HIGHLANDER (#29)
(MINFILE # 105M 001ai)

1. LOCATION AND ACCESS

The Highlander abandoned mine site is 6 km north-northeast of the community of Keno Hill and 2 km northwest of Keno Summit, at 1370 metres to 1440 metres above sea level (Figure 1). It is located at the approximate UTM co-ordinates 7 092 100m N and 487 900m E. Access to the property is via the Silver Trail Tourism Association's Keno City trail network, Trail Number 4 - Gambler Gulch Trail, and Trail Number 5 - Faro Gulch Trail. An unserviced gravel road, with rough sections, from Keno City provides vehicle access to within 1 km of the site. The last kilometre is a footpath that is suitable for all-terrain vehicles, with minor upgrading.

2. SITE PHYSIOGRAPHY

The site is located on the south side of Gambler Gulch at 1430 metres above sea level. Gambler Gulch is on the north side of Keno Hill. Soil around the site is well-drained and coarsely textured. Highlander is in an area of discontinuous permafrost on a north facing slope. No surface indications of permafrost were observed during the site visit. Vegetation consists of stunted black spruce, a variety of willow (2 to 3 metres high), scrub brush, heather, Hudson Bay tea, a variety of mosses and lichens, black berries, low bush cranberries, fireweed and sedges. The stream in Gambler Gulch runs through dense willow thickets.

Untreated mine water flows from a collapsed adit to Gambler Gulch along a 10-metre channel. All surface water from this site drains into Ladue Creek, which connects an unnamed lake (containing Wernecke tailings) and Gambler Lake.

3. GEOLOGY AND MINERALIZATION

The Highlander site is one of several small abandoned mine sites located within the Keno Hill - Galena Hill mining camps. The commodities of interest at the Highlander site are silver, lead and zinc. 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 greenstone sills and lenses, and various schistose rocks (GSC Paper 68-68, p.21). These rocks are intruded by gabbro and diabase sills.

Mineralization at the Highlander site consists of pyrite, galena, sphalerite, and freibergite in quartzite and siderite gangue (GSC Bulletin 111, p.36.).

4. SITE HISTORY

The Highlander property was likely staked in 1919-1920, following the discovery of the rich No. 9 vein on Keno Hill. Work on the Highlander claim and adjacent claims to 1929 included six open-cuts (most of which sloughed in by 1929), and an inaccessible 8 metre shaft that terminated in a drift, 14.6 metres long (GSC Memoir 284, p.603.). Inaccessible open-cuts and a shaft on the Highlander claim are also described by RW. Boyle (GSC Bulletin 111, p. 35.) after visiting the site between 1953 and 1955.

The buildings appear to have been built between 20 and 40 years ago, and the 10,000 to 15,000 tonnes of waste rock on the site was probably generated at least that long ago. The volume of waste rock indicates that at least 500 metres of underground development occurred at the Highlander site (SRK, 1996).

5. MINE DEVELOPMENT

Mine development at the lower workings includes a collapsed adit, two waste rock piles and a number of wood frame buildings located immediately adjacent to the stream in Gambler Gulch, and a second adit and waste rock complex located to the southwest on the hillside above the stream.Site details can be found on Figure 1; see attachment B for site photos.

5.1 Mine Openings And Excavations

Main Adit (photo 29-6)

Location: Main workings, located at the southeast edge of the lower waste rock piles.

Dimensions (L x W x H): N/A

Supports: N/A

Condition: Adit is collapsed.

Accessibility: Adit is securely sealed.

Upper Adits (photos 29-2,3)

Location: Two, perhaps three, adits or deep open-cuts along western edge of upper waste rock pile.

Dimensions (L x W x H): N/A

Supports: N/A

Condition: Adits are collapsed.

