ABBREVIATED PRELIMINARY ASSESSMENT

Index Bornite Mine

Cover Photo: Main adit along Lewis Creek.

Mt. Baker-Snoqualmie National Forest
Skykomish Ranger District
Snohomish County, WA

March, 2005

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EXECUTIVE SUMMARY

The Forest Service performed an Abbreviated Preliminary Assessment for the Index Bornite Mine (Site) to determine the need for further site characterization. The Site is located approximately 2 miles east of Index, WA along Lewis Creek, a tributary of the North Fork Skykomish River. Lewis Creek and the North Fork Skykomish River are known to have threatened and endangered anadromous fish populations including Fall Chinook, Coho, and Pink Salmon as well as Summer and Winter Steelhead (WA-Department of Fish and Wildlife, https://fortress.wa.gov/dfw/salmonscape accessed 3/21/2005). Additionally, Dolly Varden/Bull Trout have been documented in the North Fork Skykomish River (WA-Department of Fish and Wildlife, https://fortress.wa.gov/dfw/salmonscape accessed 3/21/2005). The Site falls on National Forest System lands managed and administered by the Skykomish Ranger District of the Mt. Baker-Snoqualmie National Forest. The mine is located on moderate to steep sideslopes at elevations of 1,700 to 1,800 feet above mean sea level (MSL). Workings include an open adit reported to be 522 ft. long and a flooded shaft reported to be 70 ft. deep. There is no apparent waste rock associated with the adit but there is a waste rock dump at the shaft.

Arsenic concentrations in both samples from the shaft waste rock dump exceeded both Washington's Model Toxics Control Act (MTCA) Method A cleanup levels and/or EPA Region IX Preliminary Remediation Goals (PRGs) for industrial properties (Appendix B, Tables 1 and 2). Arsenic, copper, and tin exceeded soil concentrations established under MTCA to be protective of terrestrial ecological receptors at most sites (Appendix B, Tables 1 and 2). However, exceedence of ecological receptor values does not necessarily trigger cleanup actions. Waste rock volume is estimated to be approximately 50 yds^3.

Stream sediment samples along Lewis Creek revealed slight increases in arsenic, iron, manganese, and molybdenum concentrations from the upstream sample to the downstream sample (Appendix B, Tables 3 and 4). Nickel and antimony were the only metals to exceed sediment guidelines. However, nickel and antimony are naturally elevated as indicated by higher concentrations in the upstream sample which also exceeded sediment guidelines. Impacts from mining on Lewis Creek stream sediment quality could not be definitively determined because of the high analytical detection limits associated with use of the NITON XRF for some metals (Appendix B, Tables 3 and 4). However, the data do not indicate obvious adverse effects to stream sediment quality in Lewis Creek from historic mining.

Based on the analytical results for soil and sediment samples; proximity of the Site to threatened and endangered fish populations; accessibility of the Site to the public; and EPA's APA Checklist (Appendix A), it is recommended that a Site Inspection (SI) be performed for the Site. However, given the analytical results, limited volume and location of waste rock materials above perennial/intermittent streams, and site specific conditions at the mine (e.g. limited mine effluent discharge, well-vegetated dump, no motorized access), a Site Inspection for the Index Bornite could be deferred until a later date when regional priorities and budget constraints allow.

Abandoned mine workings should be closed for public safety and to limit potential liability associated with the general public recreating at the Site.

1.0 INTRODUCTION

An Abbreviated Preliminary Assessment (APA) was performed by the US Forest Service in accordance with the EPA "Guidance for Performing Preliminary Assessments Under CERCLA", EPA "Improving Site Assessment: Abbreviated Preliminary Assessments" of 1999, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, the Superfund Amendments and Reauthorization Act (SARA) of 1986, and the National Contingency Plan as outlined in 40 CFR Parts 300.410(c)(1)(i-v).

The purpose of this assessment was to determine whether or not there is a potential for a release of contaminants to the environment and/or to human health. The purpose of an APA is to determine whether further site characterization is warranted. A Niton XRF 700 Series was utilized to help in the preliminary screening of this Site.

