KIGGINS-NISBET MINE COMPLEX

Mt. Hood National Forest
Clackamas County, Oregon

LONG-TERM MONITORING REPORT

April 22, 2009

Prepared For:
U.S. Forest Service, Region 6
10600 NE 51st Circle
Vancouver, Washington 98682

MSE
Millennium Science & Engineering, Inc.

LONG-TERM MONITORING PLAN

Kiggins-Nisbet Mine Complex
Mt. Hood National Forest, Oregon **April 2009**

Principal Author: Michael J. Puett, P.E., Project Manager

Reviewed By: Don Tibbets, E.I.T., Field Engineer

Prepared For: USDA Forest Service
Gifford Pinchot National Forest
10600 NE 51st Circle
Vancouver, WA 98682

Prepared by: Millennium Science and Engineering, Inc.
1555 Shoreline Drive, Suite 150
Boise, Idaho 83702
(208) 345-8292

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1.0 INTRODUCTION

- Millennium Science and Engineering, Inc. (MSE) completed a Removal Action at the Kiggins-Nisbet Mine Complex (i.e. the Site) on the Mt. Hood National Forest in August 2008.
- The Long-term Monitoring Plan is an addendum to the Removal Action Work Plan (MSE 2008) and describes post-Removal Action monitoring activities to be conducted at the Site beginning in Summer 2009.
  - The plan combines elements of a Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP).
  - The plan also discusses the laboratory analytical procedures and quality assurance/quality control (QA/QC) methods to be employed both in the field and the lab to ensure data quality.
- A site-specific Health and Safety Plan (HASP) is provided in Attachment A to this plan.
- Field forms are provided in Attachment B.
- An operator's manual for the MHE products push point pore water samplers is provided in Attachment C.

1.1 Purpose and Objectives

- MSE will conduct 3 years of annual post-removal monitoring of the aquatic habitat at the Site to assess the overall effectiveness of removal action activities. Objectives of the removal action were to: (1) eliminate potential exposure pathways to mine waste and soil containing high concentrations of arsenic and mercury, and (2) minimize offsite transport of contaminated soil and sediment to the Oak Grove Fork of the Clackamas River (OGF).
- The primary objectives of the post-removal monitoring will be to:
  - Compare post-removal aquatic habitat conditions to pre-removal conditions;
  - Assess surface water, sediment, and pore water quality; and
  - Evaluate the soil cover integrity and success of revegetation efforts.
- Surface water, pore water, sediment, and benthic samples will be collected from the OGF upstream and downstream of the Site for comparison with pre-removal monitoring results.
  - The sampling approach and methodology are based on a refined set of sampling locations and analytical parameters established in the Site Inspection (SI) completed by CES in 2004.
  - The first monitoring event will be conducted in Summer 2009, and the final monitoring event will be conducted in Summer 2011.
  - Annual monitoring reports summarizing the analytical results and comparing to previous monitoring results will be prepared and submitted to the Forest Service by the end of each calendar year.

1.2 Schedule

- The annual sampling will be scheduled to coincide with the pre-removal sampling conducted during the SI by CES in mid-September 2003.
  - Portland General Electric Company (PGE) will be contacted approximately 30 days before the anticipated sampling date to coordinate timing with their use of the penstock and to ensure that the sampling will be conducted during low flow conditions to provide safe and suitable access for sampling in the OGF.
- The first post-removal monitoring event is scheduled for 2009. The second post-removal monitoring event is scheduled for 2010, and the third and final post-removal monitoring event is scheduled for 2011.
- Specific dates will be depend on weather conditions and Site access. If possible, the second and third monitoring events will be scheduled during the same of year as the first event.

1.3 Site Description

- The Kiggins-Nisbet Mine Complex is comprised of three inactive mercury mines (Kiggins, Nisbet and Ames-Bancroft) located about 30 miles southeast of Estacada, Oregon.
- The three mines are located along the southwest bank of the OGF <1 mile downstream of the Lake Harriet Dam, approximately 0.6 miles apart.
  - The Lake Harriet Dam stores water from the OGF for Portland General Electric's (PGE) Oak Grove Hydroelectric Project.
    - During normal flow conditions: (1) all flow in the OGF is diverted into a 9-foot diameter, 4-mile long pipeline (also referred to as the "penstock") to Frog Lake, which serves as a forebay for the Oak Grove Powerhouse; and (2) flow in the OGF between the Lake Harriet Dam and the Site consists of several small springs and tributaries that flow into the OGF.
    - During peak flow conditions, OGF flows entering Lake Harriet in excess of 570 cubic feet per second (cfs) spill over the Harriet Diversion Dam and into the OGF upstream of the Site.
    - During repairs and maintenance of the pipeline and power generation facilities, all flow entering Lake Harriet spills over the Harriet Diversion Dam and into the OGF upstream of the Site.
    - PGE is currently finalizing federal relicensing requirements for the Lake Harriet Dam diversion that will likely result in increasing the base flow in the OGF at the Site.
  - Flow in the OGF ranged from 5.9 cfs upstream of the Site (OGF-2) to 36.3 cfs downstream of the Site (OGF-7) during the SI by CES in September 2003 (CES 2003).
    - At the Kiggins Mine, the OGF flows through a narrow rock chute with near vertical sidewalls and several drops.
    - There is a 75-foot tall vertical waterfall on the OGF about 0.5 mile downstream of the Nisbet Mine.
- The **Kiggins Mine** is accessed from an unmarked gated dirt road off Forest Road (FR) 4630 via FR 57 and OR-224. FR 4630 is about 1,000 feet north of the mine and across the OGF. Pre-removal site features included:
  - Two identified adits,
  - A vent consisting of a 24-inch corrugated metal pipe (CMP) extending downward into the hillside below Adit 1,
  - Waste rock and tailings, and
  - Multiple ore beneficiation structures and foundations.
- The **Nisbet and Ames-Bancroft Mines** are accessed from Oak Grove Fork Road (FR 57), which is about 200 feet south of the mine. Pre-removal site features included:
  - Two identified adits,
  - A seep,
  - Three waste rock piles,
  - Furnace foundation and tramline trestle, and
  - Two calcine deposits located adjacent to the OGF and below the furnace.

2.0 REMOVAL ACTION SUMMARY

- In general, removal action activities at the **Kiggins Mine** consisted of:
  - Excavating ~20 bank cubic yards (bcy) of mercury-contaminated soil and transporting to the Columbia Ridge RCRA Subtitle C landfill in Arlington, Oregon for disposal.
  - Removing ~1 ton of drums, piping, condensers and other miscellaneous nuisance material and transporting to the Columbia Ridge RCRA Subtitle C landfill for disposal.

- Repairing a bat gate.
- Collapsing the end of the exposed vent pipe and covering with rock.
- Removing a culvert and recontouring the stream channel to prevent flooding of the vent pipe.
- Backfilling a retort and filling a hole in the retort wall with rock and mortar.
- Grading the disturbed areas to blend with surrounding topography and covering the excavated waste areas with 1 foot of rock and soil.
- Seeding the disturbed areas and applying fertilizer and straw mulch.

- In general, removal action activities at the **Ames-Bancroft Mine** consisted of:
  - Excavating ~100 bcy of arsenic-contaminated soil and transporting to the Columbia Ridge RCRA C landfill for disposal.
  - Grading the access road and disturbed areas to blend with the surrounding topography, seeding, and applying fertilizer and straw mulch.

3.0 POST-REMOVAL MONITORING ACTIVITIES

- Post-removal monitoring activities will consist of:
  - A general visual inspection of areas disturbed during removal activities at the Site;
  - Collecting surface water, pore water, sediment and benthic macroinvertebrate samples;
  - Completing an aquatic habitat survey; and
  - Preparing Annual Monitoring Reports.

3.1 General Site Inspection

- Disturbed areas of the Site that were reclaimed during the removal action will be inspected to evaluate revegetation success.
  - The reclaimed areas will be inspected for erosion damage and cracking.
  - Any evidence of significant erosion or other damage will be photographed and reported to the Forest Service.

3.2 Sample Collection

- Surface water, pore water, and sediment, and benthic samples will be collected from the OGF upstream and downstream of the Site for comparison with pre-removal monitoring results.
  - The proposed sampling approach and methodology are based on the SI using a refined set of sampling locations and analytical parameters.
  - The list of metals to be analyzed for are based on the metals that exceeded Oregon State or Federal risk screening criteria in samples collected during the SI (CES 2004).
  - The samples to be collected and methodology are described below and summarized in **Table 1**.

4.0 SAMPLING AND ANALYSIS PLAN

- This section describes the sampling methods and procedures for each media; sample management activities such as sample identification, preservation, and shipping, laboratory analysis, decontamination procedures, and investigation derived waste.

4.1 Sampling Methods and Procedures

- The sampling approach and methods are described in the following subsections by media type.
  - Where possible, disposable single-use sampling equipment will be used for sample collection.

- Field quality control samples will consist of one matrix spike/matrix spike duplicate pair (MS/MSD) and a field blank.
- All observations, conversations, measurements and photograph descriptions will be recorded promptly in a bound waterproof logbook. The logbook will also record when, where, and how all samples were collected, along with pertinent observations.
- During the sampling, all disturbances to the environment will be minimized.
- Upon completion of the sampling, any trash or investigation derived waste generated during the sampling will be removed from the site and properly disposed of.

4.1.1 Surface Water

- Surface water sampling will include collecting grab samples, measuring stream flows, and measuring field parameters. Surface water samples will be collected from two of the nine locations on the OGF sampled during the SI: (1) upstream of the Site (OGF-02), and (2) downstream of the Site (OGF-07). The sampling locations are shown on **Figure 1.**
  - All sampling will proceed from downstream to upstream locations to avoid cross contamination.
  - The GPS coordinates of both sampling locations will be recorded and documented for future sampling events.
  - The water samples will be collected from the stream by submerging a laboratory supplied, 500-mL, wide-mouth, plastic bottle directly into the water.
    - The sample bottle will be placed upside down into the center of stream and then slowly inverted while under the surface to allow the bottle to fill; care will be taken to avoid contacting or disturbing the stream bottom.
    - Sufficient headspace will be left to allow for sample preservative.
    - Care will be taken to prevent disturbing the sediment and organic material during sample collection.
  - Samples requiring dissolved analyses will be filtered in the field using disposable Tygon tubing, a peristaltic pump, and a disposable 0.45-micron filter.
    - An unfiltered sample will first be collected as described above.
    - The unfiltered sample will then be pumped though a new disposable filter into a clean sample container.
    - A new filter and new tubing will be used for each sample.
  - The appropriate preservative (**Table 2**) will be added to the sample and the container will be tightly capped.
  - The samples will be labeled and packaged as described in Section 4.2, and submitted for the analysis summarized in **Table 1**.
  - The field parameters summarized in Table 1 will be measured during sample collection and recorded on the Water Sample Collection Record (Attachment B). The field parameters include pH, temperature, conductivity (EC), dissolved oxygen (DO), and oxidation-reduction potential (ORP) or Eh.
    - A multi-parameter water quality meter will be used to measure the field parameters by collecting a water sample in a decontaminated 500-mL beaker and submerging the sensor in the sample.
    - The instrument will be calibrated and operated per the manufacturer's specifications.
    - All field calibrations, measurements, and notations will be recorded in the Field Logbook.
  - The flow at each stream sampling location will be estimated and recorded. It is anticipated that the stream will be wadable during sampling.
    - The sample ID, flow, and field parameters will be documented on a Water Sample Collection Record (Attachment B).

4.1.2 Pore Water

- Two pore water samples will be collected from the two surface water sample locations on the OGF (OGF-02 and OGF-07).
  - The pore water samples will be collected from the pore space in stream gravels in pool habitats where the substrate exceeds 6 inches depth.
  - The samples will be collected using a 27-inch stainless-steel sampler (MHE Products PP-27) in accordance with the manufacturer's Operation Manual and Applications Guide (Attachment C).
    - The sampler will be inserted to a minimum depth of 6 inches and a pore water sample will be extracted using a syringe and Tygon tubing or peristaltic pump at a flow rate of 50 to 200 milliliters per minute (mL/min).
    - The pore water sample will be transferred from the syringe directly into a laboratory supplied, 500-mL plastic bottle.
    - Sufficient headspace will be left to allow for sample preservative.
    - New syringes and tubing will be used at each sample location and the sampler will be decontaminated as described in Section 4.4.
  - The appropriate preservative (**Table 2**) will be added to the sample and the container will be tightly capped. The samples will be labeled and packaged as described in Section 4.2, and submitted for the analysis summarized in **Table 1**.
  - Field parameters will be measured during sample collection by collecting a water sample in a decontaminated 500-mL beaker and submerging the sensor in the sample.
    - Field parameters will include pH, temperature, EC, TDS, DO, and ORP or Eh.
  - The sample ID, sample collection depth, and field parameters will be documented on a Water Sample Collection Record (Attachment B).

4.1.3 Sediment

- Two sediment samples will be collected from the two surface water sample locations on the OGF (OGF-02 and OGF-07).
  - The sediment samples will be composite samples consisting of two 250-mL subsamples, one from pool and one from riffle habitat, at each stream sample location.
    - The sediment samples will be collected from 0 to 18 inches below the streambed using disposable, single-use hand trowels, or disposable push samplers.
    - The composite samples will be homogenized by combining the subsamples in a 1-gallon plastic bag and thoroughly mixing.
    - Gravel and organic media will be removed and the samples will be placed in laboratory supplied, 500-mL, wide-mouth plastic bottles.
    - Any water in the sample will be decanted so that the bottle is filled with as much sediment as possible.
  - The bottles will be labeled and packaged as described in Section 4.2. The samples will be submitted for the analyses summarized in **Table 1.** The lab will be instructed to screen the sediment samples and discard material greater than 2 millimeters in diameter to focus the analysis on the finer material.
  - The sample will be documented on a Sediment Sample Collection Record (Attachment B).

4.1.4 Aquatic Survey and Benthic Macroinvertebrates

- An aquatic survey will be conducted at the two surface water sampling locations on the OGF (OGF-02 and OGF-07) to evaluate potential changes in the stream habitat, benthic macroinvertebrate community, and fish species.
  - One stream reach, approximately 100 meters in length, will be established at each surface water sampling location.
  - An aquatic habitat survey will be conducted for each 100-meter reach following the protocols outlined in the *U.S. EPA Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers* (Barbour *et.al* 1999) and *Benthic Macroinvertebrate Biological Monitoring Protocols for Rivers and Streams* (Plotnikoff and Wiseman 2001).
  - The aquatic habitat surveys will consist of collecting quantitative as well as qualitative data on water chemistry and physical habitat.
  - The presence of fish will be documented by visual observations during the aquatic habitat survey.
  - Habitat ratings will be completed for each reach using the *U.S EPA Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers- Habitat Assessment Field Data Sheets* (Barbor et.al. 1999).
  - Two composite macroinvertebrate samples will be collected from each reach, one from pool habitat and one from riffle habitat.
    - Each composite sample will consist of three subsamples from different pool or riffle habitats within the stream reach. Collection of macroinvertebrate samples from specific pool habitats is necessitated by the potential of tailings mobilizing into the streams and settling in areas of slower moving water.
    - The macroinvertebrate samples will be collected using a D-ring kick net. Sampling techniques will be in accordance with the *Benthic Macroinvertebrate Biological Monitoring Protocols for Rivers and Streams* (Plotnikoff and Wiseman 2001).
    - Samples will be labeled (both inside and outside the container) as described in Section 4.2.
    - Samples will be preserved in the field by 85 percent ethanol. The samples will be packaged as described in Section 4.2 and shipped to Aquatic Biology Associates, Inc. for processing.
    - The benthic samples will be documented on the appropriate forms provided in Attachment B.

4.2 Sample Management

- The following sections describe sample management activities, including sample designation, preservation, and shipping.