Accessibility: Northernmost adit is partially blocked but still accessible. Other adits are blocked with waste rock

5.2 Waste Rock Disposal Areas

There are three piles of mine rock on the site: two piles on either side of the ore processing shack outside the lower adits and one pile outside the upper adits. Waste rock was sampled in 1996 (SRK, 1997); all samples (with the exception of sample GA/WR/P204 from the upper pile) had NP:AP ratios greater than 6, indicating no acid generation potential. The lone exception was sample GA/WR/P204 which had an NP:AP ratio of 1.8, indicating that the material is potentially acid generating. The pile has been in place for at least 20 years (based on development history, surface vegetation, and the condition of adjacent adits) and is not currently acid generating (paste pH was neutral). There is little to no iron oxide staining on the surface. There is no staining visible at the base of the pile to indicate contaminated seepage or surface runoff, nor were there any signs of impacted vegetation.

A confirmatory rock sample (Highlander-WR-1) was collected near the base of the upper waste rock pile, but was not analyzed.

Upper workings waste rock pile (photo 29-2):

There is less than 5,000 tonnes in the upper waste rock pile. The rock is unsorted and the slopes appear to be stable.

Location: 25m northeast of the three upper adits

Dimensions (L x W x H): 30m x 12m x 4m

Stability: There is no evidence of the waste rock pile slumping. The waste rock pile appears stable.

Lower workings, southeastern waste rock pile (photo 29-11):

Location: 10m west of lower adit

Dimensions (L x W x H): 15m x 10m x 3m

Stability: The edges of the waste rock pile are sloped between 25° and 30° with no evidence of slumping.

Lower workings, northwestern waste rock pile (photo 29-9):

Location: 15m north of lower adit

Dimensions (L x W x H): 45m x 30m x 3m

Stability: The edges of the waste rock pile are sloped between 35° and 40°, following the underlying slope, with no evidence of slumping.

5.3 Tailings Impoundments

No milling was reported at the Highlander site, and no tailings were encountered.

6. MINE SITE INFRASTRUCTURE

Infrastructure at the Highlander site is limited to six wooden buildings (of varying size and condition) and rail infrastructure. Site details can be found on Figure 1; see Attachment A for site photos.

6.1 Buildings

There are six buildings at Highlander, including a cabin and bunkhouse, an ore processing structure, and three small (2m x 2m) wood frame sheds.

Building 29A: Ore processing building (photo 29-8)

Location: 10m northeast of lower adit entrance

Dimensions (L x W x H): 6m x 7m

Construction: three level wood frame, wood siding, and wood roof

Paint: none observed

Asbestos: none observed

Contents: none

Foundation: none

Hazardous products: none

Building 29B: wood frame cabin (photo 29-7)

Location: 30m west of lower adit

Dimensions (L x W x H): 9.5m x 6.5m x 3m

Construction: wood frame and clapboard, 2"x 6" floor, roof, and ceiling joists. partially collapsed porches

Paint: none observed

Asbestos: none observed

Contents: two wooden frame beds, various wooden shelves, large table, and the remnants of a wood burning stove

Foundation: none

Hazardous products: none observed

Building 29C: Wood frame bunkhouse (photo 29-7)

Location: 55m northwest of lower adit

Dimensions (L x W x H): 9.5m x 5.5m x 3m

Construction: wood frame and clapboard, 2"x 6" floor, roof, and ceiling joists; partially collapsed porches

Paint: none observed

Asbestos: none observed

Contents: none

Foundation: none

Hazardous products: none observed

6.2 Fuel Storage

There were no fuel drums or storage tanks encountered at this site.

6.3 Rail Infrastructure

Fabrication: steel rails and ore car

Amount of materials: approximately 10m total length of rail and one ore car

Condition: The rails and ore car are rusted, but pose no safety hazard

6.4 Milling and Processing Infrastructure

An ore processing structure (building 29A) is situated between the two lower waste rock dumps. Processing appears to have been limited to hand segregation of ore into bins; no signs of milling are evident at the Highlander site.

6.5 Electrical Equipment

None noted.

7. SOLID WASTE DUMPS

There were no solid waste dumps observed at this site.