2.0 SITE DESCRIPTION, OPERATIONAL HISTORY, AND WASTE CHARACTERISTICS

The Site falls on National Forest System lands managed and administered by the Skykomish Ranger District of the Mt. Baker-Snoqualmie National Forest. It is located approximately 2 miles east of Index, WA along Lewis Creek, a tributary of the North Fork Skykomish River. Lewis Creek and the North Fork Skykomish River are known to have threatened and endangered anadromous fish populations including Fall Chinook, Coho, and Pink Salmon as well as Summer and Winter Steelhead (WA-Department of Fish and Wildlife, https://fortress.wa.gov/dfw/salmonscape accessed 3/21/2005). Additionally, Dolly Varden/Bull Trout have been documented in the North Fork Skykomish River (WA-Department of Fish and Wildlife, https://fortress.wa.gov/dfw/salmonscape accessed 3/21/2005). Location information is as follows:

Legal:	Willamette Meridian, T 27 N, R 10 E, Sec 22, NE 1/4	
Lat./Long.:	Adit	N 47° 49' 5.3" W121° 30' 4.4"
	Shaft	N 47° 49' 2.8" W121° 30' 2.1"
USGS quadrangle:	Index and Baring	

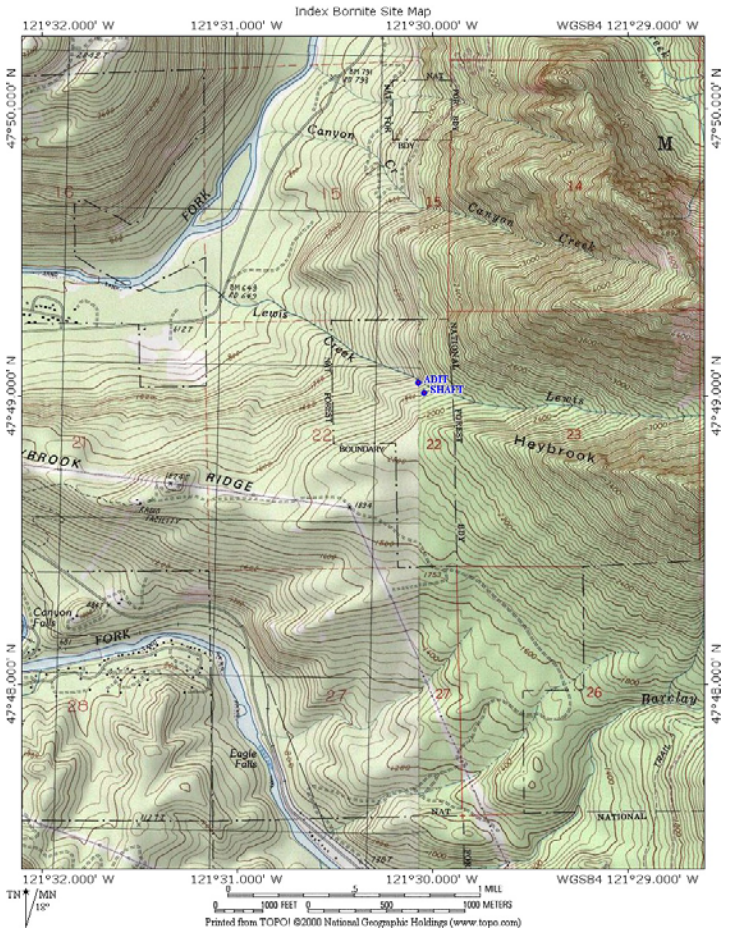
The Site was originally located in 1898 under the U.S. Mining Laws and the Index Bornite Mining Company was formed the following year in 1899 (Weaver, 1912). Weaver (1912) reported that development work at the Site consisted of 700 feet of tunnel and a 70-foot deep shaft. At present, one adit along Lewis Creek is open and reported by Church and others (1983) to be 522 ft. long. There is no waste rock dump associated with the adit along Lewis Creek so either 1) waste rock was removed from the streambed of Lewis Creek and stockpiled at a presently unrecognizable location or 2) rock was piled along Lewis Creek and has been subsequently removed by floods. Church and others (1983) also reported a 57-ft. long adit which could not be located during the field investigation. The shaft is flooded at a depth of approximately 8 feet below ground surface. The timbers supporting the shaft collar are collapsing and extremely unstable. The waste rock dump at the shaft comprises approximately 50 yds^3 and is well vegetated.

