MN-089

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Quality in Environmental Services

PHASE II ENVIRONMENTAL ASSESSMENT OF THE VENUS 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 Venus abandoned mine site (60° 01'12" N, 134° 37'58" 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 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 buildings and five open adits and raises currently pose significant health and safety hazards. In addition, the loadout facility, retaining walls, trestle and waste rock piles are potential future health and safety hazards. An assessment of the acid rock drainage potential and the quality of adit discharge water shows that there is some risk to the environment due to the presence of waste rock, however, the background water quality of the entire basin is unknown. Hazardous wastes noted at the site are limited to a number of barrels and pails containing various quantities of predominantly hydrocarbon-based liquids. A number of locations were also found to have soil contaminated above criteria. Aesthetic concerns arise from miscellaneous and metal debris and the large volume of waste rock produced at the site.

Using applicable federal and territorial criteria as well as northern mine reclamation guidelines, the recommendation is to seal or collapse all of the adits, demolish the buildings and loadout facility, burn the wastes and bury on site. All hazardous and non-hazardous wastes should be removed from the site.

Water quality and hydrology data previously collected at the site should be compiled and background water quality of the mountain should be further studied to determine heavy metal background concentrations and any impact the mine is having on Windy Arm. Based on this assessment, a monitoring program and remediation options for the site may be determined. The tailings area has not been included in this site assessment, however, runoff from this site must be included in the basin water quality program.

A program should also be initiated to monitor the stability of the retaining walls, trestle and waste rock piles at the site.

Contaminated soils noted at the site should be allowed to remediate by natural attenuation

Table 1: Summary of Potential Hazards at Venus Mine Site

ASSESSMENT COMPONENT	RISK	RECOMMENDATION
1. Building, Infrastructure, Equipment		
10 buildings	Health and safety concern	Demolish all buildings; burn and bury ashes on site
5 buildings (at Vault claims)	None	Leave as is
1 loadout structure and 1 trestle	Health and safety concern	Dismantle, remove and re-contour site
Retaining walls, stair wells, concrete pad, culvert, pole lines	Aesthetic concern	Secure and monitor for stability
2. Non-Hazardous Waste Material		
Non-hazardous debris	Aesthetic concern	Transport off site
Core samples	Aesthetic concern	Leave as is
3. Hazardous Materials		
8 barrels and 4 pails with product	Health and safety concern and environmental risk	Incinerate off site
2 areas with contaminated soils	Low environmental risk	Leave as is (natural attenuation)
4. Water Quality		
Mine Seepage - at Adit 1 & 2	Unknown environmental risk	Monitoring program to be designed and conducted
Site Drainage - towards Windy Arm	Unknown environmental risk	Monitoring program to be designed and conducted
Receiving Waters	Unknown environmental risk	Basin water quality study
5. Waste Rock Disposal Areas		
Waste rock - ARD generation	Environmental risk	Monitor impacts ie.. WQ
6. Mine Openings		
1. 2 adits - closed but not secured 2. 2 adits - open 3. 1 adit by Hwy (3 m deep) 4. Headframe and shaft	Health and safety concern	1. 2 - seal 2. 2 - collapse 3. 1 - leave 4. Dismantle and seal
7. Tailings		
Not assessed in this report	None	

TABLE OF CONTENTS

EXECUTIVE SUMMARY

1. INTRODUCTION AND BACKGROUND 1

1.1 Location 2
1.2 Overview of Site Development 2
1.3 Site Access 4

2. PURPOSE AND SCOPE OF WORK 4

3. SITE ASSESSMENT METHODOLOGY 5

3.1 Assumptions 5
3.2 Assessment Criteria 6
3.2.1 Criteria and Guidelines 6
3.2.2 Application of Criteria and Guidelines 8
3.3 Methods 9
3.3.1 Background Information 9
3.3.2 Site Assessment Components 9
3.3.3 Sampling Methods and Quality Assurance 10

4. ENVIRONMENTAL SETTING 12

4.1 Mineralization 12
4.2 Surface Hydrology 12
4.3 Climate 13
4.4 Vegetation 13
4.5 Fish and Wildlife Resources 13
4.6 Site Topography and Soils 13
4.7 Permafrost 14

5. SITE DESCRIPTION AND FINDINGS 14

5.1 Buildings, Infrastructure, Equipment 14
5.2 Non-hazardous Waste Materials 15
5.3 Hazardous Materials 16
5.4 Surface Water Quality 20
5.5 Waste Rock Disposal Areas 22
5.6 Mine Openings 24
5.7 Tailings 25

6. CONCLUSIONS 25

6.1 Health and Safety 26

1.0 INTRODUCTION AND BACKGROUND

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

At the Venus abandoned mine site, the 1993 report recommended further investigation into possible environmental impacts resulting from the previous mining activities. According to this report, there are a large number of issues which are summarized below:

Potential concerns identified at Adit 1 of the South end claims include: a potential safety hazard with regard to the adit opening; the poor condition of three buildings; the aesthetics of a large volume of waste remaining in the area; a safety hazard regarding "over-steepened" slopes of waste rock piles; undocumented core samples remaining at the site; and an environmental issue regarding the discharge of water from the adit towards the adjacent highway.

Potential concerns identified at Adit 2 of the South end claims include: a potential safety hazard with regard to an unlocked adit opening; the poor condition of five buildings, particularly the largest one which poses some safety concerns; an environmental issue regarding storage of petroleum hydrocarbons; an aesthetic concern with regard to metal and wood debris at the site; a safety concern regarding the loadout facility; a large volume of potentially contaminated adit water leaving the site resulting in icing on the highway below; aesthetics of large volumes of waste rock visible from highway; and safety concerns with regard to five other adit openings at the site.

Potential concerns at the North end claims include only a safety issue with regard to closure of the adit openings. The mill and tailings were also identified as having potential concerns in the 1993 report, however, they are currently being dealt with as separate issues and are not included in this report.

In light of these preliminary findings, Indian and Northern Affairs Canada determined that further investigation was warranted. Environmental Services, Public Works and Government Services Canada was retained to conduct an environmental assessment of the Venus abandoned mine site to a) identify specific environmental and human safety risks; and b) provide clean-up recommendations.

1.1 LOCATION

Venus mine site is located at 60^0 01'12" N latitude and 134^0 37'58" W longitude. The mine site is located approximately 22 km south of the Village of Carcross on the South Klondike Highway. The site is on a steep slope above Windy Arm of Tagish Lake, below Dall Peak in the Boundary Ranges (Coast Mountains). The site is between 670 and 960 m above sea level.

1.2 OVERVIEW OF SITE DEVELOPMENT

The Venus vein was first discovered at the turn of the century by prospectors on their way to the Klondike gold fields. In 1900, Jack Stewart and Jack Pooley staked the Venus claim group which they sold four years later to Col. J.H. Conrad.

From 1904 to 1912, Conrad developed the Venus vein in three locations: the Vault, Venus #1 and Venus #2 workings. The most extensive work was carried out at Venus #2 where two drifts exploited a 30 m (100 foot) thick length of the vein. A 457 m (1500 ft) long aerial tramline was constructed to carry ore from the 960 m (3150 foot) level to a gravity concentrator on the lake shore, elevation 670 m (2200 feet). Six thousand tons of ore were mined from Venus #2.

In 1916, the Harper Syndicate acquired the rights to the Venus property. In four years, 2410 tonnes (2650 tons) of hand cobbed ore, believed to have come from the Venus #2 workings, was mined.

The area then saw limited activity until 1966 when Venus Mines Ltd. acquired the property and began underground exploration of the Venus vein. Activity was concentrated below the Venus #1 workings, elevation 855 m (2900 feet). Two adits were collared at the 790 m and 825 m (2600 and 2700 ft) levels and cross-cuts were driven to the vein. The Venus vein was developed in five drifts at elevations of 790 m (2600 ft), 812 m (2650 ft), 825 m (2700 ft), 855 m (2800 ft) and 870 m (2850 ft) above sea level and in 35 connecting raises. In 1970, ore reserves of 1,222,710 tonnes (134,845 tons) were calculated. The decision was made to put the mine into production and to build a mill capable of handling 272 tonnes (300

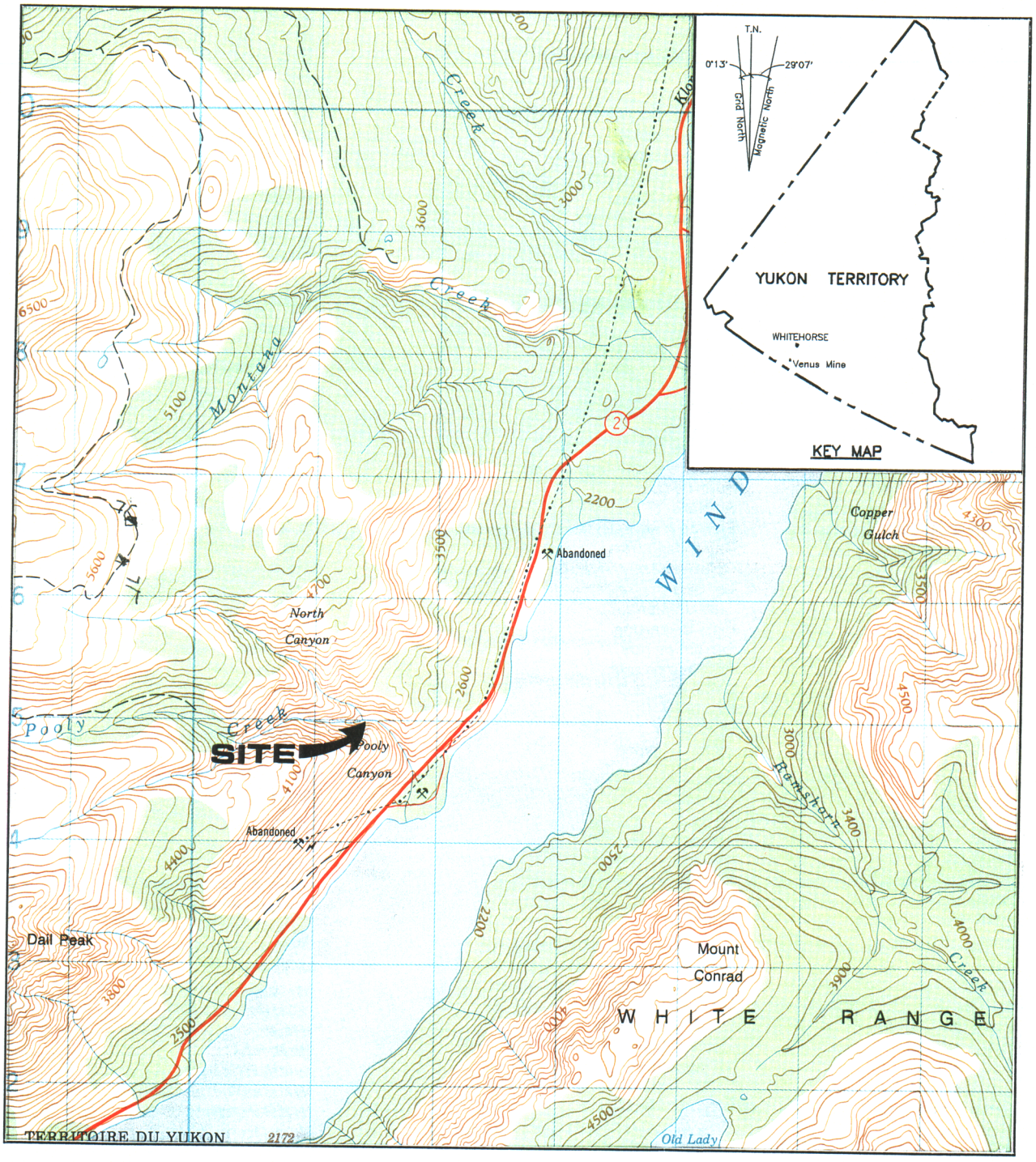

Figure 1. **Location of Venus Mine - 1:50,000, NTS- 105 D/2 [Energy Mines and Resources Canada: 1986]**

tons) of ore per day. The mill tailings are contained in a pond near the mill site . In 1971, after processing 59,360 tonnes (65,231 tons) of ore, the mine closed.

The Tagish Lake Syndicate acquired the Venus claims in 1975 and optioned them to the current property holders, United Keno Hill Mines Ltd. in 1978. A decision was made to put the Venus mine back into production in 1979.

In 1980, construction began on a new 91 tonne (100 ton) per day mill in BC, 33.6 km from Carcross, YT. Development drifting began on the 855 m (2800 ft) and 870 m (2850 ft) levels. During 1981 approximately 13,650 tonnes (15,000 tons) of tailings were removed from the 1970 mill tailings pond and hauled to the new mill in BC. The mine was closed in October 1981. The BC mill was mothballed before it had processed any ore and the mine's production was stockpiled at the mill site.

In 1984, United Keno Hill Mines Ltd. undertook further development on the 870 m (2850 ft) level. The drift was extended 166 m (545 ft) to the north and 158 m (518 ft) to the south. Two raises were driven up from the level to follow the up dip extension of high grade intersections in the drift. A further 11,978 tonnes (13,163 tons) of development were added to the stockpile at the mill site (Stubens, T.C., 1988).

1.3 SITE ACCESS

The mine is located approximately 22 km south of Carcross on the South Klondike Highway. The site is on a steep slope above Windy Arm of Tagish Lake and below Dall Peak in the Boundary Ranges (Coast Mountains). When the mine site was last worked, as late as 1981, access to the adits was gained via a trail which connected Adit 2 with the South Klondike Highway. When the highway was reconstructed, this access route was destroyed. A second access route exists from a location south of Adit 1.

2.0 PURPOSE AND SCOPE OF WORK

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

- Inspection of mine openings and workings, buildings and infrastructure, and waste disposal areas;
- Photo documentation and mapping of relevant site features;

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

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

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

3.0 SITE ASSESSMENT METHODOLOGY

3.1 ASSUMPTIONS

The assessment was limited to the area specifically developed or occupied for exploration or mining purposes, and adjacent areas and resources believed to be

affected by these activities. Water samples were taken off-site to determine potential impact to surface water bodies due to mining activities. Access roadways to mine sites were not included in the assessments.

3.2 ASSESSMENT CRITERIA

3.2.1 Criteria and Guidelines

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

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

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

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

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

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

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

1) Freshwater aquatic life,
2) Irrigation,

3) Livestock watering, and
4) Drinking water.

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

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

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

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

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

Below 3 m 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.

Barrel Clean-Up Protocol, (INAC, 1992)

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

3.2.2 Application of Criteria and Guidelines

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

A. Soils:

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

B. Water:

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

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

C. Mine Clean-Up and Reclamation:

INAC:	Mine Reclamation in Northwest Territories and Yukon

D. Barrels Clean-Up

INAC:	Barrel Clean-Up Protocol

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 Venus abandoned mine site to that date. Other published information sources were examined for site or regional information as applicable. On the basis of available information, knowledge gaps regarding existing or potential safety and environmental risks at the site were identified and a site assessment plan was developed.

3.3.2 Site Assessment Components

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

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

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

Mine Openings were inspected and documented to identify closure requirements.

Non-Hazardous Site Debris was inventoried.

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

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

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

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

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

3.3.3 Sampling Methods and Quality Assurance

Test Pit Sampling

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

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

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

Water Sampling

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

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

2 ml of HNO_3 were immediately added to water samples destined for metals analyses. For analyses of non-metallic parameters, water samples were brim-filled

to minimize head space, placed in a cooler, and maintained at 4° C until delivery to the laboratory.

Soil Sampling

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

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

Barrel, Pail, and Above-Ground Storage Tank Sampling

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

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

Approximately 20 polymetallic, gold-bearing quartz veins are hosted in rock of the mid-Cretaceous Montana Mountain volcanic complex and Montana pluton along an 8 km, northwest trending belt between Windy Arm and Brute Mountain.

The Venus deposit is a gold-silver-lead-zinc bearing quartz vein hosted in the Montana Mountain volcanic complex. The vein has been intruded along a zone of weakness which is the contact between porphyritic andesite to the south and a felsic dike to the north. The Venus vein is a simple, banded fissure-filling containing quartz, arsenopyrite (FeAsS), pyrite (FeS_2), galena (PbS), and sphalerite ((Zn, Fe)S) (Stubens, T.C., 1988).

The country rock in the Venus mine workings consists primarily of pale green to green, competent, cherty andesite breccia, alternating with dark green coloured andesite flows and possibly minor tuff (Hilker, R.G., 1992).

4.2 SURFACE HYDROLOGY

Both site and regional drainage are to the east down a steep slope across South Klondike Highway and into Windy Arm of Tagish Lake (see Figure 1). No streams were noted in the immediate area of the North and South claims, however, the Vault claims are located within Pooley Creek canyon to the north.

Seepage from both Adit 1 and Adit 2 was noted at the site. Seep volumes were calculated at approximately 5 L/sec from both adits. Water from the adit seeps flows across the highway and causes icing during winter months. Seepage volumes at the highway were approximately 1 L/sec beneath Adit 1 and less than 1 L/sec beneath Adit 2.

4.3 CLIMATE

The closest climatological information is from the Town of Carcross (60° 11'N, 134° 41'W 663 m above sea level (Environment, Canada, 1990). Total annual precipitation is 211.4 mm. This consists of 118.7 mm of rainfall and 101.3 mm of snowfall. The highest levels of rainfall occur in August and the highest levels of snowfall occur in January. Temperatures range from -19.4°C in January to 12.7°C in July. The mean annual temperature is -1.4°C.

4.4 VEGETATION

Venus mine site occurs within the Yukon Stikine Highlands ecoregion. Alpine tundra dominates at higher elevations, with vegetation including scrub heather, dwarf birch, willow, grass and lichens present. At lower elevations, subalpine areas typically consist of white spruce and alpine fir. The mine site is located in an alpine/subalpine transition zone and contains species representative of both ecosystems. Disturbed areas of the site are dominated by fireweed.

4.5 FISH AND WILDLIFE RESOURCES

Typical mammals in the area include Dall's sheep, moose, grizzly and black bear, porcupine and wolf. Typical bird species include Blue grouse and two species of ptarmigan. A number of raptors hunt and nest in the area including peregrine falcon and golden eagle. Waterfowl, including merganser species are found in lakes and rivers at the lower elevations.

4.6 SITE TOPOGRAPHY AND SOILS

The soils within the Yukon Stikine Highlands ecoregion are predominantly brunisolic and regosolic. Occasionally, cryosolic soils, dystric brunisols and eutric brunisols are also found.

The South and North end claims are located on a steep mountain slope ending at Tagish Lake approximately 120 m below the site. Drainage is predominantly in that

direction. The Vault claims, were not accessible by ground and were located in a steep walled canyon north of the main area of the site. Drainage from this area would also primarily be towards the lake.

4.7 PERMAFROST

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

5.0 SITE DESCRIPTION AND FINDINGS

5.1 BUILDING, INFRASTRUCTURE, EQUIPMENT

The building, infrastructure and equipment observed at the site are listed in Table 2.

Table 2: Buildings, Infrastructure and Equipment

Item	Size	Location	Comments
storage shed	3.7 m x 3.7 m	adjacent to Adit 1	plywood construction
storage shed	2.4 m x 3.7 m	adjacent to Adit 1	wood frame
rail track	60 m	stemming from Adit 1	satisfactory condition
concrete building foundation	30.5 m	25 m south of Adit 1	contains large volume of materials
small cribs & retaining wall	3 cribs	directly below Adit 1	
mixing tank structure containing mixing tank	2.4 m x 2.7 m x 4.9 m	10 m south of Adit 2	plywood construction
storage building	3.7 m x 4.9 m	25 m north of Adit 2	plywood construction; contains some hazardous materials

Item	Size	Location	Comments
shack	1.2 m x 1.2 m	25 m north of Adit 2	plywood construction
shack	1.2 m x 1.2 m	25 m north of Adit 2	plywood construction; precariously perched
stairway	~ 25 m	directly south of Adit 2	poor condition; leading to ventilation building
trestle	20 m	adjacent to Adit 2	poor condition
ventilation building	4.9 m x 7.3 m	directly above Adit 2	appears to be in good condition, however stairs in poor condition
offloading platform & retaining wall	~ 25 m x 5 m high	directly below Adit 2	poor condition
lower retaining wall & loadout facility	large facility	below Adit 2 at on shore of Windy Arm	current tourist attraction
headframe	~ 15 m high	~ 750 m north of and 135 m above Adit 2	very poor condition
trestle	~ 10 m	at headframe	very poor condition
approx. 5 buildings at Vault claims	2 large and 3 small	~ 750 m to 1 km north of headframe	poor condition or collapsed; inaccessible

5.2 NON-HAZARDOUS WASTE MATERIALS

A large volume of materials were noted at Adit 1, Adit 2 and at the headframe. The non-hazardous waste material observed in and around the site is listed in Table 3.

Table 3: Non-Hazardous Waste Materials

Waste Material	Number/ Volume	Location
core samples & sample boxes	~ 20 m^2	adjacent to Adit 1
lengths of steel pipe	200	on concrete pad 25 m south of and 15 m south of Adit 1
spools	9	on concrete pad 25 m south of Adit 1
wooden pallets	small pile	on concrete pad 25 m south of Adit 1
empty barrels	4	on concrete pad 25 m south of Adit 1; adjacent to Adit 2
spools of conveyor belt	5	on concrete pad 25 m south of Adit 1
stacks of rollers	small pile	on concrete pad 25 m south of Adit 1
logs	2 small pile	on concrete pad 25 m south of Adit 1; 20 m south of Adit 2
wood debris	30 m^3	on concrete pad and 15 m south of Adit 1; adjacent to Adit 2
galvanized ventilation	< 5 m^3	15 m south of Adit 1
misc. angle iron and I beams	100 - 150	15 m south of Adit 1
power poles	7	adjacent to Adit 2
culvert	30 m	10 m south of Adit 2
PVC pipe	20 m	adjacent to Adit 2
installed pipe	60 m	adjacent to Adit 2
wood debris	30 m^3	adjacent to headframe

5.3 HAZARDOUS MATERIALS

Hazardous materials at the site were limited to a number of partially full barrels and pails, most of which were located in a storage shed near Adit 2. As well, several

soil stains or potentially contaminated areas were noted at the site. Table 4 lists hazardous material found at the site.

