PHASE II ENVIRONMENTAL ASSESSMENT

OF THE

HOEY

ABANDONED MINE SITE

prepared for:

Action on Waste Program
Indian and Northern Affairs Canada

prepared by:

Environmental Services
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EXECUTIVE SUMMARY

A phase II environmental assessment was conducted at the Hoey abandoned mine site (61° 33' 26 " N, 132° 09 '08" W) in July, 1996 by Environmental Services, Public Works and Government Services Canada for the Action on Waste Program, Indian and Northern Affairs Canada. Based on the findings of the Phase I investigation performed in 1993 by DIAND Technical Services, a phase II assessment was conducted to a) identify potential environmental and human health risks associated with the present condition of the mine site, and b) provide recommendations and preliminary cost estimates for remediation of those risks.

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

The results of the investigation concluded that two mine openings are in unstable condition and are not adequately secured from public and wildlife access. The rails and trestles in front of the lower and upper adit are physically unstable and pose a health and safety hazard to humans visiting the site. An assessment of the acid rock drainage potential shows that the risk to the environment due to the presence of waste rock and adits is minor at this time. Thirteen full and partially full barrels pose a risk to the environment. Based on sampling results the liquid wastes are suitable for incineration. Aesthetic concerns arise from miscellaneous debris scattered though out the site.

Using applicable federal and territorial criteria, background characteristics, as well as northern mine reclamation guidelines, the recommendations are to secure all the two mine openings using surrounding rock and soil, remove and burn timbers, demolish and bury on site rails and trestles, collect and bury on-site all site debris. No further test work is recommended on the waste rock. It is recommended that every five years a monitoring program be undertaken to obtain water quality data for spring freshet, middle summer and late fall conditions. Should further development occur on the site, regulatory agencies should ensure that an acid drainage prevention plan is developed which includes detailed measures for handling and disposal of mineralized waste rock.

Summary of Conclusions and Recommendations

ASSESSMENT COMPONENT	RISK	RECOMMENDATION
1. Building, Infrastructure, Equipment		
1 shed - wood	Health and Safety	burn
upper rail/trestles	Health and Safety	burn and bury
lower rail/trestles	Health and Safety	burn and bury
off-site shack	Health and Safety	burn
2. Non-Hazardous Waste Material		
Waste dump area - ore cars, pressure vessels, rails, empty BLS	Aesthetic	bury
timber piles < 50 m^3	Aesthetic	burn
rail piles < 20 m^3	Aesthetic	bury
3 Empty Barrels - exploration site	Aesthetic	crush and bury
Misc. Debris	Aesthetic	burn combustibles & bury
3. Hazardous Materials		
13 full & partly full barrels - exploration site	Environmental	Use as fuel for burning, remainder remove and incinerate
4. Water Quality		
Mine Seepage - upper/ lower adit	Minor environmental risk	No Action
Site Drainage - stream	Minor environmental risk	No Action
Receiving Waters - creek	Minor environmental risk	No Action
5. Waste Rock Disposal Areas		
2 large piles	Minor environmental risk	No Action
6. Mine Openings		
2 adits (upper/lower)	Health and Safety	Seal with Waste Rock
7. Tailings		
None		

1.0 INTRODUCTION AND BACKGROUND

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

The phase I investigation revealed that there exists two unsealed and collapsing adits at the camp site that pose a potential public safety hazard. The site also contained assorted waste debris, a small building, a rails and trestles structure, and several piles of waste rock. At the exploration site there are numerous barrels with suspected petroleum hydrocarbons and some wood debris.

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

1.1 LOCATION

Hoey minesite is located at 61° 32'39"N latitude and 132°10'37"W longitude (Figure 1). The exploration site is located approximately 50km directly south southeast of the village of Ross River. The exploration site is at 1770m and the camp site is at 1370m above sea level.

1.2 OVERVIEW OF SITE DEVELOPMENT

The history of development of the site is compiled in the Minfile record 105F 055 and is summarized here. The original claims were staked in 1948. Subsequently, the property was mapped and tested with hand trenching and one packsack hole drilled to 11m in 1955. In 1964-66, dozer trenching was performed and 9 holes drilled for a total of 407 m.

A 58m adit was excavated in 1968. Additional dozer trenching and 359.3m of drilling in ~6 holes was conducted in 1976. The adit was advanced 42 m in 1980, and between 1985-87, exploration included dozer trenching and 1171 m of drilling in 13 holes.

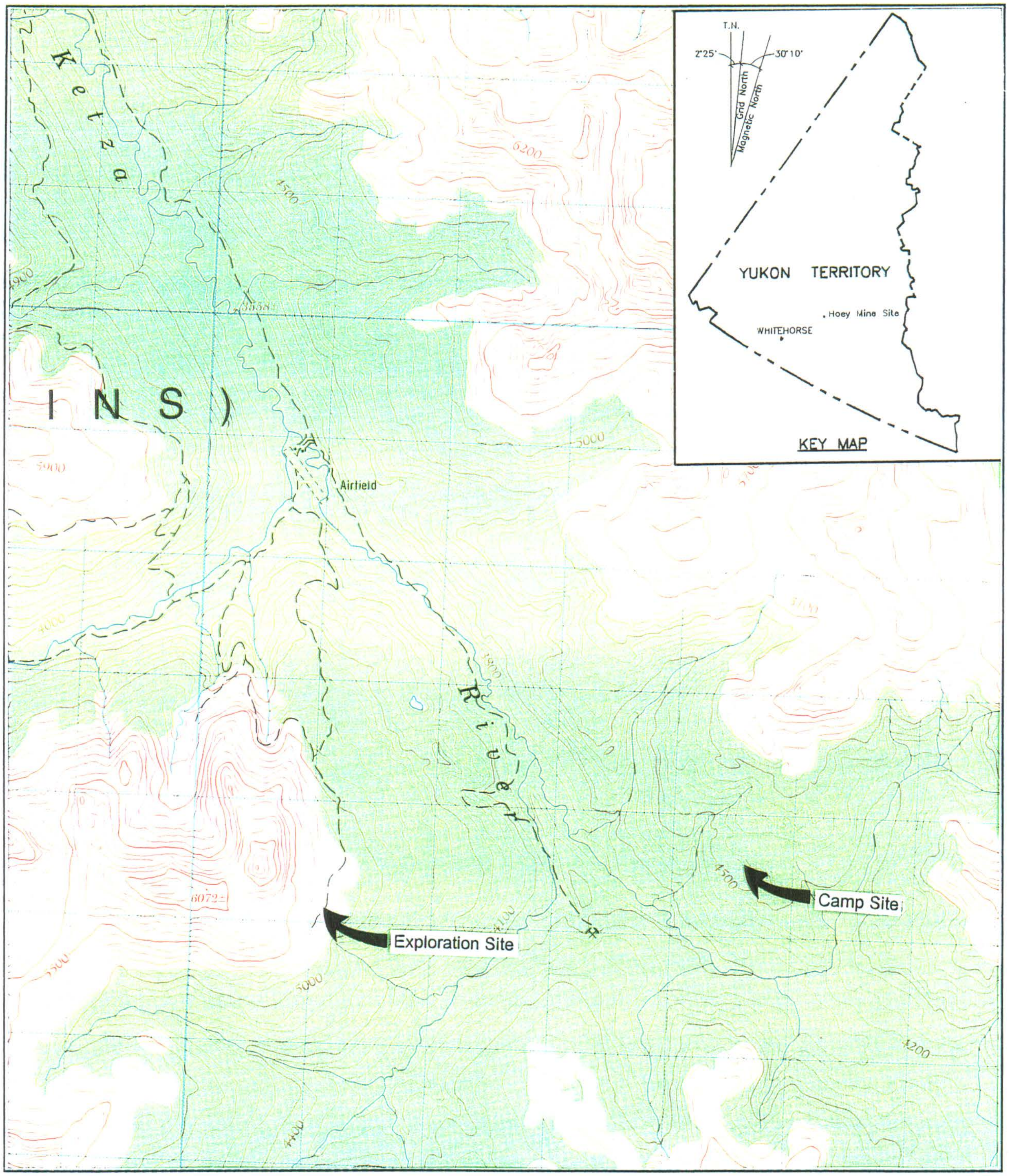

Figure 1. Location of Hoey Mine - 1:50,000, NTS-105F/9 [Energy Mines and Resources Canada: 1971]

1.3 SITE ACCESS

By road, the site is reached by travelling approximately 35km southeast from Ross River on the Campbell Highway then turning south and travelling 30km on the Ketza River road to an airstrip beside the road. The site is located approximately 3km south of the airstrip and up a road accessible by all terrain vehicle.

2.0 PURPOSE AND SCOPE OF WORK

The following assessment activities were completed:

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

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

- Physical stabilization of waste rock disposal areas;
- Chemical stabilization of the waste rock disposal areas as appropriate to local and background conditions, taking into account impact, on-site resources, and accessibility;
- Sealing of all mine openings;
- Consolidation and landfill of all non-hazardous, non-combustible solid wastes;
- Remediation or removal and disposal of contaminated soils as required to meet the more stringent of: Yukon Government's Contaminated Sites Regulations (1996) Schedule 1; and Canadian Council of Ministers of the Environment's Interim Canadian Environmental Quality Criteria for Contaminated Sites (1991) Commercial/Industrial criteria for soils;
- Removal and disposal of hazardous solid wastes;

- Draining, cleaning and disposal of drums or other containers containing petroleum products or other liquid hazardous wastes;
- Onsite flaring or removal and off-site disposal of petroleum products and other liquid hazardous wastes; and
- Demolition of buildings and infrastructure to foundation level and burning of combustible non-hazardous materials in approved location

3.0 SITE ASSESSMENT METHODOLOGY

3.1 ASSUMPTIONS

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

3.2 ASSESSMENT CRITERIA

3.2.1 Criteria and Guidelines

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

A. Soils:

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

B. Water:

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

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

C. Mine Clean-Up and Reclamation:

INAC:	Mine Reclamation in Northwest Territories and Yukon

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

3.3.2 Site Assessment Components

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

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

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

Mine Openings were inspected and documented to identify closure requirements.

