PHASE II
ENVIRONMENTAL ASSESSMENT
of the
FAITH (DUNCAN)
ABANDONED MINE SITE

prepared for:

Action on Waste Program
Indian and Northern Affairs Canada

prepared by:

Environmental Services
Public Works and Government Services Canada

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EXECUTIVE SUMMARY

A phase II environmental assessment was conducted at the Faith (Duncan) abandoned mine site (63°56'19" N, 135°07'19" W) in 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 1994 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 one adit, located on the lower access road, poses a hazard to human safety. The adit is framed by timbers, surrounded by an unstable rock face, and is not adequately secured from public and wildlife access. An assessment of the acid rock drainage potential shows that the risk to the environment due to the presence of waste rock are of minor significance and no hazardous materials were observed on site. Aesthetic concerns arise from one derelict wood and canvas cabin surrounded by metal and glass waste that is located 125 m southeast of the remnant roadway.

Using applicable federal and territorial criteria as well as northern mine reclamation guidelines, recommendations include: dismantle cabin and burn materials on-site; dismantle wood structure surrounding adit and burn materials on-site; cover adit with existing waste rock; and collect and remove metal and glass waste. Every five years a monitoring program should be undertaken to obtain water quality data for the 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 & RECOMMENDATIONS

ASSESSMENT COMPONENT	RISK	RECOMMENDATION
1. Building, Infrastructure, Equipment		
Collapsed wood cabin	Health & Safety / Aesthetic	Demolish & burn on site
Wood cribbing & surrounding adit & ladder	Health & Safety / Aesthetic	Demolish & burn on site
2. Non-Hazardous Waste Material		
Misc. metal, glass and plastic wastes scattered around cabin	Aesthetic Concern	Bury on site
Misc. wood wastes around cabin	Aesthetic Concern	Burn on site
3. Hazardous Materials		
None	None	None
4. Water Quality		
Mine Seepage	No Perceived Environ-. mental Risk	None
Site Drainage	No Perceived Environ-. mental Risk	None
Receiving Waters	No Perceived Environ-. mental Risk	None
5. Waste Rock Disposal Areas		
Partially vegetated waste rock below adit & cat trail	No Perceived Environ-. mental Risk	None
6. Mine Openings		
Adit open and accessible	Health and Safety Concern	Seal with available waste rock
7. Tailings		
None	None	None

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1.0 INTRODUCTION AND BACKGROUND

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

For the Faith (Duncan) abandoned mine site, the 1994 Phase I investigation found relatively minor environmental damage at this site related to previous mining activities and recommended that further investigation into possible environmental impacts resulting from the previous mining activities be undertaken. According to the preliminary report, the potential areas of concern included: health and safety concerns due to mine openings, site debris and infrastructure, and aesthetic concerns due to non-hazardous waste materials. No rock, tailings, soil or water samples were collected in the Phase I assessment.

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

1.1 LOCATION

The Faith (Duncan) abandoned mine site is located in the central Yukon at 63^{o} 56'19" N latitude and 135^{o} 07'26" W longitude **(Figure 1)**. The site is approximately 9 km northeast of the community of Keno between 1420 m and 1450 m above sea level.

1.2 OVERVIEW OF SITE DEVELOPMENT

According to the Department of Indian Affairs and Northern Development (Yukon Minefile 105M 003), the Faith (Duncan) property was initially staked in 1919 by D. Sparks, following the discovery of the rich No. 9 vein on Keno hill, exploring with a 14 m adit and 11.6 m of drifting. In 1923, 11.8 tonnes of hand cobbed ore was shipped. In 1946, the Faith (Duncan) claim was restaked by A.N. Martin and in 1948, the claims were optioned to Silver Basin Yukon Mining Ltd. The option was assigned in 1950 to Consolidated Yukeno Mining Ltd. and reassigned in 1951 to Yukeno Mining Ltd.