Table 4: Hazardous Waste Materials

Hazardous Material	Number/ Volume	Location	Sample #
205 L barrel labeled "aviation fuel"	1/3 full	concrete foundation 25 m south of Adit 1	VE-B101
205 L unlabeled barrel	3/4 full	concrete foundation 25 m south of Adit 1	VE-B102
205 L barrel labeled "Chevron automatic transmission fluid"; stratified liquid	3/4 full	5 m south of Adit 2	VE-B103A and VE-B103B
205 L unlabeled barrel with yellow hydrocarbon liquid	8 cm	storage shed adjacent to Adit 2	VE-B104
205 L barrel labeled "mucking machine gear oil"; yellow hydrocarbon	3/4 full	storage shed adjacent to Adit 2	VE-B105
205 L barrel labeled "Chevron OC Turbine Oil 32"; yellow hydrocarbon	½ full	storage shed adjacent to Adit 2	VE-B106
205 L barrel labeled "Chevron 30 D/B"; yellow hydrocarbon	residual	storage shed adjacent to Adit 2	VE-B107
23 L unlabeled pail; dark viscous hydrocarbon	½ full	storage shed adjacent to Adit 2	VE-B108
23 L pail labeled "Chevron Avi Motive Gear"; purple highly viscous hydrocarbon	3/4 full	storage shed adjacent to Adit 2	VE-B109
4 other barrels & 3 pails containing residual products (1 labeled Ansul Foray: fire fighting dry chemical; 1 labeled Tannergas De-icing Fluid and remainder hydrocarbon based)	residual	storage shed adjacent to Adit 2	unsampled

Based on the fact that all barrel sample analyses were below criteria, the contents may be incinerated. Laboratory results are listed in Table 5.

Table 5: Barrel Sample Laboratory Results (ppm)

Parameter	Barrel Clean Up Criteria	Sample # (VE-B*)									
		101	102	103 A	103 B	104	105	106	107	108	109
PCBs	2	< 2	< 2	< 2	< 2	< 2	< 2	<0.2	< 2	< 2	< 2
Total Halogen. Organics	1000	< 2	< 2	118	122	70	38	255	-	-	4.0
Cadmium	2	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Chromium	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Lead	100	< 1	2	15	14	< 1	< 1	< 1	< 1	3	2

Soil samples were collected from a single area with obvious visual contamination between the rail tracks near Adit 2. Five other soil samples were collected for their proximity to a potential source of contamination as indicated in Table 6.

Table 6: Soil Sample Locations

Sample #	Sample Locations
VE-S201	Below to fuel storage tank crib near Adit 1
VE-S202	Adjacent to concrete foundation south of Adit 1
VE-S203	Below pole transformer stand
VE-S204	Adjacent to pole transformer stand
VE-S205	Below storage shed (containing 205 barrels with liquid product)
VE-S206	Between rail tracks at entrance to Adit 2

All samples except S202 were sampled primarily for petroleum hydrocarbon contamination. Samples S203 to S205 were also sampled for the potential of contamination resulting from chlorinated organics (PCBs). The sample S202

location, an area where wire was burned, was sampled primarily for heavy metal contamination. All six samples were subjected to heavy metal and total extractable hydrocarbons (TEH) analysis.

TEH contamination above Yukon contaminated sites industrial remediation criteria was confirmed in samples S204 and S206.

Arsenic concentrations were above CCME commercial/industrial remediation criteria in all samples. Concentrations in samples S202 and S203 were above CCME criteria for arsenic, as well as cadmium and lead. Concentrations in S202 were also above CCME criteria for zinc and Yukon criteria for antimony. With the exception of antimony which was not included in the waste rock analyses, all of these metals were noted in similar concentrations in some waste rock analyses. As such, these concentrations should be considered background concentrations.

An elevated concentration of extractable organic halides, 63.0 ppm was also noted in sample S205. This sample was collected below the chemical storage shed where a number of partially full barrels and pails were noted. Sample analysis of these liquids showed some with elevated concentrations of organic halides, however, PCB concentrations were below method detection limits in all barrel and pail samples. Polynuclear aromatic hydrocarbons (PAHs) were also included in the analysis of sample S205. Concentrations were below detection limits for all compounds. Soil sample results are detailed in Table 7 below.

Table 7: Soil Sample Laboratory Results

Parameter	Yukon Industrial Criteria	CCME Industrial Criteria	Sample # (VE-S)					
			201	202	203	204	205	206
Total Extractable Hydrocarbon	5000	-	2600	40	< 40	**8780**	4770	**19400**
Antimony	40	40	< 20	**149**	< 20	< 20	< 20	< 20
Arsenic	-	50	**597**	**12400**	**6770**	**978**	**1170**	**2120**
Barium	2000	2000	161	138	36	93	182	69
Beryllium	8	8	0.9	< 0.5	0.8	< 0.5	0.6	< 0.5
Cadmium	-	20	3	**64**	**47**	4	17	15

Parameter	Yukon Industrial Criteria	CCME Industrial Criteria	Sample # (VE-S)					
			201	202	203	204	205	206
Chromium	800	800	38	107	26	60	36	25
Cobalt	300	300	12	135	18	14	12	18
Copper	-	500	30	492	39	40	28	48
Lead	-	1000	106	**2090**	**1720**	110	277	378
Mercury	10	10	0.016	0.034	0.041	0.022	0.024	0.018
Molybdenum	40	40	< 4	26	< 4	< 4	< 4	< 4
Nickel	500	500	23	116	32	38	23	113
Selenium	10	10	< 50	< 50	< 50	< 50	< 50	< 50
Silver	40	40	< 2	32	16	5	4	5
Tin	300	300	< 30	83	< 30	< 30	< 30	< 30
Vanadium	-	-	49	64	26	70	35	31
Zinc	-	1500	180	**4460**	1100	134	568	333
PAHs (each)	10	10	n.a.	n.a.	n.a.	n.a.	< 0.5	n.a.
Extractable Organic Halides (indicator)	-*	-*	n.a.	n.a.	< 1.5	6.5	63.0	n.a.

- no criteria exist
-* as an indicator of other parameters only
n.a. no assay performed

5.4 SURFACE WATER QUALITY

Water samples were collected from the Adit 1 discharge, VE-WQ-A101, and from Adit 2, VE-WQ-A102. The water discharging from Adit 1 seeps into the ground within 10 m of the adit entrance. It reappears as a groundwater spring approximately 100 m below the waste rock dump at the mine access road, sample VE-WQ-S101 was collected here. Sample VE-WQ-S301 was collected from a spring along the same drainage path as it was exposed by the road cut for the South Klondike Highway. The water was flowing at a rate of 1 L/sec or less (visual estimate) from both springs.

The water discharging from Adit 2 enters a culvert inside the adit's entrance which then discharges from a 300 mm pipe, 40 m southeast of the adit, onto the waste rock pile. Sample VE-WQ-A102 was collected at the discharge pipe. The water was sampled again further downstream where it was exposed by the road cut for the South Klondike Highway, VE-WQ-S201. The water was flowing at approximately 5 L/sec (visual estimate) at both sample locations.

Field pH values for the adit discharge water were 8.8 (VE-WQ-A101) and 8.6 (VE-WQ-A102). Laboratory conductivity readings were 323 μS/cm and 439 μS/cm respectively. Arsenic concentrations in both samples were above CCME freshwater aquatic life criteria. The discharge from Adit 1, VE-WQ-A101, also exceeded CCME freshwater aquatic life criteria for iron and zinc.

The seep below the Adit 1 waste rock pile, VE-WQ-S101, had a field pH value of 8.3 and its laboratory conductivity reading was 230 μS/cm. Arsenic concentrations exceeded the CCME freshwater aquatic life criteria.

Water samples were collected further downstream along the adits discharge drainage paths at their intercept with the South Klondike Highway. VE-WQ-S301, collected below Adit 1, had a field pH value of 7.7 and a laboratory conductivity of 440 μS/cm. Sample VE-WQ-S201, collected below Adit 2, had a field pH of 8.4 and a laboratory conductivity of 350 μS/cm. Concentrations of arsenic, iron and zinc exceed the CCME freshwater aquatic life criteria.

Method detection limits for arsenic, cadmium, lead, nickel, selenium and silver were above the freshwater aquatic life criteria established by CCME.

Table 8: Surface Water Samples - Significant Results

Sample ID	Sample Location	pH	Conductivity (μS/cm)	Metals
VE-WQ-A101	Adit 1 discharge	8.8	323	arsenic, iron, zinc
VE-WQ-S101	Groundwater spring ~ 100 m below Adit 1	8.3	230	arsenic
VE-WQ-S301	Groundwater discharge at highway bank cut line below Adit 1 discharge	7.7	440	low
VE-WQ-A102	Discharge pipe 40 m below Adit 2	8.6	439	arsenic
VE-WQ-S201	Groundwater discharge at highway bank cut line below Adit 2	8.4	350	arsenic, iron, zinc

5.5 WASTE ROCK DISPOSAL AREAS

The mines along the Venus vein have produced approximately 84,000 tonnes of ore during three separate periods: 1904 to 1916, 1966 to 1971, and 1978 to 1984 (Stubens, T.C., 1988). The volume of waste rock produced from the underground workings is in the order of 50,000 tonnes.

The waste rock has been side cast from rail cars along the edge of Montana Mountain in front of Adit 1 and Adit 2, as shown on the site maps. Adit 1 corresponds to the 2700 Level (825 m) adit driven in 1966 and Adit 2 corresponds to the 2600 Level (790 m) adit driven in the same time period. Smaller waste rock piles, in the order of a few hundred tonnes, are located at up to ten adits and shafts that were excavated along the Venus vein between 1900 and 1920 to the north and west of the workings investigated. The 2900 Level (885 m) adit, located between the 2700 Level (825 m) and 2600 Level (790 m) adits, appears to have been used in the 1960's and 1980's, as does an inclined raise above the 2600 Level (790 m) adit.

The barren waste rock consists of andesite. Sections of the waste rock piles that contain mineralized quartz vein material exhibit yellow coloured staining or whitish precipitates and black manganese oxides on the surface. The distribution of the secondary mineralization is shown on the site maps.

Fifteen pits were dug in the waste rock and twenty samples were collected for analysis. Results of these analyses are presented in Appendix C and summarized in Table 9.

The sample locations are shown on the site maps, except sample VE-WR-P201 which was collected at the headframe several metres above Adit 2. Samples VE-WR-P201, P301/1, P301/2, P302, P304/1, P304/2, P305, P306/1, P308/1, P308/2, P309, P311, P312/1 and P312/2 were collected from mineralized waste rock that generally contained some quartz vein material. Samples were collected of the relatively unaltered and unmineralized waste rock, and include VE-WR-P303, P310, P313 and P314. VE-WR-P307 is a sample of weathered bedrock from the surface, which has been used to seal the 2900 Level (885 m) adit. Samples VE-WR-P306/1, P306/2, P307 and P309 were collected from the waste rock below the 2900 Level (885 m) adit and samples VE-WR-P308/1 and P308/2 were collected at the inclined raise above Adit 2.

Three of the samples collected from the mineralized waste rock below Adit 1 have laboratory paste pH values ranging from 3.6 to 5.3, indicating that this material is currently generating acid. The paste pH values of the remaining mineralized samples ranged from 6.7 to 8.1, indicating that this material is not currently generating acid. The paste pH values of the relatively unmineralized material were alkaline and ranged from 8.3 to 8.8.

All of the samples of mineralized waste rock have Neutralization Potential to Acid Potential (NP:AP) ratios below 2.8, suggesting that all of the mineralized waste has the potential to become acid generating. The unmineralized waste rock, except sample P303, has NP:AP ratios between 5.6 and 14.4, indicating that this material has a low potential to generate acid. Sample P303 has an NP:AP ratio of 2.2, suggesting that the unmineralized portion of the Adit 1 dump has the potential to generate acid along with the mineralized material.

The samples collected from the unmineralized material contained generally low metal concentrations with the exception of moderately elevated cadmium levels in samples P303, P306/2, and P307. The mineralized material generally contained elevated concentrations of arsenic, cadmium, lead and silver.

An assessment of the acid rock drainage and metal leaching potential of the waste rock at the Venus mine site has been completed by Steffen Robertson and Kirsten consulting Engineers and is included in Appendix A.

Table 9: Summary Acid/Base Accounting Test Results

Sample #	Paste pH	Total S (%)	SO_4 (%)	AP	NP	Net NP	NP/AP
VE/WR/P201	7.29	1.19	0.24	29.69	84.75	55.06	2.85
VE/WR/P301/1	7.97	1.67	0.12	48.44	43.00	-5.44	0.89
VE/WR/P301/2	5.09	3.27	0.34	91.56	5.00	-86.56	< 0.1
VE/WR/P302	7.58	1.58	0.16	44.38	52.19	7.81	1.18
VE/WR/P303	8.29	0.35	-	10.94	24.50	13.56	2.24
VE/WR/P304/1	3.62	3.14	0.30	88.75	-6.81	-95.56	< 0.1
VE/WR/P304/2	5.26	2.47	0.42	64.06	11.88	-52.19	0.19
VE/WR/P305	6.68	4.55	0.39	130.0	33.13	-96.88	0.25
VE/WR/P306/1	7.87	0.20	-	6.25	8.81	2.56	1.41
VE/WR/P306/2	8.38	0.24	-	7.50	42.38	34.88	5.65
VE/WR/P307	8.16	0.16	-	5.00	18.25	13.25	3.65
VE/WR/P308/1	7.58	0.40	-	12.50	18.88	6.38	1.51
VE/WR/P308/2	7.55	0.12	-	3.75	0.44	-3.31	0.12
VE/WR/P309	7.03	0.82	-	25.63	7.69	-17.94	0.30
VE/WR/P310	8.84	0.19	-	5.94	85.25	79.31	14.36
VE/WR/P311	7.98	3.37	0.20	99.06	104.50	5.44	1.05
VE/WR/P312/1	8.12	2.28	0.19	65.31	55.63	-9.69	0.85
VE/WR/P312/2	7.90	6.26	0.19	189.4	46.25	-143.13	0.24
VE/WR/P313	8.41	0.14	-	4.38	37.38	33.00	8.54
VE/WR/P314	8.46	0.13	-	4.06	51.75	47.69	12.74

5.6 MINE OPENINGS AND EXCAVATIONS

Six openings were noted during the investigation including, three shallow, hand-excavated adits, two larger adits and the shaft at the North claims headframe. During a fly-over of the Vault claims, a number of mine buildings were noted and it

is assumed that there are mine openings in this area. Due to the inaccessibility of this area, the state of these could not be determined. It is also possible that other collapsed openings exist in the area of the South and North claims. The results of the mine openings investigation are shown in Table 10 below.

Table 10: Mine Openings

Adit	Location	Condition
small adit at 670 m elevation	near South Klondike Highway	partially collapsed
Adit 1 at 825 m (2700 ft) elevation	2.5 km south of Pooley Creek canyon	open
Adit 2 at 790 m (2600 ft)	2 km south of Pooley Creek canyon	open; door installed (lock broken)
small hand-excavated adit at 855 m (2800 ft) elevation	north of Adit 2 & south of headframe	collapsed
small hand-excavated adit at 885 m (2900 ft) elevation	north of Adit 2 & south of headframe	collapsed
headframe at 960 m (3150 ft) elevation	750 m north of Adit 2	open; headframe in poor condition
Vault Claims adits and shafts	Pooley Canyon	unknown; not investigated

5.7 TAILINGS

The tailings pond located approximately 2 km north of the site is not included in this assessment.

6.0 CONCLUSIONS

There are a large number of concerns at Venus Mine. The greatest concern is with regard to health and safety of humans and wildlife relating to the waste rock piles and contaminated water flowing from the adits. The other serious concern is with regard to the open adits, loadout facility and headframe. Aesthetic concerns are related to the numerous buildings, infrastructure, materials, debris and large volume

of waste rock remaining at the site. An additional concern is the hazardous materials contained in barrels and pails as well as the contaminated soils noted at the site. No concerns were noted at the Vault claims.

6.1 HEALTH AND SAFETY

Most of the adits, buildings, loadout structure, trestles, retaining walls and headframe are unstable and present a significant health and safety hazard to humans at the site. Currently the retaining wall and load out structure have their structural integrity intact, however, both structures will eventually fail. Failure of either structure is expected to release waste rock down-slope onto the highway creating a safety hazard.

This investigation, and others has shown water quality from the adits to have elevated concentrations of arsenic. Elevated concentrations of zinc and iron were also noted below the site. A number of communities in the area, including Whitehorse, receive drinking water from this lake, however, further study is required to determine what impact Venus mine has on the water quality in Tagish Lake.

There is also a health and safety concern with regard to adit water flowing across the highway in winter and causing a stretch of icy road below the mine workings.

6.2 ENVIRONMENTAL RISKS

The waste rock below Adit 1 contained small patches of fine grained mineralized material that has oxidized and has an acidic pH. The remaining waste rock below Adit 1 is not currently acid generating, however, it has the potential to become acid generating. The waste rock and the water discharging from Adit 1 and seeping through the waste rock pile contain elevated concentrations of arsenic that are likely adversely impacting the receiving environment.

The mineralized waste rock below Adit 2 is not currently generating acid, however, it has the potential to become net acid generating. Moderate to high conductivity measurements indicate that oxidation is occurring in some of the waste rock. The material has been exposed for 12 to 35 years without generating acidic drainage, indicating that the sulphides in the waste react slowly. Leaching of arsenic and soluble metals from the waste rock appears to be occurring. The seep sample collected below the waste rock at the highway contains a higher concentration of iron than the Adit 2 discharge water, indicating that mine waste rock is leaching iron.

The waste rock piles at the old headframe north of Adit 2, below the 2900 Level adit and at the inclined raise has the potential to become acid generating, however, the volume of the material is small, as is the catchment area above the rock piles. It is therefore considered unlikely that this material is significantly impacting the receiving environment.

Adit discharge water quality has been included in the Human Health and Safety section, however, water quality issues may also be considered environmental concerns.

Samples were collected from six locations at the site. Concentrations of priority compounds were noted above criteria in all samples, however metal contaminants were noted in concentrations similar to waste rock samples and are considered background concentrations. Additional contaminants above criteria are limited to total petroleum hydrocarbons in two samples. Based on the lack of sensitive receptors in the area and the relatively small volume of contaminant these areas should be allowed to remediate by natural attenuation.

6.3 AESTHETIC CONCERNS

The large volume of equipment and infrastructure, as well as the waste rock presents an aesthetic concern, particularly due to the site's close proximity to the South Klondike Highway immediately east of the site.

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 a detailed water quality assessment be initiated to determine background water quality at the site and impacts the mine discharge water may be having on Windy Arm of Tagish Lake.

Recommendation 2.

It is recommended that additional water quality and hydrology data previously collected by Environment Canada, DIAND and the claim holder be compiled and a monitoring program and remediation plan be designed based on this data as well as the detailed water quality assessment proposed in Recommendation 1.

Recommendation 3.

It is recommended that Adits 1 & 2 and the raise at the headframe be sealed and the headframe dismantled and burned and the ashes buried at the site. The other three small adits should be collapsed.

Recommendation 4.

It is recommended that all the buildings at the site be demolished and burned and the ashes buried within waste rock located at the site.

Recommendation 5.

It is recommended that the loadout facility be dismantled, wastes removed from the site and the area re-contoured to suit natural topography. All debris noted at the site, including a large volume of metal debris should also be removed from the site.

Recommendation 6.

It is recommended that a program be undertaken to peridiocally monitor the stability of the waste rock piles, as well as the structural integrity of the retaining walls.

Recommendation 7.

It is recommended that the barrels and pails containing petroleum hydrocarbons be removed from the site and their contents incinerated.

Recommendation 8.

It is recommended that the core samples remaining at the site be disturbed as little as possible and left for use by the current site claim holder.

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APPENDIX A

DETERMINATION OF ACID ROCK DRAINAGE POTENTIAL

P118105

VENUS
ACID ROCK DRAINAGE
ASSESSMENT REPORT

TABLE OF CONTENTS

1.0 INTRODUCTION O-1

2.0 GEOLOGY AND MINERALIZATION O-2

3.0 WASTE ROCK DISPOSAL AREAS O-2
- 3.1 Description O-2
- 3.2 Sampling O-3
- 3.3 Analytical Results O-4

4.0 EXISTING OR POTENTIAL ACID ROCK DRAINAGE CONDITIONS O-6

5.0 REMEDIATION OPTIONS O-7

6.0 CONCLUSIONS AND RECOMMENDATIONS O-9
- 6.1 Conclusions O-9
- 6.2 Recommendations O-10

7.0 REFERENCES O-11

LIST OF TABLES

TABLE 1 Venus Waste Rock Sample Descriptions O-12

TABLE 2 Venus Waste Rock Sample ABA and ICP Results O-14

TABLE 3 Venus Water Quality Results O-16

SITE MAP

P118105

VENUS
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 Venus Abandoned Mine Site*, prepared by Environmental Services, Public Works and Government Services Canada (PWGSC). As part of the Phase II assessment prepared by PWGSC, Steffen Robertson and Kirsten (SRK) was requested to assess the potential for acid rock drainage associated with the site, which is the subject of this report. The reader is directed to the PWGSC report for a comprehensive environmental assessment of the Venus site.

This report assesses existing, and potential acid rock drainage (ARD) conditions at the Venus 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 SRK, which includes similar assessments for a number of sites. The reader is directed to that report for details regarding the scope of work, site assessment methodology, ARD remediation options, and the evaluation of potential remediation options.