The workings explore a mineralized shear zone ranging from 4 inches to 4 feet wide in granodiorite host rock (Weaver, 1912). Primary ore minerals were bornite, chalcocite, and chalcopyrite; gangue minerals include quartz, calcite, and crushed granodiorite (Huntting, 1956). Commodities sought at the property included copper and silver (Huntting, 1956). There are no records of any milling operations or actual production from the Site.

Access to the Site can be accomplished by proceeding on Forest Service Primary Route 63 (Index-Galena Road) west from Index, WA for approximately 1.5 miles to the junction with Forest Service Road 6305 at Lewis Creek. Proceed southwest on Forest Service Road 6305 for 1 mile to an elevation of approximately 1,300 feet. On your left, an overgrown, abandoned road leads uphill and ends in approximately ½ mile in the vicinity of the mine. Forest Service Road 6305 is gated at it's junction with Primary Rout 63 but is driveable to the mine access road. There is no motorized vehicle access all the way to the Site.

Mining claims in the area have been staked in the past but at present, the Site is inactive and unclaimed (BLM LR2000 database, accessed 3/15/2005).

Figure 1. General location map for Index Bornite Mine along Lewis Creek.



3.0 SITE SAMPLING AND TEST RESULTS

Soil Samples

Two composite soil samples were collected from the shaft waste rock dump for bench testing using a NITON XRF per EPA Method 6200. Surface soils were removed to approximately 4 to 6 inches below grade in order to get below highly oxidized surface layers. Rocks, debris and other deleterious materials were removed. Samples were then collected, bagged, and labeled. Samples were later dried, sieved, and prepared for bench testing using a Niton XRF, XL-722S. The analytical results from this effort are

provided in Appendix B and summarized below. It is important to note that detection limits for certain elements were higher than the cleanup goals or standards to which they were compared (Appendix B, Tables 1 and 2). As a result, there may be additional exceedences of cleanup goals or standards not detectable using this reconnaissance analytical technique.

Arsenic concentrations in both samples exceeded both Washington's Model Toxics Control Act (MTCA) Method A cleanup levels and/or EPA Region IX Preliminary Remediation Goals (PRGs) for industrial properties (Appendix B, Tables 1 and 2). Arsenic, copper, and tin exceeded soil concentrations established under MTCA to be protective of terrestrial ecological receptors at most sites (Appendix B, Tables 1 and 2). However, exceedence of ecological receptor values does not necessarily trigger cleanup actions. Waste rock volume is estimated to be approximately 50 yds^3.

Water Quality

No water quality samples were collected as part of this investigation. However, field parameters for surface waters along Lewis Creek and from adit discharge were obtained using a Horiba U-22 during fieldwork in June, 2004 (Table 1). During fieldwork, water was discharging from the adit at approximately 3 gallons per minute. Mine effluent flows down a rock outcrop into Lewis Creek. The data indicate no obvious adverse effects to Lewis Creek from the adit discharge.

Table 1. Surface water field parameters at the Index Bornite mine.

Location	pH	Conductivity (µS/cm)	Turbidity (Ntu)	Dissolved Oxygen (mg/L)	Temperature (°C)	Total Dissolved Solids (µg/L)	Oxidation-Reduction Potential (mV)
Lewis Creek-above mine	8.9	2	39	5.1	7.4	.01	52
Adit Discharge to Lewis Creek	9.2	12	66	5.8	7.2	.08	42
Lewis Creek below mine	8.9	2	35	5.2	7.4	.02	46

Sediment Samples

Composite grab sediment samples were collected along Lewis Creek both upstream and downstream of the Index Bornite Mine. Sediment samples were collected using a stainless steel scoop and placed in 2 labeled Ziploc bags. Samples were later dried, sieved and prepared for bench testing using the Niton XRF. The results from this effort are outlined in Appendix B, Tables 3 and 4. There are no Washington State or EPA national standards for metals concentrations in freshwater sediments. However, Washington State Department of Ecology Toxics Program is currently considering a draft set of sediment quality values for freshwater sediments outlined in Michelsen (2003). Michelson (2003) calculated potential sediment quality standards (SQS) and cleanup screening levels (CSL) for zinc, lead, copper, chromium, nickel, cadmium, arsenic, silver, antimony, and mercury. Metals concentrations below SQS threshold values are expected to have no adverse effects on biological resources; the CSL is used to identify sites of potential concern where further study may be warranted. Persaud and others (1993) and

Cubbage and others (1997) proposed freshwater sediment standards for iron and manganese, respectively. Applicable standards for cobalt, molybdenum, selenium, and tin could not be found.

