Response Action Contract IX

FIELD SAMPLING PLAN
FOR THE
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
LAVA CAP MINE SUPERFUND SITE

U.S. Environmental Protection Agency
Contract No. 68-W-98-225

CH2M HILL, Inc.
and Team Subcontractors:
URS Greiner Woodward Clyde Federal Services, Inc.
E2 Consulting Engineers, Inc.

FIELD SAMPLING PLAN
FOR THE
REMEDIAL INVESTIGATION/
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LAVA CAP MINE SUPERFUND SITE

Prepared for:

Contract No. 68-W-98-225/WA No. 021-RICO-093Y

U.S. Environmental Protection Agency

Region IX

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September 1999

FIELD SAMPLING PLAN
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REMEDIAL INVESTIGATION/FEASIBILITY STUDY
LAVA CAP MINE SUPERFUND SITE

NEVADA CITY
NEVADA COUNTY, CALIFORNIA

EPA CONTRACT NO. 68-W-98-225
EPA WORK ASSIGNMENT NO. 021-RICO-093Y
CH2M HILL PROJECT NO.151319.FI.01

U.S. ENVIRONMENTAL PROTECTION AGENCY REGION IX

Sample Plan Title: Field Sampling Plan for the Lava Cap Mine RI/FS

Site Name: Lava Cap Mine Superfund Site

Site Location: 14501 Lava Cap Mine Road

City/State/Zip: Nevada City, California, 95959

Site EPA ID#: 3Y

Anticipated Sampling Dates: October 1999 to September 2000

EPA Project Manager: Michelle Schutz Section: SFD-7-2 415/744-2393

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QAO

Received by Quality Assurance office: ________ Date

Reviewed by: ______________________ ________ Date

Approved: ______________________ ________ Date

Chief, Quality Assurance Office
Environmental Services Branch, OPM

QAO

* *

Executive Summary- Lava Cap Mine FSP

This Executive Summary provides a summary of the Field Sampling Plan (FSP) for the Lava Cap Mine Superfund Site. The U.S. Environmental Protection Agency (EPA), under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), is conducting a Remedial Investigation (RI) and Feasibility Study (FS) to characterize and evaluate contamination associated with the Lava Cap Mine. The Lava Cap Mine Superfund Site is located at 14501 Lava Cap Mine Road southeast of Nevada City, California.

The overall goals of the RI at the Lava Cap Mine site are to characterize site conditions, collect sufficient data to determine the nature and extent of contamination, and support informed risk management decisions regarding human health and the environment. Following evaluation of the information gathered during the RI, potential remedial options will be addressed in the FS. The FS will develop, screen, and provide detailed evaluations of alternative remedial actions. The RI/FS process at the Lava Cap Mine site will lead to a Record of Decision (ROD) that will select the environmental cleanup actions necessary to mitigate risks to human health and the environment from Lava Cap Mine contamination.

The FSP is a comprehensive plan that will be used to guide all field activities for current and future field tasks performed at Lava Cap Mine. The FSP is a planning document and as such, it is prepared in the initial stages of planning for the RI. Currently planned field activities for the Lava Cap Mine RI include geologic, hydrogeologic, air, and ecological investigations that involve collection of soil, sediment, surface water, groundwater, air, and biota samples. The FSP includes all currently anticipated sample collection activities, associated analytical methods and field procedures related to this planned sampling. Samples will be collected in the following general areas:

- Background: This includes areas upgradient or upstream of potential impacts from Lava Cap Mine contaminants. Samples are collected from background areas to provide a baseline for comparison to samples collected in areas potentially impacted by contamination from the mine.
- Lava Cap Mine Source Area: This covers the portions of the mine property where tailings and waste rock from the historic mining operations are located and ongoing discharge of water from the mine occurs.
- Lava Cap Mine Area: The portion of the mine property that is potentially impacted by mine contaminants, but does not specifically contain source materials.
- Downgradient of the Lava Cap Mine: This covers the area downstream of the mine where contaminants from the Lava Cap Mine could potentially have been transported during historic and ongoing contaminant releases. In particular this covers portions of Little Clipper Creek, Clipper Creek, Lost Lake and land adjacent to these water bodies.

The major components of the FSP include: discussion of the objectives, including the data quality objectives (DQOs); site background; rationale for the planned sampling activities and the specific locations planned for sample collection; a description of the analytical methods to be used for the RI and the specific analyses being requested for each sample location; and description of the field methods and procedures to be used to conduct the RI field activities. Each of these FSP components is described below.

Objectives

The overall objectives of the Lava Cap Mine RI are discussed above. The RI field program is developed based on the Data Quality Objectives (DQOs) for the site. The DQO process has been used to guide the RI planning for the Lava Cap Mine Site. This process provides a framework to collect data to support defensible decision making in a cost-effective manner.