The Venus Mine is located on a steep slope above Windy Arm of Tagish Lake approximately 2.5 kilometres north of the Yukon / British Columbia boundary and 22 km south of the village of Carcross, YT. The underground workings and waste rock are located on the western slope of Montana Mountain between Dail Peak and Pooly Creek. Underground workings extend over a 2 km strike length along the northwest side of the Klondike Highway from Pooly Creek south to the junction of the mine access road with the highway.

Mine related disturbances observed during the site assessment consist of: several adits, two of which were being used in the 1980's; waste rock piles; a covered shaft at an old headframe (circa 1910) north of the more recent workings; ore loadout ramps; access roads along the mountain; and, a tailings pond and remnants of a mill and crushing plant on the shore of Windy Arm. The tailings pond, mill and crushing plant are not included in this assessment.

2.0 GEOLOGY AND MINERALIZATION

Approximately 20 polymetallic, gold-bearing quartz veins are hosted in rock of the mid-Cretaceous Montana Mountain volcanic complex and Montana pluton along an eight km, northwest trending belt between Windy Arm and Brute Mountain.

The Venus deposit is a gold-silver-lead-zinc bearing quartz vein hosted in the Montana Mountain volcanic complex. The vein has been intruded along a zone of weakness which is the contact between porphyritic andesite to the south and a felsic dike to the north. The Venus vein is a simple, banded fissure-filling containing quartz, arsenopyrite (FeAsS), pyrite (FeS_2), galena (PbS), and sphalerite ((Zn, Fe)S) (Stubens, T.C., 1988).

3.0 WASTE ROCK DISPOSAL AREAS

3.1 Description

The mines along the Venus vein have produced approximately 84,000 tonnes of ore during three separate periods: 1904 to 1916, 1966 to 1971, and 1978 to 1984 (Stubens, T.C., 1988). The volume of waste rock produced from the underground workings is in the order of 50,000 tonnes. The assumptions made to derive this estimate are:

- a specific gravity of 2.65;
- a total of 3700 metres of lateral development; and,
- mine opening 2.0 metres by 2.5 metres.

The waste rock has been side cast from rail cars along the edge of Montana Mountain in front of Adit No.1 and Adit No. 2, as shown on the site maps. Adit No.1 corresponds to the 2700 Level adit driven in 1966 and Adit No.2 corresponds to the 2600 Level adit

driven in the same time period. Smaller waste rock piles, in the order of a few hundred tonnes, are located at up to ten adits and shafts that were excavated along the Venus vein between 1900 and 1920 to the north and west of the workings investigated. The 2900 Level adit, located between the 2700 Level and 2600 Level adits, appears to have been used in the 1960's and 1980's, as does an inclined raise above the 2600 Level adit.

The barren waste rock consists of porphyry andesite which generally has an orange/brown stain to its surface. Sections of the waste rock piles that contain mineralized quartz vein material exhibit yellow coloured staining or whitish precipitates and black manganese oxides on the surface. The distribution of the secondary mineralization is shown on the site maps.

3.2 Sampling

Fifteen pits were dug in the waste rock and twenty samples were collected for analysis. The sample locations are shown on the site maps, except sample VEWR/P201 which was collected at the headframe several metres above Adit No.2. Summaries of the test pit logs are provided in Table 1.

Samples VEWR/P201, P301/1, P301/2, P302, P304/1, P304/2, P305, P306/1, P308/1, P308/2, P309, P311, P312/1 and P312/2 were collected from mineralized waste rock that generally contained some quartz vein material.

Samples were also collected of the relatively unaltered and unmineralized waste rock, and include VEWR/P303, P310, P313 and P314. VEWR/P307 is a sample of weathered bedrock from the surface, which has been used to seal the 2900 Level adit.

Samples VEWR/P306/1, P306/2, P307 and P309 were collected from the waste rock below the 2900 Level adit, and samples VEWR/P308/1 and P308/2 were collected at the inclined raise above Adit No.2.

Water samples were collected from the discharge from Adit No.1 (VEWQ/A101) and from Adit No.2 (VEWQ/A102). The water discharging from Adit No.1 seeps into the ground within 10 metres of the adit entrance. It reappears as a groundwater spring approximately 100 metres below the waste rock dump at the mine access road; sample

VEWQ/S101 was collected here. Sample VEWQ/P301 was collected from a spring along the same drainage path, downstream of S101, where it was exposed by the road cut for the Klondike Highway. The water was flowing at a rate of <1 L/sec (visual estimate) from both springs.

The water discharging from Adit No.2 enters a culvert inside the adit's entrance which then discharges from a 300mm pipe, 40 metres southeast of the adit, onto the waste rock pile. Sample VEWQ/A102 was collected at the discharge pipe. The water was sampled again further downstream where it was exposed by the road cut for the Klondike Highway, VEWQ/S201. The water was flowing at 5 L/sec (visual estimate) at both sample locations.

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

Three of the samples collected from the mineralized waste rock below Adit No.1 have laboratory paste pH values ranging from 3.6 to 5.3, indicating that this material is currently generating acid. The paste pH values of the remaining mineralized samples ranged from 6.7 to 8.1, indicating that this material is not currently generating acid.

The paste pH values of the relatively unmineralized material were alkaline and ranged from 8.3 to 8.8.

Acid Base Accounting

All of the samples of mineralized waste rock have Neutralization Potential to Acid Potential (NP:AP) ratios below 2.8, suggesting that all of the mineralized waste has the potential to become acid generating. Most of the unmineralized waste rock samples had NP:AP ratios between 5.6 and 14.4, indicating that this material has a low potential to generate acid. An exception is sample P303, which was collected from the relatively unmineralized waste rock dump below Adit No.1. It had an NP:AP ratio of 2.2, which

suggests that the unmineralized portion of the Adit No.1 dump may also have the potential to generate acid along with the mineralized material.

Metals Concentrations

The samples collected from the unmineralized material contained generally low metal concentrations with the exception of moderately elevated cadmium levels in samples P303 (31.7 ppm), P306/2 (30.9 ppm), and P307 (20.8 ppm).

The mineralized material generally contained arsenic (>10000 ppm) and cadmium (>100 ppm) concentrations above the method detection limit. Silver concentrations ranged from 183.3 ppm to 15.5 ppm (mean about 100 ppm). Samples P201 (>10000 ppm), P301/2 (7895 ppm), P304/1 (>10000 ppm), P304/2 (8389 ppm), P305 (>10000 ppm), P308/1 (>10000 ppm), P309 (>10000 ppm), and P311 (7988 ppm) also contained elevated concentrations of lead.

Water Quality

Field pH values for the adit discharge water were 8.8 (VEWQ/A101) and 8.6 (VEWQ/A102). Laboratory conductivity readings were 323 μS/cm and 439 μS/cm respectively. Arsenic concentrations in both samples were above CCME freshwater aquatic life criteria. The discharge from Adit No.1, VEWQ/A101, also exceeded CCME freshwater aquatic life criteria for iron (0.35 ppm) and zinc (0.184 ppm), and the concentration of arsenic (0.5 ppm) was equivalent to the Metal Mine Liquid Effluent (MMLE, 1977) discharge criteria.

The seep below the Adit No.1 waste rock pile, VEWQ/S101, had a field pH value of 8.3 and its laboratory conductivity reading was 230 μS/cm. Arsenic concentrations (0.2 ppm) exceeded the CCME freshwater aquatic life criteria.

Water samples were collected further downstream along the adits discharge drainage paths at their intercept with the Klondike Highway. VEWQ/S301, collected below Adit No.1, had a field pH value of 7.7 and a laboratory conductivity of 440 μS/cm and met the MMLE discharge criteria. Sample VEWQ/S201, collected below Adit No.2, had a field pH of 8.4 and a laboratory conductivity of 350 μS/cm. Concentrations of arsenic (0.3 ppm), iron (0.28 ppm) and zinc (0.038) exceed the CCME freshwater aquatic life criteria.

Method detection limits for arsenic, cadmium, lead, nickel, selenium and silver were above the freshwater aquatic life criteria established by CCME.

4.0 EXISTING OR POTENTIAL ACID ROCK DRAINAGE CONDITIONS

The waste rock below Adit No.1 contained small patches of fine grained mineralized material that has oxidized and formed hardpan (welded). This material has an acidic paste pH. The remaining waste rock below Adit No. 1 is not currently generating acid; however, the ABA test results indicate it has the potential to become acid generating. The waste rock, and the water discharging from Adit No.1 and seeping through the waste rock pile contains elevated concentrations of arsenic.

Paste pH measurements suggest that the mineralized waste rock below Adit No.2 is not currently generating acid; however, ABA test results indicate it has the potential to become net acid generating. Moderate to high conductivity measurements indicate that oxidation is occurring in some of the waste rock, and acidity produced is being buffered by available Neutralizing Potential (NP). The material has been exposed for 12 to 35 years without generating acidic drainage, indicating that the sulphides in the waste react slowly. The leaching of arsenic and other soluable metals from the waste rock appears to be occurring. The seep sample collected below the waste rock at the highway contains a higher concentration of iron than the Adit No.2 discharge water, indicating that mine waste rock is leaching iron.

The waste rock piles at the old headframe north of Adit No.2, below the 2900 Level adit and at the inclined raise has the potential to become acid generating; however, the volume of the material is small, as is the catchment area above the rock piles. It is therefore considered unlikely that this material is significantly impacting the receiving environment.

The results of this assessment indicate that acid generation and metal leaching from the waste rock is a potential concern at the Venus Mine site. Metals of concern are arsenic and zinc. Cadmium, lead and silver may also be a concern (as they are present in the waste rock), but the method detection limits in the water quality analyses were to high to confirm this.

5.0 REMEDIATION OPTIONS

Typical reclamation and control options for acid generating mine waste and mine openings include:

- source control which includes limiting further oxidation, for instance, by placing the waste under water thus preventing oxygen entry;
- migration control which limits the mobility of oxidation products, for example, by reducing infiltration to the waste by placing a low permeability cover; and,
- release control by collecting and treating contaminated flows prior to discharge.

Covering the waste rock at the Venus Mine site was not considered a feasible control option, because the piles can not be resloped due to the steepness of the site and the location of the Klondike Highway directly below the waste dumps.

Relocating the waste rock to a more level site where it could then be covered and/or relocating part of the material underground is possible. This option is compared with collecting and treating the site discharge and leaving the site "as is" in the following table.

Regardless of which option is chosen, the mineralized waste rock should not be used to seal of the adits. Placing more mineralized material in the path of the adit discharge water could increase the amount of metal leached. Unmineralized waste rock would be more suitable for backfilling the adits.

The Venus site is visited by tourists on a regular basis. The public is exposed to a health and safety risks from the unstable slopes of the waste rock piles, as well as from the water quality of the discharging from the site. Signs are in place along the highway notifying the public not to drink the water. Relocating the waste rock would reduce the safety risk caused by the steep waste rock piles. Collecting and treating the site drainage to decrease the arsenic and metal concentrations would reduce the health risk to the general public.

Matrix for Evaluating Applicable/Potential Remediation

Option versus Evaluation Criteria	Venus			
	Collect and Treat	**Relocate**	**Cover**	**Do Nothing**
Public Health and Safety 5 = provides full protection of public 1 = provides no protection of public	4	3	not applicable	1
Worker Health and Safety 5 = relative low risk to workers 1 = high risk to workers	3	2	not applicable	5
Ecosystem Preservation and Protection 5 = relative low risk to environment 1 = relative high risk to environment	4	3	not applicable	1
Impact on Mineral Resource 5 = allows for continued exploration 1 = impedes continued exploration	5	3	not applicable	4
Direct Costs (mobilization & materials) 5 = relative low cost 1 = relative high cost	1	2	not applicable	5
Monitoring and Maintenance Costs 5 = relative low cost 1 = relative high cost	1	3	not applicable	2
Acceptability 5 = positive response anticipated 1 = negative response anticipated	2	4	not applicable	2
Total Score	**20**	**20**	**0**	**20**

Relocating the waste rock represents a moderately high risk to workers because of the steep slopes on which machine would be required to move about. This safety risk is increased if the material is to be relocated underground.

The limited water quality data suggest that the receiving environment maybe being impacted by the waste rock and mine discharge water. Collecting and treating the site drainage would effectively reduce the risk to the environment and relocating the material and decreasing the amount of water moving through the waste rock would moderately reduce the risk to the environment.

Continued exploration and development of the Venus site would not likely be adversely impacted if a water treatment facility were established. Relocating the waste rock to the underground workings would adversely effect future exploration and development at the site if the workings were rendered inaccessible to heavy equipment. Doing nothing to remediate the site has a negative impact on future development because of the potential liability associated with the sites impact on the environment.

The costs associated with constructing a water treatment facility or relocating the waste rock to a new site are considerably higher than doing nothing at the site. Maintenance of the facility and any cover would be required. Monitoring of the receiving environment would be required regardless of the remediation option chosen.

Constructing a costly water treatment facility would likely receive as negative a response from the public as doing nothing to protect the public and the environment.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The water quality samples collected from Adits 1 and 2 indicate that metals, including arsenic and zinc, are being leached from the underground workings and discharged to the surface receiving environment. It is likely that the waste rock is also leaching metals, though this is not obvious from the water quality sampling results.

Although the ABA test results indicate that much of the waste rock on surface may have the potential to generate acid, the water quality results, both for direct adit discharge and after passing through the waste rock piles, is not generally typical of ARD. Acidities are low and pH's high. Sulphate and iron concentrations are also relatively low. Most of the surface rock and underground development is over 30 years old. Any acid generation that is occurring appears to be occurring slowly without overwhelming the available neutralizing potential. Nonetheless, metal leaching is still a concern, regardless of whether or not acid is generated .

While metal leaching is recognized as a concern at the Venus site, the data available for this assessment is insufficient to determine the relative metal loads from the underground

discharge and from the surface waste rock. Nor is there sufficient information to assess what impact these metal loads are having on Windy Arm, and downstream receiving waters.

6.2 Recommendations

A more detailed site assessment is required to assess the impacts of the waste rock and the mine discharge water in order to develop an effective remediation and monitoring plan.

The following information is required to assess the site more fully:

- discharge rates from the adits;
- historical precipitation records;
- catchment areas above the mine workings;
- areal extent of waste rock on surface;
- water quality of seeps emanating from the waste rock piles during spring freshet and following heavy rainfall events;
- receiving water quality data; and,
- additional impact assessment data, such as sediment and benthic samples results.

Monitoring of the stability of the waste rock piles should be undertaken regularly and a surface drainage ditch be constructed at Adit No.2 to divert water from the culvert buried beneath the waste rock. A drainage ditch should also be constructed at Adit No.1, to reduce the potential for erosion and the volume of water flowing through the waste rock.

The mineralized waste rock should not be placed in contact with flowing water from the underground workings.

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TABLE 1 Venus Waste Rock Sample Descriptions

Sample ID	Sample Location and Description
VEWR/P201	Grab sample of waste rock below the old headframe north of Adit No. 2.
VEWR/P301/1	Sample collected below Adit No.1 from material exhibiting a yellowish stain. Sample collected over a thickness of 14 cm in quartz vein material crushed to 1 to 5 cm. Sand was a buff yellow in colour. The field paste pH was 6.1 and the conductivity 880 μS/cm.
VEWR/P301/2	Sample collected beneath P301/1 over a thickness of 16 cm in material crushed to less than 2 cm that was altered to an orange colour. A layer of welded material existed at the top of the horizon.
VEWR/P302	Sample collected below Adit No.1 from material that was weathered to an orange/brown colour. Sample collected over a thickness of 30 cm at the base of part of the pile. 10% was quartz vein material and 80% silicified wall rock, <5 cm in diameter.
VEWR/P303	Sample collected below Adit No.1 of typical unaltered waste rock, andesite. Sample collected over a thickness of 25 cm in crushed wall rock <5 cm in diameter.
VEWR/P304/1	Sample collected below Adit No.1 from crushed welded ore containing 5% visible sulphides. The material was yellow in colour over 55 cm. The field paste pH was 3.4 and the conductivity 370 μS/cm.
VEWR/P304/2	Sample collected beneath P304/1 over a thickness of 15 cm from in reddish coloured crushed welded ore containing 10% visible sulphides.
VEWR/P305	Sample collected below Adit No. 1 from material that exhibited whitish secondary mineralization and manganese oxides on the surface. The sample was collected over a thickness of 20 cm in crushed waste rock <2 cm that red/orange lenses and yellow lenses of weathered rock. The field paste pH was 5.7 and the conductivity >1990 μS/cm.
VEWR/P306/1	Sample collected at crest of dump below the 2900 Level adit. Sample collected over 22 cm from sand and gravel size crushed mineralized rock overlying organics. Material was dark red/brown in colour.
VEWR/P306/2	Sample collected beneath P306/1 over a thickness of 20 cm. Material was rusty orange in colour and contained crushed mineralized rock similar to that found above the layer of organics.

Sample ID	Sample Location and Description
VEWR/P307	Sample collected from rock pile in front of 2900 Level adit over a thickness of 50 cm. The size of the angular fragments increased with depth up to 25 x 30 cm. The rock was derived from weathered bedrock beside the adit.
VEWR/P308/1	Sample collected from small pile in front of raise (3100 Level) above Adit No.2.The upper 20 cm was yellow/brown in colour and contained quartz vein material <5 cm on a thin layer of organics.
VEWR/P308/2	Sample collected beneath P308/1 over a thickness of 20 cm. Material collected orange /brown coloured gossan. Material consisted of sand and gravel that was <1 cm in diameter.
VEWR/P309	Grab sample collected at toe of dump below 2900 Level adit from buff red/brown coloured sand and gravel size material.
VEWR/P310	Sample collected below Adit No.2 in typical unaltered waste rock. The sample was collected over a thickness of 30 cm from 25% sand, 40% gravel and 35% cobbles of angular green/grey wall rock. Field paste pH was 7.7 and conductivity 510 μS/cm.
VEWR/P311	Sample collected below Adit No.2 from mineralized waste rock consisting of 50% sand, 20% gravel and 30% rusty brown cobbles containing pyrite. Field paste pH was 7.1 and conductivity >1990 μS/cm.
VEWR/P312/1	Sample collected below Adit No.2 from material that was yellow/brown up to 20 cm beneath the surface. Field paste pH was 7.9 and conductivity 480 μS/cm.
VEWR/P321/2	Sample collected beneath P312/1 over a thickness of 14 cm and consisted of grey clay and silt surrounding subrounded cobbles up to 25 cm.
VEWR/P313	Sample collected below Adit No.2 over a thickness of 25 cm in red/brown coloured sand and gravel, with cobbles up to 10 cm in diameter. Field paste pH was 8.1 and conductivity 310 μS/cm.
VEWR/P314	Sample collected below Adit No.2 in typical brown and grey coloured waste rock consisting of 50% sand and 50% gravel angular fragments up to 5 cm over a thickness of 30 cm. Paste conductivity was 330 μS/cm.