4.2.1 Sample Preservation

- Samples will be preserved as appropriate for the required analysis. The method of preservation and sample holding times are summarized in **Table 2**.
  - Solid media samples are preserved by chilling and maintaining them at 4 °C.
  - Aqueous samples are preserved by adding nitric acid (HNO_3), hydrochloric acid (HCl), or sodium hydroxide (NaOH), depending on the analysis.

4.2.2 Sample Designation

- Sample containers will be sealed at the time of collection and an adhesive label placed over the lid and threads to ensure that the sample container has not been tampered with prior to delivery to the laboratory.
  - The sample number, date and time of sample collection, sampler's initials, and requested analysis shall be recorded on the label using an indelible ink ball-point pen.

4.2.3 Shipping

- The sample containers will be placed in a cooler suitable for transportation or shipping to the analytical laboratory.
  - Plastic bags filled with ice and sealed shall be placed in the cooler to maintain the samples at 4 °C until delivery to the laboratory.
  - Care shall be exercised to prevent direct contact between the samples and ice.
- Chain-of-Custody forms shall be used to document and track sample possession. The samples in each cooler and the required analysis will be recorded on a Chain-of-Custody.
  - Care will be taken to ensure the required analysis is consistent with the sample labels.
  - The sampler will retain one copy of the Chain-of-Custody and the original will be sealed in a plastic bag and placed in the cooler with the samples.
  - When transferring possession of the samples, the Chain-of-Custody will be signed and dated by the sample custodian.
  - The cooler will be sealed with tape and custody seals placed across the cooler opening and initialed.
- The surface water, pore water, and sediment samples will be shipped via Federal Express to SVL Analytical (SVL) Laboratory in Kellogg, Idaho. The benthic macroinvertebrate samples will be shipped via Federal Express to Aquatic Biology Associates, Inc. in Corvallis, Oregon. The Federal Express airbills will be retained as part of the permanent Chain-of-Custody documentation.

4.3 Laboratory Analysis

- **Table 1** summarizes the samples to be collected during the post-removal monitoring and the corresponding laboratory analyses. **Table 2** summarizes the analytical methods, required sample volumes, preservatives, and holding times.
  - The metals to be analyzed for is limited to analytes that exceeded Oregon State or Federal risk screening criteria in samples collected during the SI (CES 2004).
  - The labs will be instructed to hold and maintain all remaining sample volumes for additional analysis, if determined necessary.
- The water samples will also be analyzed for hardness, pH, total dissolved solids (TDS), and total suspended solids (TSS).
- The macroinvertebrate samples will be sorted and subsampled using a Caton type sample splitter.
  - Large debris and inorganic sediment will be inspected for attached invertebrates and removed from the sample and placed back into the original container.
  - A 300-count subsample will be utilized for this project.
  - Macroinvertebrates will be identified to the lowest practical level, usually genus or species. This includes Chironomidae to genus/species and Oligochaeta to species.
  - Macroinvertebrates will be identified using published taxonomic keys.

4.4 Decontamination Procedures

- Where possible, disposable single-use sampling equipment will be used for sample collection. For non-disposable sampling equipment, a temporary decontamination area will be set up.
  - The decontamination area will be equipped with brushes, solvents, and distilled rinse water.
  - Sampling equipment will be decontaminated before each use by scrubbing with detergent, rinsing with a dilute HNO3 solution (10 parts distilled water to 1 part HNO3), and rinsing with distilled water.
  - The equipment will be allowed to air dry before use.

4.5 Investigation-derived Waste

- All decontamination fluids will be allowed to drain onto the ground surface at the Site and infiltrate.
  - Disturbances to the Sites and environment during the monitoring event will be minimized.
  - Upon completion of the monitoring event, any trash or investigation derived waste generated during sampling will be removed and properly disposed of.

5.0 QUALITY ASSURANCE PROJECT PLAN

- This section describes the data quality objectives, field QA/QC procedures, and the analytical laboratory QA/QC methods and procedures.

5.1 Data Quality Objectives

- Data quality objectives (DQO) are qualitative and quantitative statements that describe the study objectives, data to be collected and study boundary, decision rules, tolerable limits on decision errors, and sampling design. DQOs were developed using EPA's seven-step process (EPA 2000), and are presented in Table 3.

5.2 Field QA/QC

- Field QA/QC will consist of:
  - Following standard sampling procedures,
  - Maintaining proper sample handling and documentation,
  - Calibrating and maintaining field instruments, and
  - Collecting field QA/QC samples.
- All sampling methods and procedures will follow standard MSE protocols, unless otherwise noted, and all field equipment will be operated, maintained, calibrated, and standardized in accordance with the manufacturer's recommended procedures.
- Field QA/QC samples will be collected to evaluate the precision, accuracy, and representativeness of the field sampling effort. Field QA/QC samples will consist of one matrix spike/matrix spike duplicate pair (MS/MSD) and one field blank.
- The MS/MSD duplicate pair samples combine the QA/QC objectives of a normal field duplicate and a laboratory MS/MSD sample.
  - The MS/MSD duplicates are collected at the same time and in the same manner as the other samples. However, unlike typical field duplicates, the samples are clearly labeled as MS/MSD samples.
  - The laboratory prepares the MS/MSD samples by adding a known concentration of a specific analyte. The corresponding analytical results measure: (1) the efficiency of the analytical

method for the known analyte, and (2) the consistency of the overall sampling and analytical procedures for the remaining analytes.

- The samples will be submitted for the analyses listed in Tables 1 and 2.
- The field QA/QC samples will be collected, handled, transported, and analyzed in the same manner as the monitoring samples.

5.3 Laboratory QA/QC

- The EPA has accredited the analytical laboratory selected for analysis of the monitoring samples.
- The laboratory will follow EPA Level II protocol for analysis and reporting, including laboratory blanks, laboratory duplicates, and MS/MSDs.
- All samples will be analyzed within the required holding time for each analytical procedure.
- Detected concentrations between the method detection limit (MDL) and practical quantification limit (PQL) will be noted in the analytical summaries.
- All analytical results will be reviewed to ensure that the laboratory QA/QC sample results are within the acceptable limits.

6.0 ANNUAL MONITORING REPORT

- MSE will prepare and submit Annual Monitoring Reports that summarize field observations and analytical results of the samples collected. The reports will include the following:
  - Analytical results of pre-removal samples collected from the two monitoring locations during the SI for comparison and trend analysis;
  - Descriptive text and photographs that document the changing Site conditions over time;
  - An interpretation of the analytical results and discussion regarding any observed trends; and
  - Completed field forms, photographs, laboratory analytical results, tables, graphs, and any other supporting documentation.

7.0 REFERENCES

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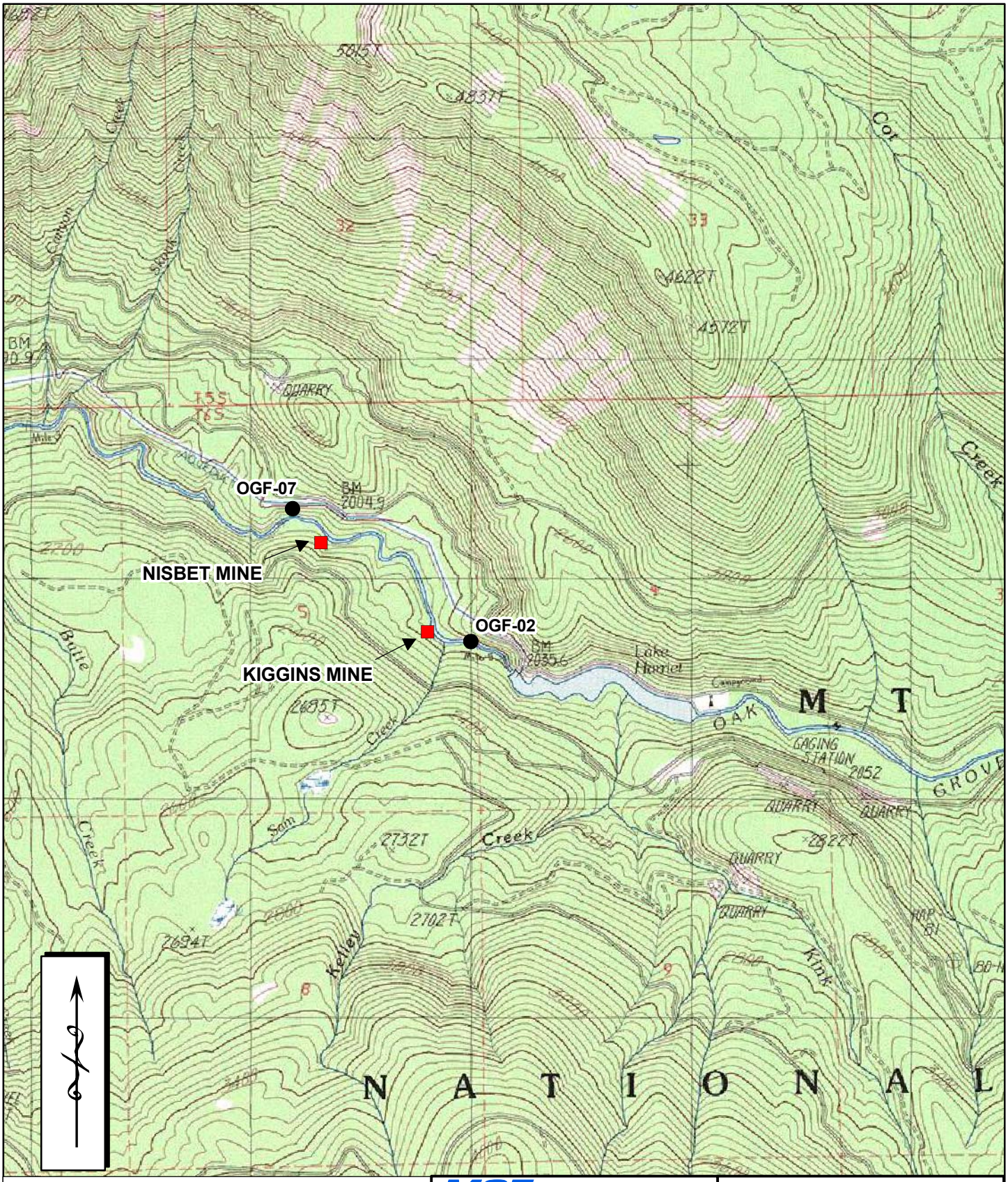
FIGURES



0 500 1,000 2,000 3,000 4,000 Feet

SCALE: 1 inch = 2,000 feet

REFERENCE: U.S.G.S. 7.5 MINUTE QUADRANGLE, MT. MITCHELL, OREGON 1985

MSE Millennium Science & Engineering, Inc.

1555 Shoreline Drive, Suite 150
Boise, ID 83702 USA
Phone: (208) 345-8292

Post-Removal Monitoring Locations

Kiggins-Nisbet Mine Complex

B2473.J	Fig1.mxd	4/22/09	Figure 1

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TABLES

Table 1. Proposed Post-Removal Monitoring Samples and Analyses

Locations	Medium	Number of Samples	Analyses
OGF-02 and OGF-07	Surface Water	2	Total recoverable metals: Al, As, Hg, Zn Hardness, pH, TDS, TSS Field: pH, temp, DO, EC, ORP/E_h
	Pore Water	2	Dissolved metals: Fe, Mn, Hg Hardness, pH, TDS, TSS Field: pH, temp, DO, EC, ORP/E_h
	Sediment	2	Metals: As, Cd, Cr, Cu, Hg, Mn, Ni
	Benthic Organisms	4	Taxonomy, generally to genus/species
Site	Water QA/QC	1 blank, 1 MS/MSD pair	Dissolved metals: Fe, Mn, Hg Total recoverable metals: Al, As, Hg, Zn

Notes:
DO = Dissolved oxygen
EC = Electrical conductivity
MS/MSD = Matrix spike/matrix spike duplicate
ORP/E_h = Oxygen reduction potential
TDS = Total dissolved solids
TSS = Total suspended solids

Table 2. Sample Volume, Preservative, and Holding Time Summary

Medium	Laboratory Analysis	Method	Container/Volume	Preservative[a]	Holding Time
Sediment	Metals: As, Cd, Cr, Cu, Mn, Ni	200.7, 200.2, 7471	One 8-oz soil jar	None	6 months
Waters	Dissolved Metals: Fe, Hg, Mn	200.7, 200.2, 245.1	One 500-mL plastic bottle	HNO_3 to pH<2	6 months
	Total Recoverable Metals: Al, As, Hg, Zn	200.7, 200.2, 245.1	One 500-mL plastic bottle	HNO_3 to pH<2	6 months, 28 days for Hg
	pH	150.1	One 25-mL plastic bottle	None	Immediately
	Hardness	200.7	One 500-mL plastic bottle	HNO_3 to pH<2	6 months
	Sulfate	300.0	One 500-mL plastic bottle	None	28 days
	TDS	160.1	One 500-mL plastic bottle	None	7 days
	TSS	160.2	One 500-mL plastic bottle	None	7 days

Notes:
[a] All samples will be cooled to 4°C.
mL = Milliliter
oz = ounce
HNO_3 = Nitric acid
TDS = Total dissolved solids
TSS = Total suspended solids

Table 3. Data Quality Objectives

STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6	STEP 7
State the Problem	**Identify the Decision**	**Identify Inputs to the Decision**	**Define Study Boundaries**	**Develop Decision Rule**	**Specify Tolerable Limits on Decision Errors**	**Optimize Sampling Design**
• The effectiveness of the removal action is unknown.	1. Do metals concentrations exceed pre-removal levels? 2. Do metals concentrations exceed state and federal regulatory criteria? 3. Has the aquatic habitat improved post-removal? 4. Did the removal action achieve the desired objectives?	• Analytical results of surface water, pore water, sediment, and benthic samples • Results of aquatic habitat survey • State and federal regulatory criteria for surface water and sediment quality	• Aquatic habitat on the OGF immediately upstream and downstream of the Site (i.e. OGF-02 and OGF-07).	• If metals concentrations exceed pre-removal levels and regulatory criteria, evaluate the need for further removal action at the Site. Otherwise, continue monitoring.	• Decision errors will be minimized through consistency in sampling locations and methodology. • Field and laboratory QA/QC samples will be used to ensure that data are of known precision and accuracy.	• Sampling locations will be selected based on locations used in the SI. • The analytical suite will be based on analytes that exceeded risk-screening criteria in pre-removal samples collected during the SI.

Notes:
OGF = Oak Grove Fork
QA/QC = Quality assurance/Quality Control
SI = Site Inspection

ATTACHMENT A

HEALTH AND SAFETY PLAN

HEALTH AND SAFETY PLAN

Post-Removal Monitoring at the Kiggins-Nisbet Mine Complex
Mt. Hood National Forest, Clackamas County, Oregon April 2009

Principal Author: Don Tibbets, E.I.T., Field Engineer

Reviewed By: Michael J. Puett, P.E., Project Manager

Prepared For: USDA Forest Service
Gifford Pinchot National Forest
10600 NE 51st Circle
Vancouver, WA 98682

Prepared by: Millennium Science and Engineering, Inc.
1555 Shoreline Dr., Suite 150
Boise, Idaho 83702
(208) 345-8292

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1.0 GENERAL

Millennium Science and Engineering, Inc. (MSE) completed a Removal Action for the United States Department of Agriculture, Forest Service (Forest Service) at the Kiggins-Nisbet Mine Complex (i.e. the Site) on the Mt. Hood National Forest in August 2008. MSE will be conducting annual post-removal monitoring of the Site and aquatic habitat upstream and downstream of the Site on the Oak Grove Fork (OGF) of the Clackamas River for 3 years beginning in September 2009.

1.1 Project Description

Post-removal monitoring field activities will consist of:

- A general visual inspection of areas disturbed during removal activities at the Site;
- Collecting surface water, pore water, sediment and benthic macroinvertebrate samples; and
- Completing an aquatic habitat survey.