There were slight increases in arsenic, iron, manganese, and molybdenum concentrations from the upstream sample to the downstream sample (Appendix B, Tables 3 and 4). Antimony, nickel, lead, cobalt, tin, and zinc concentrations decreased from the upstream sample to the downstream sample (Appendix B, Tables 3 and 4). Nickel and antimony concentrations were the only metals to exceed sediment guidelines (Appendix B, Tables 3 and 4). However, it appears nickel and antimony are naturally elevated as indicated by higher concentrations in the upstream sample which also exceeded sediment guidelines. Trends in cadmium, chromium, mercury, copper, selenium, and silver concentrations and potential exceedences of sediment guidelines could be resolved because of analytical detection limits associated with the NITON XRF. Impacts from mining to Lewis Creek stream sediment quality could not be definitively determined because of the high analytical detection limits associated with use of the NITON XRF for some metals. However, the data do not indicate obvious adverse effects to stream sediment quality in Lewis Creek from historic mining.

4.0 SUMMARY

Arsenic concentrations in the waste rock dump at the Index Bornite shaft exceeded both Washington's Model Toxics Control Act (MTCA) Method A cleanup levels and/or EPA Region IX Preliminary Remediation Goals (PRGs) for industrial properties. Arsenic, tin, and copper exceeded soil concentrations established under MTCA to be protective of terrestrial ecological receptors at most sites.

Stream sediment samples along Lewis Creek revealed slight increases in arsenic, iron, manganese, and molybdenum concentrations from the upstream sample to the downstream sample. Nickel and antimony were the only metals to exceed sediment guidelines. However, nickel and antimony are naturally elevated as indicated by higher concentrations in the upstream sample which also exceeded sediment guidelines. Impacts from mining on Lewis Creek stream sediment quality could not be definitively determined because of the high analytical detection limits associated with use of the NITON XRF for some metals. However, the data do not indicate obvious adverse effects to stream sediment quality in Lewis Creek from historic mining.

5.0 RECOMMENDATION

Based on the analytical results for soil and sediment samples; proximity to known populations of threatened and endangered anadromous fish species; accessibility of the Site to the public; and EPA's APA Checklist (Appendix A); it is recommended that a Site Inspection (SI) be performed for the Site.

As part of this inspection, a thorough study of the area to determine the extent of contamination is warranted as well as sampling water from pore spaces of the stream gravels immediately above and below the Site. Sampling of the benthic macroinvertebrates are also required. In addition to testing water samples from the pore spaces of the gravels for the presence of metallic elements, water parameters such as pH, conductivity, turbidity, dissolved oxygen, temperature, total dissolved solids, hardness, and oxygen reduction potential are required. The area should be sampled to determine the presence of waste material and tailings, and if present, the potential waste piles and tailings should be sampled at depth and a determination of volumes should be calculated. Acid base accounting (ABA) and assessment of leaching potential are required for waste rock and tailings. Sediment samples are to be collected from transects of the stream and preferably at depth and analyzed for total as well as for available metals. Surface water samples are also required for analyses of both total and dissolved metal concentrations in Lewis Creek as well as in any other seeps and/or tributaries that may be present in the vicinity of the Site.

Abandoned mine workings should be closed for public safety and to limit potential liability associated with the general public recreating at the Site.

REFERENCES

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Appendix A

ABBREVIATED PRELIMINARY ASSESSMENT CHECKLIST

ABBREVIATED PRELIMINARY ASSESSMENT CHECKLIST

This checklist can be used to help the site investigator determine if an Abbreviated Preliminary Assessment (APA) is warranted. This checklist should document the rationale for the decision on whether further steps in the site assessment process are required under CERCLA. Use additional sheets, if necessary.

Checklist Preparer: Greg Graham, Geologist — March 22, 2005
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(Address) (Phone)
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(E-Mail Address)

Site Name: Index Bornite Mine

Previous Names (if any): N/A

Site Location: Approximately 2 miles east of Index, WA along Lewis Creek, a tributary of the North Fork Skykomish River.