TABLE 2 Venus Waste Rock ABA and ICP Results

Parameter	Unit	Sample Number VEWR									
		P201	P301/1	P301/2	P302	P303	P304/1	P304/2	P305	P306/1	P306/2
Field Paste pH		na	6.07	na	na	na	3.38	na	5.74	na	na
Field Cond	uS/cm	na	880.00	na	na	na	370.00	na	>1990	na	na
Lab Paste pH		7.29	7.97	5.09	7.58	8.29	3.62	5.26	6.68	7.87	8.38
Total Sulfur	%	1.19	1.67	3.27	1.58	0.35	3.14	2.47	4.55	0.20	0.24
Sulfate	%	0.24	0.12	0.34	0.16	na	0.30	0.42	0.39	na	na
AP		29.69	48.44	91.56	44.38	10.94	88.75	64.06	130.00	6.25	7.50
NP		84.75	43.00	5.00	52.19	24.50	-6.81	11.88	33.13	8.81	42.38
NET NP		55.06	-5.44	-86.56	7.81	13.56	-95.56	-52.19	-96.88	2.56	34.88
NP/AP		2.85	0.89	<0.1	1.18	2.24	<0.1	0.19	0.25	1.41	5.65
Aluminum	%	0.36	0.44	0.24	0.55	0.47	0.18	0.30	0.28	0.57	0.66
Antimony	ppm	207	21	77	18	7	92	62	90	30	14
Arsenic	ppm	>10000	>10000	>10000	9729	2057	>10000	>10000	>10000	5208	1862
Barium	ppm	69	60	95	72	142	36	49	85	161	133
Beryllium	ppm	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	ppm	<1	<1	14	<1	<1	<1	<1	7	<1	<1
Cadmium	ppm	>100	>100	>100	>100	31.7	>100	>100	>100	>100	30.9
Calcium	%	1.79	1.61	0.70	2.43	1.32	0.16	1.06	1.58	0.66	2.26
Chromium	ppm	79	107	94	91	76	128	127	108	62	81
Cobalt	ppm	13	11	11	11	8	7	10	15	17	11
Copper	ppm	251	34	49	25	13	12	25	64	135	81
Gallium	ppm	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Iron	%	5.10	3.67	6.08	3.68	2.62	5.16	4.38	6.35	4.46	3.32
Lead	ppm	>10000	3790	7895	3100	437	>10000	8389	>10000	3752	1141
Lithium	ppm	2	4	<1	6	3	<1	<1	2	4	6
Magnesium	%	0.47	0.60	0.20	0.76	0.22	0.02	0.29	0.42	0.26	0.32
Manganese	ppm	1258	830	484	1150	485	48	538	1413	1973	1399
Molybdenum	ppm	16	12	18	13	11	16	15	19	16	12
Nickel	ppm	35	30	22	28	13	15	27	32	37	26
Potassium	%	0.13	0.14	0.13	0.20	0.19	0.14	0.16	0.18	0.20	0.22
Phosphate	ppm	930	910	660	890	840	110	570	730	1170	1130
Silver	ppm	183.3	36.3	172.2	37.0	3.7	107.4	80.8	117.5	35.4	12.0
Sodium	%	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	ppm	379	101	90	165	52	33	80	123	104	72
Thorium	ppm	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tin	ppm	3	2	4	3	2	3	3	4	2	2
Titanium	%	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tungsten	ppm	2	6	7	5	3	7	13	18	4	4
Uranium	ppm	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Vanadium	ppm	8.3	8.0	3.3	9.3	7.0	<0.1	3.8	4.0	10.3	11.7
Zinc	ppm	1411	1687	3176	2125	617	2420	5128	9222	2071	1085

AP = Acid Potential in tonnes $CaCO_3$ equivalent per 100 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 2 Venus Waste Rock ABA and ICP Results

Parameter	Unit	Sample Number VEWR									
		P307	P308/1	P308/2	P309	P310	P311	P312/1	P312/2	P313	P314
Field Paste pH		na	na	na	na	7.73	7.08	7.94	na	8.09	na
Field Cond	uS/cm	na	na	na	na	510	>1990	480	na	310	330
Lab Paste pH		8.16	7.58	7.55	7.03	8.84	7.98	8.12	7.90	8.41	8.46
Total Sulfur	%	0.16	0.40	0.12	0.82	0.19	3.37	2.28	6.26	0.14	0.13
Sulfate	%	na	na	na	na	na	0.20	0.19	0.19	na	na
AP		5.00	12.50	3.75	25.63	5.94	99.06	65.31	189.38	4.38	4.06
NP		18.25	18.88	0.44	7.69	85.25	104.50	55.63	46.25	37.38	51.75
NET NP		13.25	6.38	-3.31	-17.94	79.31	5.44	-9.69	-143.13	33.00	47.69
NP/AP		3.65	1.51	0.12	0.30	14.36	1.05	0.85	0.24	8.54	12.74
Aluminum	%	0.92	0.26	0.39	0.56	2.52	0.46	0.75	0.31	1.27	2.03
Antimony	ppm	9	112	23	213	<1	53	57	69	10	<1
Arsenic	ppm	2602	>10000	6764	>10000	212	>10000	>10000	>10000	1356	742
Barium	ppm	165	103	71	120	45	67	82	50	101	82
Beryllium	ppm	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	ppm	<1	<1	<1	<1	<1	14	<1	<1	<1	<1
Cadmium	ppm	20.8	>100	>100	>100	<0.1	>100	>100	>100	<0.1	<0.1
Calcium	%	0.98	1.16	0.32	0.68	3.94	3.20	2.04	1.45	2.23	2.61
Chromium	ppm	64	91	65	88	155	59	67	73	77	74
Cobalt	ppm	17	8	5	10	20	15	15	16	15	17
Copper	ppm	47	60	91	62	38	28	35	63	115	45
Gallium	ppm	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Iron	%	3.92	4.32	3.73	4.99	4.43	5.74	5.10	8.07	3.33	3.65
Lead	ppm	1700	>10000	1188	>10000	8	7988	4424	3939	166	13
Lithium	ppm	11	2	3	9	31	4	8	3	15	22
Magnesium	%	0.57	0.12	0.12	0.28	2.35	1.13	0.92	0.46	0.95	1.78
Manganese	ppm	1829	461	117	490	911	1446	945	785	876	738
Molybdenum	ppm	15	22	16	33	15	16	16	23	13	13
Nickel	ppm	33	20	16	25	61	41	40	34	38	44
Potassium	%	0.20	0.15	0.13	0.19	0.06	0.19	0.19	0.14	0.14	0.14
Phosphate	ppm	1360	740	320	1090	1410	970	1050	530	940	1140
Silver	ppm	15.3	136.4	15.5	>200	1.6	92.8	41.9	46.9	2.9	0.9
Sodium	%	0.02	<0.01	<0.01	<0.01	0.03	<0.01	0.02	<0.01	0.02	0.02
Strontium	ppm	81	932	296	707	127	260	259	106	54	69
Thorium	ppm	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tin	ppm	3	2	2	3	4	4	3	5	2	3
Titanium	%	<0.01	<0.01	<0.01	<0.01	0.05	<0.01	<0.01	<0.01	<0.01	0.02
Tungsten	ppm	3	2	2	2	<1	<1	<1	2	<1	<1
Uranium	ppm	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Vanadium	ppm	26.5	4.1	4.0	9.3	82.5	8.7	15.1	4.9	31.8	55.3
Zinc	ppm	1506	265	793	616	77	1713	1745	3095	190	93

AP = Acid Potential in tonnes $CaCO_3$ equivalent per 100 tonnes of material

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

na = no assay / analysis

< = lower detection limit

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TABLE 3 Venus Water Quality Results

Parameter	Units	Sample Number VEWQ/				
		S101	A101	A102	S201	S301
Field Conductivity	umhos/cm	230	230	320	350	440
Field pH		8.28	8.78	8.62	8.4	7.75
Lab Conductivity	umhos/cm	339	323	439	435	569
Lab pH		7.82	7.92	8.02	8.04	7.84
Acidity (to pH 8.3) CaCO3	mg/L	4.1	1.9	2.3	1.4	5.4
Alkalinity-Total CaCO3	mg/L	123	118	173	170	189
Sulphate SO4	mg/L	57.4	48.8	72.7	72	121
Aluminum T-Al	mg/L	0.3	0.3	0.3	<0.2	<0.2
Antimony T-Sb	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic T-As	mg/L	0.2	0.5	0.3	0.3	<0.2
Barium T-Ba	mg/L	0.02	0.03	0.02	0.04	0.02
Beryllium T-Be	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Bismuth T-Bi	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Boron T-B	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium T-Cd	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium T-Ca	mg/L	49.5	46.6	49.5	44.6	84.1
Chromium T-Cr	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt T-Co	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Copper T-Cu	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Iron T-Fe	mg/L	<0.03	0.35	<0.03	0.28	<0.03
Lead T-Pb	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium T-Li	mg/L	<0.01	<0.01	0.01	0.02	<0.01
Magnesium T-Mg	mg/L	12.2	11.7	26.9	24.8	21.6
Manganese T-Mn	mg/L	<0.005	0.008	<0.005	0.031	<0.005
Molybdenum T-Mo	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03
Nickel T-Ni	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Phosphorus T-P	mg/L	<0.3	<0.3	<0.3	<0.3	<0.3
Potassium T-K	mg/L	<2	<2	<2	<2	<2
Selenium T-Se	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Silicon T-Si	mg/L	3.67	3.61	3.95	3.56	3.84
Silver T-Ag	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium T-Na	mg/L	4	4	6	5	5
Strontium T-Sr	mg/L	0.65	0.69	1.14	1.1	1.06
Thallium T-Tl	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Tin T-Sn	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03
Titanium T-Ti	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium T-V	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03
Zinc T-Zn	mg/L	<0.005	0.184	0.023	0.038	<0.005

< = lower detection limit

Steffen Robertson and Kirsten
February, 1997

APPENDIX B

SITE PHOTOGRAPHS

VENUS MINE SITES

Photographic Record

July 27, 1996

Photos	Description
	ADIT 1 - (SOUTH) - ELEVATION 2700
V.M. # 1	Storage Shack, South End - Adit 1
V.M. # 2	Ducting, Shack, Debris
V.M. # 3	Concrete Pad, Debris, Spools, Core Samples, Pipe
V.M. # 4	Core Samples
V.M. # 5	Core Samples, Retaining Wall, Duct Pipe
V.M. # 6	Large Spool
V.M. # 7	Adit No. 1
V.M. # 8	Storage Shed
V.M. # 9	Cribbing
V.M. # 10	Cribs below Shack
V.M. # 11	Water Pipe
V.M. # 12	Miscellaneous Metals
V.M. # 13	Rail
V.M. # 14	Overall View Miscellaneous Metals
	ADIT 2 - (NORTH) - ELEVATION 2500
V.M. # 15	Overall View of Lower Adit Site
V.M. # 16	Extent of Track and Pole Lines
V.M. # 17	Mixing Tank and Ventilation Building
V.M. # 18	Wood Debris by Mixing Tank
V.M. # 19	Part of Stairway and Trestle

Photos	Description
V.M. # 20	Shack on verge of toppling over Embankment
V.M. # 21	Adit No. 2
V.M. # 22	Shack and Pole Line
V.M. # 23	Retaining Wall and Toppled Shack
V.M. # 24	Storage Shed and Offloading Platform
V.M. # 25	Retaining Walls at Offloading Platform
V.M. # 26	View from Ventilation Building - Track and PVC Pipe
V.M. # 27	View from Ventilation Building - Track and Wood Debris
V.M. # 28	Pipe discharging Water
V.M. # 29	Lower Retaining Wall - Loadout Facility at Lake Bennett below
	ADIT - 2800' LEVEL
V.M. # 30	Collapsed Adit
	ADIT - 2900' LEVEL
V.M. # 31	Collapsed Adit
	HEADFRAMES
V.M. # 32	Terrain leading to Headframe
V.M. # 33	Wood Debris at Headframe
V.M. # 34	Loadout Facility at Headframe; and Trestle
V.M. # 35	Loadout Facility at Headframe
V.M. # 36	Entrance to Adit at Headframe
	MISCELLANEOUS
V.M. # 37	Detail of Adit 1
V.M. # 38	Montana Mine
V.M. # 39	Chemical Storage in Warehouse by Adit 2

Photos	Description
V.M. # 40	Chemical Storage in Warehouse by Adit 2
V.M. # 41	Three Pails containing Residual Contents located in a Storage Shed
V.M. # 42	Two 205 L Barrels containing Liquid Product
V.M. # 43	Two Phased Liquids in a Barrel near Adit 2
V.M. # 44	Culvert carrying Seep Water below Adit 2
V.M. # 45	Water flowing from Adit 1
V.M. # 46	Seep below Adit 2 at South Klondike Highway
V.M. # 47	Vault Claims Buildings