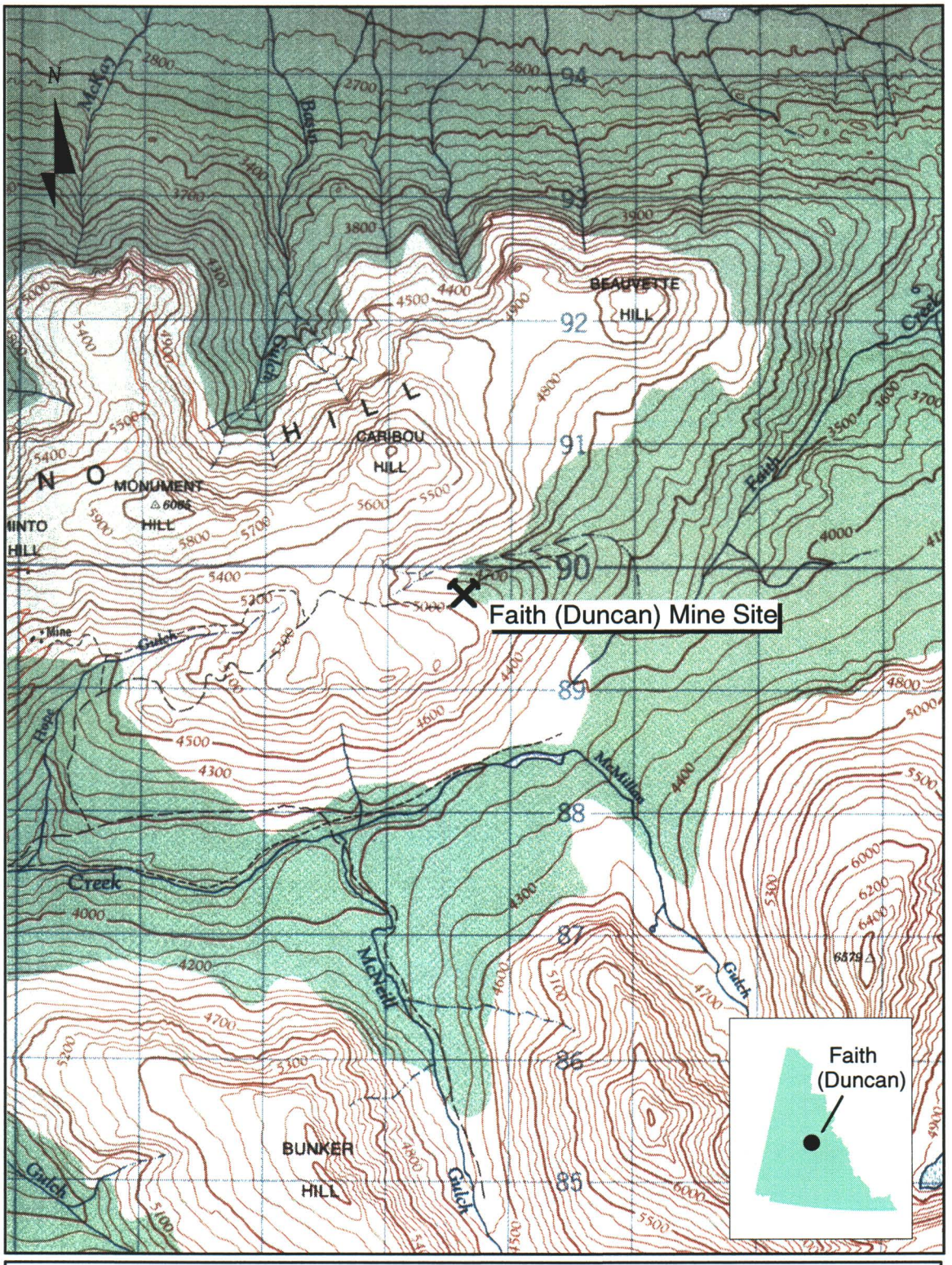


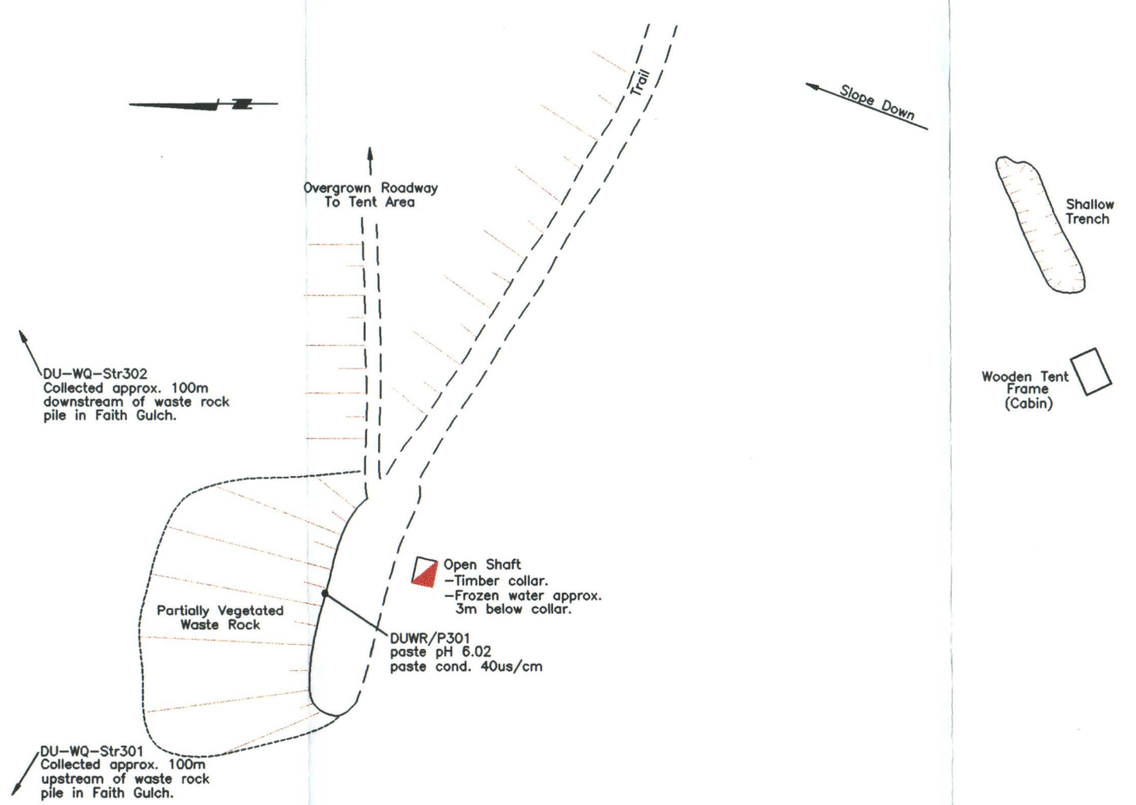
Figure 1: FAITH (Duncan) Site

N.T.S. 105 M/14 Map Name: Keno Hill Map Scale: 1:50,000

Latitude: 63° 56' 19" N Longitude: 135° 07' 26" W

Legend

W/R	Waste Rock
=====	Road
	Extent Of Waste Rock
• DUWR/P1/1	Waste Rock (site designation)
	Slope Down
	Buildings
	Shaft
	Extent of Debris, Timber, Cable, Pipe, etc.



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PLOT: 1=1
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Public Works And Government Services Canada / Travaux publics et Services gouvernementaux Canada

Architectural & Engineering Services
Western Region

designed by: / concu par: — date:
drawn by: / dessine par: R.N. Nov. /96
approved by: / approuve par:
revisions:

Drawing title: / Titre du dessin:

(Duncan) Faith Mine Site Development

Yukon Territory

project no. / no. du projet: 626967

dwg. no. / dessin no. 1 of 1

Yukeno Mining Ltd. purchased the claims in 1951 and transferred the claims to a lease in 1960 (Lot 637). The lease was sold to Rio Plata Silver Mining Ltd. in 1962. In 1983, J. Venesse tied on Liberty Bell Claims (YB77288) to the west. D. Felix and J. Brinkerhoft trenched on the Faith (Duncan) claims in 1989. Since 1946, work has consisted of minor hand trenching and a few bulldozer cuts. The amount of waste rock present at the site indicates that there is probably less than 30 metres of both vertical and lateral development in the shaft.

1.3 SITE ACCESS

The Faith (Duncan) exploration site is accessible from the community of Keno on an old exploration trail that traverses along Lightning Creek, up Hope Gulch and across Keno Hill, a distance of approximately 9 km. This trail is in poor condition due to steep terrain and rough trail conditions and may be traveled by a four-wheel drive vehicle. Due to the large number of poorly defined trails on Keno Hill, the correct trails leading to the Faith (Duncan) site may be difficult to locate.