Legal Description: Willamette Meridian, T 27 N, R 10 E, Sec 22, NE 1/4

Describe the release (or potential release) and its probable nature: Arsenic concentrations in the waste rock dump at the Index Bornite shaft exceeded both Washington's Model Toxics Control Act (MTCA) Method A cleanup levels and/or EPA Region IX Preliminary Remediation Goals (PRGs) for industrial properties. Arsenic, tin, and copper exceeded soil concentrations established under MTCA to be protective of terrestrial ecological receptors at most sites. Stream sediment samples along Lewis Creek revealed slight increases in arsenic, iron, manganese, and molybdenum concentrations from the upstream sample to the downstream sample. Nickel and antimony were the only metals to exceed sediment guidelines. However, nickel and antimony are naturally elevated as indicated by higher concentrations in the upstream sample which also exceeded sediment guidelines. Impacts from mining on Lewis Creek stream sediment quality could not be definitively determined because of the high analytical detection limits associated with use of the NITON XRF for some metals. However, the data do not indicate obvious adverse effects to stream sediment quality in Lewis Creek from historic mining.

Part 1 - Superfund Eligibility Evaluation

If All answers are "no" go on to Part 2, otherwise proceed to Part 3	**YES**	**NO**
1. Is the site currently in CERCLIS or an "alias" of another site?		**X**
2. Is the site being addressed by some other remedial program (Federal, State, or Tribal)?		**X**
3. Are the hazardous substances potentially released at the site regulated under a statutory exclusion (i.e., petroleum, natural gas, natural gas liquids, synthetic gas usable for fuel, normal application of fertilizer, release located in a workplace, naturally occurring, or regulated by the NRC, UMTRCA, or OSHA)?		**X**
4. Are the hazardous substances potentially released at the site excluded by policy considerations (i.e., deferred to RCRA corrective action)?		**X**
5. Is there sufficient documentation to demonstrate that no potential for a release that could cause adverse environmental or human health impacts exist (i.e., comprehensive remedial investigation equivalent data showing no release above ARAR's, completed removal action, documentation showing that no hazardous substance release have occurred, or an EPA approved risk assessment completed)?		**X**

Part 2 - Initial Site Evaluation

For Part 2, if information is not available to make a "yes" or "no" response, further investigation may be needed. In these cases, determine whether an APA is appropriate. Exhibit 1 parallels the questions in Part 2. Use Exhibit 1 to make decisions in Part 3.

If the answer is "no" to any questions 1, 2, or 3, proceed directly to Part 3.	**YES**	**NO**
1. Does the site have a release or a potential to release?	**X**	
2. Does the site have uncontained sources containing CERCLA eligible substances?	**X**	
3. Does the site have documented on-site, adjacent, or nearby targets?	**X**	

If the answers to questions 1, 2, and 3 above were all "yes" then answer the questions below before proceeding to Part 3.	**YES**	**NO**
4. Does documentation indicate that a target (i.e., drinking water wells, drinking surface water intakes, etc.) has been exposed to a hazardous substance released from the site?		**X**
5. Is there an apparent release at the site with no documentation of exposed targets, but there are targets on site or immediately adjacent to the site?	**X**	
6. Is there an apparent release and no documented on-site targets or targets immediately adjacent to the site, but there are nearby targets (i.e., targets within 1 mile)?	**X**	
7. Is there no indication of a hazardous substance release, and there are uncontained sources containing CERCLA hazardous substances, but there is a potential to release with targets present on site or in proximity to the site?		**X**

Notes:

The target at this Site is a sensitive environment. Lewis Creek and the North Fork Skykomish River are known to have threatened and endangered anadromous fish populations including Fall Chinook, Coho, and Pink Salmon as well as Summer and Winter Steelhead (WA-Department of Fish and Wildlife, https://fortress.wa.gov/dfw/salmonscape accessed 3/21/2005). Additionally, Dolly Varden/Bull Trout have been documented in the North Fork Skykomish River (WA-Department of Fish and Wildlife, https://fortress.wa.gov/dfw/salmonscape accessed 3/21/2005).

EXHIBIT 1
SITE ASSESSMENT DECISION GUIDELINES FOR A SITE

Exhibit 1 identifies different types of site information and provides some possible recommendations for further site assessment activities based on that information. You will use Exhibit 1 in determining the need for further action at the site, based on the answers to the questions in Part 2. Please use your professional judgment when evaluating a site. Your judgment may be different from the general recommendations for a site given below.

