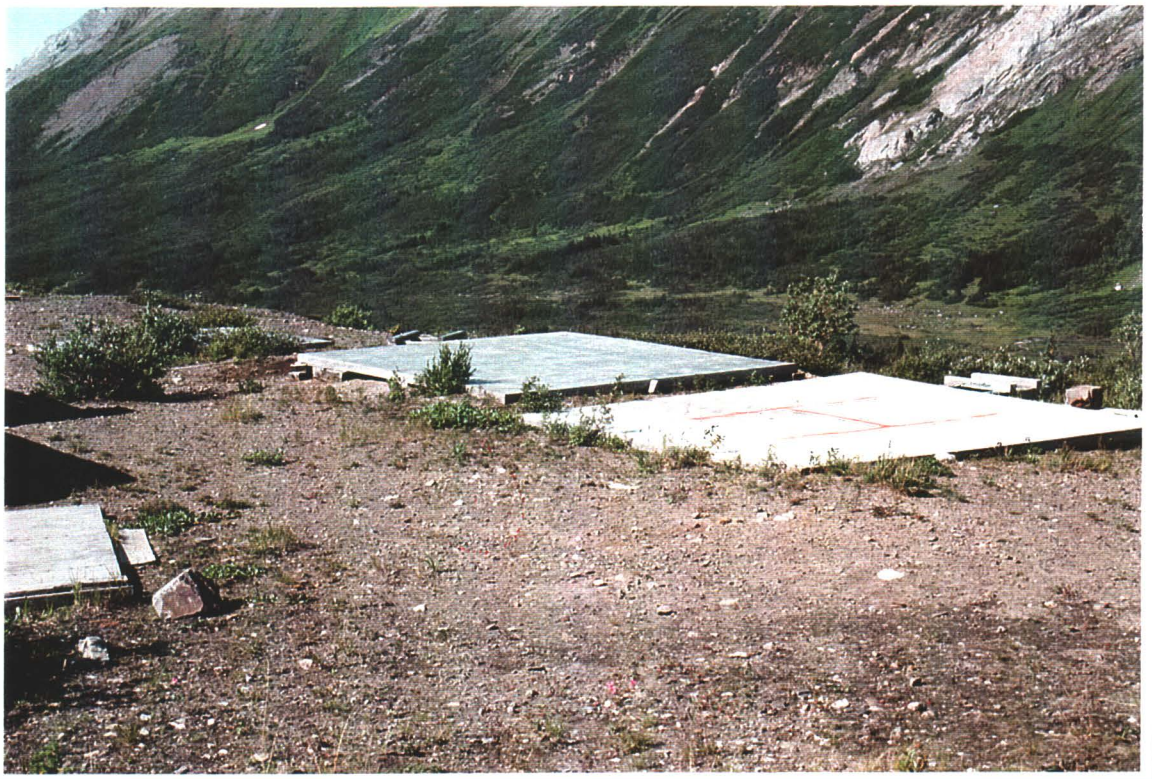
Photo# 9: Shower Facility

Photo# 10: Kitchen and Mess Buildings

Photo# 11: Mess Hall Interior

Photo# 12: Maintenance Shop Interior

Photo# 13: Core Storage in Maintenance Shop



Photo#14: Tent Pads

Photo# 15: Barrels

Photo# 16: Barrels

APPENDIX C

Analytical Results

RESULTS OF ANALYSIS - Water

File No. G3601

			Tint-WQ-A1-1 96 07 28	Tint-WQ-STR1-1 96 07 28
Physical Tests				
Conductivity (umhos/cm)			122	1340
pH			7.76	3.28
Dissolved Anions				
Acidity		CaCO3	2.1	395
Alkalinity - Total		CaCO3	60.2	<1.0
Sulphate	SO4		2.3	739
Total Metals				
Aluminum	T-Al		1.9	56.1
Antimony	T-Sb		<0.2	<0.2
Arsenic	T-As		<0.2	<0.2
Barium	T-Ba		0.02	0.02
Beryllium	T-Be		<0.005	<0.005
Bismuth	T-Bi		<0.1	0.1
Boron	T-B		<0.1	<0.1
Cadmium	T-Cd		<0.01	0.07
Calcium	T-Ca		24.5	56.9
Chromium	T-Cr		<0.01	<0.01
Cobalt	T-Co		<0.01	0.54
Copper	T-Cu		<0.01	0.39
Iron	T-Fe		1.50	44.2
Lead	T-Pb		<0.05	<0.05
Lithium	T-Li		<0.01	0.21
Magnesium	T-Mg		3.81	83.2
Manganese	T-Mn		0.044	1.64
Molybdenum	T-Mo		<0.03	<0.03
Nickel	T-Ni		<0.02	1.40
Phosphorus	T-P		<0.3	<0.3
Potassium	T-K		<2	<2
Selenium	T-Se		<0.2	<0.2
Silicon	T-Si		2.72	4.67
Silver	T-Ag		<0.01	<0.01
Sodium	T-Na		<2	4
Strontium	T-Sr		0.067	0.148
Thallium	T-Tl		<0.1	<0.1
Tin	T-Sn		<0.03	<0.03
Titanium	T-Ti		0.04	<0.01
Vanadium	T-V		<0.03	<0.03

< = Less than the detection limit indicated.
Results are expressed as milligrams per litre except for pH and Conductivity (umhos/cm).

RESULTS OF ANALYSIS - Water

File No. G3601

		Tint-WQ-A1-1 96 07 28	Tint-WQ-STR1-1 96 07 28
Total Metals			
Zinc	T-Zn	0.074	2.13

< = Less than the detection limit indicated.
Results are expressed as milligrams per litre except for pH and Conductivity (umhos/cm).

METHODOLOGY File No. G3601

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

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

Powertech Labs - Interim Results - Tel: 590-7448

Analytical Service Laboratories
1988 Triumph St.
Vancouver, B.C.
V5L 1K5

Date: 8 August 1996

Project#: 1511-44
Powertech Ref#: 96171
P.O.#: ASL Ref G3601

Attention: Heather Ross

Re: Waste Oil Analysis

Number of samples received:	16
Number of samples analyzed:	10
Sample Type:	Waste Organic Liquids
Date Received:	Aug 02, 1996
Date Reported:	Aug 08, 1996 (by fax)

METHODOLOGY

Organic Halogen was determined by a laboratory test method mod. 9020 and was analyzed with a Mitsubishi TOX 10 analyzer. Elements were determined in accordance with laboratory test method ASTM D5185.
Some of the samples contained a layer of water. The water layer was excluded from the analyses. Only the organic liquid layer (oil or fuel) was analyzed. Some of the samples received did not contain an oil or fuel layer and were likely composed of mainly water. The water samples were not analyzed as per discussion with ASL. The ASL lab numbers of the samples not analyzed are as follows: G3601-4, G3602-9, G3605-2,3,4,5.