2.0 PURPOSE AND SCOPE OF WORK

The following assessment activities were completed at the Faith (Duncan) exploration site:

- 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;
- On-site 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:

(i) open pit and underground mines;
(ii) special mines such as uranium, sand and gravel, and coal;
(iii) waste rock and tailings disposal;
(iv) acid generation and leaching; and
(v) estimating cleanup costs.

3.2.2 Application of Criteria and Guidelines

The following assessment criteria were used for the Faith (Duncan) abandoned mine site:

A. Soils:

CCME:	Remediation Criteria for Soil - Commercial/Industrial Standards

Note: As gross parameters of Petroleum Hydrocarbons are not listed in CCME, criteria were taken from the Draft Contaminated Sites Regulations (Yukon Renewable Resources, June 1996)

B. Water:

ENVIRONMENT CANADA:	Metal Mining Liquid Effluent Regulations and Guidelines - are compared to seepage from mine openings, and river/stream 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

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 Faith (Duncan) 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 release of 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 and was photographed and its location was marked on the field map.

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

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

Water Sampling

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

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

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

Soil Sampling

No soil samples were collected from the Faith (Duncan) exploration site as no evidence of soil contamination was observed.

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 Keno Hill - Galena Hill silver-lead ores occur in erratic shoots and lenses lying in vein-faults that cut fine-bedded to massive quartzite, intercalated with greenstone sill and lenses, and various schistose rocks (GSC Paper 68-68, p.21). Mineralization at the Faith (Duncan) (Faith) site consists of galena, (PbS), pyrite (FeS_2) and tetrahedrite ($(CuFe)_{12}Sb_4S_{13}$) bearing veins within graphite schist, sericite schist, phyllite, greenstone, and thin-bedded quartzite (GSC Bulletin 111, Figure 4).

4.2 SURFACE HYDROLOGY

The site is well above a tributary to Faith creek which flows into the Keno Ladue River. The creek is 1.5 to 2.4 m wide and flowing at a rate of 2 L/second (visual estimate) down a 10-15^{o} slope. The site is well drained and dry and the origin of surface water in the area is snowmelt and rainfall.

4.3 CLIMATE

The closest climatological information is from the town of Elsa, 63° 55' N, 135°29' W; 814 m a.s.l (Environment Canada, 1980). Total annual precipitation is 413.0 mm. This consists of 219.5 mm of rainfall and 202.9 mm of snowfall. Highest levels of rainfall occur in July and highest levels of snowfall occur in October. Temperatures range from -25.1°C in January to 14.1°C in July. The mean annual temperature is -4.4°C.

4.4 VEGETATION

The Faith (Duncan) exploration site is located within the Mayo Lake-Ross River Ecoregion. The mine site is located near the treeline at an approximate elevation of 1420 m to 1450 m a.s.l. The site is well drained and dry, and has sparse growth of black spruce to 8 m high and willows to 3 m high.

In this Ecoregion, the terrain below the treeline (1350 m to 1500 m a.s.l.) consists extensive forests of open black spruce, and occasionally lodgepole pine, with moss, ericaceous shrubs, and willows, dominating the understory. White spruce, occasionally with aspen or lodgepole pine, occurs on warmer and better drained sites. In drier environments, lichen development is common. Alpine fir occurs in the subalpine and alpine vegetation consists of mountain avens, dwarf willow, birch, ericaceous shrubs, grasses, and mosses.

4.5 FISH AND WILDLIFE RESOURCES

This area supports a number of carnivorous species including wolf, coyote, grizzly bear, and black bear. Ungulates include caribou, Dall's sheep, and moose. Beaver, fox, and hare are also common. Typical bird species include raven, rock and willow ptarmigan, and golden eagle. No fish habitat appears to be close to the site.

4.6 SITE TOPOGRAPHY AND SOILS

Although the regional topography is mountainous, the mountains, though steep, are rounded with few cliffs and rock outcrops that can be easily traversed. Weathered bedrock is at or near the surface on this site. The dominant soil development in the area is turbic cryosolic and eutric brunisolic, with the occasional occurrence of dystric brunisols over coarse materials.