Non-Hazardous Site Debris was inventoried.

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

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

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

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

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

3.3.3 Sampling Methods and Quality Assurance

Test Pit Sampling

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

Approximately 2 kg of rock was collected at each sample site. For test pits showing a homogeneous wall face, a plastic sheet was placed at the bottom of the test pit and the pit wall was cut vertically down with a cleaned shovel. All rock larger than 75 mm

in size was discarded. The sample was coned and quartered, discarding opposite quarters, until a 2 kg sample was obtained.

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

Water Sampling

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

250 ml water samples were collected by hand, facing upstream, ensuring that the

sample is not contaminated by disturbed sediment, debris and other floating materials. Sample bottles were rinsed three times with water from the sample stream prior to collecting the sample.

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

Soil Sampling

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

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

Barrel, Pail, and Above-Ground Storage Tank Sampling

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

One Above-Ground Storage Tank (AST) was sampled with a stainless steel Bacon bomb sampler. A plunger at the tip of the sampler depressed when contact with the tank bottom was made, allowing petroleum product to enter the body of the sampler. When the sampler was raised, the plunger closed to seal the sampler and allow removal of the sample from the AST. The sampled hydrocarbon was then drained into a 40-ml laboratory-cleaned vial which was then sealed and placed in a container for shipment to the laboratory. The bomb sampler was cleaned with laboratory-grade detergent between sampling events.

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

Quality Assurance

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

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

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

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

4.0 ENVIRONMENTAL SETTING

4.1 MINERALIZATION

The geology of the site is dominated by metamorphosed sedimentary rocks of Silurian and Devonian age. The host rock for the mineralization is a gray, platy to massive schist with strong lineation and folding. Mineralization consists of parallel bands of galena, with pyrite and tetrahedrite, which cross-cut the schist.

The major commodities at the Hoey site are silver, lead, and gold with minor copper.

4.2 SURFACE HYDROLOGY

The site drainage is to the east-southeast draining into the Ketza River (see Figure 1). The Ketza River falls within the Yukon River drainage system. Mine water seepage flows from the main adit and through stockpiled waste rock drain indirectly to Ketza River. A seasonal stream flows southeast into the Ketza River and occurs immediately adjacent to the south side of the mine site.

Flow from the lower adit was approximately 5 L/min. at the time of the site visit. The Ketza River flows at approximately 500 L/sec and the small tributary stream was flowing approximately L/sec. Baseline water quality data for the Ketza River is provided in the section on surface water quality (section 5.3)

4.3 CLIMATE

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

4.4 VEGETATION

Hoey mine site occurs within the Pelly Mountains ecoregion. Much of the ecoregion lies above the treeline, and is dominated by treeless tundra vegetation including lichens, dwarf ericaceous shrubs, birch and willows. Wetter sites are occupied by grasses, sedges, cottongrass and mosses. Subalpine regions are characterized by open stands of black and white spruce and alpine fir. Valleys and lower elevation slopes may be occupied by aspen and scrub birch.

4.5 FISH AND WILDLIFE RESOURCES

Alpine habitats are typically low in both species number and diversity. Bird species noted at the site include bald eagle, ptarmigan and rosy finches. Arctic ground squirrels and pika are the dominant rodent species and support a number of carnivorous species including wolf, coyote, and bear. Ungulates include caribou, moose and mountain sheep. This area is only able to support these species during the short summer period and most animals hibernate or move to lower elevations during the long cold winters.

Arctic Grayling and Slimy Sculpin have been observed and netted in the Ketza River. Though they do not spawn there, Chinook Salmon may overwinter in the river. Other species may include: Broad Whitefish, Rainbow Trout, Cutthroat Trout, Rainbow Trout, and Longnose.

4.6 SITE TOPOGRAPHY AND SOILS

The regional and site topography are mountainous, with a relief of about 1,200 metres at the Ketza River to 2,000 metres at some of the higher peaks. The mountains, though steep, are rounded with few cliffs and rock outcrops and can be easily traversed. The level of the main adit, site workings, and waste rock stockpiles is at 1212 metres lying 8 metres above the Ketza River to the northeast. Towards the southwest lies the upper adit and main shaft on steep slopes.

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

The Pelly Mountains ecoregion is dominated by two soil types - dystric brunisols and eutric brunisols. Turbic cryosolic soil occurs sporadically.

4.7 PERMAFROST

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

5.0 SITE DESCRIPTION AND FINDINGS

5.1 BUILDING, INFRASTRUCTURE, and EQUIPMENT

Table 1 lists all buildings, infrastructure and equipment on site by location and volume.

5.2 NON-HAZARDOUS WASTE MATERIALS

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

Table 1 Buildings, Infrastructure, and Equipment

ITEM	LOCATION	LENGTH/VOL./NO.	MATERIAL
Shed	In front of lower adit	11x4x2.4 m	wood, asphalt shingle, window
Rail and Trestle	In front of lower adit	30 m long, 15 m^3 timbers	steel, wood
Rail and Trestle	In front of upper adit	42 m long,15 m^3 timbers	steel, wood
Shed	Off-site 100m north on road	3 x 4x 3 m	wood

Table 2 Non-Hazardous Waste Materials

Waste Material	Number/Volume	Location	Comments
Logs	approx.150 - 8 ft. Pieces	lower site	stacked in 4 piles
Rails	4 pieces scattered	lower site	stacked in 4 piles
Ore cars, press. vessels, ore car wheels, 3-5m rails	approx. 55 m^3	Dump site 90 m north of shed on road	road connected to lower site
Empty Barrels	3	exploration site	some visible staining
Empty Barrels	2	southwest gully, dump	no visible staining
Debris	< 15 m^3	-scattered throughout camp site -inside shed	metal, wood, and plastic

5.3 HAZARDOUS MATERIALS

Abandoned barrels were located at the exploration site. Of the 16 barrels inventoried, 3 were empty, 6 had not been opened before, 6 had residual water and minimal petroleum hydrocarbons (<3"), and one was half full and sealed. A representative sample was taken from the last barrel and tested for disposal by incineration. These results are shown in Table 3.

Soil staining was evident in the soils underneath the barrels and sampled for lead, polycyclic aromatic hydrocarbons (PAHs), and total extractible hydrocarbons (TEHs). The concentration of total extractable hydrocarbons (THE) is above Yukon remediation criteria indicating that there is petroleum hydrocarbon contaminated soils. Based on observation, the contaminated area is approximately $25m^2$ and 1 m deep. Hydrocarbon distributions indicate that contamination is the result of diesel likely attributable to waste oil spills or leaks. One compound, Phenanthrene, was shown to have a concentration of 20.5 ppm in the surface soils which is above the criteria of 10 ppm. The other 15 PAH compounds were well below criteria. Laboratory results are detailed in Table 4 below. Complete analytical results are provided in Appendix B.

Table 3 Results of Barrel Sampling for Incineration

Parameter	Barrel Protocol Criteria (ppm)	Stu/Brl/1 (ppm)
Cadmium	2	< 1
Chromium	10	< 1
Lead	100	7.8
Total Organic Halides	1000	< 2
PCBs	2	n/a

Note: PCBs were not sampled if the Total Organic Halides were less than 2 ppm.

Table 4 Soil Sample Laboratory Results

Parameter	Yukon Criteria - Industrial (ppm)	CCME - Com./Indust. (ppm)	Hoey-s-1 (ppm)
Lead	n/a	1000	72
PAH's	10	10	0.5 to 20.5
THE's	2000	n/a	38,000

5.4 SURFACE WATER QUALITY

A water sample was collected from each of the two adits, and immediately upstream and downstream of the site in the gully to the west of the disturbed area. Water samples HOEYWQ/A2 and HOEYWQ/A1 were collected from water flowing from the upper and lower adits, respectively. Samples HOEYWQ/STR1/2 and HOEY/WQ/STR1/1 were collected upstream 20m and downstream 20m of the site, respectively.

Results of water quality analyses are listed in Appendix C and summarized in Table 5. Water sampled from the adits had slightly alkaline pH. The conductivity of these waters was high (mean=1052 µmhos/cm) and the sulphate was greater than 300 mg/L. Metal concentrations were generally below the limits of detection except for iron (mean=0.07 mg/L), magnesium (81 mg/L), and manganese (0.018 mg/L). All metals were below the MMLE criteria. The detection limits for several metals were above the CCME guidelines for freshwater aquatic life.

The quality of the water downstream from the site (STR1/1) is similar to that of the adit samples, although the conductivity (823 µmohs/cm), sulphate concentration (257 mg/L), and metal concentrations are slightly lower than those in the adit water. Conductivity and sulphate concentrations in the upstream water sample (STR1/2) are much lower than in the adit water, but are still moderate. Conductivity, for example, is 420 µmhos/cm and sulphate concentration is 63 mg/L. Furthermore, iron, magnesium and manganese concentrations are *higher* than in the adit water. Concentrations of these metals are 0.36 mg/L, 25 mg/L, and 0.33 mg/L, respectively. Generally, there was no significant variation between the downstream and upstream water qualities.

A complete acid rock drainage assessment is provided Appendix A .

5.5 WASTE ROCK DISPOSAL AREAS

Waste at the site consists of two large rock piles deposited by end-dumping from trestles outside of the upper and lower adits. The total volume of waste at the site is approximately 17,130 tons (15,544 tonnes). This volume assumes that the average density of the waste is 115 pounds per cubic foot (pcf).

There are two large waste rock piles at the site, a lower and an upper pile. The waste rock is composed primarily of shale and schist with smaller amounts of quartz

Table 5 Surface Water Samples - Significant Results

Sample ID	Sample Location	pH	Conductivity (µmhos/cm)	Metals	Other
HOWQ/A1/1	Lower Adit	7.88 (8.14)	1110 (910)	low	sulphate=331 mg/L
HOWQ/A2/1	Upper Adit	7.96 (8.30)	994 (710)	low	sulphate=311 mg/L
HOWQ/STR1/1	Downstream approx. 20m from exploration site	8.04 (8.39)	535 (680)	low	sulphate=135 mg/L
HOWQ/STR1/2	Upstream approx. 20m from exploration site	8.17 (8.39)	548 (300)	low	sulphate=138 mg/L

and dark brown to black crystalline calcium carbonate. The upper dump also contains blocks of galena and pyrite in limestone. These blocks have hematite, limonite and yellow-green sulphur staining on the surfaces.