1.2 Site Description

The three mines (Kiggins, Nisbet, and Ames-Bancroft) that compromise the Kiggins-Nisbet Mine Complex are in close proximity to one another and are located in the Mt. Hood National Forest, about 30 miles southeast of Estacada, Oregon. The mines are located along the southwest bank of the OGF <1 mile downstream of the Lake Harriet Dam, approximately 0.6 miles apart. The Lake Harriet Dam stores water from the OGF for Portland General Electric's (PGE) Oak Grove Hydroelectric Project. During normal flow conditions: (1) all flow in the OGF is diverted into a 9-foot diameter, 4-mile long pipeline (also referred to as the "penstock") to Frog Lake, which serves as a forebay for the Oak Grove Powerhouse; and (2) flow in the OGF between the Lake Harriet Dam and the Site consists of several small springs and tributaries that flow into the OGF. During peak flow conditions, OGF flows entering Lake Harriet in excess of 570 cubic feet per second (cfs) spill over the Harriet Diversion Dam and into the OGF upstream of the Site. During repairs and maintenance of the pipeline and power generation facilities, all flow entering Lake Harriet spills over the Harriet Diversion Dam and into the OGF upstream of the Site. PGE is currently finalizing federal relicensing requirements for the Lake Harriet Dam diversion that will likely result in increasing the base flow in the OGF at the Site. Flow in the OGF ranged from 5.9 cfs upstream of the Site (OGF-2) to 36.3 cfs downstream of the Site (OGF-7) during the SI by CES in September 2003 (CES 2003). At the Kiggins Mine, the OGF flows through a narrow rock chute with vertical sidewalls and several drops. There is a 75-foot tall vertical waterfall on the OGF about 0.5 mile downstream of the Nisbet Mine.

<u>Kiggins Mine</u>

The Site will be accessed an unmarked gated road off Forest Road (FR) 4630 via FR 57 and OR-224. FR 4630 is about 1,000 feet north of the mine and across the OGF. The bridge has been removed and Site access will require wading across the stream. The Site consists of remnants of a timber structures, miscellaneous debris, three adits (one of which has not been located and has likely collapsed), waste rock piles, and assorted ore beneficiation/processing structures and foundations.

<u>Ames-Bancroft Mine</u>

The Site will be accessed via Oak Grove Fork Road (FR 57) and hiking down the north side of the road. The Site currently consists of several depressions and waste piles, and a collapsed adit.

2.0 CONTACTS

All MSE Boise contacts may be reached at (208) 345–8292.

Forest Service On–Scene Coordinator	Pete Jones	(541) 951-1429
Clackamas River Ranger District - Estacada Ranger Station		(503) 630-6861
Mt. Hood National Forest		(503) 668-1700
Clackamas County Sheriff		(503) 655-8218
Portland General Electric (PGE)	Norm Ernst	(503) 630-8204
Program Director	Richard Kelsey	(208) 345–8292
Project Manager	Mike Puett	"
Boise Office Manager	Paul K. Hunter	"
Boise Health & Safety Officer	Jared Potts	"
Corporate Health & Safety Officer	Dale A. Rice	(703) 961-0710

2.1 Emergency Response Procedures

The most likely emergencies include accident, flood, and fire. MSE personnel may become involved in an emergency caused by unrelated work on the Site.

2.1.1 Availability of Communication Services

Cellular service at both the Site may be limited since both mines are located in remote mountain areas. However, cellular service may be available at some points along FR 57 heading back to the northwest toward Estacada. The nearest landline to both mines is near Estacada, approximately 30 miles from each mine.

2.1.2 Site Evacuation

Kiggins Mine

If evacuation of the Kiggins Mine is necessary, exit the Site via FR 4630 (to the southeast) and proceed on FR 57 heading northwest back towards Estacada. If fording the OGF is not possible, exit the Site by hiking up the northeast-facing hillside to FR 57 (Oak Grove Fork Road).

Ames-Bancroft Mine

If evacuation of the Ames-Bancroft Mine is necessary, exit the Site via FR 57 (Oak Grove Fork Road) and proceed to the northwest back towards Estacada.

2.1.3 Notification Procedures

In the event of an emergency, personnel should attempt to dial 911.

If 911 is unavailable, try the Clackamas River Ranger District - Estacada Ranger Station or Clackamas County Sheriff (Section 2.0).

If a situation arises which is immediately hazardous to life and health, presents a fire or explosion hazard, or results in a risk of fuel release, notify the Site contact first. As soon as practicable, notify the MSE Project Manager (PM) or Boise office manager, followed by the client (if different than the Site contact). In the event that Boise personnel are unavailable, contact Dale A. Rice at the Chantilly, Virginia office.

In case of an injury accident, provide first aid and medical attention, as required and as your qualifications allow. As soon as practicable, provide notification as in the previous paragraph.

2.1.4 Initial Response Steps

Evaluate the situation *quickly*. Is it immediately dangerous? Are there injuries that require treatment? Can injured persons be moved? Do you have the materials necessary to contain a spill? Are Site personnel or other MSE personnel readily available?

Take actions with the following priority:

1. If widespread evacuation is necessary, provide notification.
2. Remove and treat injured persons, if movement is not precluded by the injuries.
3. Contain spill, if any.
4. Obtain help for any actions you cannot handle yourself.

2.2 Nearest Hospital

The nearest full service emergency hospital is:

Willamette Falls Hospital
1500 Division Street
Oregon City, OR 97045
(503) 656-1631

Directions to hospital from Kiggins Mine:

Exit the Site via Forest Road 4630 (to the southeast) and proceed on Forest Road 57 heading northwest. Continue on OR-224 towards Estacada for approximately 25 miles. Turn left at OR-211 for about a mile. Turn right at South Hayden Road. Turn right at South Springwater Road. Turn left at South Redland Road and proceed approximately 12 miles. Turn left at Anchor Way. Turn left at 18th Street and then continue on Division Street until arriving at Willamette Falls Hospital.

Directions to hospital from Ames-Bancroft Mine:

Exit the Site via Forest Road 57 (Oak Grove Fork Road) and proceed approximately to the northwest. Continue on OR-224 towards Estacada for approximately 25 miles. Turn left at OR-211 for about a mile. Turn right at South Hayden Road. Turn right at South Springwater Road. Turn left at South Redland Road and proceed approximately 12 miles. Turn left at Anchor Way. Turn left at 18th Street and then continue on Division Street until arriving at Willamette Falls Hospital.

A MAP TO THE HOSPITAL FROM THE APPOXIMATE MINE COMPLEX LOCATION IS PROVIDED IN ATTACHMENT A.

3.0 CHEMICAL HAZARD ASSESSMENT

This section discusses potential chemical hazards at the Site, their toxicities, and the potential exposure pathways.

3.1 Characterization

The following is a brief description of the work sites and expected hazards.

Facility Type		Facility Status		Waste Type		Waste Class		Exposure Route	
Landfill		Active		Gas		Corrosive		Inhalation	X
Commercial		Inactive	X	Liquid (Kiggins Mine only)	X	Flammable		Absorption	X
Industrial		Abandoned		Solid	X	Poison		Ingestion	X
Residential		Other (specify)		Unknown		Radioactive			
Public						Oxidizer			
Military						Explosive			
Agricultural						Carcinogen	X		
Other (Mine)	X					Misc./Other			

3.2 Known Site Background Information on Chemical Hazards

Kiggins Mine

There are high concentrations of mercury in the residual mine waste rock and soil at the Site. There may also be high concentrations of other inorganic compounds commonly associated with mine waste, such as arsenic, cadmium, and cyanide.

Ames-Bancroft Mine

There are high concentrations of arsenic in the mine waste rock and soil at the Site. There may also be high concentrations of other inorganic compounds commonly associated with mine waste, such as cadmium, mercury, lead, and cyanide.

3.3 Relative Toxicity and Potential Health Risks of Chemicals

Chemicals that may be encountered at the Site are described below. CAS registry numbers are unique identification numbers assigned by the Chemical Abstracts Service, a division of the American Chemical Society. DOT numbers are assigned by the US Department of Transportation, and may be used in conjunction with the *1996 North American Emergency Response Guidebook*. NFPA ratings are assigned by the National Fire Protection Association. They are listed in the order Health–Flammability–Reactivity, where 4 represents a severe hazard and 0 a minimal hazard. Information presented here was primarily obtained from the *NIOSH Pocket Guide to Chemical Hazards*, June 1994 Edition, with supplementary information from manufacturer's Material Safety Data Sheets (MSDSs). A general discussion of the potential routes of exposure appears is presented in Section 3.4. Acronyms and abbreviations commonly used in the discussion of chemical hazards are defined in the table below.

Acronym	Meaning
mg/m^3	Milligram per cubic meter
AMD	Acid mine drainage
APF	Assigned Protection Factor
APR	Air–purifying respirator
ARD	Acid-rock drainage
CAS	Chemical Abstracts Service
DOT	US Department of Transportation
HEPA	High Efficiency Particulate Air
IARC	International Agency for Research on Cancer
IDLH	Immediately Dangerous to Life and Health
MSDS	Material Safety Data Sheet
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration

Acronym	Meaning
PEL	Permissible Exposure Limit (OSHA)
PPE	Personal protective equipment
PPM	Part per million
REL	Recommended Exposure Limit (NIOSH)
SAR	Supplied–air respirator
SCBA	Self–contained breathing apparatus
STEL	Short Term Exposure Limit
TLV	Threshold Limit Value
TWA	Time–weighted average

3.3.1 Metals, Mine Wastes, and Inorganic Compounds

Metals and inorganic compounds may be encountered in mining wastes, in industrial or agricultural wastes, or as natural geochemical constituents. Most metals may be present in many chemical forms, with differing physical properties and hazards. The eight "RCRA metals" (toxic contaminants according to 40 CFR 262.24) are: arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver. The wastewater Priority Pollutants (40 CFR 423, App. A) include 13 metals: antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium and zinc, as well as two inorganic compound classes: asbestos and cyanide compounds.

Metals generally have high melting points and negligible vapor pressures; mercury is a notable exception, being a liquid at room temperature. Current NIOSH–approved monitoring techniques require collecting samples on a filter, followed by laboratory spectrographic analysis. This is not practical for real–time field hazard monitoring. Metals are typically encountered at mine sites as mineral tailings, waste rock, sediments, or as dilute solutions in ground water and surface water, not as pure metals. The hazards described below are generally for pure materials, except as noted.

Acid Mine Drainage

Acid mine drainage (AMD) or acid rock drainage (ARD) is a complex solution of inorganic substances generated by the activity of *Thiobacillus ferrooxidans* on sulfide minerals under

aerobic conditions. AMD/ARD does occur naturally, but is typically encountered at sites where mining activity has exposed sulfide minerals to oxygen and water. The pH is typically 2.5–3, comparable to that of lemon juice or vinegar (see table below).

Substance	Stomach Juice	Lemon Juice	ARD	Vinegar	Skin
pH	1–3	2.3	2.5–3	2.4-3.4	4–5.5

Eye protection (goggles) and nitrile or other acid–resistant gloves are recommended. Additional skin or respiratory protection may be appropriate, depending on work operations. For specific health hazards, respiratory protection, symptoms and first aid, see the entries for hydrogen sulfide and the metals expected to be present.

Antimony (CAS 7440-36-0)

Elemental antimony (Sb), also known as stibium, is a silver-white, lustrous, hard, brittle solid, forming scale-like crystals; or a dark-gray, lustrous powder. It is noncombustible in solid bulk form, but antimony dust presents a moderate explosion hazard when exposed to flame. It is incompatible with strong oxidizers, acids and halogenated acids (HCl, HF, HBr), and reacts with fresh hydrogen gas to form toxic stibine gas. The OSHA PEL and the NIOSH REL are both 0.5 mg/m^3. The IDLH concentration is 50 mg/m^3.

Respirator: For concentrations up to 5 mg/m^3, NIOSH recommends any dust and mist respirator having APF of 10 (except single–use or quarter–mask models), or any SAR. For higher concentrations, consult the *NIOSH Pocket Guide*.

Symptoms: Inhalation of dusts is the primary route of exposure. Ingestion and skin or eye contact are alternate exposure routes. Symptoms include: irritation of the eyes, skin, nose, throat or mouth; cough; dizziness; headache; nausea, vomiting, diarrhea; stomach cramps; insomnia; anorexia; and interference with the sense of smell. Target organs are: eyes, skin, respiratory system and the cardiovascular system.

First Aid: Eyes should be irrigated immediately with clean water. Wash exposed skin with soapy water immediately. Respiratory support should be provided in case of breathing difficulty, and immediate medical attention is required in case of swallowing.

Source: NIOSH Pocket Guide to Chemical Hazards, http://www.cdc.gov/niosh/npg/npgd0036.html, accessed 17 April 2008.

Arsenic (CAS 7440-38-2) and inorganic arsenic compounds except arsine

Arsenic (As) is a silver–gray or tin–white, brittle, odorless solid. It is noncombustible in solid bulk form, but arsenic dust presents a slight explosion hazard when exposed to flame. It is incompatible with strong oxidizers and bromine azide, and reacts with hydrogen gas to form highly toxic arsine gas. The OSHA PEL is 0.010 mg/m^3, and the NIOSH 15–minute REL is 0.002 mg/m^3 (ceiling). The IDLH concentration is 5 mg/m^3. NIOSH considers inorganic arsenic compounds to be Potential Occupational Carcinogens.

Respirator: NIOSH usually recommends that occupational exposures to carcinogens be limited to the lowest feasible concentration, and recommends the use of a self–contained breathing apparatus (SCBA) or supplied–air respirator (SAR) at all detectable concentrations. NIOSH recommends full–face air–purifying respirator (APR) with acid gas and HEPA cartridges and

APF=50 or escape–type SAR for escape. For details, consult Appendix A in the *NIOSH Pocket Guide to Chemical Hazards*.

Symptoms: Inhalation of dusts is the primary route of exposure. Inhalation can result in ulceration of the nasal septum; absorption can result in dermatitis or gastrointestinal disturbances; contact can result in peripheral neuropathy or respiratory irritation; and ingestion can result in skin hyperpigmentation or cancer.

First Aid: Eyes should be irrigated immediately with clean water. Wash exposed skin with soapy water. Respiratory support should be provided in case of breathing difficulty, and immediate medical attention is required in case of swallowing.

Source: NIOSH Pocket Guide to Chemical Hazards, http://www.cdc.gov/niosh/npg/npgd0038.html, accessed 17 April 2008.

Barium sulfate (CAS 7727-43-7, DOT UN1564)

Barium sulfate ($BaSO_4$), also known as barite or barytes, is a white or yellowish, odorless powder. It is sparingly soluble in water. It is non–combustible, but is incompatible with phosphorus, and can explode when combined with aluminum in the presence of heat. The OSHA 8–hour PEL is 15 mg/m^3 (total) or 5 mg/m^3 (respirable fraction), and the NIOSH REL is 10 mg/m^3 (total) or 5mg/m^3 (respirable fraction). The IDLH concentration is 250 mg/m^3. It should be noted that soluble barium compounds, such as barium nitrate and barium chloride are more toxic than barium sulfate. Consult the *NIOSH Pocket Guide* if these compounds are suspected.

Respirator: No current NIOSH recommendation.

Symptoms: Inhalation and skin or eye contact are the primary exposure routes. Exposure can result in irritated eyes, nose, and upper respiratory system; or benign pneumoconiosis (baritosis).

First Aid: Eyes should be irrigated immediately with clean water. Wash exposed skin with soapy water. Respiratory support should be provided in case of breathing difficulty, and immediate medical attention is required in case of swallowing.

Source: NIOSH Pocket Guide to Chemical Hazards, http://www.cdc.gov/niosh/npg/npgd0047.html, accessed 17 April 2008.

Cadmium dust (CAS 7440-43-9) and compounds

Cadmium (Cd) is a silver-white, blue-tinged lustrous, odorless metal. The metal is insoluble in water, but many compounds are soluble. It is noncombustible in bulk form, but will burn in powder form. Elemental cadmium is incompatible with elemental sulfur, selenium and tellurium. The OSHA PEL is 0.005 mg/m^3. The IDLH concentration is 9 mg/m^3. NIOSH considers cadmium to be a Potential Occupational Carcinogen.