Results:

Results of analysis are attached

Prepared By: _____
Ed Hall
Sr. Chemical Technologist

Approved By: _____
H. Schellhase
Research Chemist
Applied Chemistry

Results of Analysis
Powertech Labs Ref: 96171
ASL Ref: G3601

ASL Ref	Powertech Ref	Organic Halogen mg/L	Arsenic mg/L	Cadmium mg/L	Chromium mg/L	Lead mg/L
Tin-Br1- 1	96171-1	<300	<4	<1	<1	297
Tin-Br1- 3	96171-3	<300	<4	<1	<1	14.1
Tin-Br1- 4	96171-4	<300	<4	<1	<1	510
Tin-Br1- 5	96171-5	<300	<4	<1	<1	43.1
Stump-BR 1-1	96172-1	<300	<4	<1	<1	51.7
HOEY-Br 1-1	96173-1	<300	<4	<1	<1	7.8
Cong-Br1 -1	96174-1	<300	<4	<1	<1	4.3
DLB-2	96175-1	<300	<4	<1	<1	23.9
S7BL-3	96175-6	<300	<4	<1	<1	<1
S7BL-4	96175-7	<300	<4	<1	<1	<1

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PUBLIC WORKS CANADA
MICHAEL NAHIR

DATE : March 3, 1997
CHEMEX PROJECT NO. : PUBI010-0502-96-07805
CLIENT REFERENCE :
CLIENT JOB NO. : TOX SAMPLES

Analytical Data Reviewed By : _____

QA/QC Reviewed By : _____

The above signatures indicate that the individuals identified have reviewed the enclosed documents.

NOTE : Soil samples and water samples (for stable parameters) will be retained for a period of 60 days after completion of analysis.
Retention beyond this period can be arranged for a fee.

CHEMEX Labs Alberta Inc. is accredited by both the Canadian Association for Environmental Analytical Laboratories and the Standards Council of Canada for specific parameters registered with the Association and the Council.

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : TIN-BRL-1
Sample Date & Time : 28-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

Chemex Worksheet Number : 96-07805-38
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : March 3, 1997
Analysis Date : November 11, 1996

PARAMETER DESCRIPTION	ENVIRODAT CODE	UNITS	R E S U L T S	DETECTION LIMIT
Total Organic Halogens (TOX)		ug/g	< 2	2.

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : TIN-BRL-1
Sample Date & Time : 28-07-96
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Sample Matrix : LIQUID
Report Date : March 3, 1997

BATCH SPECIFIC QUALITY ASSURANCE REPORT

PARAMETER	DATE ANALYZED (DD-MM-YY)	QA/QC BATCH NUM ANAL	MATRIX SPIKES DUP Rr	MATRIX SPIKES RECOV %	MATRIX SPIKES CONTROL LIMITS LOWER	MATRIX SPIKES CONTROL LIMITS UPPER	CALIBRATION CHECK RECOV %	CALIBRATION CHECK CONTROL LIMITS LOWER	CALIBRATION CHECK CONTROL LIMITS UPPER
Total Organic Halogens (TOX)	11-11-96	3 RAV	N.A.	NOT APPLICABLE			100.3	80.0	120.0

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Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

Sample Description : TIN-BRL-2
Sample Date & Time : 28-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES

Chemex Worksheet Number : 96-07805-3
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : March 3, 1997
Analysis Date : November 11, 1996

PARAMETER DESCRIPTION	ENVIRODAT CODE	UNITS	R E S U L T S	DETECTION LIMIT
Total Organic Halogens (TOX)		ug/g	< 2	2.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : TIN-BRL-2
Sample Date & Time : 28-07-96
Sampled By :
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-07805-3
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : March 3, 1997

BATCH SPECIFIC QUALITY ASSURANCE REPORT

PARAMETER	DATE ANALYZED (DD-MM-YY)	QA/QC BATCH NUM ANAL	MATRIX SPIKES DUP Rr	MATRIX SPIKES RECOV %	MATRIX SPIKES CONTROL LIMITS LOWER	MATRIX SPIKES CONTROL LIMITS UPPER	CALIBRATION CHECK RECOV %	CALIBRATION CHECK CONTROL LIMITS LOWER	CALIBRATION CHECK CONTROL LIMITS UPPER
Total Organic Halogens (TOX)	11-11-96	1 DCF	N.A.	NOT APPLICABLE			101.4	80.0	120.0

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : TIN-BRL-3
Sample Date & Time : 28-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

Chemex Worksheet Number : 96-07805-9
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : March 3, 1997
Analysis Date : October 25, 1996

PARAMETER DESCRIPTION	ENVIRODAT UNITS CODE	R E S U L T S	DETECTION LIMIT
Total Organic Halogens (TOX)	ug/g	5.0	2.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : TIN-BRL-3
Sample Date & Time : 28-07-96
Sampled By :
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-07805-9
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : March 3, 1997

BATCH SPECIFIC QUALITY ASSURANCE REPORT

PARAMETER	DATE ANALYZED (DD-MM-YY)	QA/QC BATCH NUM	ANAL	MATRIX SPIKES DUP Rr	RECOV %	CONTROL LIMITS LOWER	UPPER	CALIBRATION CHECK RECOV %	CONTROL LIMITS LOWER	UPPER
Total Organic Halogens (TOX)	25-10-96	2	RAV	N.A.	NOT APPLICABLE			100.7	80.0	120.0

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

Sample Description : TIN-BRL-3
Sample Date & Time : 28-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-9
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : March 3, 1997
Analysis Date : November 11, 1996

AROCLORS (PCBS) BY MODIFIED EPA METHOD 8081

COMPONENT	CONCENTRATION	UNIT	MDL
Aroclor 1016	< 0.3	mg/Kg	0.3
Aroclor 1221	< 0.3	mg/Kg	0.3
Aroclor 1232	< 0.3	mg/Kg	0.3
Aroclor 1242	< 0.3	mg/Kg	0.3
Aroclor 1248	< 0.3	mg/Kg	0.3
Aroclor 1254	< 0.3	mg/Kg	0.3
Aroclor 1260	< 0.3	mg/Kg	0.3
Aroclor 1262	< 0.3	mg/Kg	0.3
Aroclor 1268	< 0.3	mg/Kg	0.3

NOTES :

Results are reported in accordance with CCME guidelines, "Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites, Volume I". All results are corrected for blank levels.