Suspected/Documented Site Conditions		**APA**	**FULL PA**	**PA/SI**	**SI**
1. There are no releases or potential to release.		Yes	**No**	**No**	**No**
2. No uncontained sources with CERCLA-eligible substances are present on site.		Yes	**No**	**No**	**No**
3. There are no on-site, adjacent, or nearby targets		Yes	**No**	**No**	**No**
4. There is documentation indicating that a target (i.e., drinking water wells, drinking surface water intakes, etc.) has been exposed to a hazardous substance released from the site.	Option 1: APA SI	Yes	**No**	**No**	Yes
	Option 2: PA/SI	**No**	**No**	Yes	**No**
5. There is an apparent release at the site with no documentation of exposed targets, but there are targets on site or immediately adjacent to the site.	Option 1: APA SI	**Yes**	No	No	**Yes**
	Option 2: PA/SI	No	No	**Yes**	N/A
6. There is an apparent release and no documented on-site targets and no documented immediately adjacent to the site, but there are nearby targets. Nearby targets are those targets that are located within 1 mile of the site and have a relatively high likelihood of exposure to a hazardous substance migrating from the site.		**No**	Yes	**No**	**No**
7. There is no indication of a hazardous substance release, and there are uncontained sources containing CERCLA hazardous substances, but there is a potential to release with targets present on site or in proximity to the site.		**No**	Yes	**No**	**No**

Part 3 - EPA Site Assessment Decision

When completing Part 3, use Part 2 and Exhibit 1 to select the appropriate decision. For example, if the answer to question 1 in Part 2 was "no," then an APA may be performed and the "NFRAP" box below should be checked. Additionally, if the answer to question 4 in Part 2 is "yes," then you have two options (as indicated in Exhibit 1): Option 1 -- conduct an APA and check the "Lower Priority SI" or "Higher Priority SI" box below; or Option 2 -- proceed with a combined PA/SI assessment.

Check the box that applies based on the conclusions of the APA:

( ) NFRAP
( ) Higher Priority SI
(X) Lower Priority SI
( ) Defer to RCRA Subtitle C
( ) Defer to NRC
( ) Refer to Removal Program – further site assessment needed
( ) Refer to Removal Program – NFRAP
( ) Site is being addressed as part of another CERCLIS site
( ) Other: _____

Regional EPA Reviewer: N/A _____ _____
Print Name/Signature Date

PLEASE EXPLAIN THE RATIONALE FOR YOUR DECISION:

Arsenic concentrations in two samples from the shaft waste rock dump exceeded both Washington's Model Toxics Control Act (MTCA) Method A cleanup levels and/or EPA Region IX Preliminary Remediation Goals (PRGs) for industrial properties (Appendix B, Tables 1 and 2). Arsenic, copper, and tin exceeded soil concentrations established under MTCA to be protective of terrestrial ecological receptors at most sites (Appendix B, Tables 1 and 2). Waste rock volume is estimated to be approximately 50 yds^3.

Stream sediment samples along Lewis Creek revealed slight increases in arsenic, iron, manganese, and molybdenum concentrations from the upstream sample to the downstream sample (Appendix B, Tables 3 and 4). Nickel and antimony were the only metals to exceed sediment guidelines. However, nickel and antimony are naturally elevated as indicated by higher concentrations in the upstream sample which also exceeded sediment guidelines. Impacts from mining on Lewis Creek stream sediment quality could not be definitively determined because of the high analytical detection limits associated with use of the NITON XRF for some metals (Appendix B, Tables 3 and 4). However, the data do not indicate obvious adverse effects to stream sediment quality in Lewis Creek from historic mining.

Based on the analytical results for soil and sediment samples; proximity of the Site to threatened and endangered fish populations; accessibility of the Site to the public; and EPA's APA Checklist (Appendix A), it is recommended that a Site Inspection (SI) be performed for the Site.

NOTES:

Appendix B

NITON XRF ANALYTICAL DATA SUMMARY

Table 1. Analytical results from Index Bornite Shaft waste rock dump.