Five sample pits were dug, two in the upper dump and three in the lower dump. Besides an armor of moderately durable crust ~1.5 in. (3 cm) thick, no weathering horizons were seen in any of the sample pits. Therefore, only one sample was collected from each pit. Locations of all geochemical samples are shown on the site map.

Samples HOEYWR/P1 and HOEYWR/P2 were collected from the upper waste rock pile and samples HOEYWR/P3, HOEYWR/P4, and HOEYWR/P5 were collected from the lower waste rock pile. Rock types on the surface of the upper pile include schist; vein quartz; sulphide-bearing limestone; and brown to black calcite. The surface of the lower pile is scattered with dark orange-brown $CaCO_3$ crystals and cobbles of $CaCO_3$ and gray schist.

Results of geochemical analyses of waste rock samples are presented in Appendix A and summarized in Table 6. The five waste rock samples had laboratory and field paste pH values that were neutral to alkaline, indicating that waste is not currently generating acid. Paste field conductivities were more variable ranging from 110 µS/cm to 900 µS/cm (mean=483 µS/cm). Total sulphur concentrations ranged between 0.68% and 2.2% (mean=1.3%) and much of this was present as sulphide. Two of the samples, HOEYWR/P2 and HOEYWR/P3, had NP/AP ratios of 1.8 and 2.6, respectively, indicating that they are potentially acid generating.

The waste samples contained high concentrations of iron, lead, and manganese. For example, samples P2, P3, and P5 each contained >10,000 mg/L manganese and had lead concentrations of >10,000 mg/L, >10,000 mg/L, and 8110 mg/L, respectively. These samples also contained elevated concentrations of antimony, copper, nickel, and silver. Samples P1 and P4 contained a similar distribution of these metals, but concentrations were lower. These two samples also contained over 8% calcium, indicating that these sections of waste probably contain higher concentrations of calcite than the other sections.

Table 6 Summary Acid/Base Accounting Test Results

Sample ID	Sample Location and Description	Discussion of Results
HOEY/WR/P1/1	Gray to dark gray, composed primarily of pebbles and cobbles (up to ~5 in. (12 cm)). Clast supported with a sandy matrix.	Low potential for acid generation (NP/AP=12); high Ca, Fe, Mn, P; moderate As, Pb.
HOEY/WR/P2/1	Brown, clayey-sand matrix among clast-supported pebble to cobble sized clasts. Within the top 10 cm there are pockets of limonite staining with some iron oxide cementation of grains.	Potentially acid generating (NP/AP=1.8); high Cu, Fe, P, Pb, Mn; moderate Sb, Co, Ni, Ag.
HOEY/WR/P3/1	Dark orange-brown to brown sandy matrix among pebble to small cobble-sized clasts. Clast supported, unconsolidated material. Rare (< 1%) small (< 0.5 cm) patches of limonite.	Potentially acid generating (NP/AP=2.6); high Cu, Fe, Pb, Mn; moderate Sb, Co, Ni, Ag.
HOEY/WR/P4/1	Green-gray slightly clayey sand matrix among abundant pebbles and cobbles (clast- supported). Rocks primarily dark gray angular, blocky shale.	Low potential for acid generation (NP/AP=40); high Ca, Fe, Pb, Mn; moderate As.
HOEY/WR/P5/1	Brown sandy matrix among mostly pebbles and small cobbles (clast supported). Surface cobbles are composed of massive gray shale.	Low potential for acid generation (NP/AP=4); high Fe, Pb, Mn; moderate Cu, Ni, Zn.

5.6 MINE OPENINGS AND EXCAVATIONS

Two adits are left abandoned on-site. All opening structures are dilapidated and unstable. The surrounding rock and soil above both adits are in unstable condition and presents an immediate safety hazard. Table 7 summarizes the findings of the mine openings investigation.

Table 7 Mine Openings

Adit	Location	Drift Length	Condition
Lower Adit	lower staging area, 1151 m elev.	67 metres	unstable condition - loose rock above opening, timber structure rotting, 2x6 cladding partially blocking entrance, drift partly collapsed at opening
Upper Adit	upper site, 1182 m elev.	Unknown	unstable condition - loose rock above, dilapidated timber support structures

5.7 TAILINGS

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

6.0 CONCLUSIONS

The primary concern is the health and safety of humans and wildlife relating to the collapsing mine openings and the unstable rails and trestles. A secondary concern is the risk to the environment resulting from the presence of waste petroleum hydrocarbons at the exploration camp. Also is the aesthetic appearance of scattered timbers, metal debris site, and loose tanks and barrels located throughout the site.

6.1 HEALTH AND SAFETY

The two mine adits are in unstable condition and are not adequately secured from public and wildlife access. The lower adit is collapsed and remains unstable due both to the rotting supporting structure and surrounding soils and rock. The upper adit remains open and is readily accessible to the public. The unstable supporting structure is collapsed and entrance partly blocked by rotting timbers.

The rails and trestles in front of both the lower and upper adits are physically unstable and pose a health and safety hazard to humans visiting the site. Several large timbers used for loading and transporting ore are left perched and are a safety hazard.

One shack remains on site and presents a potential safety hazard to visitors.

6.2 Environmental Risks

Water from the adits is not acidic. Elevated conductivities indicate that oxidation is occurring and the resulting acid products are being buffered by neutralizing capacity in the wallrock. Metal concentrations appear to be low and are below the MMLE regulation and standards.

Water flowing from the site appears to have caused an increase in the conductivity and sulphate concentration of the stream bordering the site. Iron, magnesium, and manganese concentrations were higher in waters collected upstream from the site than in the water collected downstream. This suggests either that there is a source of metals upstream or that the area around the Hoey site has elevated background concentrations of these metals.

Waste rock at the site is not currently generating acid. However, the variable paste conductivities measured indicate that oxidation is occurring, and is more rapid in some portions of the waste than others. Approximately one eighth, or 2100 tons (1900 tonnes) of the waste at the site could potentially generate acid in the future, and this waste is located on the top of both rock piles. This material has been exposed to weathering at least since 1980, when the last reported work on the adits was conducted, and thus far any acidity produced has been buffered by the neutralizing minerals in the waste. If the neutralizing capacity in these portions of the waste should be exhausted, there is sufficient NP in the underlying waste to buffer any acid produced thereafter.

6.3 Aesthetic Concerns

Miscellaneous site debris, one shed (not suitable for shelter), rail and timbers, and a dilapidated trestles in front of the upper and lower adit present aesthetic concerns.

7.0 RECOMMENDATIONS

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

Recommendation 1.

It is recommended that the two mine openings be secured from human and animal access for health and safety reasons. Openings should be covered with surrounding rock and soil using readily available equipment. Timbers should be removed and buried along with other site debris. Should the mine need to be reopened, access to workings is achievable with heavy equipment.

Recommendation 2.

It is recommended that the rails and trestles, shed, and load out ramp be demolished and burned on site for health and safety reasons. This can be accomplished using locally available resources and labour and can be buried on-site together with other site debris. Burial can occur by covering waste material with surrounding rock and soil on a clearing adjacent to a rock slope.

Recommendation 3.

No further test work is recommended on the waste rock. It is recommended that every five years a monitoring program be undertaken to obtain water quality data for spring freshet, middle summer and late fall conditions. Water quality sampling is required to monitor the impact of the acid generating waste on the receiving environment. The method detection limits used are to satisfy the CCME criteria for fresh water aquatic life.

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

Recommendation 4.

Thirteen full and partially full barrels left on site contain waste petroleum hydrocarbons that should be immediately removed from the site and disposed of appropriately. If the cleanup is conducted along in a regional cleanup, the barrel contents may be incinerated at a temporary barrel incineration facility established for the purpose of incinerating waste hydrocarbons at several mine sites in the area.

Recommendation 5.

It is recommended that site debris be collected and buried on-site for aesthetic reasons. Combustible nonhazardous wastes can be burned. Empty barrels should be crushed and buried. Noncombustible wastes are also to be buried.

8.0 COST ESTIMATES TO IMPLEMENT RECOMMENDATIONS

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

REFERENCES

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

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APPENDIX A

Determination of Acid Rock Drainage Potential

HOEY
ACID ROCK DRAINAGE
ASSESSMENT REPORT

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P118105

HOEY
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 Hoey Abandoned Mine Site*, prepared by Environmental Services, Public Works and Government Services Canada (PWGSC). The reader is directed to that report for a comprehensive environmental assessment of the Hoey site.

The Hoey exploration site is located approximately 50 km south-southeast of Ross River, the Yukon Territory. The site is accessible by four-wheel drive vehicle.

Mining related disturbances observed during the site assessment consist of two adits and two waste rock piles. No mill or tailings pond is present at the site.

The site is situated on the side of an unnamed mountain above the Ketza River Valley. The area is covered by a thin, discontinuous layer of glacial till and is above the treeline. Vegetation at the site consists of short alpine grasses and willows.

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

2.0 GEOLOGY AND MINERALIZATION

The geology of the site is dominated by metamorphosed sedimentary rocks of Silurian and Devonian age. The host rock for the mineralization is a gray, platy to massive schist with strong lineation and folding. Mineralization consists of parallel bands of galena (PbS), with pyrite (FeS_2) and tetrahedrite ($(Cu,Fe)_{12}Sb_4S_{13}$), which cross-cut the schist.

The commodities of interest at the Hoey site are silver, lead, and gold.

3.0 WASTE DISPOSAL AREAS

3.1 Description

Two large rock piles were deposited by end-dumping from trestles outside of the upper and lower adits. The total volume of waste at the site is approximately 15,544 tonnes (17,130 tons). This volume assumes that the average density of the waste is 1.8 tonnes per cubic metre.