MDL - Method detection level. - Calculated on the basis of the instrument detection level, the dilution used, and the weight of the sample.

( ) - Bracketed results are values below the reliable detection level, and are subject to reduced levels of confidence. The reliable detection level is twice the method detection level.

QA/QC SUMMARY

All samples were spiked with a component whose recovery was monitored to maintain analysis accuracy. Guidelines from SW846 for suggested surrogate recoveries for each matrix are shown below.

Surrogate Recovery : 80% LIQUID surrogate limits : 63% - 134%.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : TIN-BRL-3
Sample Date & Time : 28-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

Chemex Worksheet Number : 96-07805-9
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : March 3, 1997
Analysis Date : November 11, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

BATCH : 11	BLANK	DUPLICATE			MATRIX SPIKE			CALIBRATION CHECK		
DATE : November 11, 1996	CONC.	CONC.1	CONC.2	RPD	RECOV	CONTROL LIMITS		RECOV	CONTROL LIMITS	
ANALYST:AAM	mg/Kg	mg/Kg	mg/Kg	%	%	LOWER	UPPER	%	LOWER	UPPER
Aroclor 1016	< 0.2	< 0.3	< 0.3	0						
Aroclor 1221	< 0.2	< 0.3	< 0.3	0						
Aroclor 1232	< 0.2	< 0.3	< 0.3	0						
Aroclor 1242	< 0.2	< 0.3	< 0.3	0						
Aroclor 1248	< 0.2	< 0.3	< 0.3	0						
Aroclor 1254	< 0.2	< 0.3	< 0.3	0	100	64.	130.	94	80.	130.
Aroclor 1260	< 0.2	< 0.3	< 0.3	0				70	61.	120.
Aroclor 1262	< 0.2	< 0.3	< 0.3	0						
Aroclor 1268	< 0.2	< 0.3	< 0.3	0						

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

Sample Description : TIN-BRL-4
Sample Date & Time : 28-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES

Chemex Worksheet Number : 96-07805-7
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : March 3, 1997
Analysis Date : October 25, 1996

PARAMETER DESCRIPTION	ENVIRODAT UNITS CODE	R E S U L T S	DETECTION LIMIT
Total Organic Halogens (TOX)	ug/g	48.0	2.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : TIN-BRL-4
Sample Date & Time : 28-07-96
Sampled By :
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-07805-7
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : March 3, 1997

BATCH SPECIFIC QUALITY ASSURANCE REPORT

PARAMETER	DATE ANALYZED (DD-MM-YY)	QA/QC BATCH NUM	ANAL	MATRIX SPIKES DUP Rr	MATRIX SPIKES RECOV %	MATRIX SPIKES CONTROL LIMITS LOWER	MATRIX SPIKES CONTROL LIMITS UPPER	CALIBRATION CHECK RECOV %	CALIBRATION CHECK CONTROL LIMITS LOWER	CALIBRATION CHECK CONTROL LIMITS UPPER
Total Organic Halogens (TOX)	25-10-96	1	RAV	N.A.	NOT APPLICABLE			103.0	80.0	120.0

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

Sample Description : TIN-BRL-4
Sample Date & Time : 28-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-7
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : March 3, 1997
Analysis Date : November 11, 1996

AROCLORS (PCBS) BY MODIFIED EPA METHOD 8081

COMPONENT	CONCENTRATION	UNIT	MDL
Aroclor 1016	< 0.3	mg/Kg	0.3
Aroclor 1221	< 0.3	mg/Kg	0.3
Aroclor 1232	< 0.3	mg/Kg	0.3
Aroclor 1242	< 0.3	mg/Kg	0.3
Aroclor 1248	< 0.3	mg/Kg	0.3
Aroclor 1254	< 0.3	mg/Kg	0.3
Aroclor 1260	< 0.3	mg/Kg	0.3
Aroclor 1262	< 0.3	mg/Kg	0.3
Aroclor 1268	< 0.3	mg/Kg	0.3

NOTES :

Results are reported in accordance with CCME guidelines, "Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites, Volume I". All results are corrected for blank levels.

MDL - Method detection level. - Calculated on the basis of the instrument detection level, the dilution used, and the weight of the sample.

( ) - Bracketed results are values below the reliable detection level, and are subject to reduced levels of confidence. The reliable detection level is twice the method detection level.

QA/QC SUMMARY

All samples were spiked with a component whose recovery was monitored to maintain analysis accuracy. Guidelines from SW846 for suggested surrogate recoveries for each matrix are shown below.

Surrogate Recovery : 78% LIQUID surrogate limits : 63% - 134%.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : TIN-BRL-4
Sample Date & Time : 28-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

Chemex Worksheet Number : 96-07805-7
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : March 3, 1997
Analysis Date : November 11, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

BATCH : 11	BLANK	DUPLICATE			MATRIX SPIKE			CALIBRATION CHECK		
DATE : November 11, 1996	CONC.	CONC.1	CONC.2	RPD	RECOV	CONTROL LIMITS		RECOV	CONTROL LIMITS	
ANALYST:AAM	mg/Kg	mg/Kg	mg/Kg	%	%	LOWER	UPPER	%	LOWER	UPPER
Aroclor 1016	< 0.2	< 0.3	< 0.3	0						
Aroclor 1221	< 0.2	< 0.3	< 0.3	0						
Aroclor 1232	< 0.2	< 0.3	< 0.3	0						
Aroclor 1242	< 0.2	< 0.3	< 0.3	0						
Aroclor 1248	< 0.2	< 0.3	< 0.3	0						
Aroclor 1254	< 0.2	< 0.3	< 0.3	0	100	64.	130.	94	80.	130.
Aroclor 1260	< 0.2	< 0.3	< 0.3	0				70	61.	120.
Aroclor 1262	< 0.2	< 0.3	< 0.3	0						
Aroclor 1268	< 0.2	< 0.3	< 0.3	0						

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

Sample Description : TIN-BRL-5
Sample Date & Time : 28-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES

Chemex Worksheet Number : 96-07805-37
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : March 3, 1997
Analysis Date : November 11, 1996