8. POTENTIAL CONTAMINANTS OF CONCERN

8.1 Out-of-Service Transformers

No out-of-service transformers were observed.

8.2 Metals and Hydrocarbons in Soil

Background information and the on-site investigation did not indicate any concerns regarding metals or hydrocarbons in the soil; therefore no soil samples were taken.

8.3 Liquid Hazardous Materials

No liquid hazardous materials were encountered at this site.

8.4 Solid Hazardous Materials

No solid hazardous materials were encountered at this site.

9. WATER QUALITY

Mine water flows from the lower workings adit for a distance of 10m to Gambler Gulch. No discoloration or precipitated oxides were observed in the mine water or discharge stream channel.

Three water quality samples were collected:

1. Highlander-WS-1 (Gambler Gulch, approximately 20m above the confluence with the mine water discharge);
2. Highlander-WS-2 (mine water discharge); and
3. Highlander-WS-3 (Gambler Gulch, approximately 70m downstream from northernmost waste rock pile).

A list of water quality samples, field tests and laboratory results is given in Attachment B.

10. RECLAMATION

Some grass has grown on the sides of the waste rock piles; however, there has otherwise been relatively little disturbance of the site and therefore natural reclamation has been minimal.

11. OTHER SOURCES OF INFORMATION AND DATA

Further information on this site can be found in the SRK (1997) Phase II assessment report. This report provides a detailed discussion of water quality and waste rock analyses from the 1996 field program; these analytical results are also summarized in Attachment B.

12. REFERENCES

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Findlay, D.C., 1968. *The Mineral Industry of Yukon Territory and Southwestern District of Mackenzie, 1967.* Geological Survey of Canada Paper 68-68.

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Table B1. 1999 Water Quality Analyses, Highlander Mine Site

Sample Number	Detection Limit	Units	Highlander-WS-1 99/09/16	Highlander-WS-02 15/09/99	Highlander-WS-03 15/09/99
pH (field)	N/A	pH	6.3	6.7	6.3
Conductivity (field)	N/A	µS/cm			
pH (Lab)	0.01	pH	7.34	7.93	7.65
Conductivity (Lab)	0.01	µS/cm	140	350	210
Total Alkalinity	5	mg CaCO3/L	31	105	55
Chloride	0.25	mg/L	<0.25	<0.25	<0.25
Hardness (CaCO3 equiv)	5	mg/L	62.8	170	94.8
Hardness (CaCO3 equiv)	0.1	mg/L			
Nitrate-N	0.05	mg/L	<0.05	0.06	<0.05
Nitrite-N	0.003	mg/L	<0.003	<0.003	<0.003
Sulphate	1	mg/L	38.5	65.2	44
Total Dissolved Solids	5	mg/L	91	230	134
Analysis by ICP-USN					
Aluminum	0.0008	mg/L	0.0046	0.049	0.0147
Antimony	0.005	mg/L	<0.005	<0.005	<0.005
Arsenic	0.01	mg/L	<0.01	<0.01	<0.01
Cadmium	0.00006	mg/L	0.00014	0.000076	0.000064
Calcium	0.002	mg/L	21.1	48.6	28
Chromium	0.00006	mg/L	<0.00006	0.00032	0.0004
Cobalt	0.00003	mg/L	<0.00003	0.00024	<0.00003
Copper	0.00003	mg/L	<0.00003	0.00239	0.00137
Iron	0.00001	mg/L	0.033	0.172	0.01
Lead	0.0003	mg/L	<0.0003	0.001	<0.0003
Mercury	0.0001	mg/L	<0.0001	<0.0001	<0.0001
Molybdenum	0.00007	mg/L	0.00022	0.00104	0.00077
Nickel	0.00001	mg/L	<0.00001	0.0005	<0.00001
Phosphorus	0.03	mg/L	<0.03	<0.03	<0.03
Potassium	0.4	mg/L	<0.4	<0.4	<0.4
Selenium	0.004	mg/L	0.004	<0.004	0.007
Silicon	0.004	mg/L	1.64	2.13	1.74
Silver	0.00005	mg/L	<0.00005	<0.00005	<0.00005
Sodium	0.004	mg/L	0.7	1	0.7
Strontium	0.00002	mg/L	0.0727	0.142	0.0873
Sulphur	0.008	mg/L	12.9	20.3	13.7
Thallium	0.001	mg/L	<0.001	<0.001	<0.001
Titanium	0.00002	mg/L	<0.00002	0.00062	0.00039
Vanadium	0.00003	mg/L	<0.00003	<0.00003	<0.00003
Zinc	0.0002	mg/L	0.0047	0.0067	0.005
Analysis by Hydride AA					
Arsenic	0.0002	mg/L	<0.0002	0.0009	0.0006