The rock in the piles is composed primarily of shale and schist with small amounts of quartz vein and dark brown to black crystalline calcium carbonate. The upper dump also contains blocks of galena and pyrite in limestone. These blocks have hematite, limonite, and yellow-green sulphur staining on the surfaces.

3.2 Samples

Five pits were excavated, two in the upper pile and three in the lower pile. Besides a moderately durable crust, ~1.5 in. (3 cm) thick, no weathering horizons were observed in any of the pits. Therefore, only one sample was collected from each pit. Locations of all geochemical samples are shown on the site map, Drawing 2.

Samples HOEYWR/P1 and HOEYWR/P2 were collected from the upper rock pile and samples HOEYWR/P3, HOEYWR/P4, and HOEYWR/P5 were collected from the lower rock pile. Rock types on the surface of the upper pile include schist: vein quartz; sulphide-bearing limestone; and brown to black calcite. The surface of the lower pile is scattered with dark orange/brown calcite ($CaCO_3$) crystals and cobbles of calcite and gray schist. The test pit logs are summarized in Table 1.

A water sample was collected from each of the two adits, and immediately upstream and downstream of the site in the gully bordering the site to the west. Water samples HOEY/WQ/A1 and HOEY/WQ/A2/1 were collected from water flowing from the upper and lower adits, respectively. Samples HOEY/WQ/STR1/1 and HOEY/WQ/STR1/2 were collected approximately 20 m downstream and upstream of the site, respectively.

3.3 Analytical Results

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

Paste Parameters

The laboratory and field paste pH values of the five rock samples were neutral to alkaline, indicating that waste is not currently generating acid. Paste field conductivities were variable ranging from 110 μS/cm to 900 μS/cm (mean=483 μS/cm).

Acid Base Accounting

Total sulphur concentrations ranged between 0.68% and 2.2% (mean=1.3%) and much of this was present as sulphide. Samples, HOEYWR/P2 and HOEYWR/P3, had NP:AP ratios of 1.8 and 2.6, respectively, suggesting a potential for acid generation.

Metals Concentrations

The samples that exhibited the lower NP:AP ratios are mineralized primarily in pyrite, but are also enriched in copper and lead minerals. Concentrations of other metals of concern are relatively low.

Water Quality

Water from the adits had slightly alkaline pH, with elevated conductivity (mean=1052 μS/cm). Concentrations of metals of concern were generally below the limits of detection.

The impact of the site discharge on the downstream water quality (STR1/1) is indicated primarily by a twofold increase in sulphate, calcium and magnesium. The alkalinity from the site discharge results in a decrease in zinc.

4.0 EXISTING OR POTENTIAL ACID ROCK DRAINAGE CONDITIONS

Water discharging from the adits (samples A1 and A2/1) is not acidic. Elevated conductivities indicate that oxidation is occurring, but that the resulting oxidation products are being buffered by the excess neutralizing capacity in the host rock. Metal concentrations are low, and do not exceed the Metal Mine Liquid Effluent (MMLE, 1978) criteria.

Comparison of the upstream water sample with the sample collected downstream of the Hoey site indicates that flow from the site has little impact on the water quality in the stream. The conductivity increases from 420 µS/cm to 823 µS/cm and is present primarily as sulphate, calcium and magnesium. Concentrations of other metals either showed no change in concentration downstream or decreased. The zinc concentration, for example, decreased from 0.017 mg/L in the upstream sample to < 0.005 mg/L downstream of the site. Aluminium and manganese showed similar decreases.

Stream water quality was compared to the Canadian Water Quality Guidelines (CCME, 1987) for fresh water aquatic life. Concentrations of arsenic, nickel and zinc were below the guidelines. Detection limits for a few other metals were above the guidelines, however, making it impossible to determine their impacts on receiving waters.

Mine rock at the site is not currently generating acid. However, the variable paste conductivities measured indicate that oxidation is occurring, and may be more rapid in some portions of the waste than others. It is estimated that approximately one eighth, or 1900 tonnes (2100 tons), of the waste at the site could potentially generate acid in the future. This material is located on the surface of the two dumps. Based on the characteristics of the other material on site, the underlying material may have sufficient neutralization potential to neutralize the acid if generated. The waste rock has been exposed to weathering at least since 1980, when the last reported work on the adits was conducted, and to date acidity produced has been buffered by the neutralizing minerals in the waste.

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.

Collection and treatment of water at the Hoey site was not considered an option because there does not appear to be a significant impact on the receiving water quality from the site discharge. However, this assessment of water quality is based on analytical detection limits that are above CCME freshwater aquatic life criteria.

The rock is not currently generating acid, and the potential for net acid generation is small. Therefore, relocation and covering of the rock piles are not considered necessary. Covering the rock piles with a soil cover to accelerate revegatation and inhibit infiltration may however be considered. This option is compared to the "do nothing" option in the following table.

The rock piles, at present, do not represent a health and safety risk. If a cover was constructed, workers would be exposed to a health and safety risk. Placing a cover on the waste rock entails a moderate risk to the ecosystem, since an additional site would be disturbed to provide the cover material.

The risk to the environment is small if no remediation is undertaken since the site is relatively dry and no adverse impacts to the environment were observed. Covering the waste rock pile would improve the aesthetics of the site and is, therefore, ranked slightly higher for acceptability.

Matrix for Evaluating Applicable/Potential Remediation

Option versus Evaluation Criteria	Hoey			
	Collect and Treat	Relocate	Cover	Do Nothing
Public Health and Safety 5 = provides full protection of public 1 = provides no protection of public	not applicable	not applicable	5	5
Worker Health and Safety 5 = relative low risk to workers 1 = high risk to workers	not applicable	not applicable	3	5
Ecosystem Preservation and Protection 5 = relative low risk to environment 1 = relative high risk to environment	not applicable	not applicable	4	4
Impact on Mineral Resource 5 = allows for continued exploration 1 = impedes continued exploration	not applicable	not applicable	5	5
Direct Costs (mobilization & materials) 5 = relative low cost 1 = relative high cost	not applicable	not applicable	2	5
Monitoring and Maintenance Costs 5 = relative low cost 1 = relative high cost	not applicable	not applicable	3	3
Acceptability 5 = positive response anticipated 1 = negative response anticipated	not applicable	not applicable	4	3
Total Score	**0**	**0**	**26**	**30**

Placing a cover would be a costly remediation measure, requiring studies to determine an appropriate source of cover material, monitoring of the completed cover, as well as the cost of construction. This is reflected in the above evaluation.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Covering of the rock piles is unnecessary because this material does not currently pose an environmental risk. Some of the material in the piles may have the potential to generate acid; however, this is a small portion of the waste, and the acidity would likely be buffered by the underlying material which has a high net neutralization potential. The risk to the environment is therefore considered to be low.

Water samples collected from the two adits had metal concentrations that were below the MMLE guidelines. Sampling both upstream and downstream of the Hoey site indicated that the site has little impact on receiving water quality. However, this is based on analytical detection limits for many metals above the CCME guidelines. Furthermore, sampling was conducted at one time in the summer and water quality may vary througout the year.

6.2 Recommendations

It is recommended that the stream water quality at Hoey be monitored using detection limits consistent with CCME aquatic life guidelines. Comparison of downstream water quality with upstream or background water quality would allow the impact of the site on receiving waters to be determined. Monitoring would also detect changes that occur in the quality of the water from the site. Monitoring should be conducted every five years and should include lower levels analysis for the major metals of concern, including antimony, arsenic, copper, lead, iron, nickel, and selenium. If the water quality results show an adverse impact, the need for reclaiming the site should be reassessed.

7.0 REFERENCES

Canadian Council of Ministers of the Environment, 191. Interim Canadian Environmental Quality Criteria for Contaminated Sites. The National Contaminated Sites and Remediation Program.

DIAND Technical Services, Assessment Report 105F-09-3, Hoey Abandoned Mines Assessment. Indian and Northern Affairs Canada.

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TABLE 1 Hoey Waste Rock Sample Descriptions

Sample ID	Sample Location and Description	Discussion of Results
HOEY/WR/P1/1	Gray to dark gray, composed primarily of pebbles and cobbles (up to ~5 in. (12 cm)). Clast supported with a sandy matrix.	Low potential for acid generation (NP/AP=12); high Ca, Fe, Mn, P; moderate As, Pb.
HOEY/WR/P2/1	Brown, clayey-sand matrix among clast-supported pebble to cobble sized clasts. Within the top 10 cm there are pockets of limonite staining with some iron oxide cementation of grains.	Potentially acid generating (NP/AP=1.8); high Cu, Fe, P, Pb, Mn; moderate Sb, Co, Ni, Ag.
HOEY/WR/P3/1	Dark orange-brown to brown sandy matrix among pebble to small cobble-sized clasts. Clast supported, unconsolidated material. Rare (< 1%) small (< 0.5 cm) patches of limonite.	Potentially acid generating (NP/AP=2.6); high Cu, Fe, Pb, Mn; moderate Sb, Co, Ni, Ag.
HOEY/WR/P4/1	Green-gray slightly clayey sand matrix among abundant pebbles and cobbles (clast-supported). Rocks primarily dark gray angular, blocky shale.	Low potential for acid generation (NP/AP=40); high Ca, Fe, Pb, Mn; moderate As.
HOEY/WR/P5/1	Brown sandy matrix among mostly pebbles and small cobbles (clast-supported). Surface cobbles are composed of massive gray shale.	Low potential for acid generation (NP/AP=4); high Fe, Pb, Mn; moderate Cu, Ni, Zn.