PARAMETER DESCRIPTION	ENVIRODAT UNITS CODE	R E S U L T S	DETECTION LIMIT
Total Organic Halogens (TOX)	ug/g	16.0	2.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : TIN-BRL-5
Sample Date & Time : 28-07-96
Sampled By :
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-07805-37
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : March 3, 1997

BATCH SPECIFIC QUALITY ASSURANCE REPORT

PARAMETER	DATE ANALYZED (DD-MM-YY)	QA/QC BATCH NUM	ANAL	MATRIX SPIKES DUP Rr	MATRIX SPIKES RECOV %	MATRIX SPIKES CONTROL LIMITS LOWER	MATRIX SPIKES CONTROL LIMITS UPPER	CALIBRATION CHECK RECOV %	CALIBRATION CHECK CONTROL LIMITS LOWER	CALIBRATION CHECK CONTROL LIMITS UPPER
Total Organic Halogens (TOX)	11-11-96	3	RAV	N.A.	NOT APPLICABLE			100.3	80.0	120.0

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : TIN-BRL-5
Sample Date & Time : 28-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

Chemex Worksheet Number : 96-07805-37
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : March 3, 1997
Analysis Date : November 13, 1996

AROCLORS (PCBS) BY MODIFIED EPA METHOD 8081

COMPONENT	CONCENTRATION	UNIT	MDL
Aroclor 1016	< 2.	mg/Kg	2.
Aroclor 1221	< 2.	mg/Kg	2.
Aroclor 1232	< 2.	mg/Kg	2.
Aroclor 1242	< 2.	mg/Kg	2.
Aroclor 1248	< 2.	mg/Kg	2.
Aroclor 1254	< 2.	mg/Kg	2.
Aroclor 1260	< 2.	mg/Kg	2.
Aroclor 1262	< 2.	mg/Kg	2.
Aroclor 1268	< 2.	mg/Kg	2.

NOTES :

Results are reported in accordance with CCME guidelines, "Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites, Volume I". All results are corrected for blank levels.

MDL - Method detection level. - Calculated on the basis of the instrument detection level, the dilution used, and the weight of the sample.

( ) - Bracketed results are values below the reliable detection level, and are subject to reduced levels of confidence. The reliable detection level is twice the method detection level.

QA/QC SUMMARY

All samples were spiked with a component whose recovery was monitored to maintain analysis accuracy. Guidelines from SW846 for suggested surrogate recoveries for each matrix are shown below.

Surrogate Recovery : 84% LIQUID surrogate limits : 63% - 134%.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : TIN-BRL-5
Sample Date & Time : 28-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

Chemex Worksheet Number : 96-07805-37
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : March 3, 1997
Analysis Date : November 13, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

BATCH : 11	BLANK	DUPLICATE			MATRIX SPIKE			CALIBRATION CHECK		
DATE : November 13, 1996	CONC.	CONC.1	CONC.2	RPD	RECOV	CONTROL LIMITS		RECOV	CONTROL LIMITS	
ANALYST:AAM	mg/Kg	mg/Kg	mg/Kg	%	%	LOWER	UPPER	%	LOWER	UPPER
Aroclor 1016	< 0.2	< 2.	< 2.	0						
Aroclor 1221	< 0.2	< 2.	< 2.	0						
Aroclor 1232	< 0.2	< 2.	< 2.	0						
Aroclor 1242	< 0.2	< 2.	< 2.	0				102	74.	130.
Aroclor 1248	< 0.2	< 2.	< 2.	0						
Aroclor 1254	< 0.2	< 2.	< 2.	0	108	64.	130.			
Aroclor 1260	< 0.2	< 2.	< 2.	0				100	61.	120.
Aroclor 1262	< 0.2	< 2.	< 2.	0						
Aroclor 1268	< 0.2	< 2.	< 2.	0						

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Edmonton: 9331 - 48th Street, T6B 2R4, Telephone: (403) 465-9877, FAX: (403) 466-3332
Toll Free 1-800-386-7247

Send for PCB if above 2ppm

Analytical Request Form

3995

CANADA

INVOICE TO:	REPORT TO:
Company Name: PUBLICWORKS	SAME
Contact Name: MIKE WAHIR	
Address:	
Phone & Fax #:	

Data Disk Required: ☐ Yes ☐ No _____ (format)
Purchase Order #: _____ Quotation #: _____
Project #: _____ Project Name: _____
Sampler's Initials: _____

Chemex Lab Sample #	Sample Identification	Sample Information: Matrix	Sample Information: Date / Time Sampled	Preservative Added (Y/N)	Total Metals (T) Dissolved (D), Extractable (E)	Hold For > 60 Days (Y/N)	Turnaround Required (# Days or (R) Regular)	TOX (to 1ppm)		PCB										
78655-1	CL/B/100		96-07-17					✓		✓										
-2	DLB-10B		-07-25																	
-3	TIN-BR1-2		07-28							✓										
-4	STORM-BRL-1		-07-27																	
-5	SM-B204		-07-29							✓										
-6	VE-B106		-07-27							✓										
-7	TIN-BR1-4		-07-28							✓										
-8	STORM-BR-1-1		-07-25							✓										
-9	TIN-BR1-3		-07-28							✓										
-10	SZ-BL-4		-07-26							✓										
-11	DL-B2		-07-25							✓										
-12	CONG-BR1-1		-07-24							✓										
-13	VE-B103A		-07-27					✓		✓										

TOCA (CCME) 96-11-07

Relinquished by:
Signature: _____ Date: _____
Printed Name: _____ Time: _____
Received by:
Signature: _____ Date Submitted: 96-10-17
Printed Name _____ Time: _____

SPECIAL REQUESTS: _____

Regulatory Requirements (Check One)

- ☐ Canadian Drinking Water
- ☐ Alberta Tier 1 Metals
- ☐ CCME
- ☐ PST
- ☐ Other _____

ASE
96-11-15

REV 1 (96-04-26)

FOR SAFETY REASONS, PLEASE INDICATE IF SAMPLES ARE SUSPECTED TO BE HAZARDOUS

CHEMEX Labs Alberta Inc.