The DQO process is a systematic planning process for data collection developed through the EPA total quality management activities. The DQO process represents an effort by the EPA to balance the need to minimize the cost and time of data collection with the need to collect data of sufficient quality and quantity to support defensible decision-making. To balance these competing needs, the DQO process establishes an organized, scientific methodology to guide planning by:

- Focusing on the end uses of the data;
- Making decision on the basis of risk;
- Employing statistical methods to plan for and interpret data; and
- Emphasizing collaboration among the decision-makers during the planning process.

The results of the DQO process are the DQOs themselves - a series of statements leading to an RI design that results from the application of the seven DQO steps specified by the EPA. The purpose of the DQOs is to:

- Define the type and quality of data that will be collected;
- Clarify the objectives of the investigation; and
- Specify acceptable limits of uncertainty.

DQOs are applicable to all stages of collecting environmental data and provide a framework for the entire RI planning process.

Site Background

This section in the FSP provides brief summaries of the site history; site conditions, including geology, groundwater conditions, surface water conditions, climate and ecology, and demographics; and sampling history. Because the Lava Cap Mine RI is in the early stages of the RI, limited data have been gathered on site conditions and the sampling history is not extensive. The RI field activities described in this FSP will generate significant additional detail on site conditions and the magnitude and extent of contamination associated with Lava Cap Mine.

Planned Sampling Activities

The FSP includes detailed descriptions of all sampling activities currently planned for the Lava Cap Mine RI, including sample locations and media to be sampled, and provides rationale for these sampling activities. Specific field activities described in the FSP include:

Soil

- Sampling of surface soil to characterize background conditions and conditions in the source areas at the mine, the areas at the mine away from the sources, along Little Clipper Creek, the tailings deposition area above Lost Lake, and around Lost Lake.
- Sampling of background subsurface soil and subsurface soil in the source areas at the mine and in the tailings deposition area above Lost Lake.

Groundwater

- Installation and sampling of four groundwater monitoring wells. One upgradient and three in the source areas at the Lava Cap Mine. The wells will be sampled twice during two separate sampling rounds.
- Evaluation of the groundwater elevations and groundwater flow directions.
- Sampling mine shaft groundwater and in-situ groundwater in the source areas at the mine and in the tailings deposition area above Lost Lake.
- Sampling of selected residential wells twice (two separate sampling rounds) at the mine, along the Little Clipper Creek drainage downstream of the mine, and around Lost Lake.

Surface Water

- Measuring mine discharge, tailings-pile seep, and base of the Lava Cap Mine log dam surface water flow rates and collecting water quality samples monthly for up to 12 months.
- Sampling background surface water in Little Clipper Creek and Clipper Creek.
- Sampling surface water in Little Clipper Creek adjacent to and downstream of the mine; Clipper Creek upstream and downstream of Lost Lake, Lost Lake, and, potentially, in the downstream Rollins Reservoir if initial sample results indicate elevated concentrations downstream of Lost Lake.
- Sampling ponded water in the tailings deposition area and in the abandoned buildings at the mine.
- All surface water sample locations will be sample three times to assess seasonal variability.

Air

- Conducting air sampling to characterize potential impacts from fugitive dust transport and to assess potential impacts from dust during eventual remedial action activities.
- Sampling air adjacent to a residence at the mine, in the source area at the mine, in the mine buildings, in the tailings deposition area above Lost Lake and adjacent to Lost Lake.
- All air sample locations will be sample three times to assess seasonal variability.

Ecological

- Conducting an ecological investigation to characterize contaminant concentrations in aquatic and terrestrial biota where sufficient biomass is available. Aquatic and terrestrial plants and invertebrates will be sampled, as will fish, small mammals and frogs.
- Sample collection in the following areas: background, in the source areas at the mine, in and around the mine buildings, in and adjacent to Little Clipper Creek downstream of the mine, in the tailings deposition area, in and adjacent to Clipper Creek upstream and downstream of Lost Lake, and in Lost Lake.
- Collection of surface water, sediment and soil samples to perform bioassays using various species to asses the toxicity of background and potentially impacted media in the Lava Cap Mine vicinity.
- Assessing aquatic and terrestrial habitat, species present, and potential ecological receptors to Lava Cap Mine contamination.

Miscellaneous

- Evaluation of the Lava Cap Mine log dam and the Lost Lake dam stability.
- Assessment of the thickness of waste rock and tailings piles.

Laboratory Analyses

The FSP provides details on the specific laboratory methods being requested for each sample collected, including required detection limits and holding times. The following parameters will be analyzed during the Lava Cap Mine RI:

- Soil/sediment/air filters/biota. These media will be analyzed for cyanide and the full suite of metals. In addition, selected samples adjacent to the bunkers at the mine will be analyzed for explosives and total organic carbon.
- Surface water and groundwater. The water samples will also be analyzed for cyanide and the full suite of metals. In addition, all water samples except for the residential well samples will be analyzed for hardness, anions, total dissolved solids, and alkalinity.