TABLE 2 Hoey Waste Rock ABA and ICP Results

Parameter	Units	Sample Number HOEY-WR				
		[illegible]	P2	P3	P4	P5
Field Conductivity	µS/cm	720	900	190	110	490
Field pH		8.3	7.7	8.6	8.8	8.4
Lab pH		7.55	7.45	7.69	8.5	8.13
Sulfur, total	%	1.01	2.15	1.61	0.68	1.03
Sulfate	%	0.31	0.31	0.25	0.37	0.27
AP		21.9	57.5	42.5	9.7	383.5
NP		272.0	101.6	109.3	383.5	105
Net NP		250.1	44.1	66.8	373.8	81.3
NP/AP		12.4	1.8	2.6	39.6	4.4
Aluminum, total	%	0.16	0.11	0.04	0.12	0.03
Antimony, total	ppm	<1	125	161	<1	44
Arsenic, total	ppm	74	<1	<1	97	<1
Barium, total	ppm	75	127	215	94	285
Beryllium, total	ppm	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth, total	ppm	<1	<1	<1	<1	<1
Cadmium, total	ppm	<0.1	<0.1	<0.1	<0.1	<0.1
Calcium, total	%	8.65	2.81	2.04	10.92	2.08
Chromium, total	ppm	28	36	28	32	23
Cobalt, total	ppm	13	222	23	11	23
Copper, total	ppm	43	528	741	13	179
Gallium, total	ppm	<1	<1	<1	<1	<1
Iron, total	%	4.39	13.85	>15.00	4.49	>15.00
Lead, total	ppm	131	>10000	>10000	585	8111
Lithium, total	ppm	2	<1	<1	2	<1
Magnesium, total	%	2.20	1.35	1.50	2.82	1.55
Manganese, total	ppm	1892	>10000	>10000	2383	>10000
Molybdenum, total	ppm	10	27	35	10	34
Nickel, total	ppm	33	84	110	34	106
Phosphorus, total	ppm	640	990	90	120	30
Potassium, total	ppm	0.05	0.06	0.05	0.05	0.05
Silver, total	ppm	4.9	153.6	84.4	2.6	35.7
Sodium, total	%	<0.1	<0.1	<0.1	<0.1	<0.1
Strontium, total	ppm	283	91	40	363	42
Titanium, total	%	<0.1	<0.1	<0.1	<0.1	<0.1
Thorium, total	ppm	<1	<1	<1	<1	<1
Tin, total	ppm	5	16	22	7	23
Tungsten, total	ppm	<1	<1	<1	<1	<1
Uranium, total	ppm	<1	<1	<1	<1	<1
Vanadium, total	ppm	13.2	10.2	5.4	9.3	5.7
Zinc, total	ppm	32	41	20	39	131

AP = Acid Potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material
NP = Neutralization Potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material
Net NP = Net Neutralization Potential = tonnes $CaCO_3$ equivalent per 1000 tonnes of material
na = no assay / analysis
< = lower detection limit
> = upper detection limit

TABLE 3 Hoey Water Quality Results

Parameter	Units	Sample Number [illegible]			
		A1	A2	STR1/1	STR1/2
Lab Conductivity	umhos/cm	1110	994	823	420
Lab pH		7.88	7.96	8.18	7.84
Acidity ($CaCO_3$)	mg/L	12.6	6.4	<1.0	5.0
Alkalinity ($CaCO_3$)	mg/L	358	305	238	168
Sulfate	mg/L	331	311	257	62.5
Aluminum, total	mg/L	<0.2	<0.2	<0.2	0.042
Antimony, total	mg/L	<0.2	<0.2	<0.2	<0.2
Arsenic, total	mg/L	<0.2	<0.2	<0.2	<0.2
Barium, total	mg/L	0.01	0.02	0.04	0.07
Beryllium, total	mg/L	<0.005	<0.005	<0.005	<0.005
Bismuth, total	mg/L	<0.1	<0.1	<0.1	<0.1
Boron, total	mg/L	<0.1	<0.1	<0.1	<0.1
Cadmium, total	mg/L	<0.01	<0.01	<0.01	<0.01
Calcium, total	mg/L	133	117	84.1	48.1
Chromium, total	mg/L	<0.01	<0.01	<0.01	<0.01
Cobalt, total	mg/L	<0.01	<0.01	<0.01	<0.01
Copper, total	mg/L	<0.01	<0.01	<0.01	<0.01
Iron, total	mg/L	0.07	0.07	<0.03	0.36
Lead, total	mg/L	<0.05	<0.05	<0.05	<0.05
Lithium, total	mg/L	<0.01	<0.01	<0.01	<0.01
Magnesium, total	mg/L	86.1	75.7	67.1	24.6
Manganese, total	mg/L	0.016	0.020	<0.005	0.033
Molybdenum, total	mg/L	<0.03	<0.03	<0.03	<0.03
Nickel, total	mg/L	<0.02	<0.02	<0.02	<0.02
Phosphorus, total	mg/L	<0.3	<0.3	<0.3	<0.3
Potassium, total	mg/L	<2	<2	<2	<2
Selenium, total	mg/L	<0.2	<0.2	<0.2	<0.2
Silicon, total	mg/L	1.52	1.76	1.87	1.87
Silver, total	mg/L	<0.01	<0.01	<0.01	<0.01
Sodium, total	mg/L	<2	<2	<2	<2
Strontium, total	mg/L	0.866	0.662	0.632	0.282
Thallium, total	mg/L	<0.1	<0.1	<0.1	<0.1
Tin, total	mg/L	<0.03	<0.03	<0.03	<0.03
Titanium, total	mg/L	<0.01	<0.01	<0.01	<0.01
Vanadium, total	mg/L	<0.03	<0.03	<0.03	<0.03
Zinc, total	mg/L	<0.005	<0.005	<0.005	0.017

< = lower detection limit

APPENDIX B

Site Photographs

HOEY

Photographic Record

July 24, 1996

Photos	Description
H. # 1	Aerial View of Camp Site
H. # 2	Aerial View of Trenching
H. # 3	Processing Building - Lower Site
H. # 4	Interior of Processing Building - Lower Site
H. # 5	Lower Adit
H. # 6	Sloughing above Lower Adit
H. # 7	Track and Trestle - Lower Site
H. # 8	Track and Trestle - Lower Site
H. # 9	Mine Water Seepage - Lower Site
H. # 10	Mine Water Seepage and Channel - Lower Site
H. # 11	Adit and Mine Water Seepage - Upper Site
H. # 12	Downstream Water Sample - Adjacent Stream
H. # 13	Track - Upper Site
H. # 14	Trestle - Upper Site
H. # 15	Waste Rock Sample - Hoey/wr/p1/1
H. # 16	Waste Rock Sample - Hoey/wr/p2/1
H. # 17	Waste Rock Sample - Hoey/wr/p3/1
H. # 18	Waste Rock Sample - Hoey/wr/p4/1
H. # 19	Waste Rock Sample - Hoey/wr/p5/1
H. # 20	Drainage
H. # 21	Camp Site
H. # 22	Barrels at Camp Site

Photo# 1: Aerial View of Upper & Lower Site

Photo# 2: Aerial View of Site, Adjacent Stream and Drainage

Photo# 3: Processing Building - Lower Site

Photo# 4:Interior of Processing Building - Lower Site

Photo# 5: Lower Adit

Photo# 6: Sloughing Above Lower Adit

Photo# 7: Track and Trestle - Lower Site

Photo# 8: Track and Trestle - Lower Site

Photo# 9: Mine Water Seepage - Lower Site

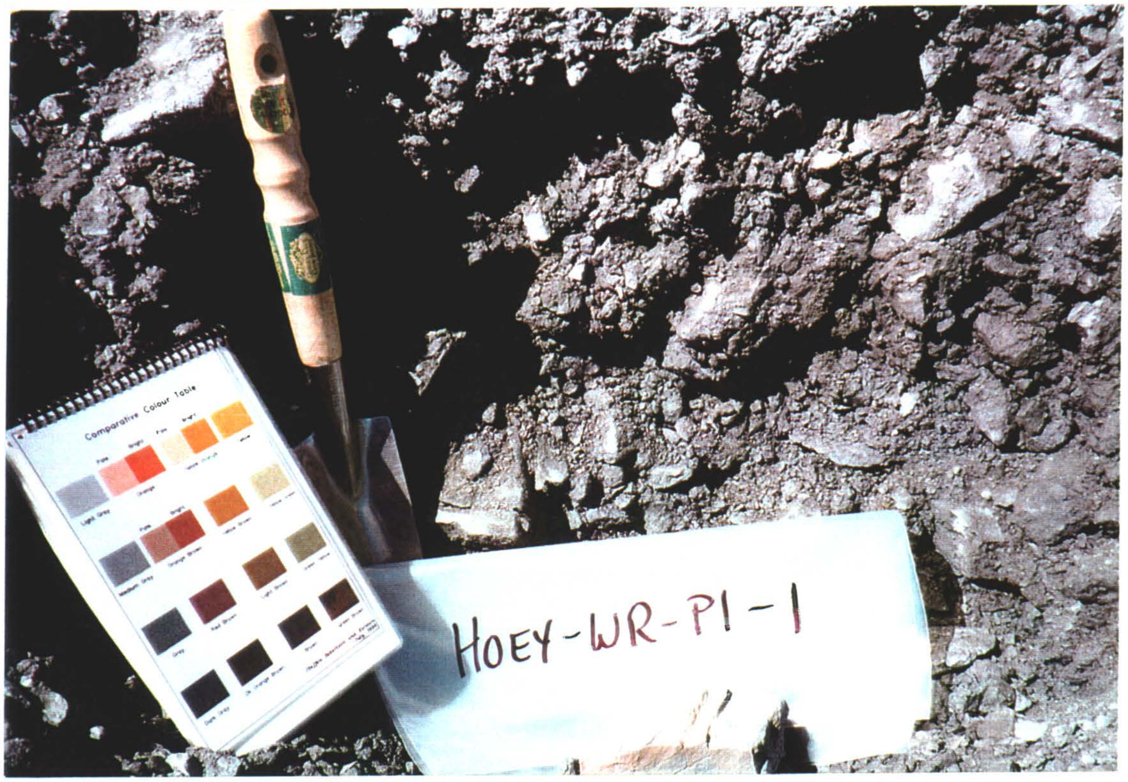
Photo# 10:Mine Water Seepage and Channel - Lower Site