Respirator: NIOSH usually recommends that occupational exposures to carcinogens be limited to the lowest feasible concentration, and recommends the use of a self–contained breathing apparatus (SCBA) or supplied–air respirator (SAR) at all detectable concentrations. NIOSH recommends full–face air–purifying respirator (APR) with HEPA cartridge and APF=50 or escape–type SAR for escape. For details, consult Appendix A in the *NIOSH Pocket Guide to Chemical Hazards*.

Symptoms: Inhalation and ingestion of dusts are the primary exposure routes. Exposure can result in pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild anemia, and possibly cancer.

First Aid: Eyes should be irrigated immediately with clean water. Wash exposed skin with soapy water. Respiratory support should be provided in case of breathing difficulty, and immediate medical attention is required in case of swallowing.

Source: NIOSH Pocket Guide to Chemical Hazards, http://www.cdc.gov/niosh/npg/npgd0087.html, accessed 17 April 2008.

Chromium (CAS 7440-47-3)

Chromium may be encountered either as a metal, in salts, or as a cation in solution. The toxicity of the metallic form is low relative to the cation (as a salt or in solution). It is not likely that chromium metal will be encountered as part of this project. Chromium salts may exhibit a corrosive action on the skin and mucous membranes. NIOSH considers all compounds containing chromium in the hexavalent oxidation state to be carcinogens. The OSHA PEL is 0.005 mg CrO_3/m^3 for chromic acid and chromates and the IDLH concentration is 15 mg Cr(VI)/m^3 for Cr(VI) compounds. The primary routes of exposure are ingestion, dermal contact, and inhalation of aerosols. Ingestion of even small amounts may result in death, symptoms vary with the particular chromium compound. Contact may result in lesions confined to exposed skin areas and mucous membranes of the nasal septum. If exposure continues, perforation of the nasal septum may result.

Source: NIOSH Pocket Guide to Chemical Hazards, http://www.cdc.gov/niosh/npg/npgd0087.html, accessed 17 April 2008.
NIOSH Pocket Guide to Chemical Hazards, http://www.cdc.gov/niosh/npg/npgd0138.html, accessed 21 April 2008.

Hydrogen cyanide (CAS 74-90-8, DOT UN1613)

Synonyms: prussic acid, cyanic acid, formonitrile.

Hydrogen cyanide is a colorless or pale blue gas (or liquid below 78ºF) with a bitter, almond–like odor. It is a Class IA Flammable Liquid/Flammable Gas (flash point 0ºF, explosive range 5.6–40%). It has a specific gravity of 0.69, but is miscible in water. Hydrogen cyanide is incompatible with: amines, oxidizers, acids, sodium hydroxide, calcium hydroxide, sodium carbonate, caustics, ammonia. Cyanide salts are also highly soluble in water, and under acidic conditions liberate the highly toxic gas hydrogen cyanide. The OSHA 8–hour PEL is 10 ppm for skin absorption, and the NIOSH 15–minute STEL is 4.7 ppm. Concentrations of 50 ppm are immediately dangerous to life and health (IDLH). The primary routes of exposure are inhalation and skin/eye contact.

Respirator: NIOSH recommends any air–supplied respirator (APF=10) for concentrations of up to 47 ppm, with full-face air–purifying respirators equipped with appropriate cartridges acceptable for escape.

Symptoms: Hydrogen cyanide can enter the body through inhalation, skin absorption, ingestion, or skin and/or eye contact. Cyanide displaces oxygen from hemoglobin molecules in the bloodstream, and results in symptoms of oxygen deprivation. **Medical attention is required in case of exposure exceeding the PEL or STEL.** Symptoms of exposure include: asphyxia; lassitude (weakness, exhaustion), headache, confusion; nausea, vomiting; increased rate and depth of respiration or respiration slow and gasping; thyroid, blood changes.

First Aid: Eyes should be irrigated immediately with clean water. Flush exposed skin with water. Respiratory support should be provided in case of breathing difficulty, and immediate medical attention is required in case of swallowing.

Source: NIOSH Pocket Guide to Chemical Hazards, http://www.cdc.gov/niosh/npg/npgd0333.html, accessed 17 April 2008.

Hydrogen sulfide (CAS 7783-06-4, DOT UN1053)

Hydrogen sulfide is a colorless gas with a strong odor of rotten eggs. The sense of smell becomes fatigued upon exposure, and the odor is often perceived as sweet in cases of H_2S poisoning. The gas may be present in equilibrium with sulfide minerals in acidic reducing conditions, and is often generated in sanitary sewers by the action of microorganisms on proteinaceous material. Hydrogen sulfide gas is somewhat denser than air. The liquid boils at –77ºF, leading to a risk of contact frostbite. Hydrogen sulfide is a Flammable Gas (no flash point, but explosive range 4–44%). The primary route of entry is inhalation. The OSHA PEL is a 20 ppm ceiling for 8-hour exposures, with a peak of 50 ppm over a ten minute period. The NIOSH REL is a 10 ppm ceiling over a ten minute period.

Respirator: NIOSH recommends a full–face air–purifying respirator (APF=10) or better for concentrations of up to 100 ppm.

Symptoms: Hydrogen sulfide can enter the body by inhalation or contact. Symptoms of exposure include irritation of the eyes and respiratory system; apnea, coma, convulsions, conjunctivitis, eye pain, tearing, light sensitivity, corneal vesiculation, dizziness, headaches, fatigue, irritability, insomnia and gastrointestinal distress.

First Aid: Eyes or skin should be treated as for frostbite. Respiratory support should be provided in case of breathing difficulty.

Source: NIOSH Pocket Guide to Chemical Hazards, http://www.cdc.gov/niosh/npg/npgd0337.html, accessed 17 April 2008.

Lead (and inorganic lead compounds, CAS 7439-92-1)

Lead is a heavy, ductile, blue-gray metal that is very soft. Inorganic lead compounds include lead oxides, metallic lead, and lead salts. Lead is slightly soluble in water. Ingestion of lead dust is the primary route of entry for metallic lead. However, organically complexed lead can be present as a constituent in petroleum fuels. The OSHA 8–hour PEL and NIOSH 8–hour REL for metallic lead, lead oxides and inorganic lead salts and soaps is 0.050 mg/m^3. The IDLH concentration is 100 mg/m^3 (as lead).

Symptoms: Lead compounds can enter the body through inhalation, adsorption, or ingestion. Systemic effects of lead poisoning are difficult to identify except through laboratory testing. Symptoms of exposure include weakness, lassitude, insomnia, facial pallor, eye palpitations, anorexia, constipation, tremor, headache, aching bones and kidney disease.

First Aid: Eyes should be irrigated immediately with clean water. Flush exposed skin with soapy water. Respiratory support should be provided in case of breathing difficulty, and immediate medical attention is required in case of swallowing.

Source: NIOSH Pocket Guide to Chemical Hazards, http://www.cdc.gov/niosh/npg/npgd0368.html, accessed 17 April 2008.

Mercury (and inorganic mercury compounds, CAS 7439-97-6 [metal], DOT UN2809)

Metallic mercury is a heavy, silver–white odorless liquid between –38ºF and at 674ºF. Inorganic mercury compounds include all inorganic and aryl Hg compounds, but not alkyl compounds (such as methyl mercury). The primary routes of entry for mercury are by inhalation, absorption, and ingestion. The NIOSH 8–hour PEL for mercury vapor is 0.050 mg/m^3 (as Hg) and the ceiling limit is 0.1 mg/m^3. The OSHA PEL is also 0.050 mg/m^3. The IDLH concentration is 10 mg/m^3 (as Hg).

Symptoms: Mercury compounds can enter the body through inhalation, adsorption, or ingestion. Symptoms of exposure include irritated eyes, skin irritation, coughing, chest pain, insomnia, anorexia, tremor, headache, and fatigue.

First Aid: Eyes should be irrigated immediately with clean water. Flush exposed skin with soapy water. Respiratory support should be provided in case of breathing difficulty, and immediate medical attention is required in case of swallowing.

Source: NIOSH Pocket Guide to Chemical Hazards, http://www.cdc.gov/niosh/npg/npgd0383.html, accessed 17 April 2008.

Selenium (CAS 7782-49-2, DOT UN2658)

Elemental selenium (Se) is an amorphous or crystalline, red to gray solid. Selenium also occurs as an impurity in most sulfide ores. It is a combustible solid, and also reacts with acids, strong oxidizers and cadmium. The OSHA PEL and NIOSH REL are 0.2 mg/m^3 (as Se) for selenium and its compounds, except selenium hexafluoride gas. The IDLH concentration is 1 mg/m^3 (as Se).

Respirator: NIOSH recommends any dust and mist respirator or APR with HEPA cartridge for concentrations up to 1 mg/m^3.

Symptoms: Inhalation, ingestion and, skin and/or eye contact are exposure routes. Exposure can result in irritation of the eyes, skin, nose or throat; visual disturbance; headache; chills, fever; dyspnea (breathing difficulty), bronchitis; metallic taste, garlic breath, gastrointestinal disturbance; dermatitis; or eye/skin burns. Exposure in animals can result in anemia; liver necrosis, cirrhosis; kidney, spleen damage. Consumption of selenium–accumulating plants such as *Astragalus* spp. (locoweed) are thought to cause blind staggers and other diseases in livestock (http://www.pprl.usu.edu/selenium_accumulators.htm).

First Aid: Eyes should be irrigated immediately with clean water. Flush exposed skin with soapy water. Respiratory support should be provided in case of breathing difficulty, and immediate medical attention is required in case of swallowing.

Source: NIOSH Pocket Guide to Chemical Hazards, http://www.cdc.gov/niosh/npg/npgd0550.html, accessed 17 April 2008.

Silver dust and soluble compounds (CAS 7440-22-4[metal])

Metallic silver (Ag) is a white, lustrous solid. Some silver salts are soluble in water. Metallic silver is a noncombustible solid, but is flammable in the dust or powder forms. It is incompatible with acetylene, ammonia, hydrogen peroxide, bromoazide, chlorine trifluoride, ethyleneimine, oxalic acid and tartaric acid. The OSHA PEL and NIOSH REL are both 0.01 mg/m^3, and concentrations of 10 mg/m^3 are immediately dangerous to life and health (IDLH).

Respirator/PPE: For concentrations up to 0.5 mg/m^3, any full–face APR with HEPA filter, SAR or SCBA having APF of 50 meets NIOSH recommendations. For higher concentrations, consult the *NIOSH Pocket Guide*. Eye and skin protection are also recommended.

Symptoms: Inhalation is the primary exposure route. Alternate routes of exposure include ingestion and skin or eye contact. Symptoms include: blue-gray eyes, irritation of the nasal septum or throat; irritation or ulceration of the skin; and gastrointestinal disturbance. The target organs are: the nasal septum, skin and eyes.

First Aid: Eyes should be irrigated immediately with clean water. Flush exposed skin with water. Respiratory support should be provided in case of breathing difficulty, and immediate medical attention is required in case of swallowing.

Source: NIOSH Pocket Guide to Chemical Hazards, http://www.cdc.gov/niosh/npg/npgd0557.html, accessed 17 April 2008.

Sodium cyanide (CAS 143-33-9, DOT UN1689)

Sodium cyanide, like other cyanide salts, is a white granular crystalline solid with a faint almond–like odor. Cyanide salts are highly soluble in water, and under acidic conditions liberate the highly toxic gas hydrogen cyanide (*q.v.*). They are also reactive with strong oxidizers, such as chlorine. The OSHA PEL is 5 mg/m^3, and concentrations of 25 mg/m^3 are immediately dangerous to life and health (IDLH). The NIOSH REL ceiling limit is 5 mg/m^3 for a 10 minute period. Primary routes of exposure are inhalation, ingestion and skin/eye contact.

Cyanide displaces oxygen from hemoglobin molecules in the bloodstream, and results in symptoms of oxygen deprivation. These include: weakness, headache, confusion, nausea, vomiting, increased respiratory rate, slow gasping respiration, thyroid and blood changes, and death. Minor exposure can result in irritation to the eyes or skin.

First aid for contact is immediate irrigation. Skin contacting cyanide salts should be immediately washed with soapy water. In case of breathing difficulties, respiratory support should be provided. **Medical attention is required.**

Source: NIOSH Pocket Guide to Chemical Hazards, http://www.cdc.gov/niosh/npg/npgd0562.html, accessed 17 April 2008.

3.3.2 Reagents

Chemical reagents that may be used by MSE personnel during removal activities include:

Methanol (CAS 67-56-1, DOT UN1230, NFPA 1-3-0)

Methanol (also known as methyl alcohol, wood alcohol or carbinol) is a colorless liquid with a characteristic pungent odor, and is miscible with water. It may be used as a decontamination solvent. It is a Class IB Flammable Liquid (flash point 52°F, flammable range 6.0–36%) and burns with a colorless flame. The PEL is 200 ppm (with a NIOSH 15–minute exposure limit of 250 ppm for skin absorption). Exposure routes include inhalation, skin absorption, ingestion and skin/eye contact.

Symptoms: Exposure may result in irritation of the eyes, skin and upper respiratory tract; headaches, drowsiness, dizziness, vertigo, lightheadedness, nausea, vomiting; distorted vision, optic nerve damage (blindness) and/or dermatitis.

First Aid: Eyes should be irrigated immediately with clean water. Wash exposed skin with soapy water. Respiratory support should be provided in case of breathing difficulty, and immediate medical attention is required in case of swallowing.

Sources: NIOSH Pocket Guide to Chemical Hazards, http://www.cdc.gov/niosh/npg/npgd0397.html, accessed 17 April 2008.

Hydrochloric Acid (*CAS 7647-01-0, *DOT UN1789 [solution])

Hydrochloric acid (also known as muriatic acid) is a colorless to slightly yellow gas with a pungent, irritating odor. It is most often used in an aqueous solution and can be used as a laboratory preservative. Both the OSHA ceiling PEL and the NIOSH ceiling REL are 5 ppm. Exposure routes include inhalation, ingestion (solution), and skin and/or eye contact. Hydrochloric acid is highly corrosive to most metals and should also be kept away from hydroxides, amines, and alkalis.

Symptoms: Exposure may result in irritation of the nose, throat, and larynx, causing coughing or choking, dermatitis, eye and skin burns, and frostbite (liquid).

First Aid: Eyes should be irrigated immediately with clean water. Flush exposed skin with water. Respiratory support should be provided in case of breathing difficulty, and immediate medical attention is required in case of swallowing.

Sources: NIOSH Pocket Guide to Chemical Hazards, http://www.cdc.gov/niosh/npg/npgd0332.html, accessed 18 April 2008.

Nitric Acid (CAS 7697-37-2, DOT UN2031)

Nitric acid is a colorless, yellow, or red, fuming liquid with an acrid, suffocating odor that is often used in an aqueous solution. It can be used as a laboratory preservative. Both the NIOSH REL and OSHA PEL are 2 ppm. The NIOSH short-term limit is 4 ppm and concentrations above 25 ppm are immediately dangerous to life and health (IDLH). Exposure routes include inhalation, ingestion, and skin and/or eye contact. Nitric acid reacts with water to produce heat. It is also reactive with combustible materials, metallic powders, hydrogen sulfide, carbides, and alcohols.

Symptoms: Exposure may result in irritation of the eyes, skin, and mucous membranes, delayed pulmonary edema, pneumonitis, bronchitis, and dental erosion.

First Aid: Eyes should be irrigated immediately with clean water. Flush exposed skin with water. Respiratory support should be provided in case of breathing difficulty, and immediate medical attention is required in case of swallowing.

Sources: NIOSH Pocket Guide to Chemical Hazards, http://www.cdc.gov/niosh/npg/npgd0447.html, accessed 18 April 2008.