4.7 PERMAFROST

The Faith (Duncan) site lies in a discontinuous permafrost zone. No attempt was made to establish the presence or absence of permafrost at this site, however, ice (permafrost) was observed 3 m below collar of the adit.

5.0 SITE DESCRIPTION AND FINDINGS

5.1 BUILDING, INFRASTRUCTURE, EQUIPMENT

The main development of the site took place over 70 years ago. It was apparent from the inspection that no recent exploration activity has taken place. The road to the site has not been used in recent years and has been re-colonized by vegetation **(See Photos 1 & 2)**.

The remains of a vertical shaft that was excavated between 1919 and 1923 was found on the site. The top of this shaft is open which poses a human safety risk. Wood cribbing made out of vertical posts supports the top of the shaft and an old wooden ladder extends into the shaft. Also observed was the remains of a wooden frame which was likely used to support a windlass above the shaft. A metal pail, likely used to lift ore from the shaft, was found near the adit **(See Photos 4, 5, & 6)**.

Remnants of a building were also found on site, located 125 m southeast of the remnant roadway and adit **(See Table 1)**. This structure has deteriorated since the site was abandoned - only the frame and a portion of the walls and floor remain intact **(See Photo 7)**.

Table 1: Buildings, Infrastructure & Equipment

Structure	Construction Features	Interior Contents
Tent Structure	Dilapidated wood frame with metal waste about	None

5.2 NON-HAZARDOUS WASTE MATERIALS

Non-hazardous waste materials observed in and around the site are listed in Table 1.

5.3 HAZARDOUS MATERIALS

No hazardous materials were observed at the site.

Table 2 Non-Hazardous Waste Materials

Waste Material	Number/ Volume	Location	Comments
Wood cribbing/ ladder/frame		top of vertical shaft	burnable, bury residue
Metal Pail	1	near vertical shaft	empty, no staining
wood frame	< 5 m^3	abandoned cabin	burnable, bury residue
small cans, metal scraps, glass bottles	< 5 m^3	scattered around abandoned cabin	non-burnable

5.4 SURFACE WATER QUALITY

No seepage was observed below the waste rock pile or from the base of the shaft's collar. A tributary of Faith Creek is situated 150 m to the north of the waste rock pile identified in **Drawing 1, Faith (Duncan) Mine Site Development and Geological Information**. Upstream and downstream water samples were collected to the northwest and northeast of the waste pile. Sample DU/WQ/301 was collected approximately 100 m upstream of the waste rock pile's surface drainage path.

The creek was 1.5 to 2.4 m wide and flowing at a rate of 2 litres/second (visual estimate) down a 10° to 15° gradient at the time of site assessment. The field pH was measured to be 8.0 and conductivity was measured at 40 uS/cm. Sample DU/WQ/302 was collected approximately 100 m downstream of the waste rock pile's surface drainage path. At the time of the site assessment the creek was 1.5 m wide and flowing at a rate of 3 L/second (visual estimate). The field pH of the stream as 6.8 and the conductivity 60 uS/cm **(See Photo 10)**.

Table 3 identifies the significant findings of the sampling program conducted to determine the potential impact of the site on surface water bodies. Complete analytical results are provided in **Appendix B**.

Background (upstream) and downstream water quality parameters were similar. Therefore, the water quality of the creek downstream of the mine site did not appear to be significantly impacted by the waste rock (at the time of site assessment). In addition, both the upstream and downstream samples met CCME criteria for freshwater aquatic life indicating there are no elevated concentrations for any of the water quality parameters measured naturally occurring in this creek.

Table 3 Surface Water Samples - Significant Laboratory Results

Parameter	DU/WQ/STR/302 (downstream)	DU/WQ/STR/301 (upstream)	Guidelines for Freshwater Aquatic Life
Conductivity (mhos/cm)	60.2	40.8	n/a
Hardness	25.8	16.6	n/a
pH	7.26	7.27	6.5-9.0
Aluminum	10	76	5-100
Arsenic	1.2	< 0.1	50
Chromium	< 1	< 1	2-20
Iron	< 30	50	300
Lead	< 1	1	1-7
Mercury	< 0.05	<0.05	0.1
Selenium	0.7	1.3	1
Silver	< 0.1	0.1	0.1
Zinc	< 5	< 5	30