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Edmonton: 9331 - 48th Street, T6B 2R4, Telephone: (403) 465-9877, FAX: (403) 466-3332
Toll Free 1-800-386-7247

Se[illegible] to PCB if above 2ppm

Analytical Request Form

	INVOICE TO:	REPORT TO:
Company Name:	PUBLIC WORKS CANADA	SAME
Contact Name:	MIKE NAHIR.	
Address:		
Phone & Fax #:		

Data Disk Required: ☐ Yes ☐ No _____ (format)
Purchase Order #: _____ Quotation #: _____
Project #: _____ Project Name: _____
Sampler's Initials: _____

Chemex Lab Sample #	Sample Identification	Sample Information: Matrix	Sample Information: Date / Time Sampled	Preservative Added (Y/N)	Total Metals (T) Dissolved (D), Extractable (E)	Hold For > 60 Days (Y/N)	Turnaround Required (# Days or (R) Regular)	TOX (to 1ppm)	PCB
28G5-14	AC-B102B		96-07-26					✓	✓
-15	VE-B107		-27						✓
-16	VE-B104		-27						✓
-17	AC-B101		-27						✓
-18	AC-B102-A		-27						✓
-19	VE-B108		-27						✓
-20	SM-B208		-29						✓
-21	ST-BL-3		-26						✓
-22	BL-B4		-25						✓
-23	SM-B207		-29						✓
-24	SM-B206		-29						✓
-25	VE-B101		-27						✓
-26	SM-B201		-29						✓

TO CALGARY 96-11-07 DVE 96-11-15

TO CALGARY 96-11-11 PW

Relinquished by:
Signature: _____ Date: _____
Printed Name: _____ Time: _____
Received by:
Signature: _____ Date Submitted: Feb 12-97
Printed Name _____ Time: _____

Regulatory Requirements (Check One)

- ☐ Canadian Drinking Water
- ☐ Alberta Tier 1 Metals
- ☐ CCME
- ☐ PST
- ☐ Other _____

SPECIAL REQUESTS: _____

REV 1 (96-04-26)

FOR SAFETY REASONS, PLEASE INDICATE IF SAMPLES ARE SUSPECTED TO BE HAZARDOUS

CHEMEX Labs Alberta Inc.

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Edmonton: 9331 - 48th Street, T6B 2R4, Telephone: (403) 465-9877, FAX: (403) 466-3332
Toll Free 1-800-386-7247

Send to AC if above 2ppm

Analytical Request Form

CANADA

	INVOICE TO:	REPORT TO:
Company Name:	Bow. PUBLIC WORKS	SAME
Contact Name:	MIKE NAHIR	
Address:		
Phone & Fax #:		

Data Disk Required: ☐ Yes ☐ No _____ (format)
Purchase Order #: _____ Quotation #: _____
Project #: _____ Project Name: _____
Sampler's Initials: _____

Chemex Lab Sample #	Sample Identification	Sample Information: Matrix	Sample Information: Date / Time Sampled	Preservative Added (Y/N)	Total Metals (T) Dissolved (D), Extractable (E)	Hold For > 60 Days (Y/N)	Turnaround Required (# Days or (R) Regular)	TOX (ppb/ppm)	PB	
7855-27	VE-B105		96-07-27					✓	✓	
-28	VE-B102		"						✓	
-29	SM-B202		-29						✓	
-30	VE-B103B		-27							
-31	SM-B203		-29							
-32	~~HOT~~ -BR 1-1		-28							
-33	DLB-12		-25							
-34	DLB-7B		-25						✓	
-35	VE-B109		-27						✓	
-36	SM-B205		-29							
-37	TW-BR1-5		-28						✓	
-38	TW-BR1-1		-28							
								✓		

ANALYSIS REQUESTED (WRITE PREFERRED METHOD)

PB to Calgary 96-11-11

Relinquished by:
Signature: _____ Date: _____
Printed Name: _____ Time: _____
Received by:
Signature: _____ Date Submitted: 17.10.96
Printed Name _____ Time: _____

SPECIAL REQUESTS: _____

Regulatory Requirements (Check One)

- ☐ Canadian Drinking Water
- ☐ Alberta Tier 1 Metals
- ☐ CCME
- ☐ PST
- ☐ Other _____

REV 1 (96-04-26)

FOR SAFETY REASONS, PLEASE INDICATE IF SAMPLES ARE SUSPECTED TO BE HAZARDOUS

APPENDIX D

Sampling Records

WATER SAMPLING

PROJECT NAME: Tintina, YT NAME OF SAMPLER: Tracy Delaney

Location: _____ Date: July 28, 1996

SAMPLE#: TNT-WQ-A1-1 Imm, Tm pH: 8.4 Eh = 80mS

Location description: At edge of snow covering mouth of adit (~ 2m)

Analysis: (metals) (water chem) Eh total sulphur

SAMPLE#: TNT-WQ-STE1-1 Imm, Tm pH: _____

Location description: taken just below where FeOx seeps enter main drainage ~200m from adit

Analysis: (metals) (water chem) Eh total sulphur

SAMPLE#: _____ pH: _____

Location description: _____

Analysis: metals water chem Eh total sulphur

SAMPLE#: _____ pH: _____

Location description: _____

Analysis: metals water chem Eh total sulphur

SAMPLE#: _____ pH: _____

Location description: _____

Analysis: metals water chem Eh total sulphur

Comments: _____

Sample # Format site name-Wnumber
eg. Tintina-W1

BL=barrel S=soil
W=water WR=waste rock

BARREL SAMPLING

PROJECT NAME: Tintina Mine **SAMPLE #:** Tin-BrL-1

Location: by maintenance shop *Date:* 7/28/96

Name of sampler: Michael Nahm

Physical Observation

Condition of barrel: poor fair (good)

Size (L): (205L) other Labels _____

Soil staining: Y / (N)

Barrel Contents

Quantity of liquid: 1/4 1/2 (3/4) full

Colour of liquid: (light) (dark) multiphase other

Suspected type of liquid: gasoline jet fuel (waste oil) glycol oil other _____

Sludge observed: Y / (N) Quantity _____

Analysis (if required)

Type of sample taken: composite (grab)

Analysis required: (metals) PCBs (chlorine) other _____

Comments: BrL sealed (being closed)

Sample # Format site name - BL number
eg. Tintina-BL1

BL =barrel
W=water
S=soil
WR=waste rock

BARREL SAMPLING

PROJECT NAME: Tintina Mine **SAMPLE #:** Tin BL-2

Location: inside Marilen shop *Date:* 7/28/96

Name of sampler: M Nahm

Physical Observation

Condition of barrel: poor (fair) good

Size (L): 205L (loose) other Labels 10 gal

Soil staining: Y (N)