Photo # 1 - Storage Shack, South End - Adit 1



Photo # 2 - Ducting, Shack, Debris



Photo # 3 - Concrete Pad, Debris, Spools, Core Samples, Pipe



Photo # 4 - Core Samples



Photo # 5 - Core Samples, Retaining Wall, Duct Pipe



Photo # 6 - Large Spool



Photo # 7 - Adit No. 1



Photo # 8 - Storage Shed



Photo # 9 - Cribbing



Photo # 10 - Cribs below Shack



Photo # 11 - Water Pipe



Photo # 12 - Miscellaneous Metals



Photo # 13 - Rail



Photo # 14 - Overall View Miscellaneous Metals



Photo # 15 - Overall View of Lower Adit Site



Photo # 16 - Extent of Track and Pole Lines



Photo # 17 - Mixing Tank and Ventilation Building



Photo # 18 - Wood Debris by Mixing Tank



Photo # 19 - Part of Stairway and Trestle



Photo # 20 - Shack on verge of toppling over Embankment



Photo # 21 - Adit No. 2

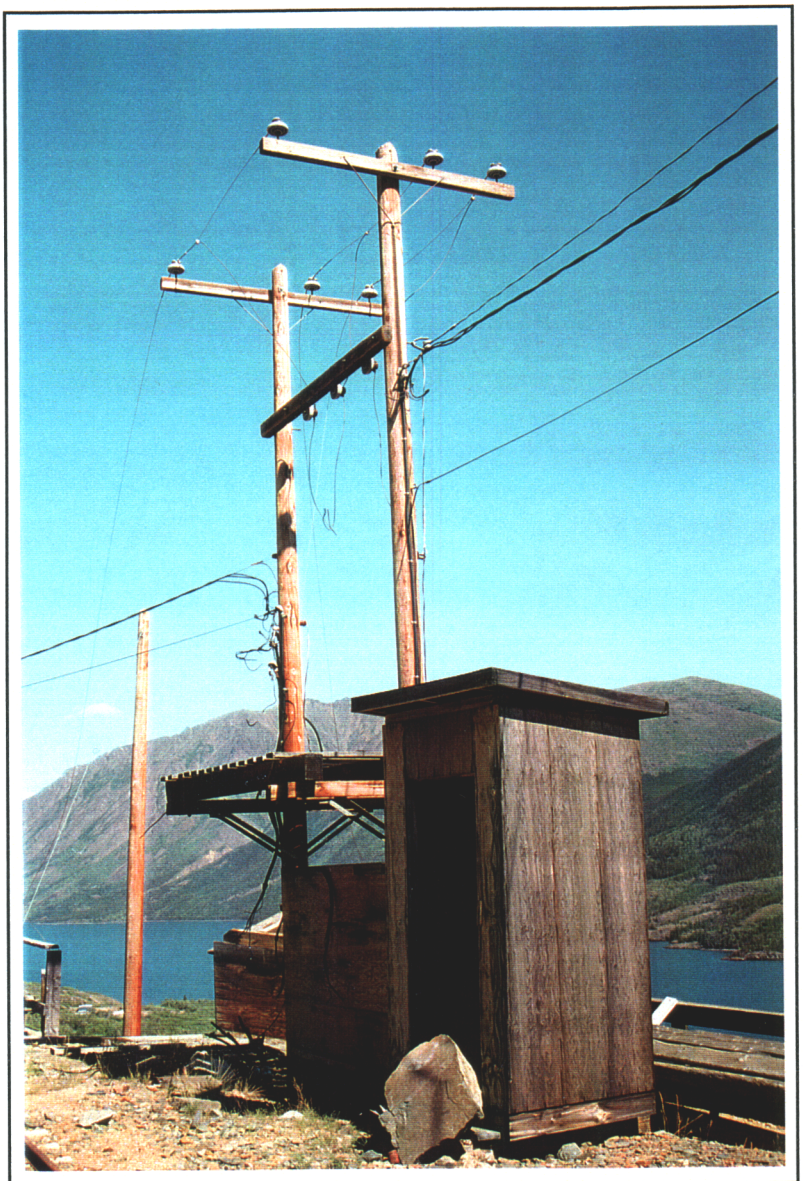

Photo # 22 - Shack and Pole Line



Photo # 23 - Retaining Wall and Toppled Shack



Photo # 24 - Storage Shed and Offloading Platform



Photo # 25 - Retaining Walls at Offloading Platform



Photo # 26 - View from Ventilation Building - Track and PVC Pipe



Photo # 27 - View from Ventilation Building - Track and Wood Debris



Photo # 28 - Pipe discharging Water



Photo # 29 - Lower Retaining Wall - Loadout Facility at Lake Bennett below



Photo # 30 - Collapsed Adit



Photo # 31 - Collapsed Adit



Photo # 32 - Terrain leading to Headframe



Photo # 33 - Wood Debris at Headframe



Photo # 34 - Loadout Facility at Headframe; and Trestle

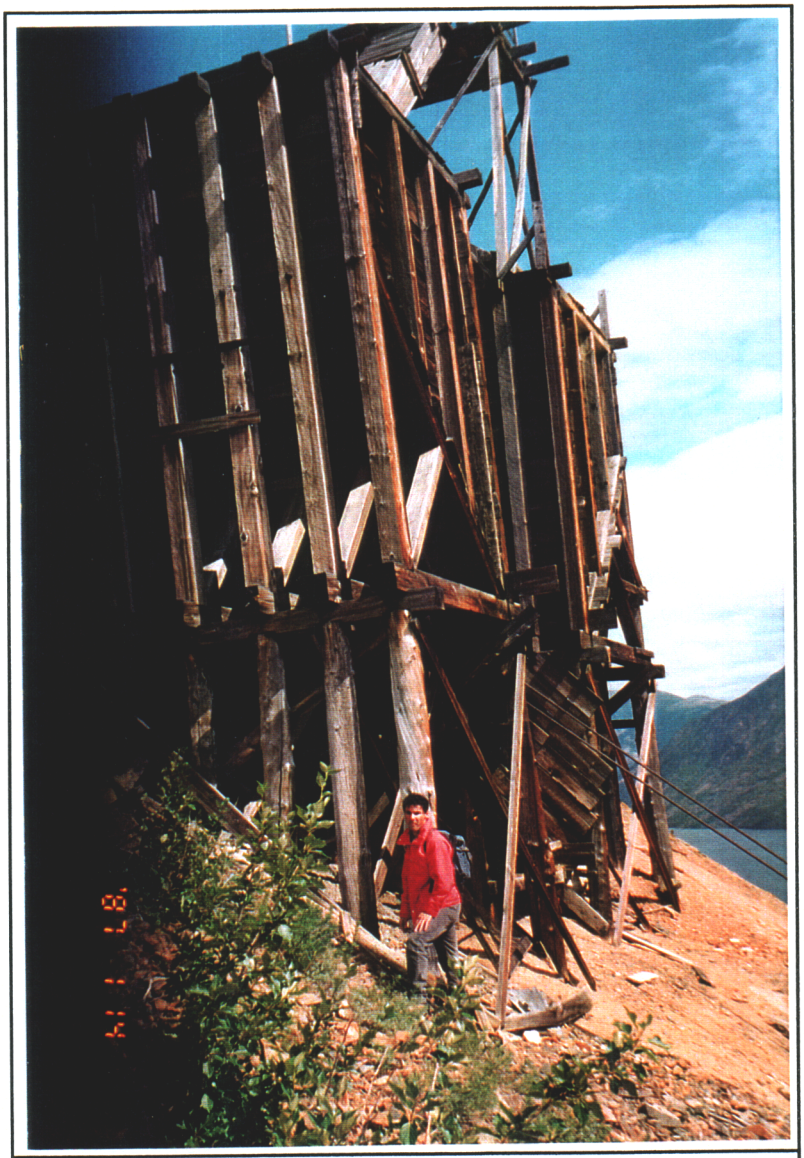

Photo # 35 - Loadout Facility at Headframe

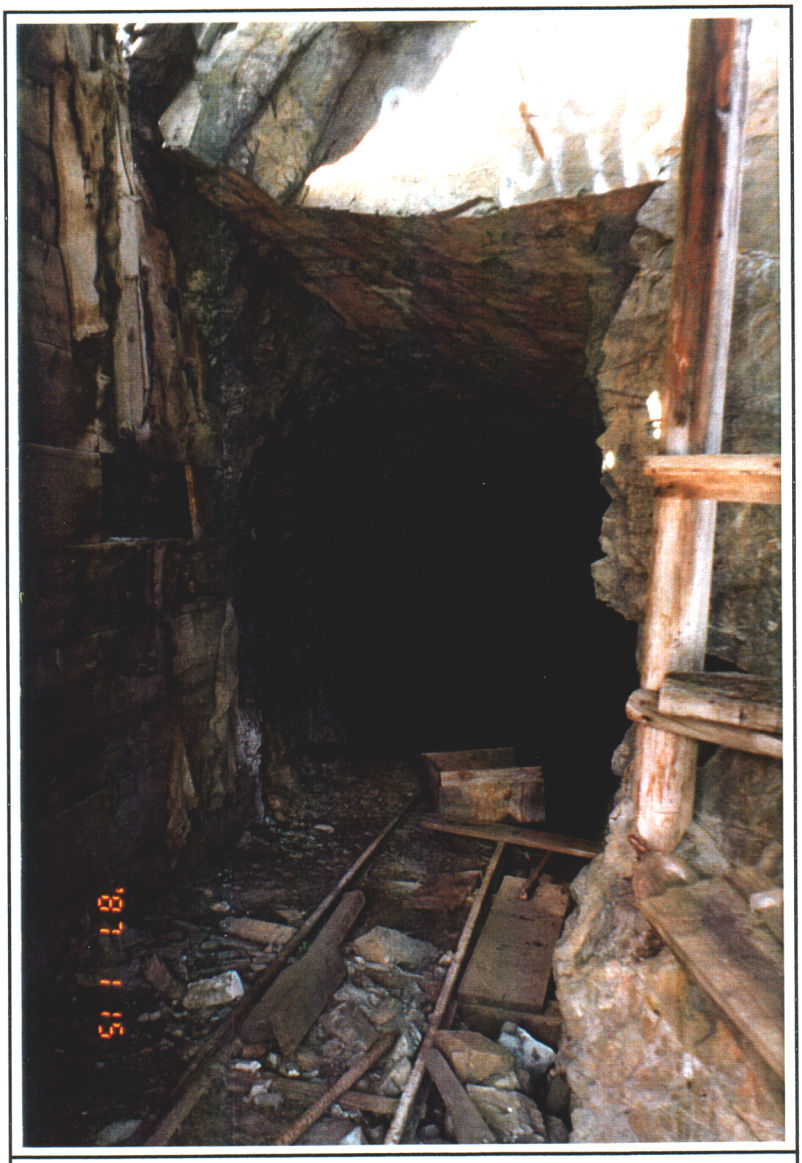

Photo # 36 - Entrance to Adit at Headframe



Photo # 37 - Detail of Adit 1



Photo # 38 - Montana Mine



Photo # 39 - Chemical Storage in Warehouse by Adit 2



Photo # 40 - Chemical Storage in Warehouse by Adit 2

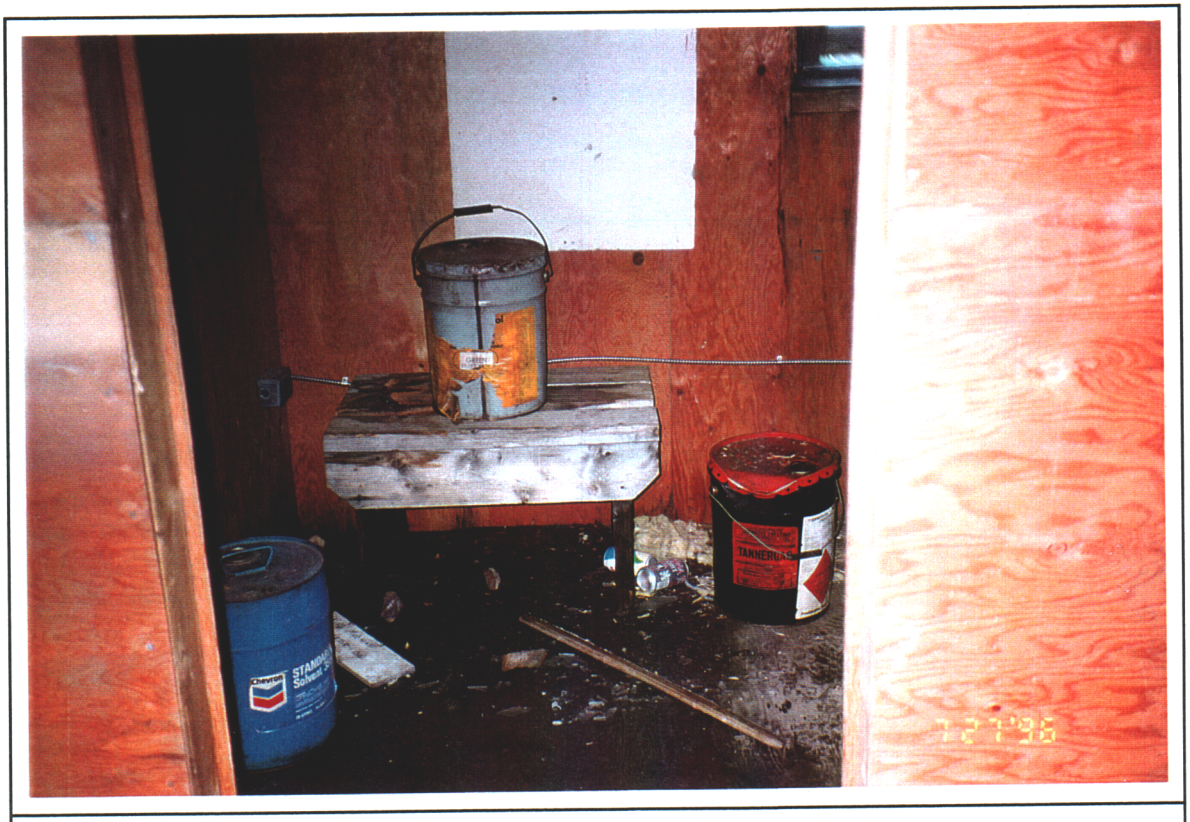

Photo # 41 - Three Pails containing Residual Contents located in a Storage Shed



Photo # 42 - Two 205 L Barrels containing Liquid Product



Photo # 43 - Two Phased Liquids in a Barrel near Adit 2



Photo # 44 - Culvert carrying Seep Water below Adit 2



Photo # 45 - Water flowing from Adit 1

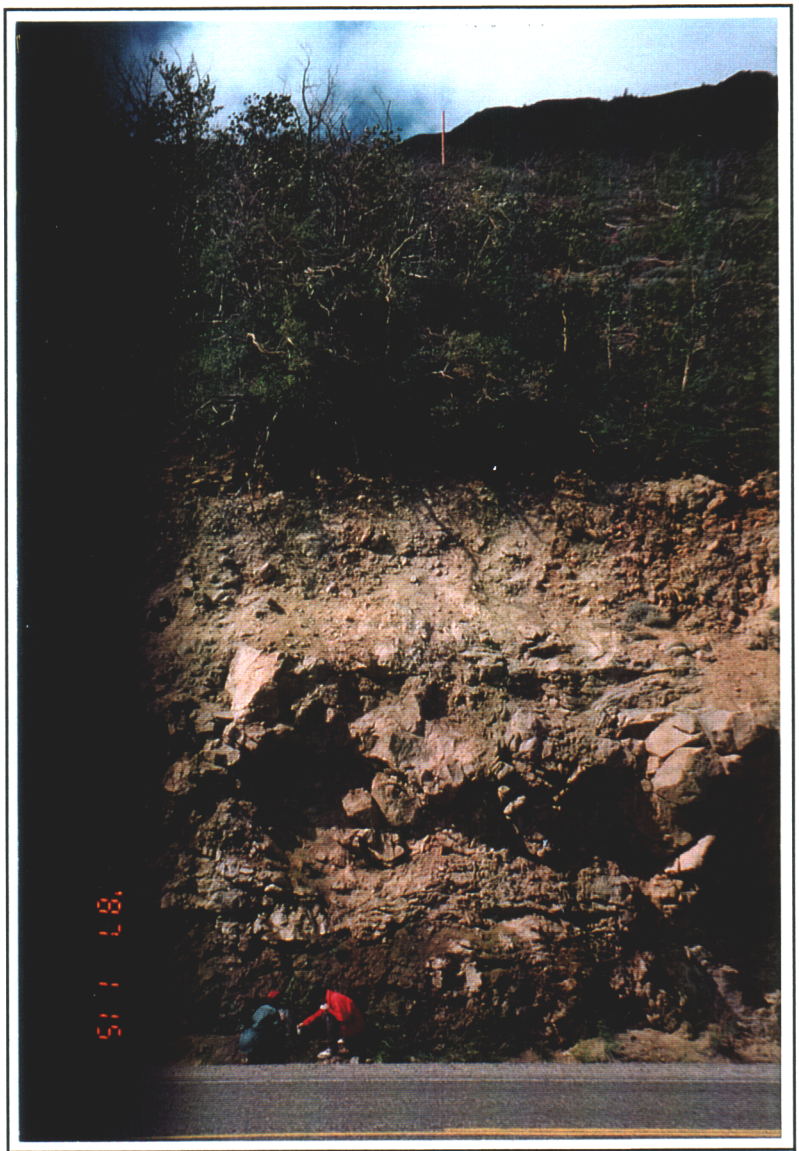

Photo # 46 - Seep below Adit 2 at South Klondike Highway

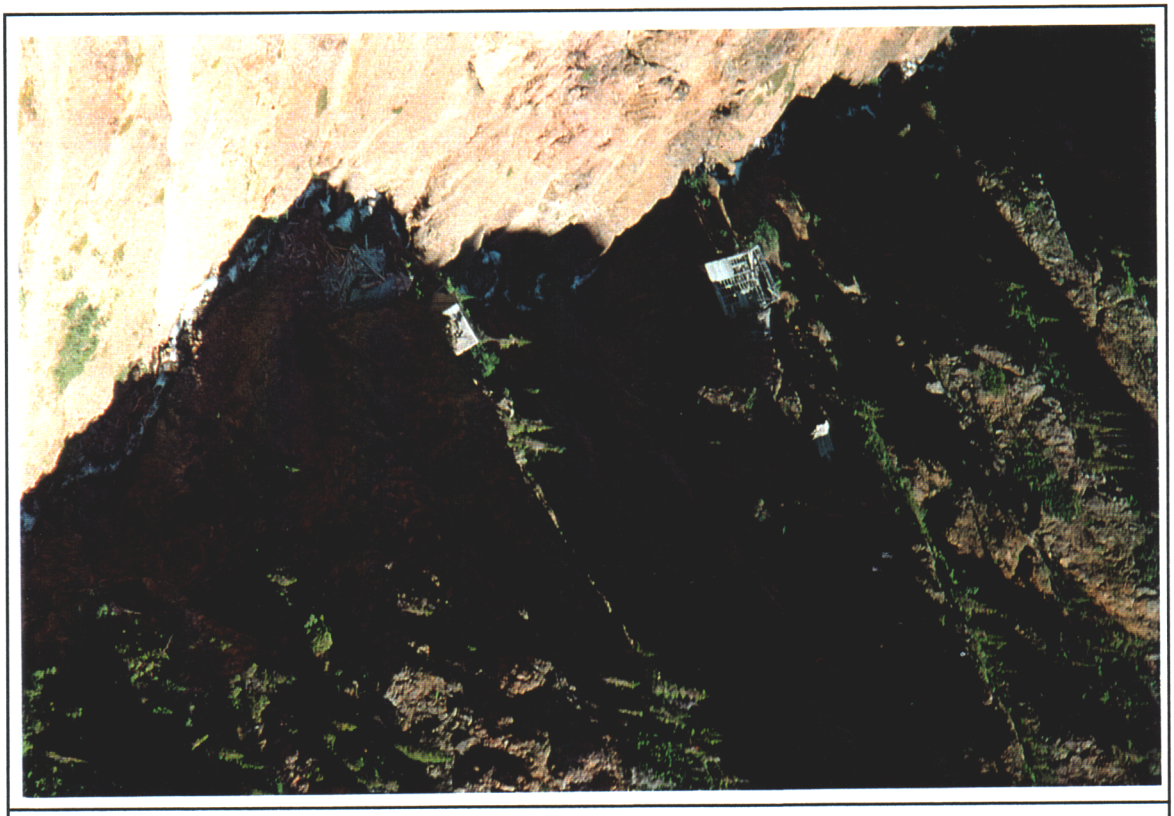

Photo # 47 - Vault Claims Buildings

APPENDIX C

ANALYTICAL RESULTS

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : VE-B101
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

Chemex Worksheet Number : 96-07805-25
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
Analysis Date : November 9, 1996

PARAMETER DESCRIPTION	NAQUADAT 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
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Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-07805-25
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996

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)	09-11-96	1 RAV	N.A.	NOT APPLICABLE			98.9	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 : VE-B101
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-25
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
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 : 78% LIQUID surrogate limits : 63% - 134%.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : VE-B101
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

Chemex Worksheet Number : 96-07805-25
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
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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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

Sample Description : VE-B102
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES

Chemex Worksheet Number : 96-07805-28
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
Analysis Date : November 9, 1996

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

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

PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : VE-B102
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-07805-28
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996

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)	09-11-96	2 RAV	N.A.	NOT APPLICABLE			98.5	80.0	120.0

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

Sample Description : VE-B102
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-28
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
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 : 80% LIQUID surrogate limits : 63% - 134%.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : VE-B102
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

Chemex Worksheet Number : 96-07805-28
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
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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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

Sample Description : VE-B103A
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-13
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
Analysis Date : November 5, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	R E S U L T S	DETECTION LIMIT
Total Organic Halogens (TOX)		ug/g	118.0	2.

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

PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : VE-B103A
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-07805-13
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996

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)	05-11-96	3 RAV	N.A.	NOT APPLICABLE			99.5	80.0	120.0

CHEMEX Labs Alberta Inc.

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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 : VE-8103A
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-13
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
Analysis Date : November 11, 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 :

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( ) - 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 : VE-B103A
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

Chemex Worksheet Number : 96-07805-13
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
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 : VE-B103B
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-30
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
Analysis Date : November 9, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	R E S U L T S	DETECTION LIMIT
Total Organic Halogens (TOX)		ug/g	122.0	2.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : VE-B103B
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-07805-30
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

PARAMETER	DATE ANALYZED (DD-MM-YY)	QA/QC BATCH NUM	ANAL	MATRIX SPIKES DUP Rr	RECOV %	CONTROL LIMITS LOWER	CONTROL LIMITS UPPER	CALIBRATION CHECK RECOV %	CONTROL LIMITS LOWER	CONTROL LIMITS UPPER
Total Organic Halogens (TOX)	09-11-96	2	RAV	N.A.	NOT APPLICABLE			98.5	80.0	120.0

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

Sample Description : VE-B103B
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-30
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
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 : 76% LIQUID surrogate limits : 63% - 134%.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : VE-B103B
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

Chemex Worksheet Number : 96-07805-30
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
Analysis Date : November 13, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

BATCH : 11 DATE : November 13, 1996 ANALYST:AAM	BLANK CONC. mg/Kg	DUPLICATE CONC.1 mg/Kg	 CONC.2 mg/Kg	 RPD %	MATRIX SPIKE RECOV %	CONTROL LIMITS LOWER	 UPPER	CALIBRATION CHECK RECOV %	CONTROL LIMITS 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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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

Sample Description : VE-B104
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES

Chemex Worksheet Number : 96-07805-16
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
Analysis Date : November 5, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	R E S U L T S	DETECTION LIMIT
Total Organic Halogens (TOX)		ug/g	70.0	2.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : VE-B104
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-07805-16
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996

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)	05-11-96	4 RAV	N.A.	NOT APPLICABLE			102.6	80.0	120.0

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

Sample Description : VE-B104
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-16
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
Analysis Date : November 11, 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 : 80% LIQUID surrogate limits : 63% - 134%.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : VE-B104
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

Chemex Worksheet Number : 96-07805-16
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
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 : VE-B105
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES

Chemex Worksheet Number : 96-07805-27
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
Analysis Date : November 9, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	R E S U L T S	DETECTION LIMIT
Total Organic Halogens (TOX)		ug/g	38.0	2.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : VE-B105
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-07805-27
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996

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)	09-11-96	2 RAV	N.A.	NOT APPLICABLE			98.5	80.0	120.0

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

Sample Description : VE-B105
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-27
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
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 : 78% LIQUID surrogate limits : 63% - 134%.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : VE-B105
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

Chemex Worksheet Number : 96-07805-27
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
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						

C.L

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

Sample Description : VE-B106
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-6
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
Analysis Date : October 25, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	R E S U L T S	DETECTION LIMIT
Total Organic Halogens (TOX)		ug/g	255.0	2.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : VE-B106
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-07805-6
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996

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	1	RAV	N.A.	NOT APPLICABLE			103.0	80.0	120.0

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : VE-B106
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

Chemex Worksheet Number : 96-07805-6
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
Analysis Date : November 11, 1996

AROCLORS (PCBS) BY MODIFIED EPA METHOD 8081

COMPONENT	CONCENTRATION	UNIT	MDL
Aroclor 1016	< 0.2	mg/Kg	0.2
Aroclor 1221	< 0.2	mg/Kg	0.2
Aroclor 1232	< 0.2	mg/Kg	0.2
Aroclor 1242	< 0.2	mg/Kg	0.2
Aroclor 1248	< 0.2	mg/Kg	0.2
Aroclor 1254	< 0.2	mg/Kg	0.2
Aroclor 1260	< 0.2	mg/Kg	0.2
Aroclor 1262	< 0.2	mg/Kg	0.2
Aroclor 1268	< 0.2	mg/Kg	0.2

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

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : VE-B106
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

Chemex Worksheet Number : 96-07805-6
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
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 : VE-B107
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-15
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
Analysis Date : November 11, 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 : 90% LIQUID surrogate limits : 63% - 134%.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

Sample Description : VE-B107
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-15
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
Analysis Date : November 11, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

BATCH : 11 DATE : November 11, 1996 ANALYST:AAM	BLANK CONC. mg/Kg	DUPLICATE CONC.1 mg/Kg	 CONC.2 mg/Kg	 RPD %	MATRIX SPIKE RECOV %	 CONTROL LIMITS LOWER	 UPPER	CALIBRATION CHECK RECOV %	 CONTROL LIMITS 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 : VE-B108
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-19
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
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 : VE-B108
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

Chemex Worksheet Number : 96-07805-19
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
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

PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

Sample Description : VE-B109
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-35
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
Analysis Date : November 9, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	R E S U L T S	DETECTION LIMIT
Total Organic Halogens (TOX)		ug/g	4.0	2.

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

Sample Description : VE-B109
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-07805-35
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

PARAMETER	DATE ANALYZED (DD-MM-YY)	QA/QC BATCH NUM ANAL	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)	09-11-96	2 RAV	N.A.	NOT APPLICABLE			98.5	80.0	120.0

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PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

Sample Description : VE-B109
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-35
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
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 :

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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

Sample Description : VE-B109
Sample Date & Time : 27-07-96
Sampled By :
Sample Type : GRAB
Sample Received Date: October 18, 1996
Sample Station Code :

TOX SAMPLES
Chemex Worksheet Number : 96-07805-35
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
Analysis Date : November 13, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

BATCH : 11 DATE : November 13, 1996 ANALYST: AAM	BLANK CONC. mg/Kg	DUPLICATE CONC.1 mg/Kg	 CONC.2 mg/Kg	 RPD %	MATRIX SPIKE RECOV %	CONTROL LIMITS LOWER	 UPPER	CALIBRATION CHECK RECOV %	CONTROL LIMITS 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						

HYDROCARBON DISTRIBUTION REPORT

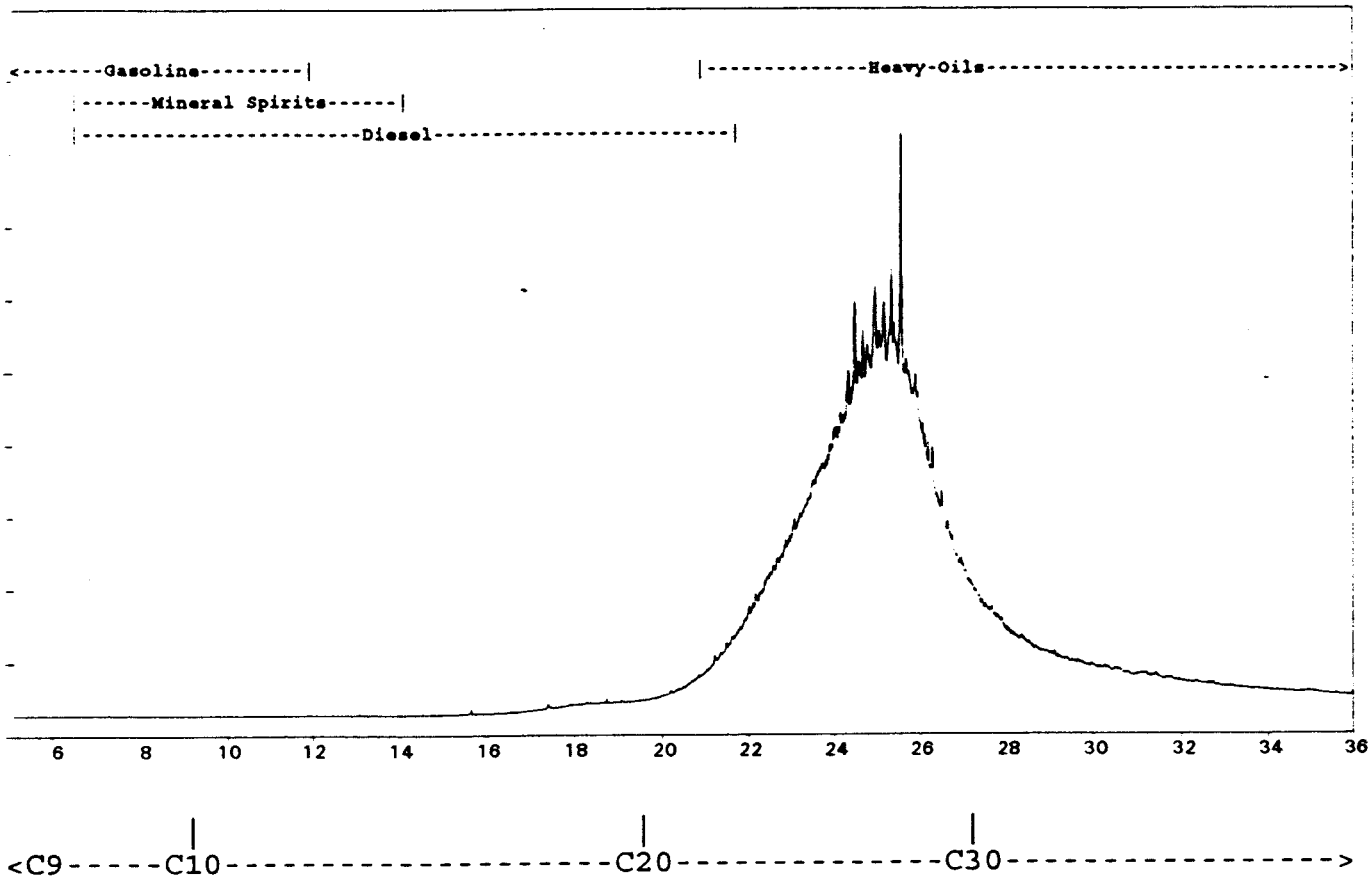
VE-S201

SAMPLE NAME: G3879 27

Sample acquired: AUG 16, 1996 21:00:09

File Name: c:\TEH\TEH16AUG.08R , Sample Name: G3879 27

Sequence file: TEHAUG16



ASL Sample ID: G3879 27* 8.0Dilution

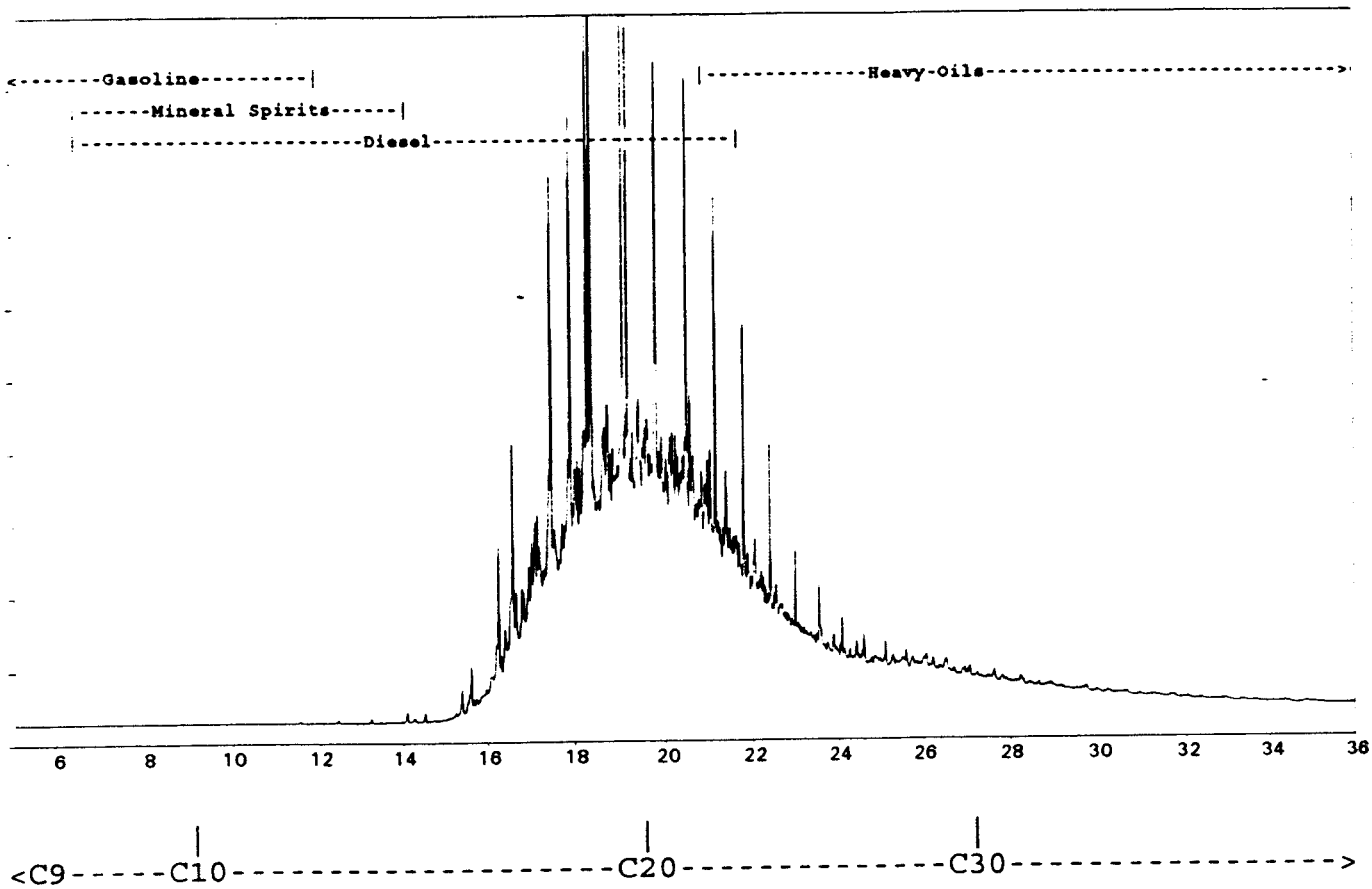
HYDROCARBON RANGE (C#)		RELATIVE AMOUNT (%)
Less than Carbon 10	(<C10)	0.0
Carbon 10 to Carbon 20	(C10-C20)	1.9
Carbon 20 to Carbon 30	(C20-C30)	72.8
Greater than Carbon 30	(>C30)	25.3