Table B2. Highlander 1996 Water Quality Results

Table B2. Highlander 1996 Water Quality Results

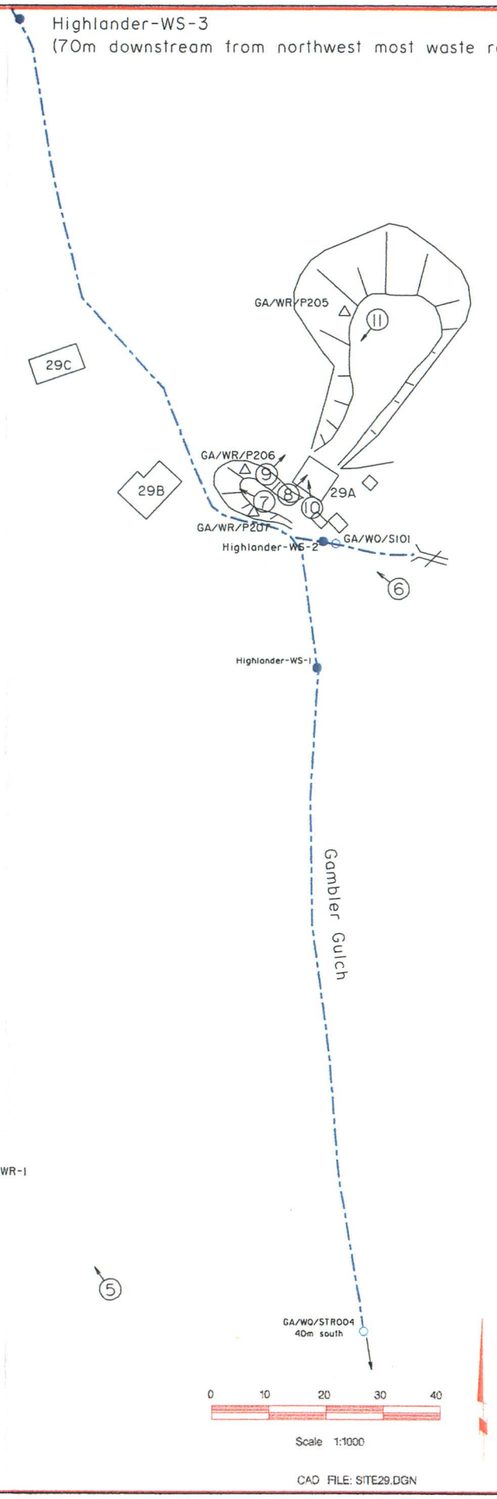
Sample ID Sampling date	GA/WQ/Str 004 18 Sept 1996	GA/WQ/Str 005 18 Sept 1996	GA/WQ/S 101 1 Sept 1996
Physical Tests			
Conductivity	36	186	282
(umhos/cm)	13.1	85.3	135
Hardness (as CaC03)	6.52	7.53	7.79
pH			
Dissolved Anions			
Acidity (as CaCO3)	6.1	1.0	1.0
Alkalinity - Total (as	7.1	49.4	94.4
CaCO3) Sulphate (as	8.3	42.4	52.2
S04)			
Total Metals			
Aluminum T-Al	0.008	0.246	0.044
Arsenic T-As	0.0001	0.0002	0.0018
Barium T-Ba	0.02	0.02	<0.01
Beryllium T-Be	<0.005	<0.005	<0.005
Boron T-B	<0.1	<0.1	<0.1
Cadmium T-Cd	<0.0002	<0.0002	<0.0002
Calcium T-Ca	3.52	25.9	39
Chromium T-Cr	<0.001	<0.001	<0.001
Cobalt T-Co	<0.02	<0.02	<0.02
Copper T-Cu	<0.001	<0.001	0.001
Iron T-Fe	<0.03	<0.03	0.15
Lead T-Pb	<0.001	<0.001	0.003
Lithium T-Li	<0.02	0.03	<0.02
Magnesium T-Mg	1.06	4.97	9.12
Manganese T-Mn	<0.005	<0.005	0.012
Mercury T-Hg	<0.00005	<0.00005	<0.00005
Molybdenum T-Mo	<0.03	<0.03	<0.03
Nickel T-Ni	<0.02	<0.02	<0.02
Selenium T-Se	0.0006	0.0006	0.0008
Silver T-Ag	<0.0001	<0.0001	<0.0001
Sodium T-NA	<2	<2	<2
Vanadium T-V	<0.03	<0.03	<0.03
Zinc T-Zn	0.009	<0.005	0.006