(all values in g/L unless otherwise stated); n/a = no guidelines available

5.5 WASTE ROCK DISPOSAL AREAS

A minor waste rock pile was identified east of the abandoned cabin and above the adit entrance **(see Drawing 1, Faith (Duncan) Mine Site Development and Geological Information)**. Waste rock has been deposited below the shaft in a relatively homogenous pile that covers an area approximately 40 m X 45 m and appears to consist of less than 5000 tonnes of rock. The top of the pile has been leveled and compacted by a bulldozer or backhoe. The slopes of the pile support the growth of fireweed, mosses, alders and a few small pine trees **(See Photos 2, 8, & 9)**.

One sample was collected near the crest of the waste rock pile, DU/WR/P301 where the angular rocks ranged up to 20 cm in diameter. The material sampled consisted of 70% chlorite sericite schist, 20% quartzite and quartz carbonate vein material and 10% graphite schist and was collected over a thickness of 40 cm. Approximately 60% of the material sampled was greater than 2 cm in diameter.

Samples were analyzed for Acid Base Accounting (ABA) and Inductively Coupled Plasma-Atomic Emission Spectrophometry (ICP-AES). A summary of the results of the

analyses are listed in **Table 4** and detailed results are presented in **Appendix B**. Field paste pH and paste conductivity tests were conducted on the waste rock. The sample locations and results of field paste tests are shown on the attached site map.

The paste pH of the material sampled was 6.0 and the paste conductivity measured 40 uS/cm, indicating that the material is not currently oxidizing and generating acid. The sample had an Neutralization Potential to Acid Potential (NP:AP) ratio < 0.1, suggesting that this material may produce acid at some time in the future. However, the total sulphur content, not accounting for sulphate, was low (0.07%) as was the paste conductivity value. Therefore, the waste rock is not likely to become acid generating.

Table 4 Summary Acid/Base Accounting Test Results

Sample #	Paste pH	Total S (%)	SO4 (%)	AP	NP	Net NP	NP/AP
DU/WR/P301	7.20	0.07	0.00	2.2	-1.5	-3.7	< 0.1

5.6 MINE OPENINGS AND EXCAVATIONS

A timbered collar clearly marks the location of the shaft. Access to the underground workings is restricted by ice, which appears to be permanent, 3 m below the top of the collar **(See Photos 1 - 6)**.

Table 5 Mine Openings

Adit	Location	Drift Length	Condition
1	Lower access road, 7 m up embankment	2.1 long by 2.4 m wide	Adit is framed in timbers but is open on top; ladder is present; shaft is 3.7 m to snow on bottom; surrounding rock face is unstable

5.7 TAILINGS

No milling of ore has occurred at this site; therefore, no tailings are present.

6.0 CONCLUSIONS

The primary concern is the health and safety of humans and wildlife relating to the mine opening. A secondary concern is the aesthetic appearance of the dilapidated cabin and glass and metal debris found on the site.

6.1 HEALTH AND SAFETY

The shaft does not represent a significant health and safety risk because it is plugged with ice a few metres below the surface. Erosion of the waste rock pile is controlled by the vegetation which has taken root on the slopes; therefore, the risk of slope failure is low.

6.2 ENVIRONMENTAL RISKS

Waste rock at the Faith (Duncan) site represents a low risk to the environment. Considering the near neutral pH of the material, the volume of the waste rock, and the lack of surface runoff at the site, it is unlikely that drainage from the site is, or will in the future, significantly impact the downstream environment. No further water quality or waste rock testing is recommended.

6.3 AESTHETIC CONCERNS

Aesthetic concerns arise from the abandoned cabin and glass and metal debris scattered around the cabin.

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. The overall priority rating assigned to the clean-up and remediation recommendations for the Faith (Duncan) abandoned mine site is Low.

Recommendation 1

It is recommended that the mine opening be secured from human and animal access for health and safety reasons by covering the opening with existing waste rock. Should the mine need to be reopened, access to workings is achievable with heavy equipment.

Recommendation 2

It is recommended that the cabin demolished, burned and the debris buried on site for aesthetic, 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

Additional water quality sampling is not required as there is no acid generating waste present on-site. However, 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.