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: G3879 28 VE-S202

Sample acquired: AUG 16, 1996 21:48:08
File Name: c:\TEH\TEH16AUG.09R , Sample Name: G3879 28
Sequence file: TEHAUG16



ASL Sample ID: G3879 28* 8.0Dilution

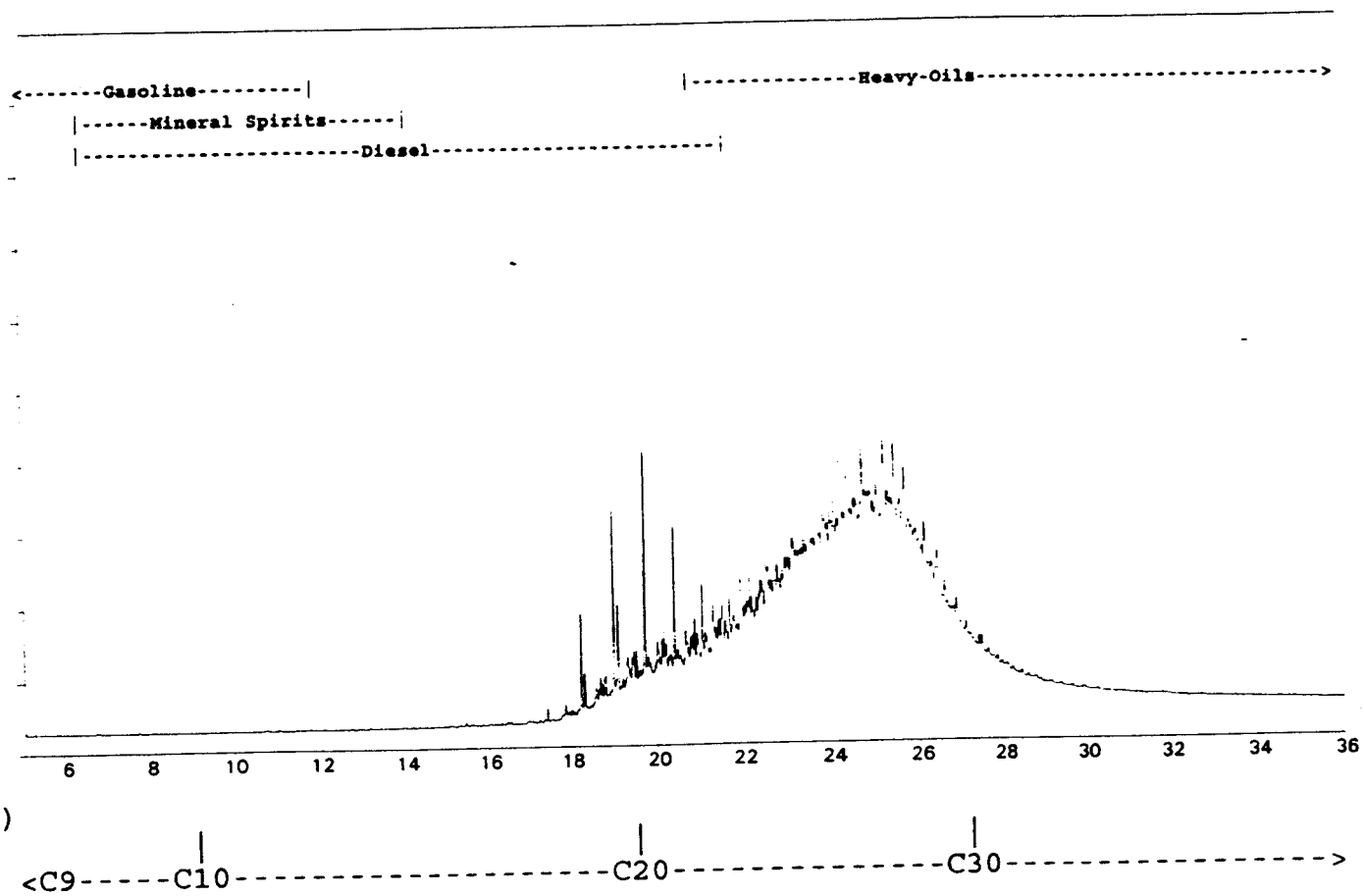
HYDROCARBON RANGE (C#)		RELATIVE AMOUNT (%)
Less than Carbon 10	(<C10)	0.0
Carbon 10 to Carbon 20	(C10-C20)	56.6
Carbon 20 to Carbon 30	(C20-C30)	35.4
Greater than Carbon 30	(>C30)	8.1

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: G3879 30 VE-S204

Sample acquired: AUG 24, 1996 20:41:10
File Name: c:\TEH\TEHAUG23.68R , Sample Name: G3879 30
Sequence file: TEHAUG23



ASL Sample ID: G3879 30* 5 X Dilution

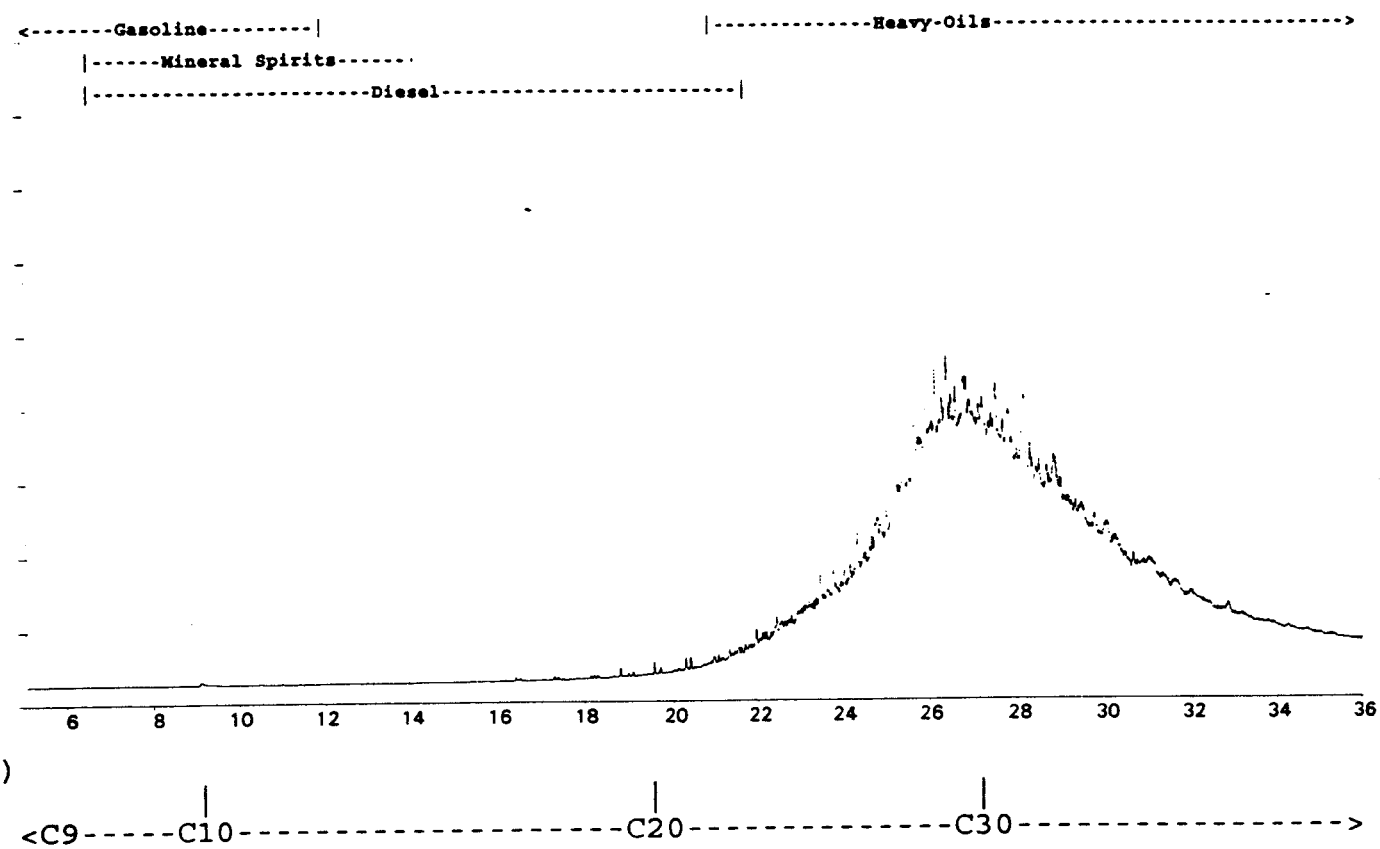
HYDROCARBON RANGE (C#)		RELATIVE AMOUNT (%)
Less than Carbon 10	(<C10)	0.1
Carbon 10 to Carbon 20	(C10-C20)	10.3
Carbon 20 to Carbon 30	(C20-C30)	71.7
Greater than Carbon 30	(>C30)	17.9

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: G3879 31 VE-S205

Sample acquired: AUG 24, 1996 21:30:21
File Name: c:\TEH\TEHAUG23.59R , Sample Name: G3879 31
Sequence file: TEHAUG23



ASL Sample ID: G3879 31* 5 X Dilution

HYDROCARBON RANGE (C#)		RELATIVE AMOUNT (%)
Less than Carbon 10	(<C10)	0.0
Carbon 10 to Carbon 20	(C10-C20)	0.5
Carbon 20 to Carbon 30	(C20-C30)	32.5
Greater than Carbon 30	(>C30)	67.0

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

HYDROCARBON DISTRIBUTION REPORT

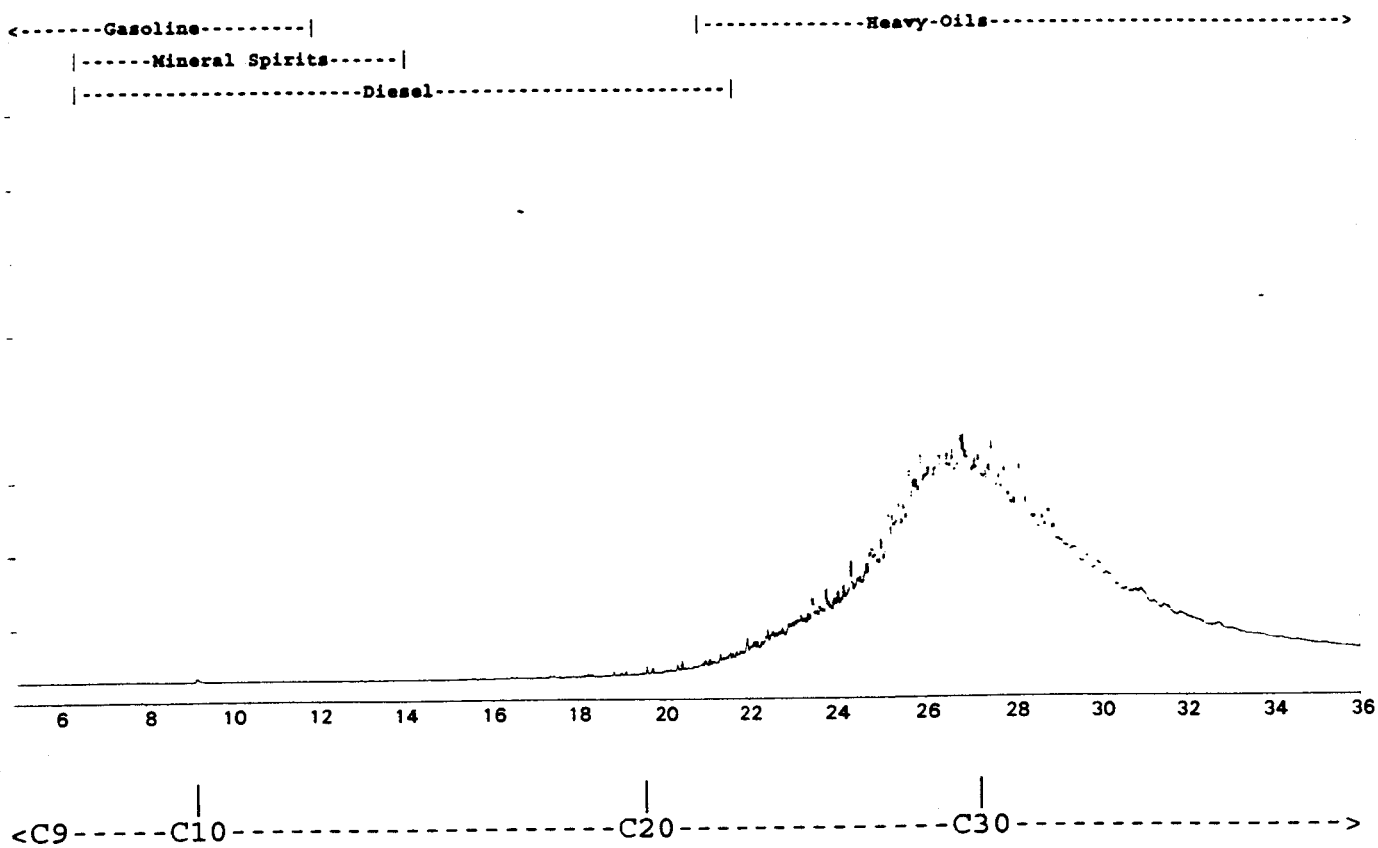
SAMPLE NAME: G3879 - 31

VE-S205 LRep

Sample acquired: AUG 24, 1996 21:30:21

File Name: c:\TEH\TEHAUG23.70R , Sample Name: QC 69739#G3879 31DUP

Sequence file: TEHAUG23



ASL Sample ID: QC 69739#G3879 31DUP* 5 X Dilution

HYDROCARBON RANGE (C#)		RELATIVE AMOUNT (%)
Less than Carbon 10	(<C10)	0.0
Carbon 10 to Carbon 20	(C10-C20)	0.5
Carbon 20 to Carbon 30	(C20-C30)	33.8
Greater than Carbon 30	(>C30)	65.7

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

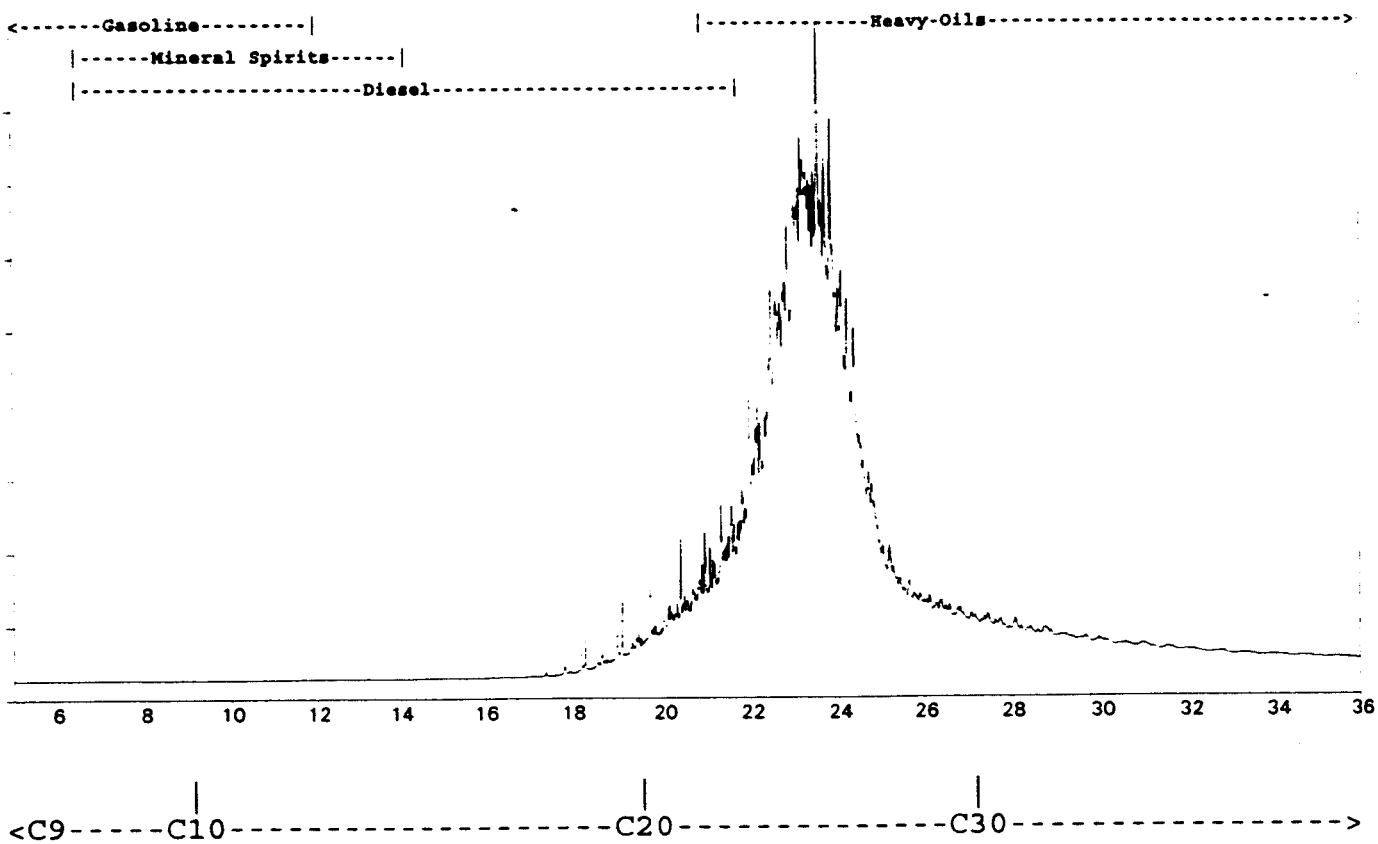
HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: G3879 32 VE-S206

Sample acquired: AUG 24, 1996 22:19:21

File Name: c:\TEH\TEHAUG23.71R , Sample Name: G3879 32

Sequence file: TEHAUG23



HYDROCARBON RANGE (C#)		RELATIVE AMOUNT (%)
Less than Carbon 10	(<C10)	0.0
Carbon 10 to Carbon 20	(C10-C20)	5.4
Carbon 20 to Carbon 30	(C20-C30)	82.8
Greater than Carbon 30	(>C30)	11.8

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RESULTS OF ANALYSIS - Sediment/Soil[1]

File No. G3879

		VE-S202	VE-S203	VE-S204	VE-S205	VE-S206
Physical Tests						
Moisture	%	1.4	1.4	0.9	1.6	0.6
Total Metals						
Antimony	T-Sb	149	<20	<20	<20	<20
Arsenic	T-As	12400	6770	978	1170	2120
Barium	T-Ba	138	36	93	182	69
Beryllium	T-Be	<0.5	0.8	<0.5	0.6	<0.5
Cadmium	T-Cd	64	47	4	17	15
Chromium	T-Cr	107	26	60	36	25
Cobalt	T-Co	135	18	14	12	18
Copper	T-Cu	492	39	40	28	48
Lead	T-Pb	2090	1720	110	277	378
Mercury	T-Hg	0.034	0.041	0.022	0.024	0.018
Molybdenum	T-Mo	26	<4	<4	<4	<4
Nickel	T-Ni	116	32	38	23	113
Selenium	T-Se	<50	<50	<50	<50	<50
Silver	T-Ag	32	16	5	4	5
Tin	T-Sn	83	<30	<30	<30	<30
Vanadium	T-V	64	26	70	35	31
Zinc	T-Zn	4460	1100	134	568	333

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

RESULTS OF ANALYSIS - Sediment/Soil[1]

File No. G3879

	VE-S202	VE-S203	VE-S204	VE-S205	VE-S206
Polycyclic Aromatic Hydrocarbons					
Acenaphthene	-	-	-	<0.5	-
Acenaphthylene	-	-	-	<0.5	-
Anthracene	-	-	-	<0.5	-
Benzo(a)anthracene	-	-	-	<0.5	-
Benzo(a)pyrene	-	-	-	<0.5	-
Benzo(b)fluoranthene	-	-	-	<0.5	-
Benzo(g,h,i)perylene	-	-	-	<0.5	-
Benzo(k)fluoranthene	-	-	-	<0.5	-
Chrysene	-	-	-	<0.5	-
Dibenz(a,h)anthracene	-	-	-	<0.5	-
Fluoranthene	-	-	-	<0.5	-
Fluorene	-	-	-	<0.5	-
Indeno(1,2,3-c,d)pyrene	-	-	-	<0.5	-
Naphthalene	-	-	-	<0.5	-
Phenanthrene	-	-	-	<0.5	-
Pyrene	-	-	-	<0.5	-
Extractables					
Total Extr Hydrocarbons (C10-30)	4020	<40	8780	4770	19400
Organic Parameters					
Extractable Organic Halide	-	<1.5	6.5	63.0	-

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

Appendix 1 - QUALITY CONTROL - Replicates

File No. G3879

Sediment/Soil[1]		VE-S205	VE-S205 QC # 69739
Physical Tests			
Moisture	%	1.6	1.7
Total Metals			
Antimony	T-Sb	<20	<20
Barium	T-Ba	182	141
Beryllium	T-Be	0.6	0.5
Cadmium	T-Cd	17	14
Chromium	T-Cr	36	40
Cobalt	T-Co	12	13
Copper	T-Cu	28	26
Lead	T-Pb	277	186
Mercury	T-Hg	0.024	0.026
Molybdenum	T-Mo	<4	<4
Nickel	T-Ni	23	26
Selenium	T-Se	<50	<50
Silver	T-Ag	4	3
Tin	T-Sn	<30	<30
Vanadium	T-V	35	31
Zinc	T-Zn	568	474
Polycyclic Aromatic Hydrocarbons			
Acenaphthene		<0.5	<0.5
Acenaphthylene		<0.5	<0.5
Anthracene		<0.5	<0.5
Benzo(a)anthracene		<0.5	<0.5
Benzo(a)pyrene		<0.5	<0.5
Benzo(b)fluoranthene		<0.5	<0.5
Benzo(g,h,i)perylene		<0.5	<0.5
Benzo(k)fluoranthene		<0.5	<0.5
Chrysene		<0.5	<0.5
Dibenz(a,h)anthracene		<0.5	<0.5
Fluoranthene		<0.5	<0.5
Fluorene		<0.5	<0.5
Indeno(1,2,3-c,d)pyrene		<0.5	<0.5
Naphthalene		<0.5	<0.5
Phenanthrene		<0.5	<0.5
Pyrene		<0.5	<0.5

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

Appendix 1 - QUALITY CONTROL - Replicates

File No. G3879

Sediment/Soil[1]	VE-S205	VE-S205 QC # 69739
Extractables		
Total Extr Hydrocarbons (C10-30)	4770	3020

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

RESULTS OF ANALYSIS - Product[1,2]

File No. G3879

	VE-B103A	VE-B103B	VE-B104	VE-B105	VE-B108
	96 07 27	96 07 27	96 07 27	96 07 27	96 07 27
Organic Parameters					
Adsorbable Organic Halide	<300	<300	<300	<300	4800

Remarks regarding the analyses appear at the beginning of this report.
< = Less than the detection limit indicated.
[1] Adsorbable Organic Halide may be considered to be Total Organic Halide in product samples.
[2] Results are expressed as milligrams per litre.