Table B3. Highlander 1996 Waste Rock Test Results

Parameter	Units	GA/WR/P204	GA/WR/P205	GA/WR/P206	GA/WR/P207
Field Paste	pH	6.12	8.33	8.96	8.66
Field Cond		10	90	50	80
ps/cm		6.68	7.83	8.47	8.46
Lab Paste	pH	0.11	0.71	0.30	0.70
		0.05	0.18	0.17	0.16
Total Sulfur	%				
Sulfate	%				
AP		1.9	16.6	4.1	16.9
NP		3.4	111.3	103.9	109.0
NET NP		1.6	94.7	99.8	92.1
NP/AP		1.8	6.7	25.6	6.5
Aluminum	%	0.70	0.70	1.70	0.90
Antimony	ppm	715	14	< 1	7
Arsenic	ppm	< 1	87	165	101
Barium	ppm	123	37	53	51
Beryllium	ppm	<0. 1	<0. 1	<0.1	<0.1
Bismuth	ppm	13	< 1	< 1	< 1
Cadmium	ppm	39.7	<0. 1	<0.1	<0.1
Calcium	%	0.24	2.99	3.69	3.62
Chromium	ppm	52	45	95	50
Cobalt	ppm	25	27	23	20
Copper	ppm	980	39	137	56
Gallium	ppm	< 1	< 1	< 1	<1
Iron	%	3.13	6.66	3.56	3.93
Lead	ppm	572	633	398	122
Lithium	ppm	3	10	25	15
Magnesium	%	0.21	1.55	2.06	1.31
Manganese	ppm	6730	>10000	1816	3675
Molybdenum	ppm	13	21	11	14
Nickel	ppm	52	119	62	60
Potassium	%	0.11	0.11	0.06	0.11
Phosphate	ppm	970	570	350	950
Silver	ppm	>200	6.7	4.7	3.3
Sodium	%	<0.01	<0.01	<0.01	0.01
Strontium	ppm	14	12	20	31
Thorium	ppm	< 1	< 1	< 1	< 1
Tin	ppm	4	10	6	5
Titanium	%	<0.01	<0.01	<0.01	<0.01
Tungsten	ppm	12	< 1	3	< 1
Uranium	ppm	< 1	< 1	< 1	< 1
Vanadium	ppm	15.9	24.5	52.0	26.4
Zinc	ppm	4545	1465	1760	459