Photo# 11:Adit and Mine Water Seepage - Upper Site

Photo# 12: Downstream Water Sample - Adjacent Stream

Photo# 13: Track - Upper Site

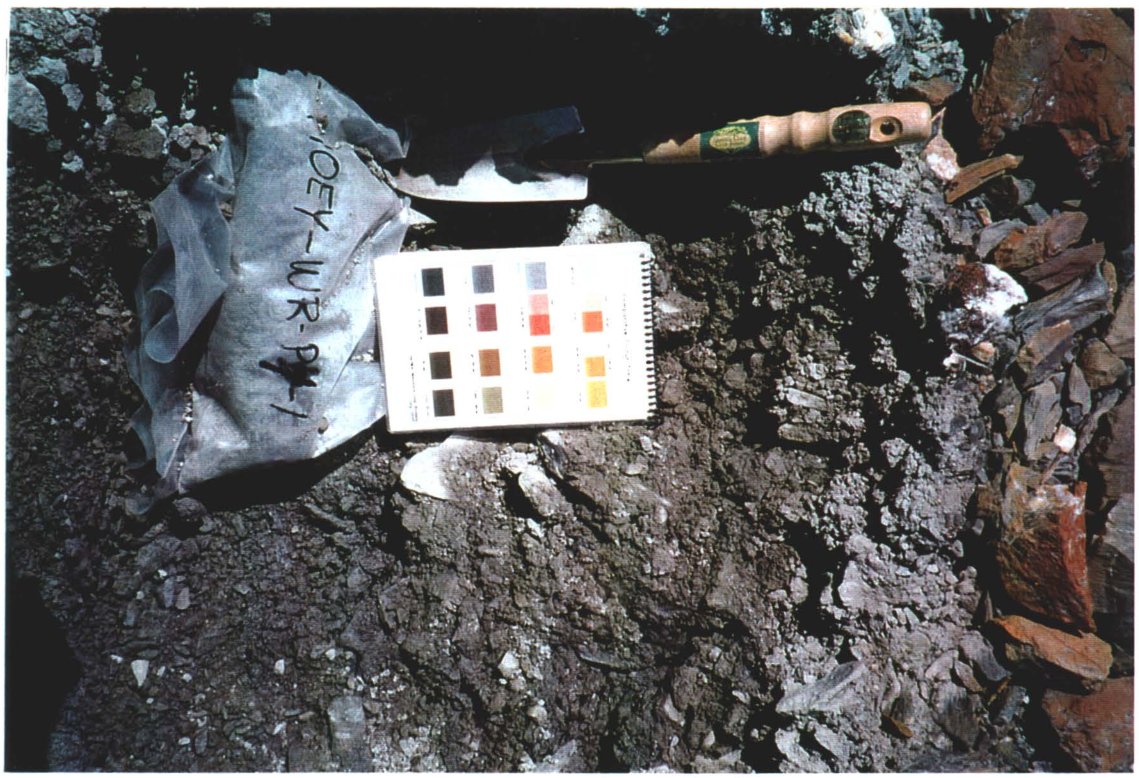
Photo# 14: Trestle - Upper Site



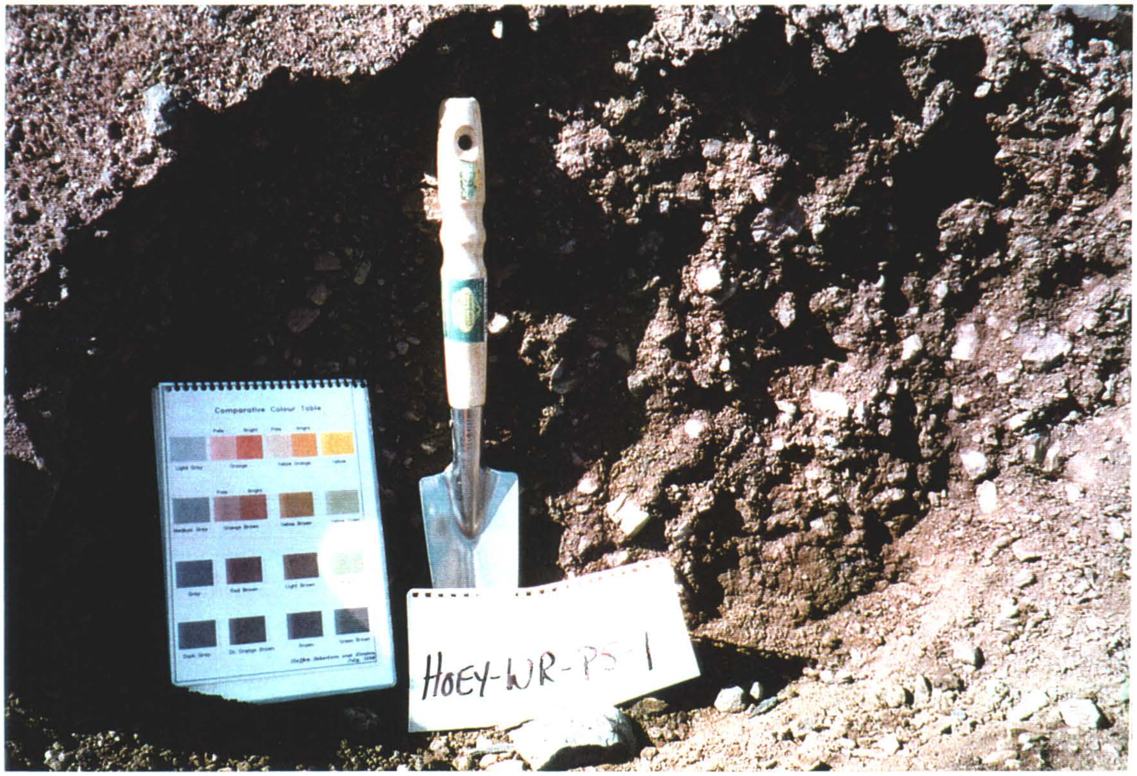
Photo# 15: Waste Rock Sample - Hoey/wr/p1/1

Photo# 16: Waste Rock Sample - Hoey/wr/p2/1

Photo# 17: Waste Rock Sample - Hoey/wr/p3/1



Photo# 18: Waste Rock Sample - Hoey/wr/p4/1



Photo# 19: Waste Rock Sample - Hoey/wr/p5/1

Photo# 20: Drainage

Photo# 21: Camp Site

Photo# 22: Barrels at Camp Site

APPENDIX C

Analytical Results

ASL

RESULTS OF ANALYSIS - Water[1]

File No. G3603

		HO-WQ-A1	HO-WQ-STR1-1	HO-WQ-STR1-2	HO-WQ-A2-1
		96 07 26	96 07 26	96 07 26	96 07 26
Physical Tests					
Conductivity (umhos/cm)		1110	823	420	994
pH		7.88	8.18	7.84	7.96
Dissolved Anions					
Acidity	CaCO3	12.6	<1.0	5.0	6.4
Alkalinity - Total	CaCO3	358	238	168	305
Sulphate	SO4	331	257	62.5	311
Total Metals					
Aluminum	T-Al	<0.2	<0.2	0.042	<0.2
Antimony	T-Sb	<0.2	<0.2	<0.2	<0.2
Arsenic	T-As	<0.2	<0.2	<0.2	<0.2
Barium	T-Ba	0.01	0.04	0.07	0.02
Beryllium	T-Be	<0.005	<0.005	<0.005	<0.005
Bismuth	T-Bi	<0.1	<0.1	<0.1	<0.1
Boron	T-B	<0.1	<0.1	<0.1	<0.1
Cadmium	T-Cd	<0.01	<0.01	<0.01	<0.01
Calcium	T-Ca	133	84.1	48.1	117
Chromium	T-Cr	<0.01	<0.01	<0.01	<0.01
Cobalt	T-Co	<0.01	<0.01	<0.01	<0.01
Copper	T-Cu	<0.01	<0.01	<0.01	<0.01
Iron	T-Fe	0.07	<0.03	0.36	0.07
Lead	T-Pb	<0.05	<0.05	<0.05	<0.05
Lithium	T-Li	<0.01	<0.01	<0.01	<0.01
Magnesium	T-Mg	86.1	67.1	24.6	75.7
Manganese	T-Mn	0.016	<0.005	0.033	0.020
Molybdenum	T-Mo	<0.03	<0.03	<0.03	<0.03
Nickel	T-Ni	<0.02	<0.02	<0.02	<0.02
Phosphorus	T-P	<0.3	<0.3	<0.3	<0.3
Potassium	T-K	<2	<2	<2	<2
Selenium	T-Se	<0.2	<0.2	<0.2	<0.2
Silicon	T-Si	1.52	1.87	1.87	1.76
Silver	T-Ag	<0.01	<0.01	<0.01	<0.01
Sodium	T-Na	<2	<2	<2	<2
Strontium	T-Sr	0.866	0.632	0.282	0.662
Thallium	T-Tl	<0.1	<0.1	<0.1	<0.1
Tin	T-Sn	<0.03	<0.03	<0.03	<0.03
Titanium	T-Ti	<0.01	<0.01	<0.01	<0.01
Vanadium	T-V	<0.03	<0.03	<0.03	<0.03

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

RESULTS OF ANALYSIS - Water[1]

File No. G3603

		HO-WQ-A1	HO-WQ-STR1-1	HO-WQ-STR1-2	HO-WQ-A 2-1
		96 07 26	96 07 26	96 07 26	96 07 26
Total Metals					
Zinc	T-Zn	<0.005	<0.005	0.017	<0.005

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

RESULTS OF ANALYSIS - Sediment/Soil[1]

File No. G3603

		HOEY-S-1-1 96 07 28
Physical Tests		
Moisture	%	27.3
Total Metals		
Lead	T-Pb	72

< = 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. G3603

	HOEY-S-1-1 96 07 28
Polycyclic Aromatic Hydrocarbons	
Acenaphthene	2.7
Acenaphthylene	0.7
Anthracene	1.7
Benzo(a)anthracene	0.6
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	5.7
Indeno(1,2,3-c,d)pyrene	<0.5
Naphthalene	<0.5
Phenanthrene	20.5
Pyrene	2.3
Extractables	
Total Extr Hydrocarbons (C10-30)	70600