RESULTS OF ANALYSIS - Product[1,2]

File No. G3879

	VE-B107	VE-B101	VE-B102	VE-B106	VE-B109
	96 07 27	96 07 27	96 07 27	96 07 27	96 07 27
Organic Parameters					
Adsorbable Organic Halide	9860	<300	<300	<300	<300

Remarks regarding the analyses appear at the beginning of this report.
< = Less than the detection limit indicated.
[1]Adsorbable Organic Halide may be considered to be Total Organic Halide in product samples.
[2]Results are expressed as milligrams per litre.

RESULTS OF ANALYSIS - Product[1,2]

File No. G3879

		VE-B103A	VE-B103B	VE-B104	VE-B105	VE-B108
		96 07 27	96 07 27	96 07 27	96 07 27	96 07 27
Total Metals						
Cadmium	T-Cd	<1	<1	<1	<1	<1
Chromium	T-Cr	<1	<1	<1	<1	<1
Lead	T-Pb	15	14	<1	<1	3

Remarks regarding the analyses appear at the beginning of this report.
< = Less than the detection limit indicated.
[1]Adsorbable Organic Halide may be considered to be Total Organic Halide in product samples.
[2]Results are expressed as milligrams per litre.

RESULTS OF ANALYSIS - Product[1,2]

File No. G3879

		VE-B107	VE-B101	VE-B102	VE-B106	VE-B109
		96 07 27	96 07 27	96 07 27	96 07 27	96 07 27
Total Metals						
Cadmium	T-Cd	<1	<1	<1	<1	<1
Chromium	T-Cr	<1	<1	<1	<1	<1
Lead	T-Pb	<1	<1	2	<1	2

Remarks regarding the analyses appear at the beginning of this report.
< = Less than the detection limit indicated.
[1]Adsorbable Organic Halide may be considered to be Total Organic Halide in product samples.
[2]Results are expressed as milligrams per litre.

RESULTS OF ANALYSIS - Sediment/Soil[1]

File No. G3879

		BT-S204	BT-S205	BT-S206	BT-S207	VE-S201
Physical Tests						
Moisture	%	3.3	28.0	10.0	7.6	1.4
Total Metals						
Antimony	T-Sb	<20	37	<20	<20	<20
Arsenic	T-As	135	2340	1150	1370	597
Barium	T-Ba	96	90	51	45	161
Beryllium	T-Be	1.4	0.9	<0.5	0.6	0.9
Cadmium	T-Cd	5	12	3	5	3
Chromium	T-Cr	4	16	14	12	38
Cobalt	T-Co	4	6	5	4	12
Copper	T-Cu	16	265	40	39	30
Lead	T-Pb	194	281	145	169	106
Mercury	T-Hg	0.006	0.036	0.019	0.010	0.016
Molybdenum	T-Mo	4	12	6	6	<4
Nickel	T-Ni	3	8	6	16	23
Selenium	T-Se	<50	<50	<50	<50	<50
Silver	T-Ag	<2	12	5	5	<2
Tin	T-Sn	<30	<30	<30	<30	<30
Vanadium	T-V	8	29	29	19	49
Zinc	T-Zn	417	246	107	117	180

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

RESULTS OF ANALYSIS - Sediment/Soil[1]

File No. G3879

	BT-S204	BT-S205	BT-S206	BT-S207	VE-S201
Extractables					
Total Extr Hydrocarbons (C10-30)	<40	85	84	<40	2600

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

RESULTS OF ANALYSIS - Water File No. G3765

			VE-WQ-S 101	VE-WQ-A 101	VE-WQ-A 102	SM-WQ-Str 301	SM-WQ-S 201
			96 07 27	96 07 27	96 07 27	96 07 29	96 07 29
Physical Tests							
Conductivity (umhos/cm)			339	323	439	164	289
pH			7.82	7.92	8.02	7.89	4.08
Dissolved Anions							
Acidity		CaCO3	4.1	1.9	2.3	1.9	99.1
Alkalinity - Total		CaCO3	123	118	173	60.9	<1.0
Sulphate	SO4		57.4	48.8	72.7	24.4	148
Total Metals							
Aluminum	T-Al		0.3	0.3	0.3	<0.2	15.3
Antimony	T-Sb		<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic	T-As		0.2	0.5	0.3	<0.2	<0.2
Barium	T-Ba		0.02	0.03	0.02	0.05	0.04
Beryllium	T-Be		<0.005	<0.005	<0.005	<0.005	<0.005
Bismuth	T-Bi		<0.1	<0.1	<0.1	<0.1	<0.1
Boron	T-B		<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium	T-Cd		<0.01	<0.01	<0.01	<0.01	<0.01
Calcium	T-Ca		49.5	46.6	49.5	26.8	7.38
Chromium	T-Cr		<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	T-Co		<0.01	<0.01	<0.01	<0.01	0.04
Copper	T-Cu		<0.01	<0.01	<0.01	<0.01	0.33
Iron	T-Fe		<0.03	0.35	<0.03	<0.03	0.16
Lead	T-Pb		<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	T-Li		<0.01	<0.01	0.01	<0.01	<0.01
Magnesium	T-Mg		12.2	11.7	26.9	3.71	5.44
Manganese	T-Mn		<0.005	0.008	<0.005	<0.005	0.570
Molybdenum	T-Mo		<0.03	<0.03	<0.03	<0.03	<0.03
Nickel	T-Ni		<0.02	<0.02	<0.02	<0.02	0.04
Phosphorus	T-P		<0.3	<0.3	<0.3	<0.3	<0.3
Potassium	T-K		<2	<2	<2	<2	<2
Selenium	T-Se		<0.2	<0.2	<0.2	<0.2	<0.2
Silicon	T-Si		3.67	3.61	3.95	1.93	13.6
Silver	T-Ag		<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	T-Na		4	4	6	<2	6
Strontium	T-Sr		0.650	0.690	1.14	0.079	0.080
Thallium	T-Tl		<0.1	<0.1	<0.1	<0.1	<0.1
Tin	T-Sn		<0.03	<0.03	<0.03	<0.03	<0.03
Titanium	T-Ti		<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	T-V		<0.03	<0.03	<0.03	<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. G3765

		VE-WQ-S 101	VE-WQ-A 101	VE-WQ-A 102	SM-WQ-Str 301	SM-WQ-S 201
		96 07 27	96 07 27	96 07 27	96 07 29	96 07 29
Total Metals						
Zinc	T-Zn	<0.005	0.184	0.023	<0.005	0.264

< = 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. G3765

			BT-WQ-Str 104	AS-WQ-Str 102	VE-WQ-S 201	UN-WQ-Str 203	VE-WQ-S 301
			96 07 25	96 07 30	96 07 30	96 07 24	96 07 30
Physical Tests							
Conductivity (umhos/cm)			15.1	63.2	435	219	569
pH			6.80	6.99	8.04	7.74	7.84
Dissolved Anions							
Acidity		CaCO3	1.6	4.5	1.4	2.3	5.4
Alkalinity - Total		CaCO3	4.8	28.3	170	64.2	189
Sulphate	SO4		1.6	2.7	72.0	43.0	121
Total Metals							
Aluminum	T-Al		1.6	<0.2	<0.2	<0.2	<0.2
Antimony	T-Sb		<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic	T-As		<0.2	<0.2	0.3	<0.2	<0.2
Barium	T-Ba		<0.01	<0.01	0.04	0.01	0.02
Beryllium	T-Be		<0.005	<0.005	<0.005	<0.005	<0.005
Bismuth	T-Bi		<0.1	<0.1	<0.1	<0.1	<0.1
Boron	T-B		0.2	<0.1	<0.1	<0.1	<0.1
Cadmium	T-Cd		<0.01	<0.01	<0.01	<0.01	<0.01
Calcium	T-Ca		5.12	9.64	44.6	38.6	84.1
Chromium	T-Cr		<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	T-Co		<0.01	<0.01	<0.01	<0.01	<0.01
Copper	T-Cu		<0.01	<0.01	<0.01	<0.01	<0.01
Iron	T-Fe		0.08	0.11	0.28	<0.03	<0.03
Lead	T-Pb		<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	T-Li		0.19	<0.01	0.02	<0.01	<0.01
Magnesium	T-Mg		0.34	1.99	24.8	1.96	21.6
Manganese	T-Mn		<0.005	<0.005	0.031	<0.005	<0.005
Molybdenum	T-Mo		<0.03	<0.03	<0.03	<0.03	<0.03
Nickel	T-Ni		<0.02	<0.02	<0.02	<0.02	<0.02
Phosphorus	T-P		<0.3	<0.3	<0.3	<0.3	<0.3
Potassium	T-K		<2	<2	<2	<2	<2
Selenium	T-Se		<0.2	<0.2	<0.2	<0.2	<0.2
Silicon	T-Si		1.20	3.51	3.56	2.43	3.84
Silver	T-Ag		<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	T-Na		<2	<2	5	<2	5
Strontium	T-Sr		0.033	0.048	1.10	0.355	1.06
Thallium	T-Tl		<0.1	<0.1	<0.1	<0.1	<0.1
Tin	T-Sn		<0.03	<0.03	<0.03	<0.03	<0.03
Titanium	T-Ti		<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	T-V		<0.03	<0.03	<0.03	<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. G3765

		BT-WQ-Str 104	AS-WQ-Str 102	VE-WQ-S 201	UN-WQ-Str 203	VE-WQ-S 301
		96 07 25	96 07 30	96 07 30	96 07 24	96 07 30
Total Metals						
Zinc	T-Zn	0.012	<0.005	0.038	<0.005	<0.005

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

APPENDIX D

DRAWINGS

Legend

W/R — Waste Rock

Adit

Road

Extent Of Waste Rock

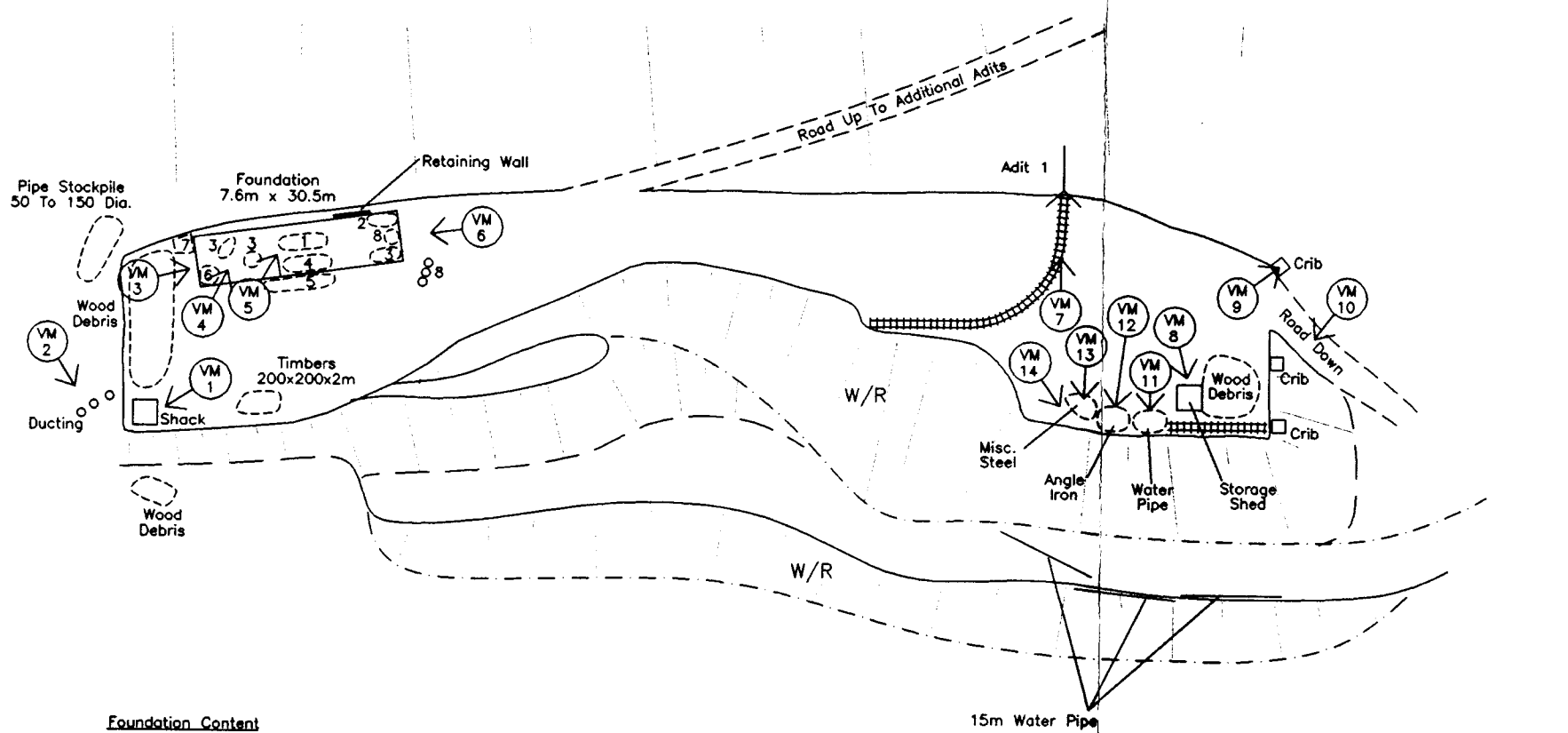
Track

Slope Down

Buildings

Extent of Debris, Timber, Cable, Pipe, etc.

VM 1 — Photograph No. & Direction



Foundation Content
1. Core Samples
2. Water Pipe
3. Spools (9)
4. Ducting
5. Wood
6. 6 Lengths Of Belting
7. Stack Of Rollers
8. Barrels (2)
9. Misc. Metals

Approx. Scale: 1:1000

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

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

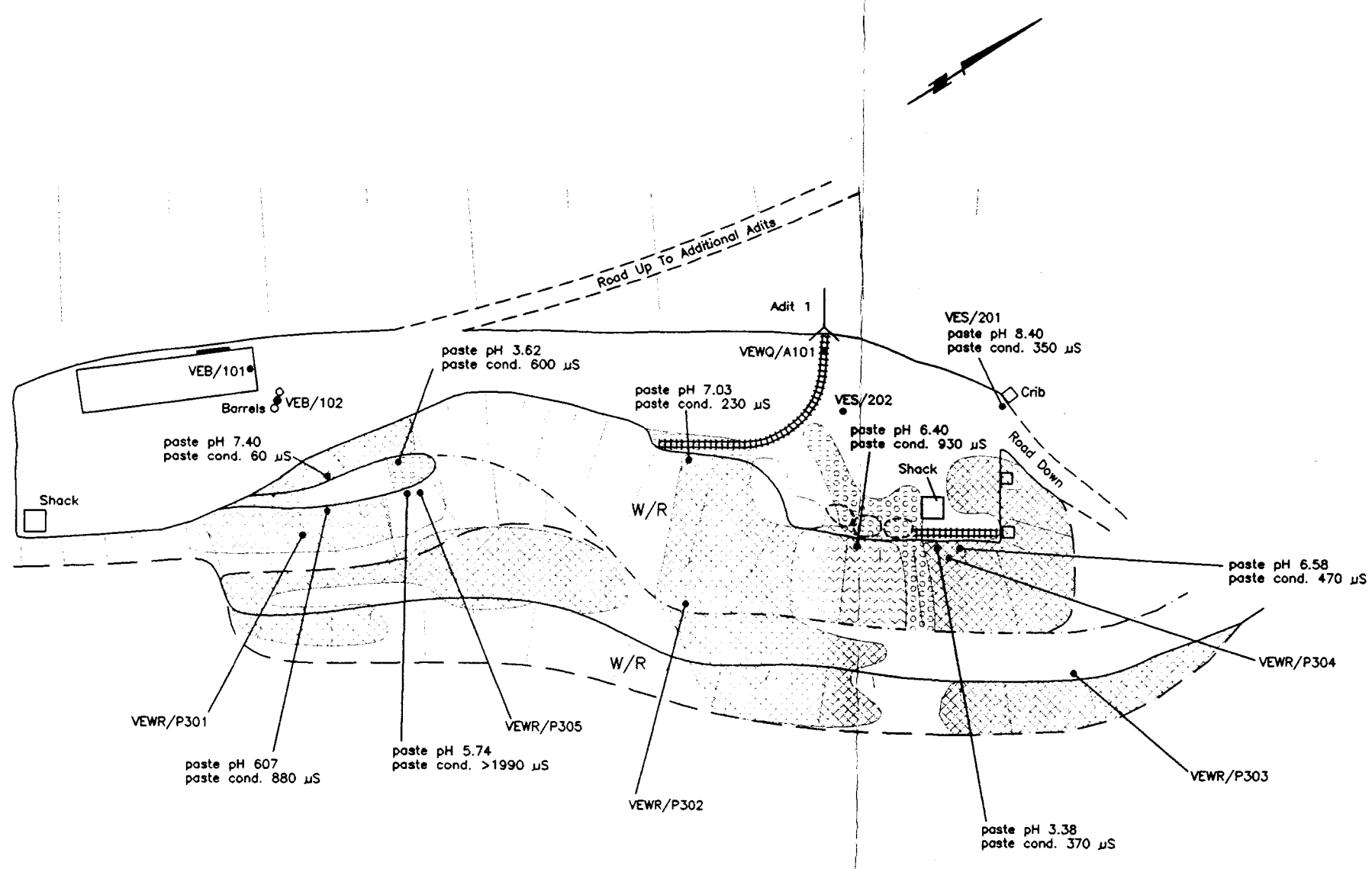
Project Title / Titre du projet:
Venus Mine
Site & Photo Information
Adit 1
Yukon Territory

Project No. / No. du projet: 668724

Dwg. No. / dessin no.: 1 of 4

Legend

W/R	Waste Rock
	Adit
	Road
	Extent Of Waste Rock
	Track
• VEWR/P1/1	Waste Rock (site designation
• VEWQ/A3/1	Water Quality Sample (site designation)
• VES/1	Soil Sample (site designation)
• VEB/1	Barrel Sample (site designation)
	Slope Down
	Orange Brown Stain Secondary Mineralization
	Whitish Stain Secondary Mineralization
	Yellowish Stain Secondary Mineralization
	Quartz Rich Material, py 1%
	Buildings
	Extent of Debris, Timber, Cable, Pipe, etc.