Barrel Contents

Quantity of liquid: 1/4 (1/2) 3/4 full

Colour of liquid: (light) dark multiphase other

Suspected type of liquid: (gasoline) jet fuel waste oil glycol oil other _____

Sludge observed: Y / (N) Quantity _____

Analysis (if required)

Type of sample taken: composite (grab)

Analysis required: (metals) PCBs (chlorine) other _____

Comments: - Red 10 gal barrel
- small opening in open

Sample # Format site name - BL number
eg. Tintina-BL1

BL =barrel
W=water
S=soil
WR=waste rock

BARREL SAMPLING

PROJECT NAME: Tintina Mine **SAMPLE #:** Tin-Brl-3

Location: South end of Mine (group of 3 brls) *Date:* 7/29/96

Name of sampler: M Nahm

Physical Observation

Condition of barrel: poor fair (good)

Size (L): (205L) other Labels _____

Soil staining: Y (N)

Barrel Contents

BRL A BRL B BRL C

Quantity of liquid: (1/4) 1/2 (3/4) (full)

Colour of liquid: (light) dark multiphase other

Suspected type of liquid: gasoline (jet fuel) waste oil glycol oil other _____

Sludge observed: Y (N) Quantity _____

Analysis (if required)

Type of sample taken: composite (grab)

Analysis required: (metals) PCBs (chlorine) other _____

Comments: - Sampling barrel A because it looks slightly contaminated
other brls are clean
- Red Brls
- Bungs closed

Sample # Format site name - BL number
eg. Tintina-BL1

BL =barrel
W=water
S=soil
WR=waste rock

BARREL SAMPLING

PROJECT NAME: Tintina Mine **SAMPLE #:** Tin-Brl-4

Location: By main barrel storage area *Date:* 7/28/96

Name of sampler: M. Nahir

Physical Observation

Condition of barrel: poor fair (good)

Size (L): (205L) other *Labels* _____

Soil staining: (Y)/N small stain 2' diam slight

Barrel Contents

Quantity of liquid: (1/4) 1/2 3/4 full

Colour of liquid: (light) dark multiphase other

Suspected type of liquid: gasoline jet fuel waste oil glycol oil other diesel

Sludge observed: Y (N) *Quantity* _____

Analysis (if required)

Type of sample taken: composite (grab)

Analysis required: (metals) PCBs (chlorine) other _____

Comments: - Small berg missing
- Reel
- on side

Sample # Format site name - BL number
eg. Tintina-BL1

BL =barrel
W=water
S=soil
WR=waste rock

BARREL SAMPLING

PROJECT NAME: Tintina Mine **SAMPLE #:** Tin-Brl-5

Location: Main Barrel cache *Date:* 7/28/96

Name of sampler: M. Nahm

Physical Observation

Condition of barrel: poor (fair) good

Size (L): (205L) other Labels _____

Soil staining: Y / (N)

Barrel Contents

Quantity of liquid: 1/4 1/2 3/4 (full)

Colour of liquid: light (dark) multiphase other

Suspected type of liquid: gasoline jet fuel waste oil glycol (oil)
other _____

Sludge observed: Y / (N) Quantity _____

Analysis (if required)

Type of sample taken: composite (grab)

Analysis required: (metals) PCBs (chlorine) other _____

Comments: - light Blue chemon
- Burg closed

Sample # Format site name - BL number
eg. Tintina-BL1

BL =barrel
W=water
S=soil
WR=waste rock

APPENDIX E

Barrel Clean Up Protocol

BARREL CLEAN UP PROTOCOL

A flow diagram of the methodology for the processing, cleanup and disposal of barrels is attached.

A. Inspection

1. *The area around the barrels should be tested with a VOC metre to ensure safe working conditions. If the VOC levels exceed 20% of the Lower Explosive Limit (LEL), then all work shall be conducted in accordance with appropriate sections of the NIOSH Guidelines, the National Fire Code of Canada and the TDGA for flammable and combustible materials.*

2. *All barrels are to be inspected to address the following items which shall be recorded and used as a guide when opening barrels (section B.3):*

    1. *Symbols, words, or other marks on the barrel that identify its contents, and/or that its contents are hazardous: e.g. radioactive, explosive, corrosive, toxic, flammable.*
    2. *Symbols, works, or other marks on the barrel that indicate that it contains discarded laboratory chemicals, reagents, or other potentially dangerous materials in small-volume containers.*
    3. *Signs of deterioration or damage such as corrosion, rust, or leaks at seams, rims, and V grooves.*
    4. *Spillage or discolouration on the top and sides of the barrel.*
    5. *Signs that the barrel is under pressure such as bulging and swelling.*

B. Opening and Sampling

1. *Pressurized barrels are extremely hazardous and shall be opened with extreme caution. Only non-sparking equipment shall be used to open barrels. All personnel responsible for opening barrels shall be provided with appropriate safety equipment and clothing. Procedures outlined in NIOSH USEPA 1988 Safety and Health Compliance for Managers (165.8) USEPA-29-CFR, 1910-1920, shall be followed.*

2. *If the bungs can readily be moved; then the barrels shall be opened slowing allowing time for any pressure in the barrel to be released before the bung is fully removed.*

3. *If the bungs are not readily moved, or inspection suggests that opening of the barrel presents a special hazard, then the barrels shall be vented remotely to relieve any internal pressure that may be present prior to opening. Remote venting shall be conducted using a suitable device such as a sharp spear weighted and dropped from an appropriate height or released from a tube housing a spring to penetrate the barrel. The remote venting operation shall be conducted from a safe distance from other site operations and from behind suitable walls or barricades. After sampling, the spear opening shall be plugged.*

4. *Samples of the contents of all barrels shall be extracted using a drum thief. All barrels shall be clearly numbered using spray paint or other suitable marker.*

5. *Barrels shall not be transported until it has been determined that they are not under pressure, do not leak and are sufficiently sound for transport.*

6. *Barrels containing less than 50 mm of liquid may be combined with compatible material prior to sampling; samples inferred to contain only water on a visual examination shall be tested prior to this consolidation. Barrel contents which consist of black oil shall not be consolidated.*

7. *Consolidation of barrel contents shall take place in a secure barrel processing area. At many DEW Line sites several caches of barrels are present and, therefore, it may be desirable to establish several secure sorting areas; barrels scattered on the tundra may be vented, then closed, and then transported to a barrel sorting area for sampling and possible consolidation.*