< = 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. G3603

Water[1]			HO-WQ-STR1-1	HO-WQ-STR-1
			96 07 26	QC # 69051
Physical Tests				
Conductivity (umhos/cm)			823	824
pH			8.18	8.18
Dissolved Anions				
Acidity		CaCO3	<1.0	<1.0
Sulphate	SO4		257	254

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

Appendix 1 - QUALITY CONTROL - Replicates File No. G3603

Water[1]		HO-WQ-STR1-1 96 07 26	HO-WQ-STR-1 QC # 69051
Total Metals			
Aluminum	T-Al	<0.2	<0.2
Antimony	T-Sb	<0.2	<0.2
Arsenic	T-As	<0.2	<0.2
Barium	T-Ba	0.04	0.03
Beryllium	T-Be	<0.005	<0.005
Bismuth	T-Bi	<0.1	<0.1
Boron	T-B	<0.1	<0.1
Cadmium	T-Cd	<0.01	<0.01
Calcium	T-Ca	84.1	82.4
Chromium	T-Cr	<0.01	<0.01
Cobalt	T-Co	<0.01	<0.01
Copper	T-Cu	<0.01	<0.01
Iron	T-Fe	<0.03	<0.03
Lead	T-Pb	<0.05	<0.05
Lithium	T-Li	<0.01	<0.01
Magnesium	T-Mg	67.1	65.9
Manganese	T-Mn	<0.005	<0.005
Molybdenum	T-Mo	<0.03	<0.03
Nickel	T-Ni	<0.02	<0.02
Phosphorus	T-P	<0.3	<0.3
Potassium	T-K	<2	<2
Selenium	T-Se	<0.2	<0.2
Silicon	T-Si	1.87	1.84
Silver	T-Ag	<0.01	<0.01
Sodium	T-Na	<2	<2
Strontium	T-Sr	0.632	0.619
Thallium	T-Tl	<0.1	<0.1
Tin	T-Sn	<0.03	<0.03
Titanium	T-Ti	<0.01	<0.01
Vanadium	T-V	<0.03	<0.03
Zinc	T-Zn	<0.005	<0.005

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

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

Conventional Parameters in Water

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

Metals in Water

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

Moisture

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

Metals in Sediment/Soil

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

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

Polycyclic Aromatic Hydrocarbons in Sediment/Soil

This analysis is carried out using a procedure adapted by ASL from U.S. EPA Methods 3500, 3630, and 8270 (Publ. #SW-846 3rd ed., Washington, DC 20460). The procedure involves a microwave assisted extraction with dichloromethane followed by a clean-up using silica gel column chromatography. This clean-up procedure has been found to effectively remove aliphatic and heterocyclic hydrocarbons which could potentially interfere with the analysis. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection.

Total Extractable Hydrocarbons in Sediment/Soil

This analysis is carried out in accordance with U.S. EPA Method 3500/8015 (Publ. # SW-846 3rd ed., Washington, DC 20460). This procedure involves hexane/acetone extraction followed by analysis of the extract by capillary column gas chromatography with flame ionization detection.

End of Report

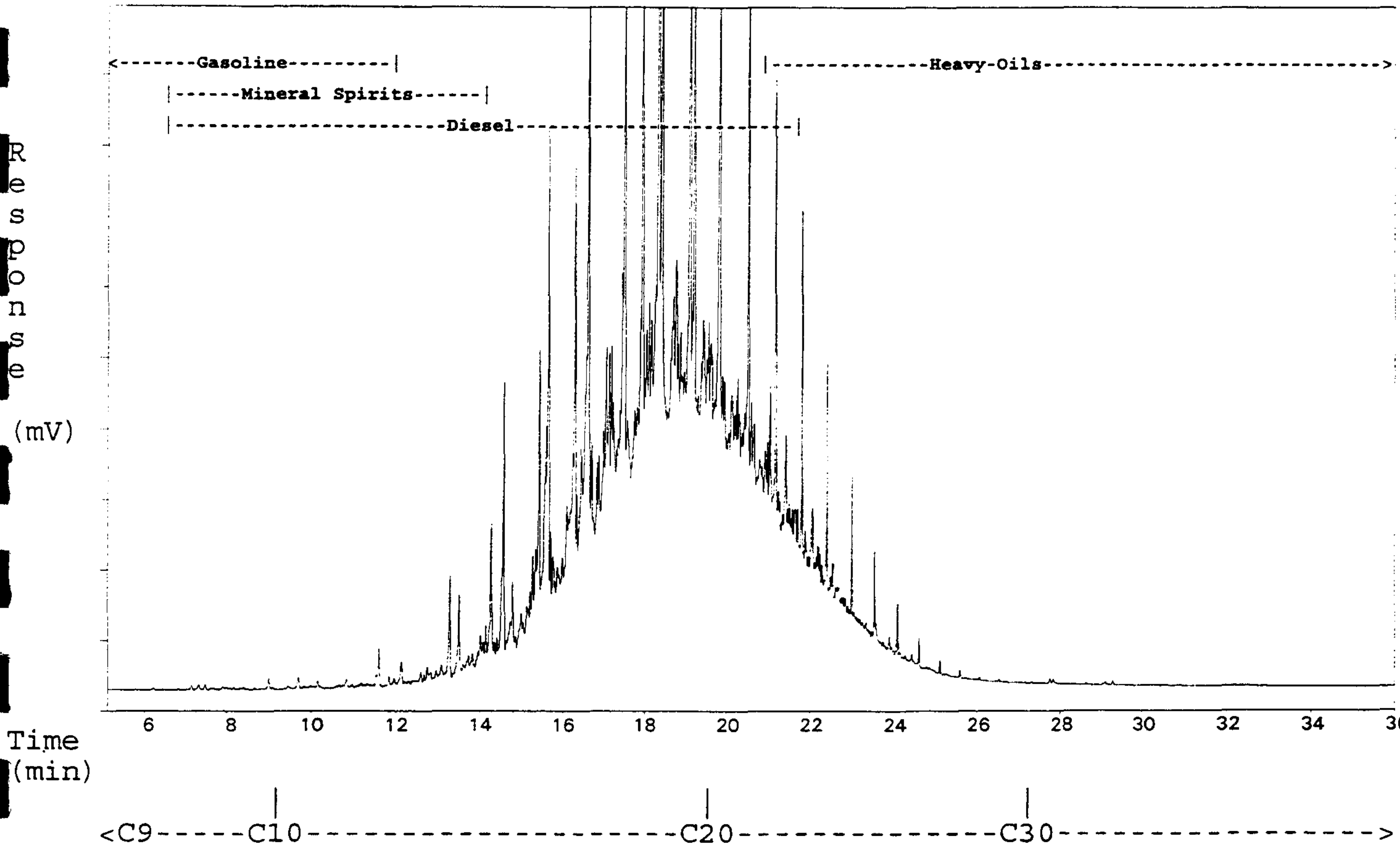
HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: G3603 6 **HOEY-S- 1-1** **96 07 28**

Sample acquired: AUG 13, 1996 10:54:14

File Name: c:\TEH\TEH12AUG.31R , Sample Name: G3603 6#Rx5

Sequence file: TEH12AUG



ASL Sample ID: G3603 6#Rx5* 5 X Dilution

HYDROCARBON RANGE (C#)		RELATIVE AMOUNT (%)
Less than Carbon 10	(<C10)	0.1
Carbon 10 to Carbon 20	(C10-C20)	74.6
Carbon 20 to Carbon 30	(C20-C30)	24.7
Greater than Carbon 30	(>C30)	0.6

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.

Powertech Labs - Interim Results - Tel: 590-7448

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

Date: 8 August 1996

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

Attention: Heather Ross

Re: Waste Oil Analysis

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

METHODOLOGY

Organic Halogen was determined by a laboratory test method mod. 9020 and was analyzed with a Mitsubishi TOX 10 analyzer. Elements were determined in accordance with laboratory test method ASTM D5185.

Some of the samples contained a layer of water. The water layer was excluded from the analyses. Only the organic liquid layer (oil or fuel) was analyzed. Some of the samples received did not contain an oil or fuel layer and were likely composed of mainly water. The water samples were not analyzed as per discussion with ASL. The ASL lab numbers of the samples not analyzed are as follows: G3601-4, G3602-9, G3605-2,3,4,5.

Results:

Results of analysis are attached

Prepared By: ______________
Ed Hall
Sr. Chemical Technologist

Approved By: ______________
H. Schellhase
Research Chemist
Applied Chemistry

POWERTECH LABS INC.

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

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

CHEMEX Labs Alberta Inc.

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

PUBLIC WORKS CANADA
ATTENTION : MICHAEL NAHIR

TOX SAMPLES

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

Chemex Worksheet Number : 96-07805-32
Chemex Project Number : PUBI010-0502
Sample Access :
Sample Matrix : LIQUID
Report Date : November 15, 1996
Analysis Date : November 11, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	RESULTS	DETECTION LIMIT
Total Organic Halogens (TOX)		ug/g	< 2	2.

APPENDIX D

Sampling Records

WATER SAMPLING

PROJECT NAME: HOEY MINE **NAME OF SAMPLER:** Michael Nahm...