Approx. Scale: 1:1000

PLOT: 1=1
CAD FILE: INVEN-96\VENUS\VENUS-1A

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

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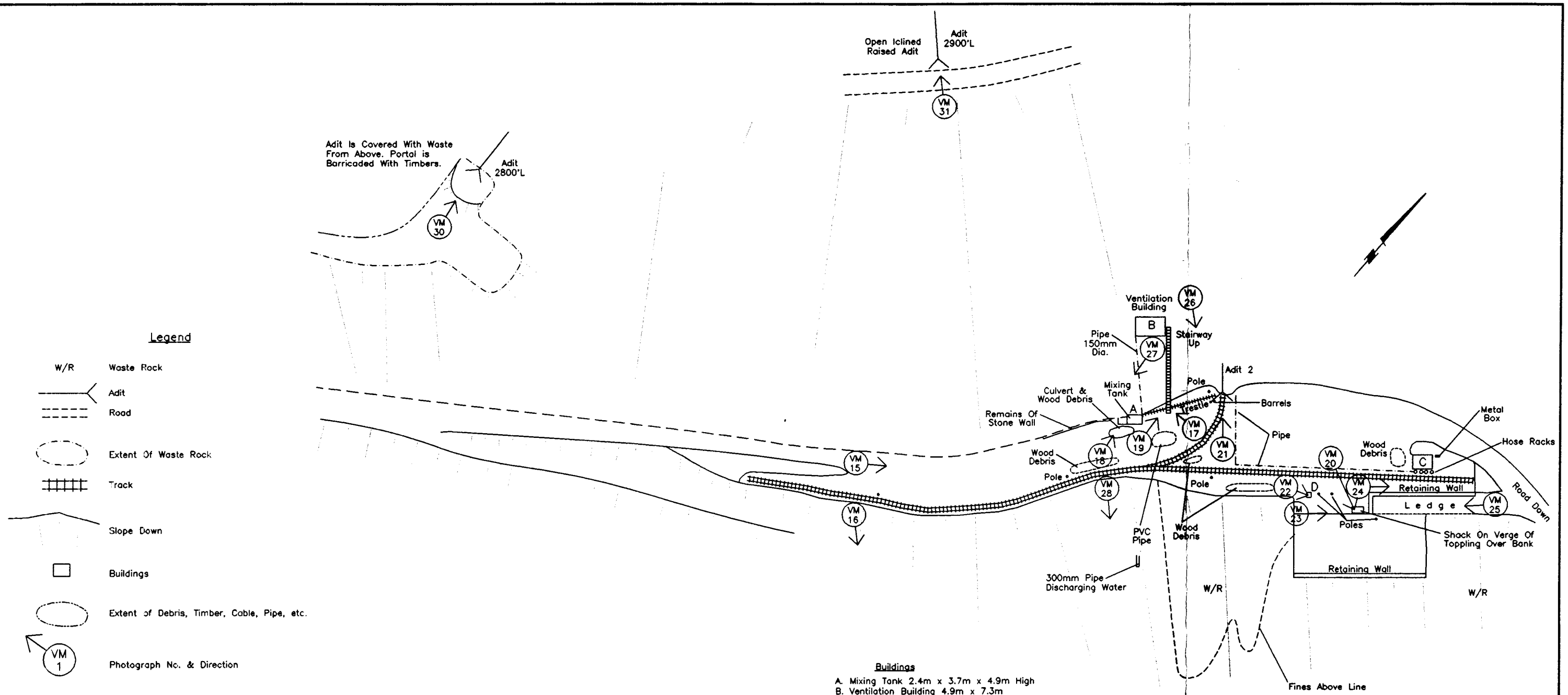
Venus Mine
Geological Information
Adit 1
Yukon Territory

668724

2 of 4



Legend

- W/R — Waste Rock
- Adit
- Road
- Extent Of Waste Rock
- Track
- Slope Down
- Buildings
- Extent of Debris, Timber, Cable, Pipe, etc.
- VM 1 — Photograph No. & Direction

Buildings

A. Mixing Tank 2.4m x 3.7m x 4.9m High
B. Ventilation Building 4.9m x 7.3m
C. Storage Building 3.7m x 4.9m
D. Shack 1.2m x 1.2m Plywood Shack

Approx. Scale: 1:1000

PLOT: 1=1
CAD FILE: INVEN-96\VENUS\VENUS-2

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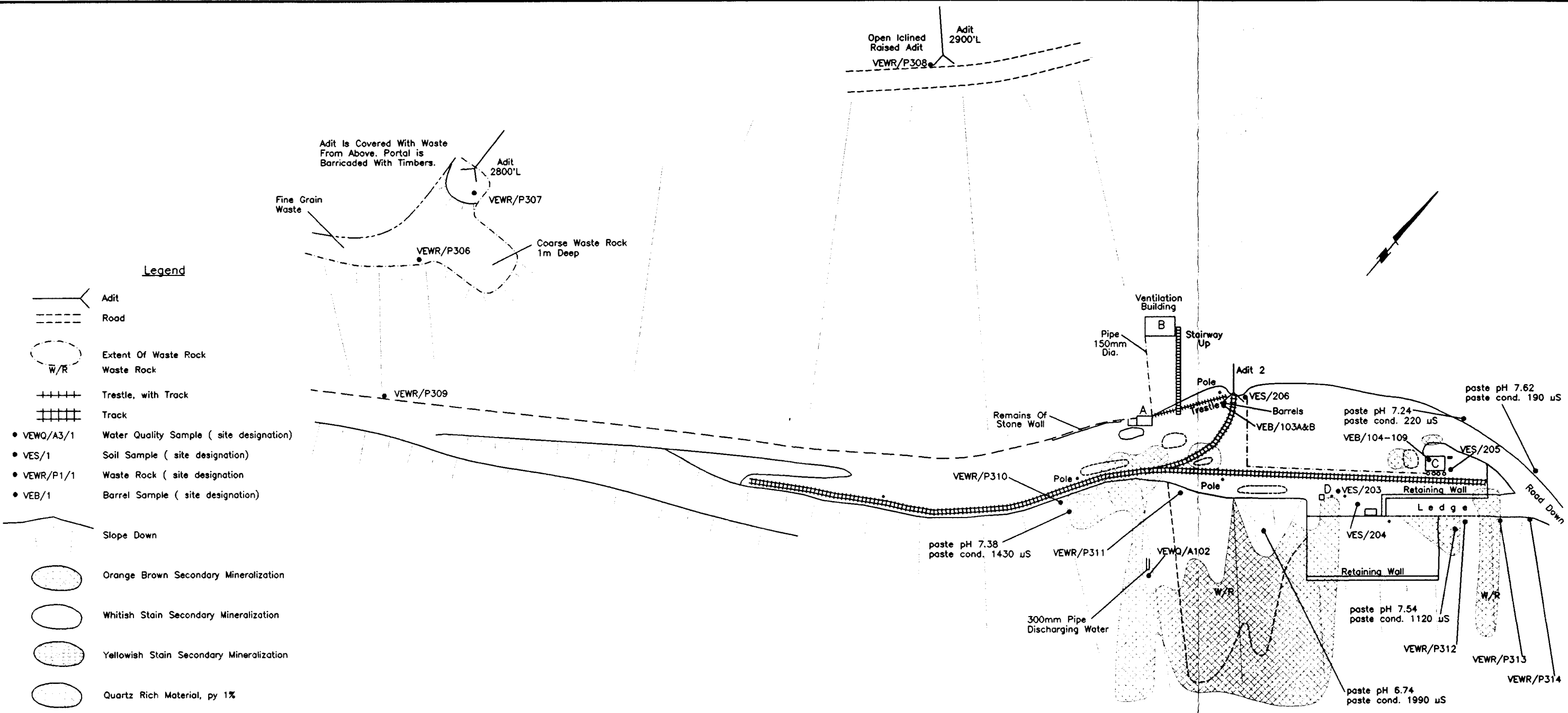
Western Region

Venus Mine
Site & Photo Information
Adit 2
Yukon Territory

project no. / no. du projet: 668724
dwg. no. / dessin no.: 3 of 4



Legend

- Adit
- Road
- Extent Of Waste Rock
- W/R Waste Rock
- Trestle, with Track
- Track
- • VEWQ/A3/1 Water Quality Sample (site designation)
- • VES/1 Soil Sample (site designation)
- • VEWR/P1/1 Waste Rock (site designation
- • VEB/1 Barrel Sample (site designation)
- Slope Down
- Orange Brown Secondary Mineralization
- Whitish Stain Secondary Mineralization
- Yellowish Stain Secondary Mineralization
- Quartz Rich Material, py 1%
- Buildings
- Extent of Debris, Timber, Cable, Pipe, etc.

Waste Rock Sample#	paste pH Sample#	paste cond. µS/cm
VEWR/P309	–	–
VEWR/P310	7.73	510
VEWR/P311	7.08	1430
VEWR/P312	7.94	480
VEWR/P313	8.09	310
VEWR/P314	–	340

Approx. Scale: 1:1000

PLOT: 1=1
CAD FILE: INVEN-96\VENUS\VENUS-2A

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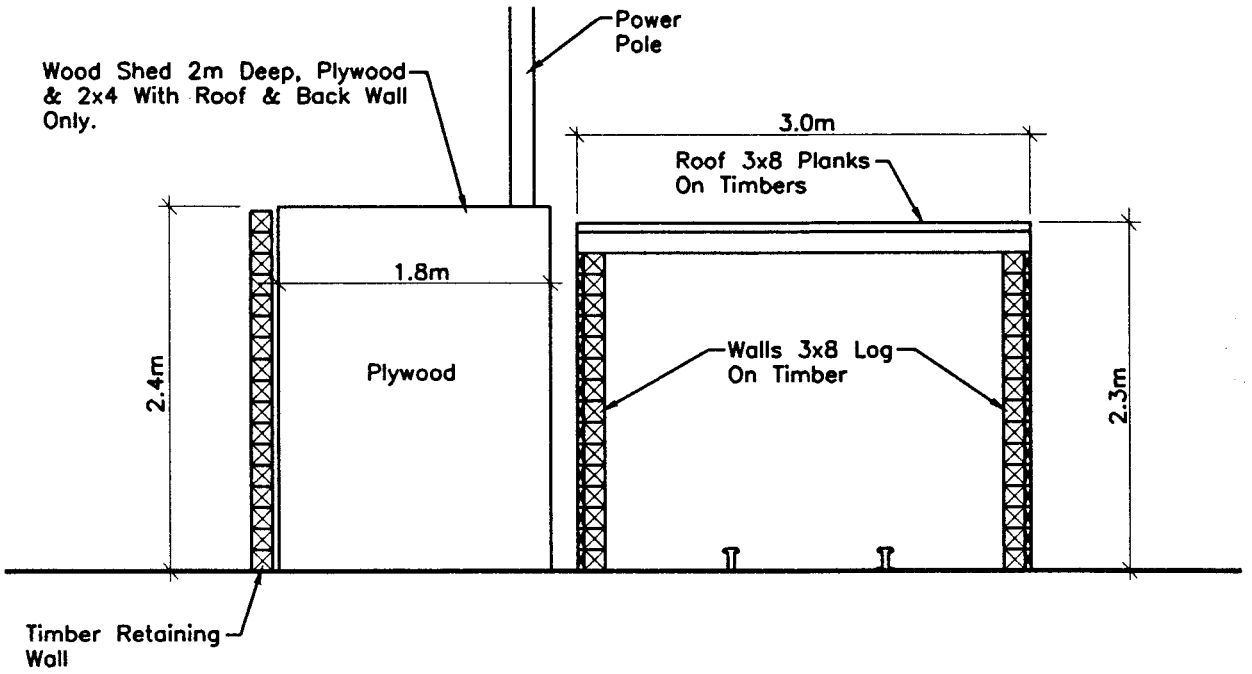
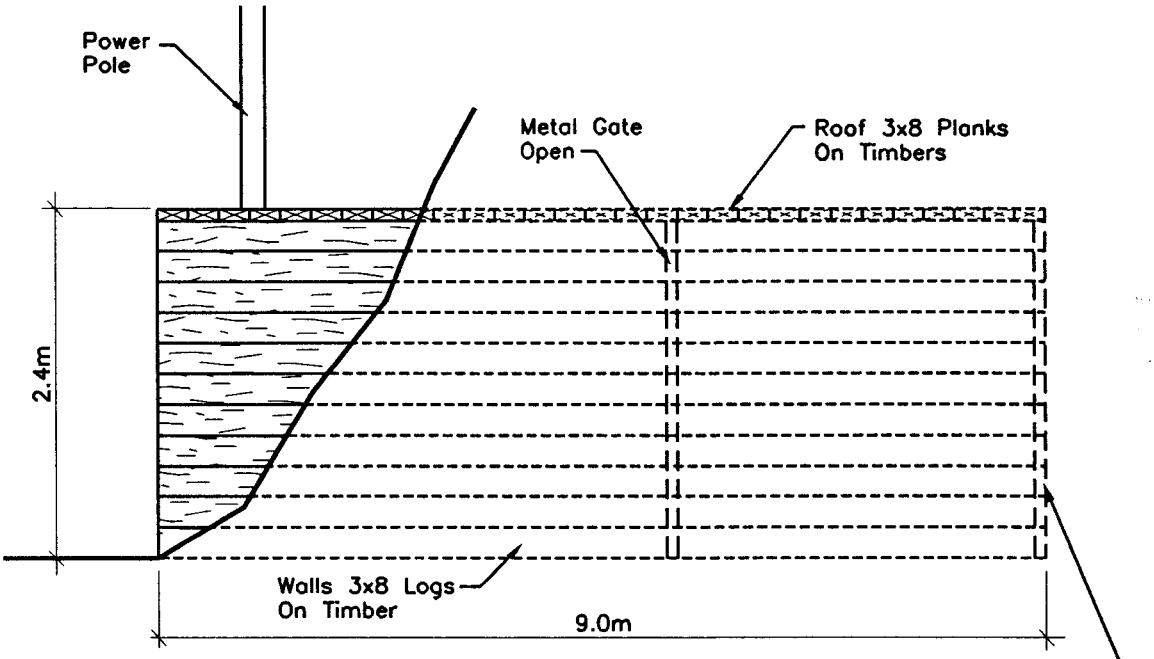
Dwg. no. / dessin no.: 4 of 4



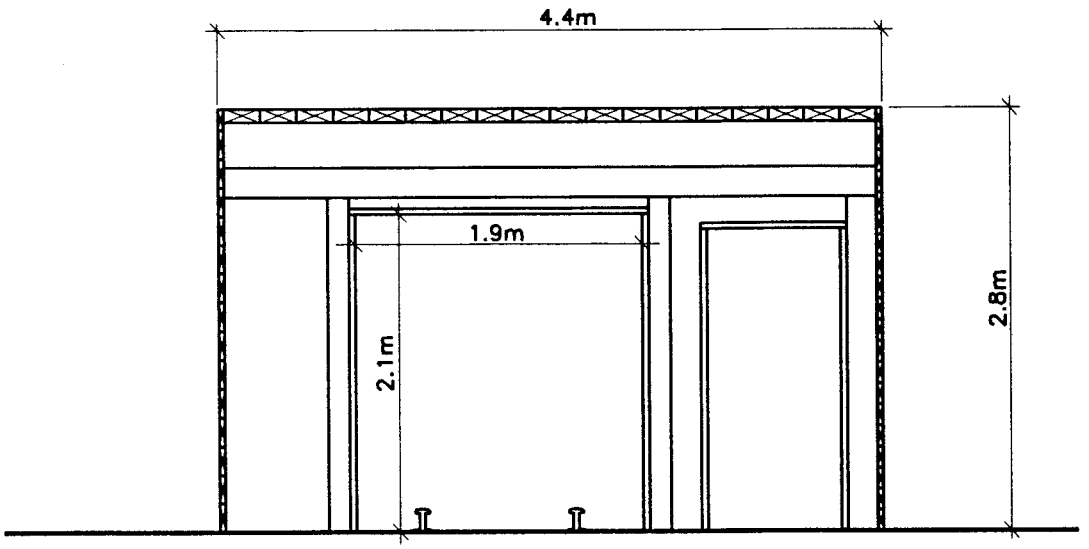
FRONT VIEW
N.T.S.



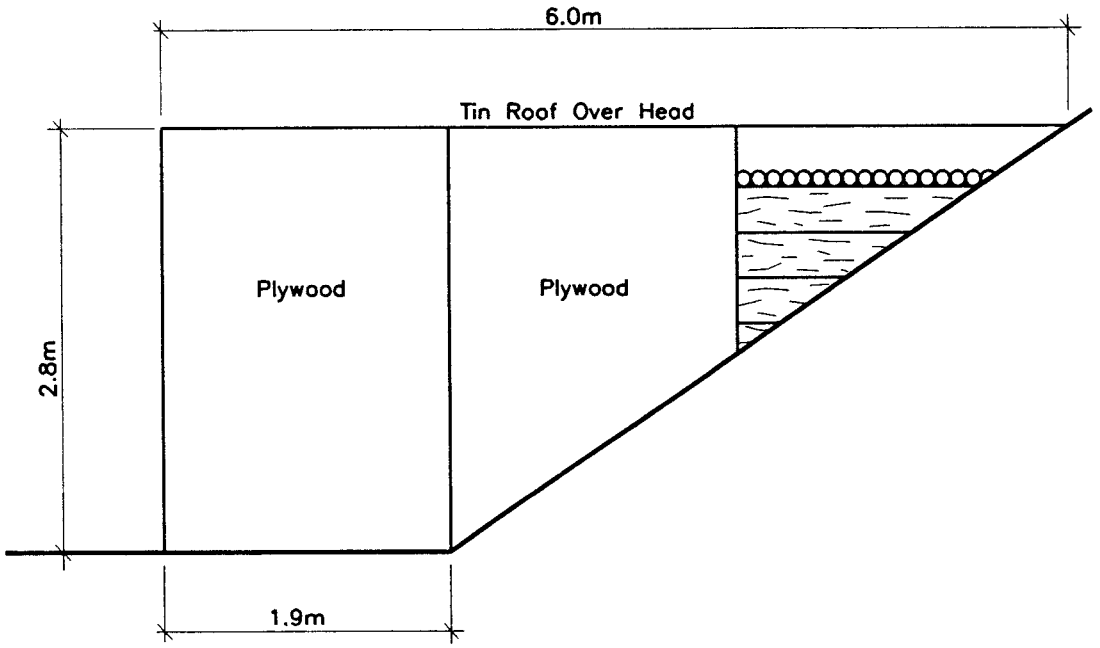
INSIDE SIDE VIEW
N.T.S.

CAD FILE: INVEN-96\VENUS\VENUS-3 PLOT: 20=1

Venus Mine
Adit 1



FRONT VIEW
N.T.S.



INSIDE SIDE VIEW
N.T.S.

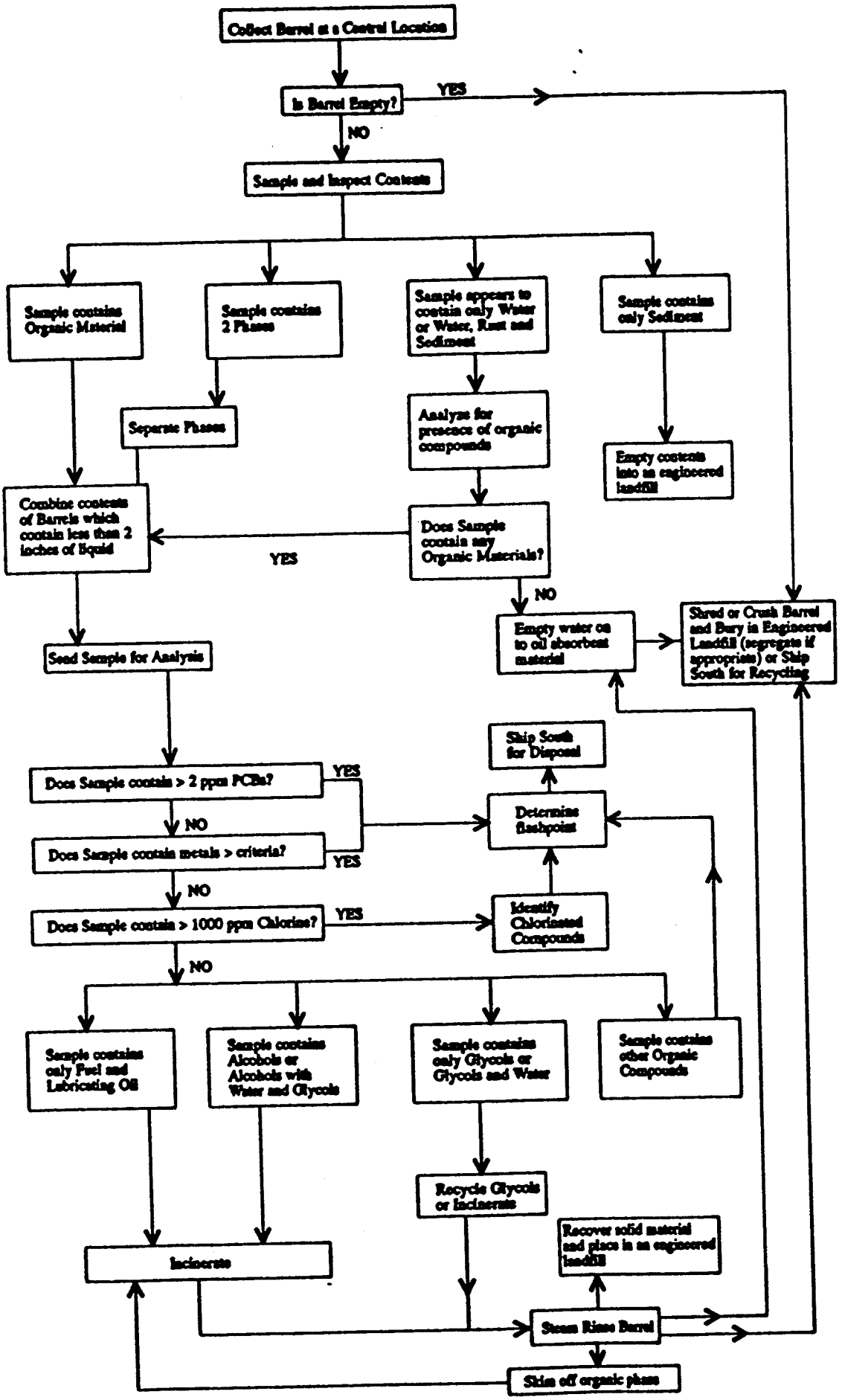
CAD FILE: INVEN-96\VENUS\VENUS-4 PLOT: 20=1

Venus Mine
Adit 2

APPENDIX E

BARREL PROTOCOL

FLOW CHART FOR THE DEW LINE CLEANUP OF BARRELS



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.*