SAMPLE	ANALYTE	ANALYTICAL RESULT (mg/kg)[1]	MTCA Method A (mg/kg)[2]	EPA REGION IX PRG (mg/kg)[3]	SIMPLIFIED ECOLOGICAL EVALUATION (mg/kg)[4]
IB-WR-1	Total Arsenic Arsenic III Arsenic V	**55.9**	20	Noncancer – 260 Cancer - 1.6	 20 260
	Cadmium	BDL (49.2)	2	450	36
	Total Chromium Chromium VI Chromium III	BDL (285)	 19 2,000	450 64 100,000	135
	Lead	BDL (14.85)	1,000	750	220
	Mercury	BDL (17.25)	2	310	Inorganic - 9 Organic - .7
	Antimony	111.2		410	--
	Cobalt	BDL (420)		1,900	--
	Copper	*681.2*		41,000	550
	Iron	31,590.4		100,000	--
	Manganese	BDL (675)		19,000	23,500
	Molybdenum	16.5		5,100	71
	Nickel	BDL (180)		20,000	1,850
	Selenium	BDL (8.55)		5,100	.8
	Silver	BDL (150)		5,100	--
	Tin	*1,140*		100,000	(275)
	Zinc	78.8		100,000	570

[1] BDL-Below Detection Limit; detection limit in mg/kg is indicated in parenthesis (e.g. BDL (450))
[2] From WAC 173-340-900, Table 745-1, MTCA Method A Cleanup Levels for Industrial Properties.
[3] From EPA, Region IX, Preliminary Remediation Goals, 10/1/2002.
[4] From WAC 173-340-900, Table 749-2, Priority Contaminants of Ecological Concern for Sites that Qualify for the Simplified Terrestrial Ecological Evaluation Procedure. All concentrations are for industrial/commercial sites; if unavailable, unrestricted land use values denoted with parenthesis ( ) were utilized.

Table 2. Analytical results from Index Bornite Shaft waste rock dump.

SAMPLE	ANALYTE	ANALYTICAL RESULT (mg/kg)[1]	MTCA Method A (mg/kg)[2]	EPA REGION IX PRG (mg/kg)[3]	SIMPLIFIED ECOLOGICAL EVALUATION (mg/kg)[4]
ID-WR-2	Total Arsenic Arsenic III Arsenic V	**144.1**	20	Noncancer – 260 Cancer - 1.6	 20 260
	Cadmium	BDL (47.85)	2	450	36
	Total Chromium Chromium VI Chromium III	BDL (330)	 19 2,000	450 64 100,000	135
	Lead	32	1,000	750	220
	Mercury	BDL (21.3)	2	310	Inorganic - 9 Organic - .7
	Antimony	171.1		410	--
	Cobalt	618.4		1,900	--
	Copper	*2,139.2*		41,000	550
	Iron	40,883.2		100,000	--
	Manganese	BDL (780)		19,000	23,500
	Molybdenum	21.5		5,100	71
	Nickel	BDL (210)		20,000	1,850
	Selenium	BDL (9.45)		5,100	.8
	Silver	BDL (165)		5,100	--
	Tin	*1,809.6*		100,000	(275)
	Zinc	136.1		100,000	570

[1] BDL-Below Detection Limit; detection limit in mg/kg is indicated in parenthesis (e.g. BDL (450))
[2] From WAC 173-340-900, Table 745-1, MTCA Method A Cleanup Levels for Industrial Properties.
[3] From EPA, Region IX, Preliminary Remediation Goals, 10/1/2002.
[4] From WAC 173-340-900, Table 749-2, Priority Contaminants of Ecological Concern for Sites that Qualify for the Simplified Terrestrial Ecological Evaluation Procedure. All concentrations are for industrial/commercial sites; if unavailable, unrestricted land use values denoted with parenthesis ( ) were utilized.

Table 3. Analytical results for Lewis Creek stream sediment sample upstream of Index Bornite Mine.

SAMPLE	ANALYTE	ANALYTICAL RESULT (mg/kg)[1]	FRESHWATER SEDIMENT QUALITY VALUE (mg/kg)	SOURCE
IB-SS-U	Total Arsenic Arsenic III Arsenic V	BDL (16.35)	20/51	Sediment Quality Standards/ Cleanup Screening Levels from Michelsen, 2003
	Cadmium	BDL (53.85)	0.6/1.0	"
	Total Chromium Chromium VI Chromium III	BDL (330)	95/100	"
	Lead	21.9	335/430	"
	Mercury	BDL (17.25)	0.50/0.75	"
	Antimony	**155.6**	0.4/0.6	"
	Cobalt	538	--	
	Copper	BDL (104.1)	80/830	"
	Iron	34,892.8	40,000	Severe Effect Level from Persaud and others, 1993
	Manganese	BDL (765)	1,800	Cubbage and others, 1997
	Molybdenum	BDL (7.8)	--	
	Nickel	**1,440**	60/70	Sediment Quality Standards/ Cleanup Screening Levels from Michelsen, 2003
	Selenium	BDL (8.7)	--	
	Silver	BDL (165)	2.0/2.5	"
	Tin	1,729.6	--	
	Zinc	132.4	140/160	"