Location: Hoey Mine, Yukon Date: 7/26/95

SAMPLE#: HO-WQ-A1 IMM/TM	pH: 8.14 Eh: 910
Location description: seepage at lower adit	
Analysis: metals water chem Eh total sulphur	

SAMPLE#: HO-WQ-STR1-1/IMM/TM	pH: 8.39 Eh: 680
Location description: Drainage creek downstream of Mine including seepage through wasterock (South of Mine)	
Analysis: metals water chem Eh total sulphur	

SAMPLE#: HO-WQ-STR1-2/IMM/TM	pH: 8.39 Eh: 300
Location description: Upstream of Drainage South of Mine	
Analysis: metals water chem Eh total sulphur	

SAMPLE#: HO-WQ-A2-1/IMM/TM	pH: 8.30 Eh: 710
Location description: Seepage at Upper Adit	
Analysis: metals water chem Eh total sulphur	

SAMPLE#:	pH:
Location description:	
Analysis: metals water chem Eh total sulphur	

Comments:

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

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

BARREL SAMPLING

PROJECT NAME: Hoey Mine **SAMPLE #:** Hoey-BL-1

Location: Hoey Exploration Site *Date:* 7/26/96

Name of sampler: Mike Nahm

Physical Observation

Condition of barrel: poor (fair) good

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

Soil staining: (Y) / N light staining under most barrels on site

Barrel Contents

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

Colour of liquid: (light) dark multiphase other

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

Sludge observed: Y / (N) Quantity ______

Analysis (if required)

Type of sample taken: composite (grab)

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

Comments:
- Soil under barrels noticeably stained
- [illegible]
- [illegible] closed
- other barrels had small water

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

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

Soil Sampling

Location: Hoey Mine

Date: 7/20/96

Name of Sampler: T. Sachman

Sample #	Time	Depth (m)	Type of Soil (%) Clay	Silt	Sand	Confining Layer	Distance to surfaceH2O	oil stainin (Y/N)	grab/ composite	Analysis required	Comments
HOEY-[illegible]	12:30	0	20	60	20	N/A	8 m	Y	G	MOG/[illegible] + PAH	LOVELY DAY, GREAT PLACE
											STAINED AREA 5X5 m, NO SHEEN
											ON STREAM SURFACE; LITTLE EVIDENCE OF VEG STRESS

Comments:

Sample # format: site name-Snumber

eg. Tintina-S1

APPENDIX E

Barrel Clean Up Protocol

BARREL CLEAN UP PROTOCOL

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

A. Inspection

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

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

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

B. Opening and Sampling

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

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

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

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

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

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

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

C. *Testing*

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

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

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

D. *Disposal of Barrel Contents*

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

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

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

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

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

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

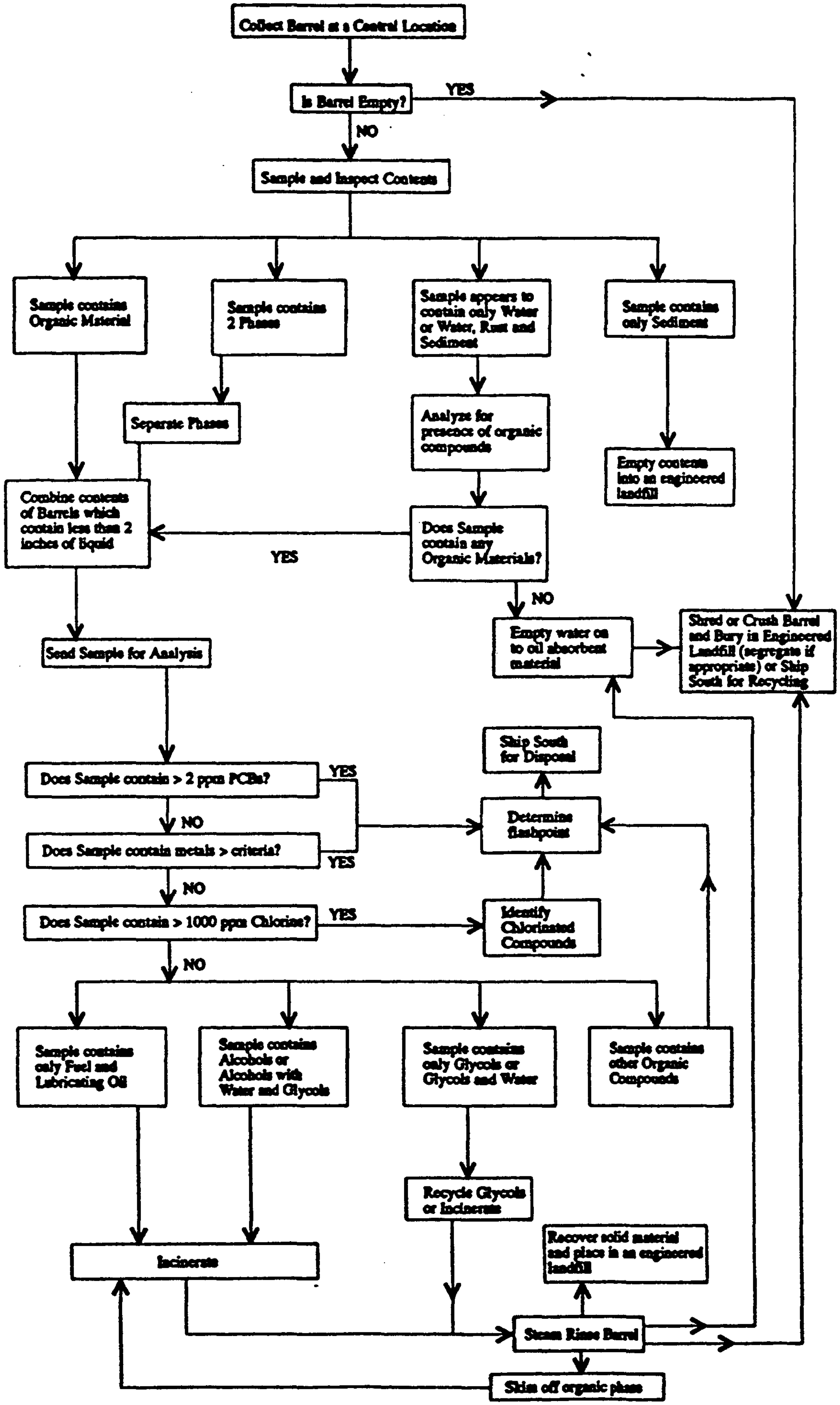
E. Cleaning and Disposing of Barrels

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

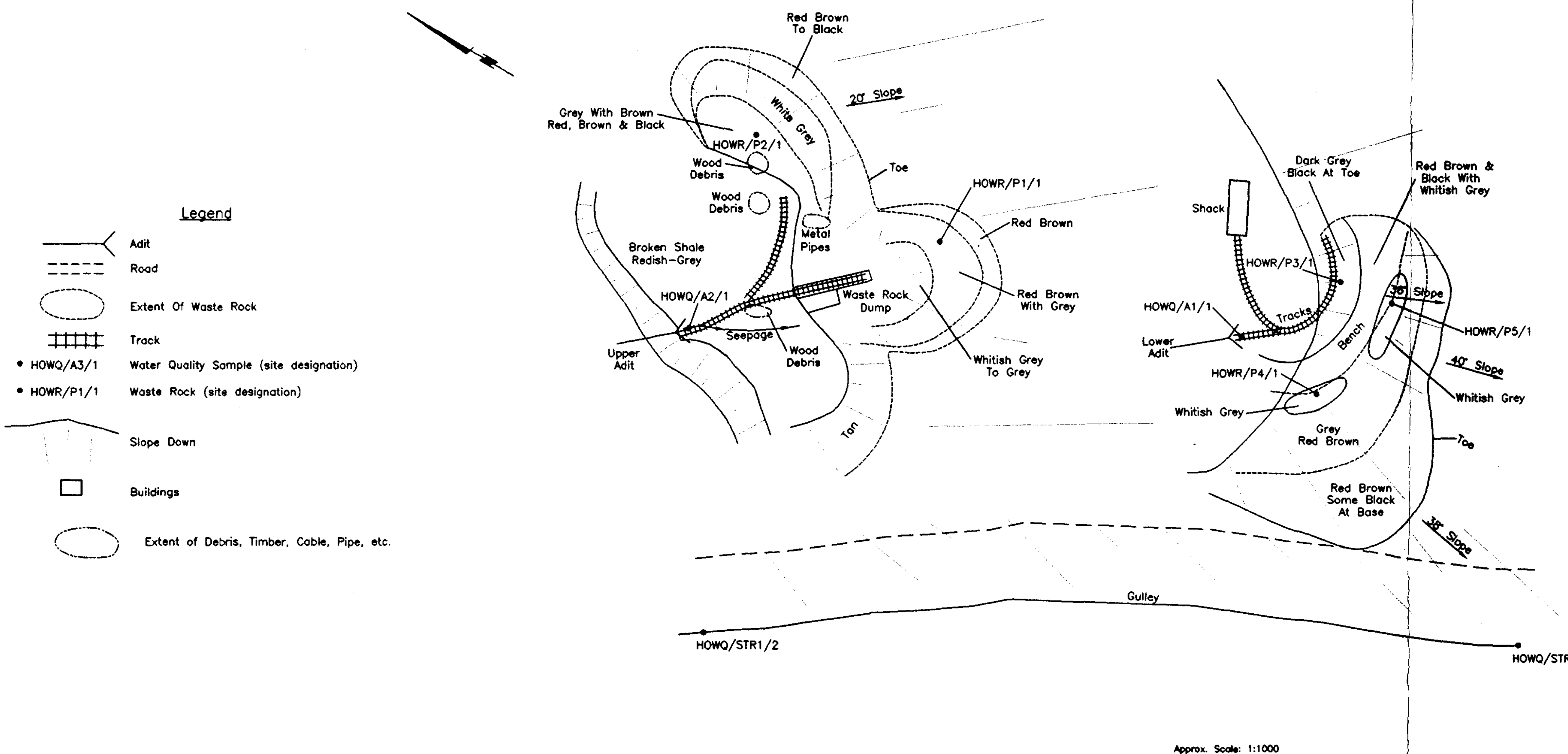
2. *Only empty barrels resulting from consolidation of small volumes (section B.6), from incineration (section D.3) and from solvent washing (section E.1) require steam cleaning; after cleaning they shall be treated as described in E.3. Recycling of rinsate is permitted. The resulting wash water shall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

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

FLOW CHART FOR THE DEW LINE CLEANUP OF BARRELS



DRAWINGS



PLOT: 1=1

CAD FILE: INVEN-96\HOEY\HOEY-1

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

Architectural & Engineering Services
Western Region

designed by / conçu par	date
drawn by / dessiné par	
approved by / approuvé par	
revisions	

Drawing title / Titre du dessin

Hoey Mine Site Investigation

Yukon Territory

project no. / no. du projet	dwg. no. / dessin no.
626967	1 of 1