Recommendation 4.

It is recommended that site debris be collected and buried on-site for aesthetic reasons. Structural timbers, and miscellaneous glass and metal debris, surrounding the site can be collected using locally available labour and resources.

8.0 COST ESTIMATES TO IMPLEMENT 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. An estimated breakdown of expected remediation/mitigation costs to an accuracy of 25% is provided under separate cover to this report. The cost estimate includes contractor and project management costs and contingencies. The estimated cost to implement the recommendations is provided under separate cover.

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APPENDIX A

DETERMINATION OF ACID ROCK DRAINAGE POTENTIAL

Faith (Duncan) Waste Rock Sample ABA and ICP Results

Parameter	Units	Sample No. DU/WR/P301
Field Conductivity	uS/cm	40
Field Paste pH		6.02
Lab Paste pH		7.2
Total Sulfur	%	0.07
Sulfate	%	n/a
AP	*	2.19
NP	**	-1.50
Net NP	***	-3.69
NP/AP		< 0.1
Ag	ppm	5.2
Al	%	0.34
As	ppm	141
Ba	ppm	93
Be	ppm	< 0.1
Bi	ppm	< 1
Ca	%	0.09
Cd	ppm	< 0.1
Co	ppm	6
Cr	ppm	114
Cu	ppm	34
Fe	%	2.05
Ga	ppm	< 1
K	%	0.06
Li	ppm	5
Mg	%	0.10
Mn	ppm	1042
Mo	ppm	7
Na	%	< 0.01
Ni	ppm	27
P	ppm	610
Pb	ppm	503
Sb	ppm	12
Sn	ppm	< 1
Sr	ppm	14
Th	ppm	< 1
Ti	%	< 0.01
U	ppm	< 1
V	ppm	7.0
W	ppm	6
Zn	ppm	230

*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

n/a = no assay / analysis; < = lower detection limit; > = upper detection limit

APPENDIX B

SITE PHOTOGRAPHS

Photo 1. View of open shaft from cat trail looking east.

Photo 2. Top of shaft enclosure (looking north downslope) will not prevent entry to shaft.

Photo 3. Wood waste upslope and downslope of shaft enclosure and excavation material below shaft entrance.

Photo 4. Timber shaft enclosure.

Photo 5. Top of timber shaft enclosure with access ladder at right.

Photo 6. Interior of shaft enclosure with frozen water 3 m below.

Photo 7. Dilapidated wood tent frame upslope from shaft entrance.

Photo 8. View west from revegetated waste rock pile north downslope from shaft.

Photo 9. View east from sample DU-WR-P/301collected approximately 100 m upstream from waste rock pile in Faith Gulch.

Photo 10. Faith Gulch looking west upstream of sampling location DU-WQ-P-302.

APPENDIX C

ANALYTICAL RESULTS

Faith (Duncan) Water Quality Results (ug/L)

Parameter	DU/WQ/STR/301	DU/WQ/STR/302	Guidelines for Freshwater Aquatic Life
Field Conductivity	40.8	60.2	---
Hardness	16.6	25.8	---
pH	7.27	7.26	6.5-9
Acidity	3100	3800	---
Alkalinity - Total	7900	11700	---
Sulphate	10700	15500	---
Aluminum	10	10	5-100
Arsenic	1.4	1.2	50
Barium	70	70	---
Beryllium	< 5	< 5	---
Boron	< 100	< 100	---
Cadmium	< 0.2	< 0.2	0.2-1.8
Calcium	4450	7530	---
Chromium	< 1	< 1	2-20
Cobalt	< 20	< 20	---
Copper	< 1	< 1	2-4
Iron	< 30	< 30	300
Lead	< 1	< 1	1-7
Lithium	< 20	< 20	---
Magnesium	1330	1700	---
Manganese	< 5	< 5	---
Mercury	< 0.05	< 0.05	0.1
Molybdenum	< 30	< 30	---
Nickel	< 20	< 20	25-150
Selenium	0.5	0.7	1
Silver	< 0.1	< 0.1	0.1
Sodium	< 2000	< 2000	---
Vanadium	< 30	< 30	---
Zinc	6	< 5	30

--- = Value not established; < = Less than the detection limit indicated