3.4 Routes of Chemical Exposure

The potential routes of chemical exposure and relevant safety practices are briefly described below.

3.4.1 Inhalation

Breathing a gas, vapor, mist, fume, or dust is the most common type of accidental exposure. Generally, respirators should be worn when activities involve the generation of airborne particles or when organic vapors are suspected. It is the responsibility of the site safety officer (SSO) to determine where and when respirators will be worn (see Section 5.0).

3.4.2 Skin Absorption

Skin absorption is the second most common accidental means of entry of chemicals to the body. Avoid unnecessary contact with contaminated surfaces. All skin areas shall be protected when working with hazardous materials. Items to protect the skin may include: disposable Tyvek® suits, rubber boots, gloves and face shield.

After fieldwork is completed, all contaminated PPE must be decontaminated or disposed of in accordance with the applicable and relevant or appropriate regulations.

3.4.3 Ingestion

Ingestion is a common route of chemical exposure. Thus, the following activities are prohibited on site within the primary work area: eating, drinking, smoking or chewing gum.

3.4.4 Eye Contact

Most chemicals have the ability to injure the eye to some degree through surface contact or absorption. Appropriate safety goggles shall be worn on the Site. Furthermore, contact lenses are not allowed in work areas where hazardous chemicals are encountered.

4.0 PHYSICAL HAZARDS

Field personnel may be exposed to a number of physical hazards at the Site, including:

- Open and collapsed mine workings;
- Collapsed structures and debris;
- Fire and explosion;
- Industrial hazards: lifting, hand tools, falls and slips;
- Heat or cold stress;
- Biological hazards from plants and animals; and
- Flood.

*****CRITICAL*****

Flows in the OGF can increase very quickly to hazardous conditions without warning. During storm events, an emergency floodgate at the Harriet Lake Dam may trigger and suddenly release a large volume of water into the OGF upstream of the Site. Similarly, if PGE has to perform repairs or maintenance on the pipeline or power generation facilities, the flow is directed back into the OGF and can increase flows by more than 500 cfs. Before initiating sampling activities, the field crew must contact PGE at (503) 630-8204 to coordinate access and determine whether PGE will be diverting flows into the OGF during field sampling activities.

Hazardous conditions in the OGF also include: (1) a narrow rocky chute with near vertical sidewalls and several drops adjacent to the Kiggins Mine, and (2) a 75-foot tall vertical waterfall about 0.5 mile downstream of the Site. **Extreme caution should be taken during sampling to avoid being swept downstream.**

5.0 SAFETY AND HEALTH CONTROLS

This section discusses accident prevention, chemical hazards mitigation, and biological hazards.

5.1 Accident Prevention

5.1.1 General

The following general accident prevention practices shall be observed by all field personnel:

- First aid and safety equipment will be provided as listed in Section 5.2.1 below.
- PPE will be worn, as required in Section 5.2.2 below. Facial hair that interferes with the satisfactory fit of respirators must be shaved before respirator use.
- No alcoholic beverages or illegal drugs are allowed on site.
- Accidents shall be reported to the PM and the Boise Regional Manager in a timely fashion.
- Tools and equipment will be used in accordance with normal safe working procedures. This includes equipment inspection before use, and will usually require the use of eye protection.
- Safe lifting and carrying procedures shall be followed. Lift with your legs, not with your back!

5.1.2 Fire Protection

Portable fire extinguishers shall be provided in each MSE vehicle at the Site. These fire extinguishers will be inspected and maintained in accordance with National Fire Protection Agency Regulation 10, *Portable Fire Extinguishers*.

5.1.3 Explosion Prevention

If any explosives are encountered at either mine, do not disturb the material, cordon off the area with surveryor's tape, and notify the Forest Service OSA/COR immediately.

5.1.4 Excavation Hazards

The post-removal field activities will not involve any excavation.

5.1.5 Heat Stress

Anticipated weather conditions indicate that the risk of heat stress is moderate. Various degrees of heat stress are described below.

Extreme heat can cause heat exhaustion or heat stroke, possibly resulting in death. Heat stress can be avoided by taking rest breaks in cool or shaded areas, drinking water or dilute drinks to maintain electrolyte balance, and maintaining physical fitness.

Heat exhaustion is characterized by pale, cool and clammy skin; profuse perspiration, fatigue or weakness, headache, dizziness, slurred speech or confusion, and nausea. First aid procedures call for removing the victim to a cool uncontaminated area, removing PPE, cooling the victim with water and fanning, allowing the victim to drink water and rest.

Heat stroke is characterized by extremely high body temperature; hot, red and dry skin; reduced perspiration; a rapid strong pulse; and possible confusion or unconsciousness. First aid is the same as for heat exhaustion, but the victim should be transported to a medical facility, since *heat stroke is a medical emergency*.

5.1.6 Cold Stress

Anticipated weather conditions indicate that the risk of cold stress is low during removal activities. Various degrees of cold stress are described below.

Frostnip is characterized by a sudden blanching of the skin. First aid requires covering the affected area with warmth until symptoms subside.

Frostbite is characterized by white or waxy skin which feels firm to the touch. First aid procedures call for covering the affected area with warmth, and moving the victim to a heated shelter when possible. A physician's care should be sought as soon as possible.

Mild hypothermia is characterized by shivering, numbness and drowsiness. For first aid, apply heat and move the victim to a heated shelter.

5.1.7 Confined Spaces

The scope of work does not require entry into any confined space, as defined by 29 CFR 1910.146. A permit-required confined space (permit space) is a confined space which:

1. Contains or has potential to contain a hazardous atmosphere; or
2. Contains a material that has the potential of engulfing an entrant; or
3. Has an internal design that could trap or asphyxiate an entrant by walls that converge inwardly, or by a floor that slopes downward and tapers to a smaller cross-section; or
4. Contains any other recognized serious safety or health hazard.

On the basis of the potential to contain a hazardous atmosphere and the potential to engulf an entrant, mine adits will usually be classified as a permit-required confined space. **Entrance into mine adits is forbidden under this scope of work.**

5.1.8 Forest or Rangeland Fire

This project is on National Forest System lands, and workers may encounter wildfire. Specific fire protection and suppression measures (R6-FS-6300-52, 5/97 rev) for the Pacific Northwest Region are provided in Attachment B. **Contact the local Ranger District at (503) 630-6861 to determine the fire status before mobilizing to the Site.**

- Do not build a campfire outside of designated fire pits, and have fire buckets filled and ready during campfire use;
- Minimize the use of sparking equipment, and never use such equipment in areas that have not been cleared of fuel;
- Be prepared to smother local small fires with shovels;
- Know the way out, and identify alternate escape routes incase your main route is blocked;
- Know the whereabouts of the members of your party;
- Make sure someone knows that you are on the Forest, and where your job site is;
- Pay attention to conditions of high temperature, low humidity, winds and thunderstorms;
- If a fire starts nearby, get out! **Leave when you can, not when you must; and**
- Fire consumes oxygen, so taking refuge in water may not help you.

Awareness of fire behavior can help you plan your escape:

- Fire usually burns faster uphill than downhill;
- If the wind changes, the fire can change direction or move downhill;
- Fires in “fine” fuel like grass or brush typically spread fastest (several miles an hour);
- Fires in “heavy” fuel like downed trees and snags can move fast and burn intensely;
- Large fires may have complex behavior that makes prediction of their spread or intensity difficult;
- Smoke tends to settle in valley bottoms at night; and
- A fire that looks out or just smoldering can spring to life if conditions change, especially if the wind comes up.

Source: Fire in the Mountains, Umatilla National Forest, http://www.fs.fed.us/r6/uma/maps/brochures.shtml, accessed August 2004.

5.2 Chemical Hazard Minimization

5.2.1 Required First Aid and Safety Equipment

Safety Equipment:		**Monitoring Equipment:**	
Fire extinguisher	x	PID or FID	
First–aid kit	x	Draeger tubes	
Eye–wash station			
Traffic cones			
Two-way radios			

5.2.2 Required Personal Protective Equipment

5.2.2.1 Kiggins Mine

For the purposes of the removal activities, level "D" protection (minimum) shall be used. Since the atmosphere is not expected to contain hazardous gases in concentrations above regulatory limits, no respiratory protection or air monitoring is being required. Nitrile gloves are required during sampling.

The following PPE is required:

Hard hat		Harness	
Safety glasses		Coveralls, coated Tyvek	
Safety goggles		Hearing protection	
Outer gloves, type		Respirator (see below)	
Inner gloves (nitrile)	x	Traffic vests (Union Pacific RR)	
Safety shoes	x	Fire–resistant clothing (CPL)	
Boots w/ steel toe	x		

5.2.2.2 Ames-Bancroft Mine

For the purposes of the removal activities, level "D" protection (minimum) shall be used. Since the atmosphere is not expected to contain hazardous gases in concentrations above regulatory limits, no respiratory protection or air monitoring is being required. Nitrile gloves are required during sampling.

The following PPE is required:

Hard hat		Harness	
Safety glasses		Coveralls, coated tyvek	
Safety goggles		Hearing protection	
Outer gloves, type		Respirator (see below)	
Inner gloves (nitrile)	x	Traffic vests (Union Pacific RR)	
Safety shoes	x	Fire–resistant clothing (CPL)	
Boots w/ steel toe	x		

http://www.cdc.gov/ncidod/diseases/hanta/hps/noframes/prevent5.htm

5.2.3 Respiratory Protection

5.2.3.1 Kiggins Mine

Since the atmosphere is not expected to contain hazardous gases in concentrations above regulatory limits, it is not anticipated that respiratory protection will be required to perform the scope of work at Kiggins Mine.

5.2.3.2 Ames-Bancroft Mine

Since the atmosphere is not expected to contain hazardous gases in concentrations above regulatory limits, it is not anticipated that respiratory protection will be required to perform the scope of work at Ames-Bancroft Mine.

5.2.4 Vapor Monitoring

Vapor monitoring is not required to perform any of the outdoor activities in the scope of work.

5.2.5 Decontamination

An area shall be designated as the decontamination area. All equipment decontamination and removal and bagging of PPE shall occur in this area.

5.2.6 Training

All MSE personnel assigned to this project shall be qualified for working at mine sites. Qualification requires the following:

- Successful completion of a 40–hour training program as required by 29 CFR 1910.120.
- Successful completion of an 8–hour refresher training course, provided the 40–hour training occurred over 12 months ago.
- Successful completion of Hazard Communication training in accordance with the MSE Safety and Health Manual.

5.2.7 Medical Monitoring

All MSE personnel assigned to this project shall be enrolled in MSE's Medical Surveillance Program. The program requires baseline (upon employment) and periodic (annual) examinations by a licensed physician. Records of these examinations for Boise personnel are maintained at Occupational Medicine

Associates, 6533 West Emerald Street, Boise, Idaho (208) 377–1520. Records for Salt Lake City personnel are maintained at Work Care, 2390 South Redwood Road, Salt Lake City, Utah.

5.3 Biological Hazards from Plants and Animals

This work activity is being conducted on National Forest System lands. Staff may encounter plants and animals that present a hazard, such as bears, ticks, mosquitoes, poisonous snakes, spiders, or plants. Awareness and avoidance of biological hazards is the first line of defense. Topical insect repellants are a recommended precaution. Typically, minor insect bites bites and contact dermatitis from plants can be managed with non-prescription antihistamines, calamine lotion, or with prescription topical corticosteroids.

Systemic reactions to insect bites or stings (bees, hornets, wasps, yellow jackets, ants) can include fatal anaphylaxis, a severe, potentially life-threatening allergic response that is marked by swelling, hives, lowered blood pressure, and dilated blood vessels. In severe cases, a person will go into shock and it can be fatal. Reactions to poisonous spider bites may be treated with muscle relaxants or anticonvulsives administered by a medical professional. Snakebites from venomous species may require antivenin. Personnel who have received bites from poisonous snakes or spiders or exhibit severe allergic reactions to bee stings should be evacuated to the nearest medical facility for treatment by medical professionals. Accurate identification of the species inflicting the bite can be important in making decisions concerning treatment.

5.3.1 Poisonous Snakes

The project area may lie within rattlesnake habitat, and there is a potential for encountering a rattlesnake during field activities. Typically, rattlesnakes will make a rattling noise to warn an organism that comes near. Upon hearing a rattling noise, be still and try to locate the rattlesnake. When the rattlesnake is located, move away from the snake, and pick a route that avoids being within striking distance. Do not pick up, harm, or harass the snake. Always look before placing your hand on a rock or in vegetation.

Symptoms: Sometimes, a rattlesnake may not inject venom with a bite ("dry bite"). However, the painful bite may still become infected. If venom is injected, one or more of the following symptoms may result:

- Swelling, pain, bleeding
- Nausea/vomiting, sweating, chills
- Dizziness, weakness
- Numbness or tingling of the mouth or tongue
- Changes in heart rate and blood pressure
- Excessive salivation, thirst
- Swollen eyelids, blurred vision
- Muscle spasms
- Unconsciousness

Treatment: Try to calm the victim. If available, use a snakebite kit. If a snakebite kit is not available, gently wash the area with soap and water. Apply a cold, wet cloth over the bite. Immobilize the bite area and keep it below the heart. Transport the victim to the nearest emergency facility for further treatment as soon as possible.

If an extended period of time will be required to reach the nearest medical facility, an additional step should be taken. This step is to wrap a bandage around the extremity 2 to 4 inches above the bite to help

slow the venom. The bandage should be snug but it should not cut off blood flow. The bandage should be loose enough to allow a finger to be able to be slipped underneath it.

5.3.2 Biting or Stinging Insects

Black Widow Spiders: Black Widow spiders have a shiny, black, globular abdomen with a reddish or yellowish hourglass marking on the underside of the spider. Most of the time these spiders are not aggressive but they will bite if bothered or cornered. Their webs are usually built outdoors close to the ground in trash, rubbish piles and under or around buildings.

Symptoms:

- Slight swelling with two faint red spots around the bite area.
- One to three hours after being bitten pain intensifies and travels up or down the arm or leg and localizing in the abdomen and back with rigid abdominal muscles and cramping.
- Pain in the muscles and soles of the feet, swollen eye lids, nausea, vomiting, tremors, labored breathing, profuse perspiration, a feeble pulse, cold clammy skin, unconsciousness, convulsions and in rare cases death.

Treatment:

1. Wash with soap and water.
2. Put antiseptic on the bite area.
3. Get medical attention as soon as possible. Recovery usually occurs in 2 to 5 days.

Brown Recluse Spiders: Mature Brown Recluse spiders have a violin-shaped marking on the top surface of the cephalothorax (fused head and thorax). However, this feature can be very faint, particularly those in the southwestern U.S., or how recently the spider has molted. The abdomen is uniformly colored, although the coloration can range from light tan to dark brown, and is covered with numerous fine hairs that provide a velvety appearance. The long, thin, brown legs also are covered with fine hairs, but not spines. Adult brown recluse spiders have a leg span about the size of a quarter. Their body is about 3/8 inches long and about 3/16 inches wide. Males are slightly smaller in body length than females. Both sexes are venomous.

Symptoms:

- Bite may feel like a pinprick, a stinging sensation followed by intense pain, or go unnoticed.
- A small white blister usually initially rises at the bite site surrounded by a swollen area.
- Lesion or sunken, ulcerating sore.
- Infrequently, general systemic reactions may include restlessness, generalized itching, fever, chills, nausea, vomiting, or shock. Fatalities are extremely rare

Treatment:

1. Try to calm the victim.
2. Immediately seek medical attention (contact your physician, hospital and/or poison control center).
3. Apply an ice pack directly to the bite area to relieve swelling and pain.
4. Collect the spider (even a mangled specimen has diagnostic value), if possible, for positive identification. A plastic bag, small jar, or pill vial is useful and no preservative is necessary, but rubbing alcohol helps to preserve the spider.