AP = Acid Potential in tonnes CaC03 equivalent per 100 tonnes of material
NP = Neutralization Potential in tonnes CaC03 equivalent per 1000 tonnes of material
Net NP = Net Neutralization Potential = tonnes CaC03 equivalent per 1000 tonnes of material

- Building (22A: building site present reference*) / 22A* Indicates Asbestos Material
- 22A Collapsed Building
- Adit
- Collapsed Adit
- Shaft
- Collapsed/Backfilled Shaft
- Mine Rock Dump
- Bedrock Open Pit
- Trench
- Stripped Overburden Stockpile
- Stripped / Disturbed Area
- Outcrop Boundary
- Highway
- Road (gravel, 2 wheel drive)
- Road (gravel, 4X4 accessible)
- Road (inaccessible)
- Trail
- Culvert
- 24501-01 1999 Soil Sample (this study)
- Pre 1999 Soil Sample (other sources)
- 25WR04-01 1999 Waste Rock Sample (this study)
- Pre 1999 Waste Rock Sample (other sources)
- WO-12-06 1999 Water Sample
- Pre 1999 Water Sample
- Tension Cracks
- Mass Movement (note: for Forms; BelleKeno)
- Groundwater Seep
- Surface Water Flow (Stream, Creek, River)
- Lake
- Settling Pond / Water Treatment Pond
- Tailings Dam / Tailings Pond / Mill Tails
- Ponded Water / Trench
- Barrels
- Abandoned Equipment (compressors, ore cars, rails, air and water pipe)
- Mine Rails / Trestle
- Collapsed Trestle
- Solid Waste Disposal Site
- Area of Soil Contamination
- *(6) Transformer Loaction (number of transformer in brackets)
- Power Line
- Power Line Collapsed
- Aerial Transmission Towers
- 5 Photo Site (arrow shows view direction)
- GPS Survey Location
- Former Building Site (Elsa)



CAD FILE: SITE29.DGN

Waste Rock Geological Legend

This legend intended for use as a key to the observed lithological content of the mine dumps and stockpiles of surficial materials investigated. It does not represent regional stratigraphy and no stratigraphic sequence is implied.

Pyrite content as percent: eg. Py 2%. Occurs as an alteration halo adjacent to vein fault structure.

Oxidation: Weak (wOx), moderate (mOx) and intense (iOx).

Quarternary: (5) Undifferentiated, unconsolidated colluvium, glacial till.

Veins: (4a) Quartz veins;
(4b) Quartz-pyrite veins;
(4c) Quartz-siderite *trace galena-sphalerite veins;
(4d) Siderite-quartz *trace galena-sphalerite veins;
(4e) Suphide (galena-sphalerite) *quartz*siderite veins.

Greenstone: (3) Amphibole-chlorite-plagioclase metadiorite or metagabbro.

Quartzite: (2a) Thick beded, blocky gray quartzite;
(2b) Thin banded, broken, quartzite with carbonaceous phyllite interbeds;
(2c) Calcareous quartzite.

Phyllite: (1a) Broken sericite-chlorite phyllite;
(1b) Carbonaceous phyllite.

date:

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

Architectural & Engineering Services
Western Region

designed by:
conçu par:
drawn by: C.S. Nov./99
dessine par:
approved by:
approuvé par:
revisions:

Drawing title: / Titre du dessin:

Highlander Site #29
Site Assessment
Yukon Territory

project no. / no. du projet: 125-12.01

dwg. no. / dessin no. 1 of 1

Photo 29-1: Panorama of upper Highlander area showing both older hand/excavator trenches and more recent cat trenches.

Photo 29-2: Northern partlycollapsed adit, upper workings.

Photo 29-3: Lower workings waste rock piles, bunkhouse and ore processing building viewed to northeast of upper workings.

Photo 29-4: Upper workings waste rock piles.

Photo 29-5: Collaopsed adit, lower workings."

Photo 29-6: Bunkhouse and cabin, looking northwest.

Photo 29-7: Ore processing building.

Photo 29-9: Interior of ore processing building.