C. Testing

1. *Liquid samples shall be inspected and classified as either containing water or organic materials. Samples thought to contain water shall be analysed on-site to confirm that they are indeed water and contain less than 2% glycols or alcohols by Fourier transform infrared spectroscopy (FTIR).*

2. *The contents of barrels containing organic materials, including aqueous samples which contain more than 2% glycols or alcohols, shall be tested for PCBs, Total chlorine, cadmium, chromium and lead, in addition to identification of the major components e.g. fuel oil, lubricating oil. Samples containing greater than 1000 ppm chlorine shall be further tested to identify the chlorinated compounds present.*

3. *Contents of barrels which contain two or more phrases shall have all phrases analysed; the organic phases as described above and the aqueous phases to ascertain whether it contains less than 2% organics. In addition, the aqueous phases shall be tested for any components found in the organic phases above the criteria described below.*

D. Disposal of Barrel Contents

1. *Barrels containing only rust and sediment shall be treated as empty barrels.*

2. *Barrel contents comprising water only (less than 2% glycols or alcohols) shall be transferred to an open vessel such as a utility tub or half-barrel and any organic material removal by agitation with a pillow or segment of oil absorbent material. The water may then be discarded on to the ground that is a minimum of 30 metres distance from natural drainage courses. Used oil absorbent material shall be treated as described in Section D.5.*

3. *Barrel contents which are composed of water with glycols and/or alcohols or*

organics phases, and which contain less than 2 ppm PCBs, 1000 ppm chlorine, 2 ppm cadmium, 10 ppm chromium and 100 ppm lead, may be disposed of by incineration. Alternatively these contents may be disposed of off-site at a licensed disposal facility. The solid residual material resulting from incineration shall be subjected to a leachate extraction test. Material found to be not leachate toxic material shall be treated as hazardous waste, packaged in accordance with TDGA and/or IATA regulations as required, and disposed of off-site at a licensed disposal facility.

4. *Barrel contents which contain greater than 2 ppm PCBs, 1000 ppm chlorine, 2 ppm cadmium, 10 ppm chromium or 1000 ppm lead shall be disposed of off-site at a licensed disposal facility. Contents may be combined with compatible materials for shipping purposes (note section E.1). Flash point may be required to be determined if they cannot be inferred from the product identification.*

5. *Used oil absorbent material should be treated as hazardous waste and disposed of off-site at a licensed disposal facility unless, it is shown to be uncontaminated with PCBs (<2 ppm), chlorine (<1000 ppm) cadmium (<2 ppm), chromium (<10 ppm) and lead (<100 ppm) in which case it may be incinerated on site.*

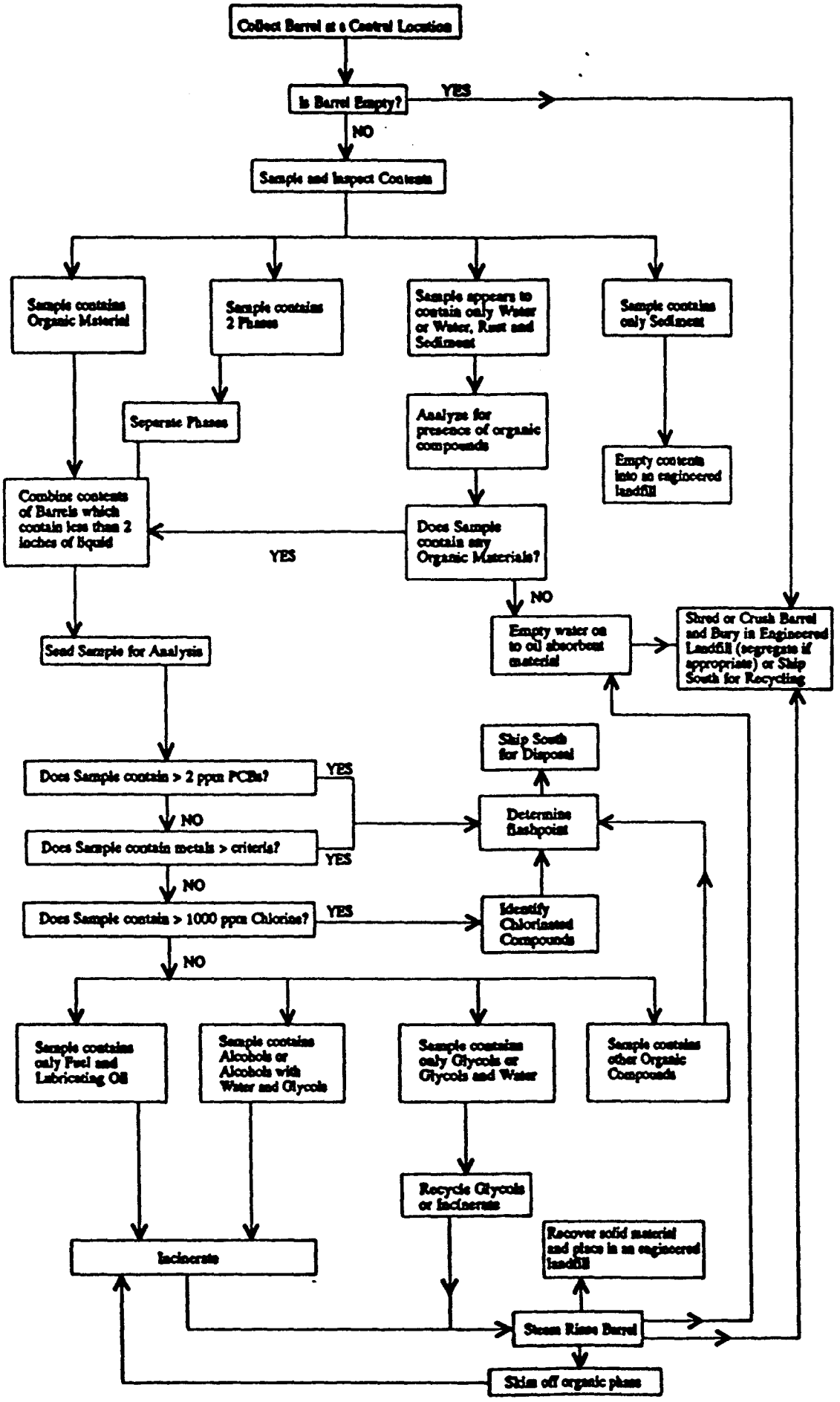
E. Cleaning and Disposing of Barrels

1. *Empty barrels resulting from consolidation of contaminated material (Section D.4) shall be triple rinsed with solvent (varsol, diesel, etc.) Prior to steam cleaning; solvent washings shall be added to the bulked contaminated products unless analysed separately and shown to be suitable for incineration. Alternatively, the empty barrels may be shipped off-site and labelled appropriately (TDGA).*