Paper Wasps: Paper wasps include Yellowjackets, Hornets and Polistes wasps. They usually feed on insects but some species (e.g. Yellowjackets) are also scavengers and are attracted by garbage and food. All of these wasps are capable of producing a painful sting but most won't sting unless provoked. Between 0.4 and 0.8 percent of humans are allergic to social wasp and bee venom. Nearly 80 percent of all serious venom-related deaths occur within 1 hour of the sting. Multiple stings are especially dangerous. Some people may develop sensitivity to venom after repeated stinging episodes over a short or long period of time.

Symptoms:

- Localized swelling and pain that gradually disappear in a few hours.
- Mild headache and fever
- In extreme cases a severe allergic reaction may occur which includes difficulty in breathing, dizziness, nausea and development of hives

Treatment:

1. Antiseptic, cool compresses and crushed aspirin to help relieve the pain and swelling.
2. Oral antihistamines may control symptoms.
3. If symptoms are more serious than localized swelling, reddening and pain, immediate medical attention is required.

5.3.3 Ticks

The ***Rocky Mountain wood tick*** and the ***American dog tick*** are the most common ticks associated with people in the Mountain West. Most tick bites are harmless but ticks can be carriers of illnesses such as Lyme disease, Rocky Mountain spotted fever and Colorado tick fever. The most common disease associated with ticks is Colorado tick fever. Rocky Mountain spotted fever is rare but can occur in this area. Although uncommon in the area Lyme disease is also a potential concern. Ticks are most active in the spring and early summer, then they go dormant during the heat of the summer until the following spring. They poise themselves on top of vegetation then cling to passing animals. They are usually found along paths in bushy areas, edges of fields and woodlands, grassy areas and shrublands. The best repellents for ticks are repellents that have DEET (N,N-diethyl-metatolamide). The repellent should be applied directly to the skin and clothes especially around the lower body. Wearing long sleeves and pants also helps keeps ticks from attaching to skin.

General Tick Bite Symptoms: Rash, fever, muscle aches, joint pain and swelling.

Symptoms of Colorado Tick Fever:

- Aching, fever, chills and fatigue which lasts 1 to 3 days.
- Most cases are not reported due to similarity to flu symptoms.

Symptoms of Rocky Mountain Spotted Fever:

- General feeling of malaise and/or aching and a high fever.
- A rash also develops starting on the wrists and ankles
- Rash may later spreads to the rest of the body including the palms and the soles of the feet.

Symptoms of Lyme Disease:

- A red rash typically appears between 1 week and 1 month after the bite and slowly expands over a few days.
- Sometimes multiple secondary skin rashes. Not everyone develops this rash!
- Flu-like and may include fatigue, headache, neck stiffness, jaw discomfort, slight fever, pain or stiffness in joints or muscles, swollen glands, and/or reddening of eyes.

Tick Removal and Treatment:

1. If possible, have someone else remove the tick from you.
2. Use tweezers or forceps rather than your fingers.
3. Grasp the mouthparts or head end of the tick as close to the skin as possible.
4. Gently pull the tick straight out, steadily and firmly.
5. The mouthparts are barbed like a harpoon and may break off in the skin. If they do, it is not cause for concern. They do not carry the bacterium and are no more harmful than a small sliver.
6. Wash hands and the bite area with soap and water; apply an antiseptic to the bite area.
7. Keep the tick specimen. You may need to have it identified if disease symptoms occur later. Place the tick in a small container of alcohol labeled with the date the tick was removed and the place it was picked up.
8. Monitor the bite area. The bite area is likely going to be red at first due to normal sensitivities to the bite; however, an expanding rash (red area) may be an early indication of infection with the spirochete (bacterium) that transmits Lyme Disease.
9. Get medical attention if symptoms persist.

5.3.4 Scorpions

Scorpions are unlikely to be encountered.

5.3.5 Bears

Bears may be encountered on some Forest Lands. Bears are intelligent, curious animals that tend to travel alone (except mothers with their cubs). They have excellent senses of smell and hearing. They can outrun Olympic runners, and are also good swimmers. Black bears are very good tree climbers, and grizzlies can climb as well. Bears rarely attack humans, unless they perceive a threat to themselves, their cubs or their food.

Bears usually avoid people. You should avoid bears whenever possible, using techniques such as these:

- Pay attention to the signs of bears: scat, tracks, etc.;
- Do not leave open food, garbage, soap or other odorous items unattended—store them in hanging bear bags or bear boxes;
- Keep a clean camp (if camping) and person;
- Make bears aware of your presence by making loud noises or singing;
- Avoid hiking at night; and
- Avoid carcasses (bears may protect these as food).

If you meet a bear:

- Usually the bear has detected you first, and will respond in a defensive, agitated manner;
- Move away cautiously to give the bear room to escape;
- Do not threaten the bear, its cubs or its food;
- Identify yourself as human by talking calmly and waving your arms, and try to give the bear your scent;
- Do not run; the bear could pursue you, and you can't outrun it;
- If a bear attacks defensively, such as a grizzly surprised at close range or a black bear sow defending her cubs, play dead;
- If the bear approaches aggressively or with curiosity, speak in a firm voice, stomp your feet and make yourself as big as possible;
- If the bear attacks aggressively, fight for your life. Kick, punch or hit the bear with whatever weapon is available. Concentrate your attack on the face, eyes and nose. Fight any bear that attacks you in your building or tent. Black bears have been driven away when people have fought back with rocks, sticks, binoculars and even their bare hands.

Sources: *Bear Encounters*, Yellowstone National Park, www.nps.gov/yell/planvisit/todo/hikes/bearenc.htm, May 20, 2004.
Staying Safe in Bear Country, Safety in Bear Country Soc'y, www.bearbiology.com/StayingSafeMainMessages.htm, 2001.

6.0 GENERAL SAFETY AND HEALTH REQUIREMENTS

All field personnel shall comply with the following general safety and health requirements:

- All MSE personnel shall follow the corporate Health and Safety Manual, except where this site-specific Health and Safety plan conflicts, in which case this plan shall take precedence.
- Each day a brief safety meeting will be held at the Site. At a minimum, the following information will be reviewed:
    - Work to be done
    - Basic and specific work procedures
    - Review of chemical/physical hazards
- No persons other than those pre-approved by the SSO shall be allowed on the Site during field activities.
- A minimum of two persons (including USFS personnel) are required on Site during field activities.
- Smoking, eating, drinking, and chewing gum are not permitted on site. Wash hands and face before engaging in these activities off site.
- Avoid touching on–site materials, walking through known or suspected "hot zones" or contaminated puddles, kneeling or sitting on the ground, sitting or leaning against potentially contaminated equipment or machinery.
- All contractors or subcontractors shall contact the SSO or PM if any unsafe condition or practice occurs.

7.0 AUTHORITY

7.1 Site Safety Officer

The SSO has the authority to enforce all rules and regulations applicable to this project and to ensure MSE's policies and procedures are followed, including this Health and Safety Plan. The SSO shall consult with the Office Health and Safety Officer (OSHO) and/or PM before making changes because of

changing or unexpected Site conditions, except in case of an emergency in which such consultation is impractical. The SSO shall keep written records of all such changes to the Plan.

7.2 Project Manager

The PM has the responsibility for making sure that all aspects of the Health and Safety Plan are reviewed prior to starting field activities.

7.3 Subcontractors

The MSE SSO and PM have the right to stop any work activities of a subcontractor if, in his/her opinion, the subcontractor is operating in an unsafe manner. This authority in no way absolves the subcontractor from responsibility for the safety of its own employees or other persons.

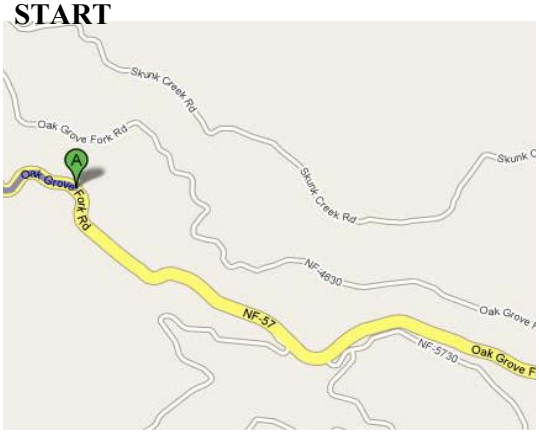
7.4 Signatures

Plan Title	Kiggins-Nisbet HASP April 22, 2009
Plan Author(s):	
Site Safety Officer:	_____
Project Manager:	_____
Boise Health & Safety Officer:	_____
MSE Field Personnel:	_____
	_____
	_____

ATTACHMENT A

Route to Hospital

START



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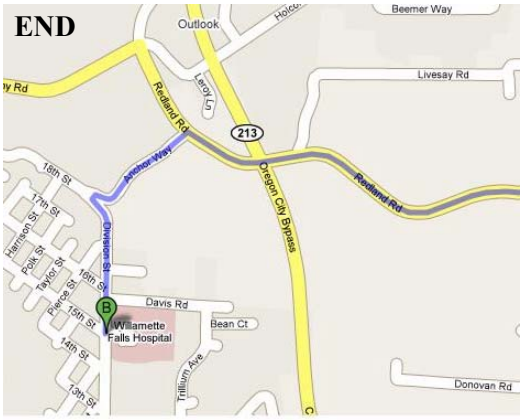


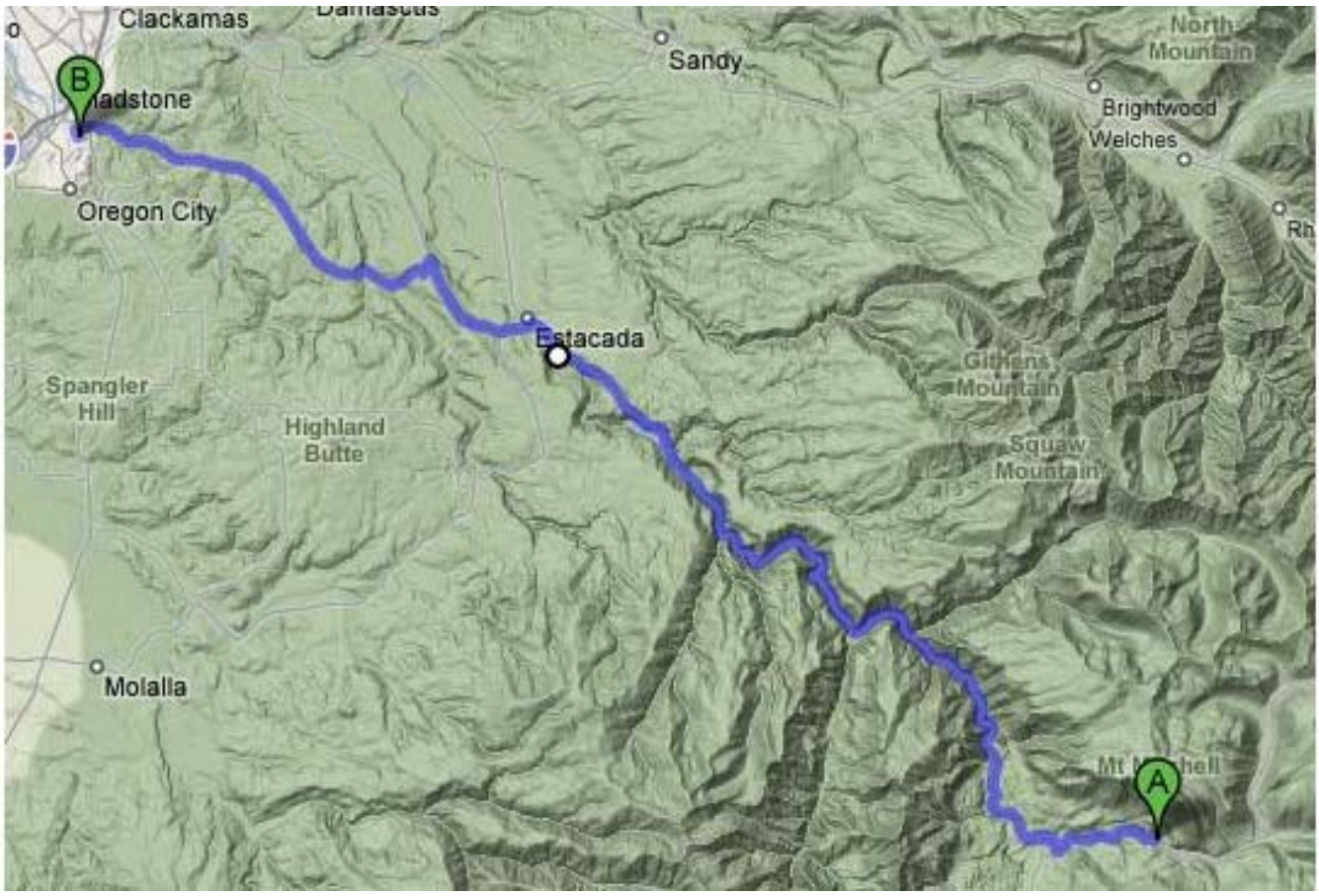
Willamette Falls Hospital
1500 Division Street
Oregon City, OR 97045
(503) 656-1631

Directions to hospital from Kiggins Mine:

> Exit the Site via Forest Road 4630 (to the southeast) and proceed on Forest Road 57 heading northwest. Continue on OR-224 towards Estacada for approximately 25 miles. Turn left at OR-211 for about a mile. Turn right at South Hayden Road. Turn right at South Springwater Road. Turn left at South Redland Road and proceed approximately 12 miles. Turn left at Anchor Way. Turn left at 18th Street and then continue on Division Street until arriving at Willamette Falls Hospital.

Directions to hospital from Ames-Bancroft Mine:

> Exit the Site via Forest Road 57 (Oak Grove Fork Road) and proceed approximately to the northwest. Continue on OR-224 towards Estacada for approximately 25 miles. Turn left at OR-211 for about a mile. Turn right at South Hayden Road. Turn right at South Springwater Road. Turn left at South Redland Road and proceed approximately 12 miles. Turn left at Anchor Way. Turn left at 18th Street and then continue on Division Street until arriving at Willamette Falls Hospital.



ATTACHMENT B

Fire Protection and Suppression

R6-FS-6300-52 (5/97)

USDA FOREST SERVICE

PACIFIC NORTHWEST REGION

FIRE PROTECTION AND SUPPRESSION

1. Fire Period and Closed Season

Specific fire prevention measures are listed below and shall be effective for the period April 1 to October 31 of each year. The Forest Service may change the dates of said period by advance written notice if justified by unusual weather or other conditions. Required tools and equipment shall be kept currently in serviceable condition and immediately available for initial attack on fires.

2. Fire Plan

Before starting any operations on the project, the Contractor, Permittee, Licensee, or Purchaser, hereinafter referred to as the "Contractor," shall prepare a fire plan in cooperation with the Contracting Officer providing for the prevention and control of fires in the project area.

The Contractor shall certify compliance with fire protection and suppression requirements before beginning operations during the fire period and closed season, and shall update such certification when operations change

3. Substitute Measures

The Contracting Officer may by written notice authorize substitute measures or equipment or may waive specific requirements during periods of low fire danger.

4. Emergency Measures

The Forest Service may require emergency measures, including the necessary shutting down of equipment or portions of operations in the project area during periods of fire emergency created by hazardous climatic conditions.

5. Fire Control

The Contractor shall, independently and in cooperation with the Forest Service, take all reasonable action to prevent and suppress fires in the project area. Independent initial action shall be prompt and shall include the use of all personnel and equipment available in the project area.

For the purpose of fighting forest fires on or in the vicinity of the project which are not caused by the Contractor's operations, the Contractor shall place employees and equipment temporarily at the disposal of the Forest Service. Any individual hired by the Forest Service will be employed in accordance with the Interagency Pay Plan for Emergency Firefighters. The Forest Service will compensate the Contractor for equipment rented at fire fighting equipment rates common in the area, or at prior agreed to rates.

6. Compliance with State Forest Laws

Listing of specific fire precautionary measures herein is not intended to relieve the Contractor in any way from compliance with the State Fire Laws covering fire prevention and suppression equipment, applicable to operations under this contract, permit or license.