[1] BDL-Below Detection Limit; detection limit in mg/kg is indicated in parenthesis (e.g. BDL (450))

Table 4. Analytical results for Lewis Creek stream sediment sample downstream of Index Bornite Mine.

SAMPLE	ANALYTE	ANALYTICAL RESULT (mg/kg)[1]	FRESHWATER SEDIMENT QUALITY VALUE (mg/kg)	SOURCE
IB-SS-D	Total Arsenic Arsenic III Arsenic V	19.7	20/51	Sediment Quality Standards/ Cleanup Screening Levels from Michelsen, 2003
	Cadmium	BDL (36.6)	0.6/1.0	"
	Total Chromium Chromium VI Chromium III	BDL (300)	95/100	"
	Lead	18.6	335/430	"
	Mercury	BDL (16.35)	0.50/0.75	"
	Antimony	BDL (48.45)	0.4/0.6	"
	Cobalt	520.8	--	
	Copper	BDL (78.3)	80/830	"
	Iron	37,196.8	40,000	Severe Effect Level from Persaud and others, 1993
	Manganese	804.8	1,800	Cubbage and others, 1997
	Molybdenum	9.8	--	
	Nickel	**170.5**	60/70	Sediment Quality Standards/ Cleanup Screening Levels from Michelsen, 2003
	Selenium	BDL (8.4)	--	
	Silver	BDL (136.35)	2.0/2.5	"
	Tin	452	--	
	Zinc	127.3	140/160	"

[1] BDL-Below Detection Limit; detection limit in mg/kg is indicated in parenthesis (e.g. BDL (450))

Appendix C

Site Photos

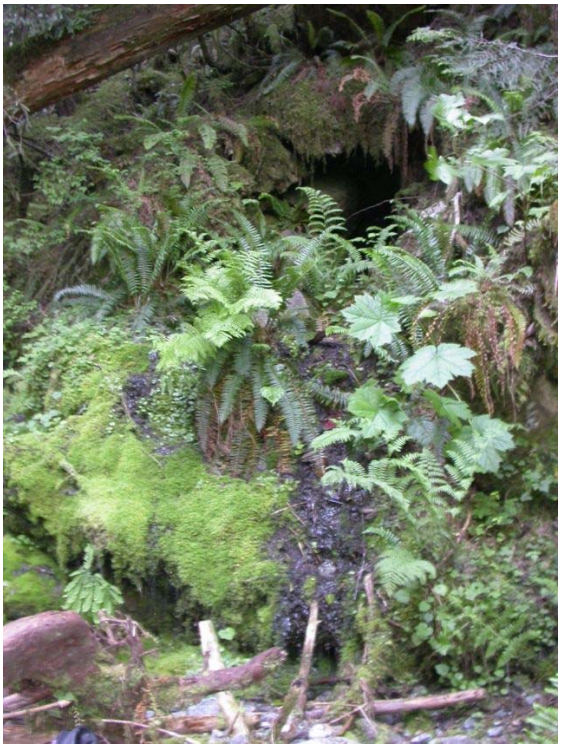

Photo 1. Main adit along Lewis Creek, view to the southwest from stream channel (photo by G. Graham, 6/22/04).

Photo 2. View inside main adit along Lewis Creek, note water on sill, view to the southwest (photo by G. Graham 6/22/2004).

Photo 3. View of shaft and waste rock dump at Index Bornite Mine, view to the northwest (photo by G. Graham, 6/22/2004).

Photo 4. Toe of waste rock dump at mine shaft, note well vegetated surface, view to the southeast (photo by G. Graham, 6/22/2004).

Photo 5. Close-up of flooded shaft collar which poses a serious physical hazard at the Site (photo by G. Graham, 6/22/2004).