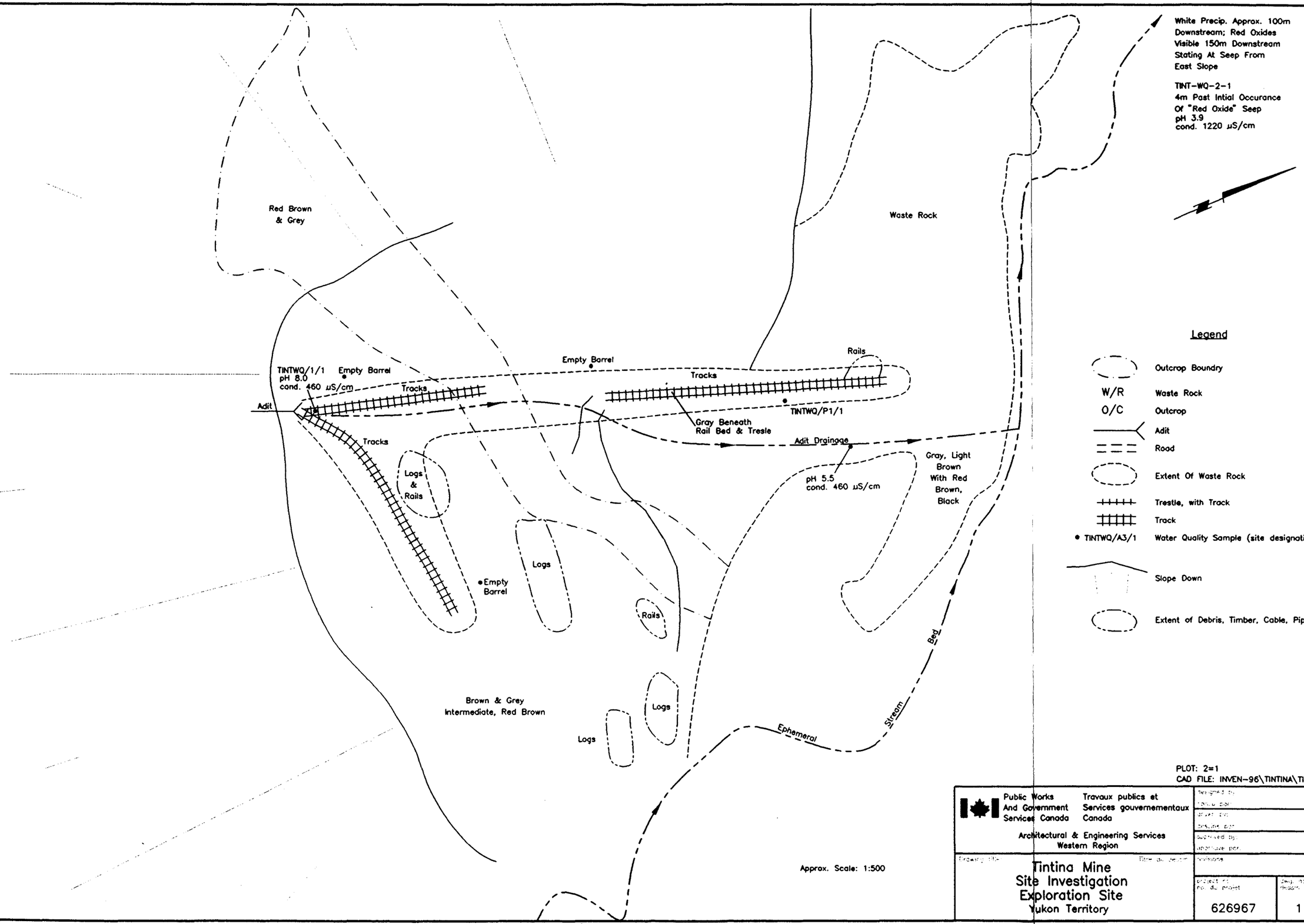
2. *Only empty barrels resulting from consolidation of small volumes (section B.6), from incineration (section D.3) and from solvent washing (section E.1) require steam cleaning; after cleaning they shall be treated as described in E.3. Recycling of rinsate is permitted. The resulting wash water shall have any organic material removed by agitation with a pillow or segment of oil absorbent material. The water shall then be analysed for cadmium, chromium and lead. If these metals are present at less than 0.01, 0.10 and 0.10 ppm respectively, then the water may be discarded on land that is a minimum of 30 metres from natural drainage courses, but if not then it shall be disposed of off-site at a licensed disposal facility. Alternatively, the wash water may be shipped off site without testing for disposal at a licensed disposal facility. Used absorbent material shall be disposed of as described in section D.5.*

3. *Empty barrels may be crushed or shredded and be landfilled on-site as non-hazardous wastes. The barrels shall be crushed in such a manner so as to reduce their volume by a minimum of 75%. Shredded barrels may be disposed of off-site as recycled metals.*

FLOW CHART FOR THE DEW LINE CLEANUP OF BARRELS



DRAWINGS



PLOT: 2=1
CAD FILE: INVEN-96\TINTINA\TINTIN-1

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

Architectural & Engineering Services
Western Region

Tintina Mine
Site Investigation
Exploration Site
Yukon Territory

626967

1 of 2

3-Orange Barrels
(1/4,3/4, Full)

• TINB/3

• TINB/5

• TINB/4

1-Orange 10 gal. (4" Water)
1- Light Blue (Full)
12- Blue Barrels (Full)
1-Red Barrel (2" Water)

Outhouse

Helicopter
Pads

Mess

Kitchen

Shower

• TINB/1

• TINB/2

Maintenance
Shop

1-Empty Barrel
36m Rail

Bunkhouse

Approx. Scale: 1:500

Legend

• TINB/1	Barrel Sample (site designation)
	Slope Down
	Buildings
	Extent of Debris, Timber, Cable, Pipe, etc.

PLOT: 2=1
CAD FILE: INVEN-96\TINTINA\TINTIN-1

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

Architectural & Engineering Services
Western Region

Drawing title / Titre du dessin:

Tintina Mine
Site Investigation
Camp Site
Yukon Territory

Project no. / No. du projet: 626967

Dwg. no. / dessin no.: 2 of 2