7. Fire Precautions

Specific fire precautionary measures are as follows:

a. Smoking and Open Fires

Smoking and fires shall be permitted only at the option of the Contractor. The Contractor shall not allow open fires on the project area without advance permission in writing from Forest Service.

Unless restricted by State Law or Federal Regulation, smoking shall be permitted only in such portions of the project area that are free of flammable material. Smokers shall sit down to smoke in such a position that any burning material will fall within a cleared area, and shall extinguish and press out in mineral soil all burning material before leaving the cleared area.

b. Fire Extinguishers and Equipment on Trucks, Tractors, etc.

All power-driven equipment operated by the Contractor on National Forest land, except portable fire pumps, shall be equipped with one fire extinguisher having a UL rating of at least 5 BC, and one "D" handled or long handled round point shovel, size "0" or larger. In addition, each motor patrol, truck and passenger-carrying vehicle shall be equipped with a double-bit axe or Pulaski, 3-1/2 pounds or larger.

Equipment shall be kept in a serviceable condition and shall be readily available.

c. Power Saws

Each gasoline power saw operator shall be equipped with a pressurized chemical fire extinguisher of not less than 8-ounce capacity by weight, and one long-handled round point shovel, size "0" or larger. The extinguisher shall be kept in possession of the saw operator at all times. The shovel shall be accessible to the operator within 1 minute.

d. Extinguishers

One refill for each type or one extra extinguisher sufficient to replace each size extinguisher required on equipment shall be safely stored in the fire tool box or other agreed upon place on the project area that is protected and readily available.

e. Spark Arresters and Mufflers

Each internal combustion engine shall be equipped with a spark arrester meeting either (1) USDA Forest Service Standard 5100-1a, or (2) appropriate Society of Automotive Engineers (SAE) recommended practice J335(b) and J350(a) as now or hereafter amended unless it is:

(1) Equipped with a turbine-driven exhaust supercharger such as the turbocharger. There shall be no exhaust bypass

(2) A passenger-carrying vehicle or light truck, or medium truck up to 40,000 GVW, used on roads and equipped with a factory-designed muffler complete with baffles and an exhaust system in good working condition.

(3) A heavy duty truck, such as a dump or log truck, or other vehicle used for commercial hauling, used only on roads and equipped with a factory designed muffler and with a vertical stack exhaust system extending above the cab.

Exhaust equipment described in this subsection, including spark arresters and mufflers, shall be properly installed and constantly maintained in serviceable condition.

f. Emergency Fire Precautions

The Contractor shall restrict operations in accordance with the Industrial Fire Precaution Levels listed below. The Forest Service may change the Industrial Fire Precaution Levels to other values upon revision of the National Fire Danger Rating System and may change the specific Industrial Fire Precaution Levels when such changes are necessary for the protection of the National Forest. When sent to the Contractor, the revised Industrial Fire Precaution Levels will supersede the attached levels.

INDUSTRIAL FIRE PRECAUTIONS SCHEDULE

INDUSTRIAL FIRE PRECAUTION (IFPL)

LEVEL

I. Closed season **- Fire precaution requirements are in effect. A fire watch/security is required at this and all higher levels unless otherwise waived.**

II. Partial hoot owl - The following may operate only between the hours of 8 p.m. and 1 p.m., local time:

a) power saws, except at loading sites;
b) cable yarding;
c) blasting;
d) welding or cutting of metal.

III. Partial shutdown - The following shall be prohibited except as indicated:

Cable yarding - except that gravity operated logging systems employing non-motorized carriages may be operated between the hours of 8 p.m. and 1 p.m., local time, when all block and moving lines, except the line between the carriage and the chokers, are suspended 10 feet above the ground;

Power saws - except power saws may be used at loading sites and on tractor/skidder operations between the hours of 8 p.m. and 1 p.m., local time.

In addition, the following are permitted between the hours of 8 p.m. and 1 p.m., local time:

a) tractor/skidder operations;
b) mechanized loading and hauling of any product or material;
c) blasting;
d) welding or cutting of metal;
e) any other spark-emitting operation not specifically mentioned.

IV. General shutdown - All operations are prohibited.

The following definitions shall apply to these Industrial Fire Precaution Levels:

Cable yarding systems: A yarding system employing cables and winches in a fixed position.

Closed season (Fire Precautionary Period): That season of the year when a fire hazard exists as declared by the responsible agency official.

Contracting Officer: The person executing the contract, permit or license on behalf of the Government and includes that person's designated representative, acting within the limits of their authority or the duly appointed successor to the individuals.

Loading sites/woods site/project area: A place where any product or material (including but not limited to logs, firewood, slash, soil, rock, poles, posts, etc.) is placed in or upon a truck or other vehicle

Low hazard area: Means any area where the responsible agency representative (WDNR, ORF, BIA, BLM) determines the combination of elements reduces the probability of fire starting and/or spreading.

Tractor/skidder operations: include a harvesting operation, or portion of a harvesting operation, where tractors, skidders, or other harvesting equipment capable of constructing fire line, are actively yarding forest products and can quickly reach and effectively attack a fire start.

Waivers, written in advance, may be used for any and all activities. Activities for which waivers may be issued include, but are not limited to:

a) mechanized loading and hauling;
b) road maintenance such as sprinkling, graveling, grading and paving;
c) cable yarding using gravity systems or suspended lines and blocks, or other yarding systems where extra prevention measures will significantly reduce the risk of fire;
d) powers saws at loading sites or in felling and bucking where extra prevention measures will significantly reduce the risk of fire;
e) maintenance of equipment (other than metal cutting and welding) or improvements such as structures, fences and power lines.

Such waiver, or substitute precautions will prescribe measures to be taken by the Contractor to reduce the risk of ignition, and/or the spread of fire. The Contracting Officer shall consider site specific weather factors, fuel conditions, and specific operations that result in less risk of fire ignition and/or spread than contemplated when precaution level was predicted. Consideration shall also be given to measures that reduce the precaution levels above. The Contractor shall assure that all conditions of such waivers or substitute precautions are met.

The Contractor shall obtain the predicted Industrial Fire Precaution Level daily, prior to the start of work, from the appropriate Ranger District headquarters. If predictions made after 6:00 p.m., local time, are significantly different than the original prediction, the Forest Service will inform the Contractor when changes in restrictions or industrial precautions are made.

NOTE: The IFPL system does not apply on lands protected by ODF east of the summit of the Cascades.

Where hauling involves transit through more than one shutdown/regulated use area, the precaution level at the woods loading site shall govern the level of haul restriction, unless otherwise prohibited by other than industrial precaution level system.

8. Fire Tools

The Contractor shall furnish serviceable fire fighting tools in a readily accessible fire tool box or compartment of sound construction with a hinged lid and hasp so arranged that the box can be secured or sealed. The box shall be red and marked "Fire Tools" in letters one inch high. It shall contain a minimum of:

a) 2 axes or Pulaskis with a 32-inch handle;
b) 3 adze eye hoes. One Pulaski may be substituted for 1 adze eye hoe;
c) 3 long-handled, round point shovels, size "0" or larger.

9. Fire Security

When the Industrial Fire Precautions Level is "I" or higher, unless a waiver is granted, the Contractor shall designate a person who shall perform fire security services listed below on the project area and vicinity. The designated person shall be capable of operating the Contractor's communications and fire fighting equipment specified in the contract, excluding helicopters, and of directing the activities of the Contractor's personnel on forest fires. In lieu of having the designated person perform the required supervisory duties, the Contractor may provide another person meeting the qualifications stated above to direct the activities of Contractor's personnel and equipment during all fire fighting activities.

Services described shall be for at least 1 hour from the time the Contractor's operations are shut down. For the purposes of this provision, personnel servicing equipment, and their vehicles, who are not engaged in cutting or welding metal are excluded.

Fire security services shall consist of moving throughout the operation area or areas constantly looking, reporting, and taking suppression action on any fires detected. Where possible, the designated person shall observe inaccessible portions of helicopter operating areas from vantage points within or adjacent to project area.

10. Blasting

Whenever the Industrial Fire Precaution Level is "II" or greater, a fire security person equipped with a long-handled, round point, No. "0" or larger, shovel, and a five-gallon backpack pump can filled with water will stay at location of blast for 1 hour after blasting is done. Blasting may be suspended by Forest Service in writing, in an area of high rate of spread and resistance to control.

Fuses shall not be used for blasting. Explosive cords shall not be used without written permission of Forest Service, which may specify conditions under which such explosives may be used and precautions to be taken.

Additional Fire Precautionary Measure 2 - Communications

11. The contractor shall provide adequate two-way communication facilities to report a fire to Forest Service within 15 minutes of detection. FCC Regulations prohibit commercial use of Citizen Band (CB) radios. (CB's are not considered adequate two-way communications). Such communications shall be operable during periods of operation of power-driven equipment, including the time fire security is required. Fire Period and Closed Season.

Fire Plan

(For use with Forms R6-6300-50,
R6-FS-6300-51, and R6-FS-6300-52)

Contractor	Contract Number
Project Name	Contract Performance Period

Contractor's Representative for Fire Matters

Name	Title	Office Phone	Home Phone

Contracting Officer's Representative

Name	Office Phone	Home Phone

Forest Service Inspector(s)

Name	Office Phone	Home Phone

Action by Contractor

The Contractor shall take on reasonable and practical action to prevent and suppress fires in the project area. The Contractor shall take suppression action immediately upon discovery of, or becoming aware of, such fire.

Action by Forest Service

The Forest Service may counsel with the Contractor on suppression action and will, when necessary, supplement the Contractor's efforts by furnishing personnel and equipment not available to the Contractor. In the event that a fire is not suppressed by the Contractor, and will require appreciable reinforcements, the Forest Service may take over suppression of the fire and may employ the Contractor's personnel and equipment.

Fire Prevention and Suppression

Predicted fire precautions class may be obtained from the following sources:

_____

_____

_____

The Contractor has employed or designated the following named individual(s) as fireguard, whose duty is the detection and suppression of fires:

Name	Office Phone	Home Phone

Contractor ☐ will, ☐ will not, permit employees to smoke while in the project area.
Open fires ☐ will, ☐ will not, be permitted by the Contractor. Although these activities may be permitted by the Contractor, it is understood that neither shall be allowed without being authorized, in writing, by the Contracting Officer's Representative.

Fires shall be reported to one of the following Forest Service employees:

Name	Address or Location	Office Phone	Home Phone

Special Fire Qualifications of Contractor's Employees

Name	Best Fire Assignment	Other Qualifications

Total number of employees who could perform firefighting duties: _____

Vehicle Description, Type, Make, Model, Size, Year	Number of Units	Location

Joint Preparation of this fire plan is acknowledged:

Contractor or Designated Representative	Contracting officer's Representative
Date	Date

ATTACHMENT B

FIELD FORMS

MSE Daily Field Summary

Project:	Kiggins-Nisbet Mine Complex Post-Removal Monitoring
Project Number:	
Location:	Mount Hood National Forest, Oregon
Field Personnel:	
USFS Personnel:	
Date:	

FIELD CONDITIONS

Weather:	Temp:
Precipitation:	Wind:

VISITORS TO THE SITE

Name	Company:	Purpose of Visit:

FIELD WORK SUMMARY

MSE Water Sample Collection Record

SAMPLE ID:

Sample Location: Photo:

Description:

Date:

Field Personnel:

Conditions: Weather:

FIELD PARAMETER MEASUREMENT

Field Meter:	Field Parameters:	Observation 1	Observation 2	Observation 3
	Temperature (Celcius)			
	pH (pH units)			
	SpCond (microS/cm)			
	Dissolved O_2 (mg/L)			
	ORP (mV)			

Method:

Measurement START Time: Measurement END Time:

FLOW MEASUREMENT

Method: Flow Meter: Flume: Timed Volumetric:

Description:

Flow:

SAMPLE COLLECTION

Sample Method: Bottle Pump Other:

Sample Collection Time:

	Size			Filtration		Analysis							Preservative			
# Sample Containers	500-mL plastic bottle	250-mL plastic bottle	1000-mL glass bottle	Filtered	Unfiltered	Total: Al, As, Hg, Zn	Dissolved: Fe, Mn, Hg	TDS	TSS	pH	Hardness	Other	HCl	HNO_3	NaOH	NONE

STREAM CROSS-SECTION/COMMENTS

MSE Sediment Sample Collection Record

SAMPLE ID:

Sample Location: Photo:

Description:

Date:

Field Personnel:

Conditions: Weather:

METHOD

Grab: Depth:

Composite:	Habitat	Depth	Comments

SAMPLE COLLECTION

Equipment: Trowel Push Sampler Other:

Sample Collection Time:

# Sample Containers	Size				Analysis							Other
	500-mL Bottle	12-oz glass jar	8-oz glass jar	Brass Sleeve	Metals: As, Cd, Cr, Cu, Hg, Mn, Ni							

DESCRIPTION/COMMENTS

MSE Sample Collection Record

SAMPLE ID:

Sample Location: Photo:

Description:

Date:

Field Personnel:

Conditions: Weather:

METHOD

Grab: Depth:

Composite:

Container	Depth	Comments

SAMPLE COLLECTION

Equipment: Trowel Siphon Other:

Sample Collection Time:

	Size				Analysis								Other
# Sample Containers	1000-mL glass bottle	8-oz glass jar	4-oz glass jar	40-ml VOA vial									

DESCRIPTION/COMMENTS

MSE Sample Collection Inventory

Sample ID	Medium								Location	Sample Type				Analysis											Date	By
	Mine Waste	Background Soil	Surface Water	Pore Water	Sediment	Benthics	Drums/Other	Quality Control		Grab	Composite	Filtered	Unfiltered													

ATTACHMENT C

MHE Products Push Point Sampler Operator's Manual

MHE Products PushPoint Sampler (Patent Pending)
Operators Manual and Applications Guide

Ver. 2.00 8/5/01

Models: PP27, PP14, PPX36, PPX72

Introduction

The groundwater/surface water interface (GSI) has been a research interest of mine for the past decade. This transitional zone is usually rich in biomass and may play a predominant role in the bioattenuation of contaminated groundwater entering surface water bodies. Usually these biologic processes have limited effectiveness in attenuating highly contaminated groundwater, leaving a plume of parent contamination and metabolic byproducts that eventually expresses itself in receiving waters - usually classified as non-point sources of pollution because of the uncertainty of the discharge area. Part of the problem in the detection and study of these plumes is that there were no devices on the market for the rapid, discrete collection of pore water samples. Reliance on conventional technology and techniques to perform a detailed investigation required extensive effort and burdensome equipment.

Through several iterations, I have evolved a simple device for collecting pore water samples from beneath surface water bodies or the beach areas surrounding them. Pore-water sampling using the PushPoint becomes a simple and efficient process, generating a wealth of information and very little waste. If one collects groundwater samples in a transect perpendicular to groundwater flow in the suspected area of plume discharge to an open water body, their analysis yields information about the aerial extent of contaminant discharge to the water body. At this point, additional sampling can complement the initial data and provide the information necessary to map the plume expression in both magnitude and aerial distribution. This is becoming increasingly important to regulators as they decide the ecological impacts of discharging contaminant plumes.

Sampling at each location usually takes 5 minutes, allowing a small crew to collect dozens of samples in an afternoon. These samples can be analyzed in the field for real-time information useful in directing field investigations and research. The work that I have conducted at several contamination sites indicates that many groundwater plumes discharge in surface water bodies in 2-3' of water depth - accessible to investigators wearing hip boots or waders. Many plumes, especially Light Non-Aqueous Phase Liquid (LNAPL) plumes can be delineated by collection of samples in very shallow water or from under beaches. My initial experience has shown that Dense Non-Aqueous Phase Liquid (DNAPL) contaminant plumes express themselves in the shallow, near-shore water as well, even though the on-shore depth of the contaminant mass was deep in the aquifer.

Directions

Look at Figure 1.

As you can see, the PushPoint device is a very simple, precisely machined tool consisting of a tubular body fashioned with a screened zone at one end and a sampling port at the other. The bore of the PushPoint body is fitted with a guard-rod that gives structural support to the PushPoint and prevents plugging and deformation of the screened zone during insertion into sediments. The PushPoint is made of 316 stainless steel assuring compatibility with most sampling environments. The screened-zone consists of a series of interlaced machined slots which form a short screened-zone with approximately 20% open area.

Operation of the device is not difficult. One simply holds the device in a manner that squeezes the two handles towards each other to maintain the guard-rod fully inserted in the PushPoint body during the insertion process (as shown in Figure 2). Holding the device in this manner, push the PushPoint into the

sediments or beach to the desired depth using a gentle twisting motion. When the desired depth is reached (or you hit refusal, usually at an aquitard) remove the guard-rod from the PushPoint body without disturbing the position of the deployed sampler. Once the guard-rod has been removed from the PushPoint, it SHOULD NOT be reinserted into the device until the bore of the PushPoint has been thoroughly cleansed of all sand, silt, etc.

Attach a syringe or peristaltic pump to the PushPoint sample-port (see Figure 3) and withdraw water at a low-flow sampling rate (50-200 ml/min.). The first 20-50 ml of groundwater will be turbid. This is the "development" water and should be discarded. Once non-turbid aliquots have been withdrawn, representative samples can be collected for on-site and off-site analysis.

Cleaning and Maintenance

I cannot stress how important cleanliness and linearity are to the working life of the instrument. The PushPoint was designed as an indefinitely reusable device; potentially able to be reused hundreds of times. The tolerance between the guard-rod and the bore of the PushPoint is very small. Increases in this tolerance through abrasion and damage may allow silty material into this annular space, eventually jamming the guard-rod into the bore - maybe permanently!

Excess wear and abrasion can also be introduced if the guard-rod is inserted frequently when the PushPoint body is bent. All the small bends should be "undone" prior to reinsertion of guard-rod to avoid scraping the sides of the bore causing burrs. Before reinsertion of the guard-rod into the cleaned PushPoint, the device should be "straight as an arrow". Use caution when straightening the screened-zone, it is somewhat delicate without the guard-rod inside it, and can be broken through repeated bending. Similarly, the guard-rod should be bend-free and clean when inserted into the bore of the device. When a clean and straight PushPoint is assembled, the guard-rod should slide fairly easily through the PushPoint bore and its handle should seat against the sampling port.

Clean the exterior of the guard-rod and PushPoint body and screened-zone with a stiff brush and cleaning solution (soapy water).Cleaning and decontamination of the bore of the instrument is easily accomplished using the cleaning adapter provided. Remove the spray nozzle of a "garden sprayer" filled with cleaning solution. Connect the adapter as shown in Figure 4. Insert the sampling port of the PushPoint to the adapter and squirt ~ 100 ml of pressurized cleaning solution backwards through the sampler and out the screened-zone into a waste receptacle. Gently push the guard rod into the bore of the PushPoint to its end to dislodge any bridged material. Re-rinse the bore with cleaning solution. Follow this with a distilled water and/or methanol rinse. Reinsert the guard-rod and the device is ready to be used again.

In some instances it may be advantageous to force the cleaning solution through the screened-zone and out the sampling port. To do so, gently insert the screened-zone of the PushPoint into the cleaning adapter, making sure not to bend the screened-zone, until the entire screened-zone is within the adapter. The screened-zone is somewhat fragile. To avoid damage, do not bend the screen-zone during insertion into the adapter. Squirt cleaning solution through the sampler to a waste receptacle.

Helpful Hints, Information, and Cautions

- Multiple depths can be sampled in one hole if samples are collected, in order, from deepest to shallowest. Insert the sampler using a twisting motion until you reach refusal. Remove the guard-rod. **Do not push the sampler further into the sediments once the guard-rod has been removed as this may damage the screened-zone and plug the device with sediment**. Once sampling has been completed at this deepest depth, the PushPoint can be partially pulled from the hole to a new sampling elevation. Remember, to prevent screened-zone damage, do not to insert the PushPoint into the sediments without the guard-rod inserted into the PushPoint body. Alternately, multiple holes can be used to collect samples from multiple depths at a particular sampling location. If vertical sampling is performed in one hole, it is recommended that some type be device such as a sampling platform be used to prevent lateral movement and slippage of the PushPoint as sampling is conducted near the top

of the hole (see Figure 3). This offsets the leverage of the instrument and reduces hole degeneration. A simple platform would be a plate of steel with a 3/16" dia. hole through its center and would serve the fundamental purpose of maintaining a rigid hole opening . MHE offers a 8" dia., heavy-duty steel sampling platform engineered for the precise sampling depth requirements of field research. If repeated shallow sampling is to be conducted, it may be more convenient to use a shorter sampler (i.e. MHE - PP14").

- If you wish to reuse the PushPoint sampler at a particular sampling location and want to clean the bore quickly while you're there so that the guard-rod may be safely reinserted, you can use a syringe filled with surface water or DI water to backflush the bore several times before reinserting the guard-rod. Use at least 100 ml of water. If you have too much trouble reinserting the guard-rod (i.e. grit), it will be necessary to use the standard cleaning procedures.
- If the screened-zone of the PushPoint becomes plugged while inserted in the sediments due to passage through "something", it is frequently possible to hydraulically/pneumatically shock the screened-zone free of adhering material while it is inserted into the sediments. Attach a large-volume (50 ml) syringe to the sampling port. In a quick motion, pull the syringe plunger most of the way back (creating a vacuum) and then immediately release the plunger - the plunger will slam to a neutral position, sending a shock wave through the bore of the PushPoint and may alleviate the problem.
- The PushPoint can be used as a piezometer to determine the static head of the groundwater and hence, the potential direction of groundwater movement. To do this, a tube is connected to the sample port as shown in Figure 5. A continuous stream of water is established from the syringe (or pump) to the screened-zone by pumping out any air remaining in the PushPoint /tubing. When the tube is disconnected from syringe, the static water level in the tube will represent the static water level at the depth that the screened-zone occupies. In some discharge areas I have found several feet of head differential, and when the tubing is removed, the PushPoint flows like a miniature artesian well.
- It is frequently possible to push the PushPoint through thin lenses of low-permeably material and collect samples from below them and gather valuable geochemical samples. At many of the sites where the PushPoint has been used, sampling from just below a layer of fine sand/silt/clay, one occasionally encounters seemingly large pockets of gas that seem to have coalesced and collected under this less permeable stratum. Analysis of these pockets may provide additional insight to predominant biological processes. It is likely true that the concentration of volatile chemicals in the groundwater has equilibrated with these bubbles which means that their presence in a sampling stream or syringe would not significantly affect the concentration of dissolved volatile organic chemicals (VOC's). In fact, if one assumes that equilibrium conditions exist, the concentration of VOC's in the bubbles is directly related the concentration in the surrounding groundwater. An different condition may exist if the groundwater is supersaturated with bacterial metabolic waste gasses and the negative pressure exerted by the pump (or syringe) initiates degassing of dissolved gasses from the groundwater. In this instance, VOC's would partition from the groundwater to the bubbles as they are formed in the sampling tubing (this is fairly evident if occurring). The consequence of this condition is that part of the dissolved contaminant mass has partitioned into the gas phase and unless the gas-phase is captured, quantified and accounted for, the native VOC concentration of the groundwater is not reflected by analysis of the groundwater alone. If this condition exists, the degassing effect can be minimized by decreasing the sampling rate to a rate more easily yielded by the sampled formation. With experience, it is easy to distinguish which of these conditions (or combination of conditions) exist and to what extent they affect sample quality.
- The internal volume of a PushPoint PP27 is approx. 1.5 ml. A 50 ml syringe full of distilled water, decon water, methanol, etc. will push about 33 volumes through the bore.
- When straightening the screened zone it is sometimes helpful to flush out the bore of the device with a cleaning solution and then insert the guard-rod to the area of the bend in the screened-zone. Gently unbend the portion of the screened-zone nearest the rod and carefully advance the rod to the next bend. After the rod has been fully inserted into the screened-zone perform the final screened-zone, straightening until the guard-rod slides freely through it.
- If the sampling port of the PushPoint is above the static level of the water body, each time you remove the syringe or pump from the PushPoint sampling port, air will fill the bore of the PushPoint, allowing the water level in the bore to reach its static head. To avoid this plug of air from entering the

subsequent syringe, attach a pinch clamp and/or a 3-way valve between the sampling port and the syringe or pump inlet as shown in Figure 7.

- I have conducted dye tests (concentrated uranine dye) by injecting concentrated dye under a perforated 1.5' diameter disk through which the PushPoint was inserted from depths of 3" - 12" into sediments. The goal of these tests was to determine whether or not surface water and dye are drawn into samples collected in near surface sediments (i.e. whether a cone of depression is formed). The results indicated that no surface water is drawn into samples even though sampling was conducted with a peristaltic pump at its maximum rate of 600 ml/min for several minutes.
- I usually couple my field investigations with global positioning system (GPS) identification of the sampling location. If conditions permit, a pin flag can be placed at the sampling location for later location by GPS - I usually use sub-meter grade GPS for this surveying. GPS can then used in the future to relocate previously sampled location even if certain site physical characteristics have changed (eroding shorelines, etc.). If long-term study of a shoreline is planned it will be useful to have an elevation benchmark established on shore that can be used as a reference. The elevation of the sampling locations can then accurately measured. This may be helpful in areas where sediment levels are not stable such as in erosional areas.
- Sampling by syringe has many advantages. This is my preferred field method due to its simplicity and versatility. It is useful to be able to collect several 50 ml syringes full of groundwater, store them on ice and perform the sample transfer to VOA vial, etc. under more controlled conditions. To transfer sample to a VOA vial, place the end of the transfer tube (Figure 8) to the bottom of the VOA vial. Dispense sample into the VOA vial and slowly withdraw the transfer tube from the vial maintaining the mouth of the transfer tube just below the sample surface. When the transfer tube is almost out of the vial, continue to dispense sample and leave an "anti-meniscus" of sample above the rim of the vial. Add several drops of HCl (which will displace a few drops of sample) and cap. If VOC samples are to be collected and/or stored temporarily in a syringe, I recommend 100% polyethylene/polypropylene ("two piece") syringes such as those made by Henke Sass Wolf GMBH (NormJect ®, 50 ml)) configured as shown in Figure 8. From personal experience I have found that small amounts of aromatic compounds (BTEX) can leach from the rubber parts of the rubber-tipped plunger found in common medical syringes. Rubber-tipped plunger syringes have less side-wall resistance and work much smoother than the 100% polyethylene/polypropylene syringes so I use medical syringes for "development" of the PushPoint. Standard medical syringes also work well for collecting samples for non-VOC analysis. I utilize handheld meters for pH, conductivity, redox, DO, etc. One can dispense sample from the syringe into these types of instruments for field measurements. The disposable syringes may be cleaned and reused several times, but because they are a friction fit; prolonged reuse results in scoring of the barrel which eventually causes air leaks.
- The 50 ml, 100% polyethylene/polypropylene "two piece" syringes mentioned above can be purchased directly from MHE, configured with tubing, clamp, and stopper as was the example syringe included with your order, or customized to suit your individual needs. If you would to make your own, the syringes that I am currently using are purchased from National Scientific. The tubing is Tygon 1/4"OD x 1/8" ID. Be sure to use some type of clamp at the tubing mouth to ensure a good seal at the sampler port. The entire syringe assemblies are now available from MHE at a reasonable cost.
- Headspace GC analysis of VOC's can be easily accomplished using 100% polyethylene/polypropylene syringes. Dispense all but 25 ml of the sampled groundwater from the syringe. Refill the syringe to the 50 ml mark with ambient air and then stopper the tubing (and heat the syringe in a water bath if desired) as shown in Figure 9. Shake the syringe assembly to equilibrate the VOC's in the sample with the contained atmosphere. Insert a GC syringe needle through the transfer tube into the sample syringe headspace and withdraw a sample for GC analysis.
- Occasionally a small amount sand and silt is withdrawn into the syringe or pump sampling stream, even after proper "development" of the PushPoint. This may be due to the nature of the geologic formation. This fine material is probably already at equilibrium with the surrounding groundwater and tests have shown that its presence should not influence analysis of VOC's in the groundwater sample. The sample can be transferred to its shipping container without this silt if the syringe is dispensed in such a manner as to let the solid material settle out in the syringe and not carry over to the shipping vial.

- The PushPoint has been used very successfully for underwater investigations using SCUBA equipment and a series of 100% polyethylene syringes. Once again, GPS equipment was used for location of the position that the divers collected groundwater samples of contaminant plume expression in the lake. Underwater notes (temperature, depth, observations, etc.) can be written directly on the sample syringes if they are pre-prepared with a strip of Scotch Magic Transparent Tape applied down the syringe body and writing is done with a soft pencil.
- The PushPoint may be used to inject nutrients or dyes into the sediments for field trials of biologic or geochemical testing or tracing groundwater paths. Simply insert the PushPoint to the desired depth, and after the guard-rod has been removed, connect a syringe or pump and slowly inject the desired fluid into the sediments, perhaps followed by a small amount of native groundwater to flush the instrument.
- The PushPoint is constructed of 316 stainless steel as mentioned previously. There are two places where the stainless parts are silver soldered together, the handle of the guard-rod and the handle on the PushPoint sampler. If the investigator is collecting samples for metals analysis, the silver solder joint on the guard-rod may impart trace levels metallic residue to the sampling port mouth. This has never caused a problem but the possibility exists. The silver solder that I use is Safety-Silv 45 which contains silver (45%), copper (30%),and zinc (25%). MSDS available upon request. In the unlikely event that these metals cause contamination of samples, MHE can produce specialty guard-rods that are not silver soldered. What can I say, these devices were originally built to sample for VOC's.
- These devices can be dedicated as semi-permanent underwater monitoring devices. If a PushPoint is inserted to the desired depth through a plate (such as the sampling platform mentioned earlier) that can lock the sampler at the correct insertion depth, a vinyl cap can be placed over the mouth of the sampler, and the sampler can be dedicated to that location so that future samples can be withdrawn when desired.
- It has been useful to carry several samplers in "quivers" made of 2" PVC tubing….one tube for (10-15) clean/assembled samplers and one tube for used samplers and their separated guard-rods. This arrangement protects both the investigators and the instruments.
- I have been using a Myron 6P Ultrameter available from www.ColeParmer.com for most of my work. This instrument measures pH, specific conductance, ORP, temperature, and TDS using only a few milliliters of sample and is perfectly suited to samples dispensed by syringe. The instrument is waterproof to 3 m. There will soon be a link on the MHEproducts.com web page.
- I have been using the Chemetrics Vacu-Vial technique (www.Chemtrics.com) in conjunction with PushPoint sampling. I use this for dissolved oxygen and dissolved iron measurements. Many other analytical tests are also available such as nitrate, phenols, etc.. This analytical technique also works very well with samples collected in syringes. The sample is dispensed into a plastic cone until it overflows. The tip of an evacuated ampoule containing the necessary reagents is broken off at the bottom of the cone allowing the vacuum in the ampoule to pull in a aliquot of sample that has not contacted the atmosphere. The ampoule is shaken and is then is then placed as a cuvette into a handheld spectrophotometer. The results are nearly instantaneous and are displayed in ppm. There will soon be a link on the MHEproducts.com web page.

I hope that users will find many useful and innovative uses for this device. If you have other helpful information, uses, and advice concerning these samplers, please write or e-mail suggestions to me for inclusion in future manual revisions. I have finally started a web site: www.MHEproducts.com and have posted pictures, new products, and the latest version of this manual.

Thanks. MHE

MHE Products
3371 Sherman Rd.
East Tawas, MI 48730
USA
Phn: 989 362 5179
517 393 0948

e-mail: sales@MHEProducts.com