Field Methods

The FSP includes details on all field activities and procedures to be implemented as part of the Lava Cap Mine RI. Specific topics covered include: sample collection, disposal of contaminated materials, equipment decontamination, sample containers, sample preservation, sample packaging and shipment, field documentation, QC samples and corrective actions.

Sample collection covers a long list of field methods, including:

- Surface Soil Sampling
- Field Screening with X-Ray Fluorescence
- Installation of Soil Borings
- Subsurface Soil Sampling
- Monitoring Well Installation
- Groundwater Sampling
  - In-situ
  - Monitoring Wells
  - Residential Wells
- Surface Water
- Ambient Air Sampling
- Sediment Sampling
- Characterization of Terrestrial and Aquatic Habitat
- Aquatic Plant Sampling
- Aquatic Invertebrate Sampling
- Fish Sampling
- Terrestrial Plant Sampling
- Terrestrial Invertebrate Sampling
- Small Mammal Sampling

The attached detailed FSP has been prepared for use by contractors performing environmental services at Lava Cap Mine to ensure that the RI/FS produces analytical data that are scientifically valid and defensible. The establishment and documentation of these procedures ensures that the data are collected and analyzed in a consistent manner.

Addenda to the FSP will be prepared prior to each subsequent RI sampling event (a total of three are planned). In addition, the FSP will be revised as necessary when guidelines and regulatory documents are revised, or when additional sampling or analysis methods are required for the RI/FS. As revisions are required, they will be prepared as part of the specific task and amended to the FSP.

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Appendixes:

Tables

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List of Acronyms

ASTM	American Society for Testing and Materials
bgs	below ground surface
CC	Clipper Creek
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
CLP	Contract laboratory program
COC	chain-of-custody
COPCs	contaminants of potential concern
COPECs	contaminants of potential ecological concern
DQO	Data Quality Objective
DTSC	California Department of Toxic Substances Control
EB	equipment or field blank
EPA	United States Environmental Protection Agency
FD	field duplicate
FS	Feasibility Study
FSP	Field Sampling Plan
GIS	Geographical Information System
gpm	gallons per minute
GPS	global positioning satellite
ICP	inductively coupled argon plasma
IDW	investigation derived waste

LCC	Little Clipper Creek
LUFT	Leaking Underground Fuel Tank
MCL	maximum contaminant level
mg/kg	milligrams/kilogram (approximately equivalent to part per million [ppm])
MS	matrix spike
MSD	matrix spike duplicate
MS/MSD	matrix spike/matrix spike duplicate
NaOH	sodium hydroxide
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
PPE	personal protective equipment
PRG	preliminary remediation goal
ppb	parts per billion
ppm	parts per million
QA	quality assurance
QA/QC	quality assurance/quality control
QAO	Quality Assurance Office
QAPP	Quality Assurance Project Plan
QC	quality control
RBP	Rapid Bioassessment Procedure
RFA	request for analysis
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study

ROD	Record of Decision
RPD	relative percent difference
RSCC	Regional Sample Control Coordinator
RWQCB	California Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SOP	Standard Operating Procedures
TAL	Target Analyte List
TC	Toxicity Characteristics
TCL	Target Compound List
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
TOC	total organic carbon
TPH	total petroleum hydrocarbons
µg/L	micrograms per liter (approximately equivalent to parts per billion [ppb])
USA	Underground Service Alert
XRF	X-ray fluorescence

1 Introduction

This Field Sampling Plan (FSP) has been prepared to support field and laboratory activities associated with implementation of the Remedial Investigation/Feasibility Study (RI/FS) at the Lava Cap Mine Superfund site. The U.S. Environmental Protection Agency (EPA), under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), is conducting a Remedial Investigation (RI) and Feasibility Study (FS) to address contamination associated with the Lava Cap Mine. The Lava Cap Mine is located at 14501 Lava Cap Mine Road southeast of Nevada City, California. The location of the Lava Cap Mine is shown in Figure 1-1. This FSP has been developed in accordance with *Preparation of a U.S. EPA Region 9 Field Sample Plan for EPA-Lead Superfund Projects*, prepared by the Quality Assurance Management Section, U.S. EPA, Region 9, August, 1993 and accompanies the Quality Assurance Project Plan (QAPP) [EPA, 1999] prepared for the Lava Cap Mine RI/FS.

The overall goals of the RI at the Lava Cap Mine site are to characterize site conditions, collect sufficient data to determine the nature and extent of contamination, and support informed risk management decisions regarding human health and the environment. Following evaluation of the information gathered during the RI, potential remedial options will be addressed in the FS. The FS will develop, screen, and provide detailed evaluations of alternative remedial actions. The RI/FS process at the Lava Cap Mine site will lead to a Record of Decision (ROD) that will select the environmental cleanup actions necessary to mitigate risks to human health and the environment from Lava Cap Mine contamination.

This FSP addresses geologic, hydrogeologic, air, and ecological investigations that involve collection of soil, sediment, surface water, groundwater, air, and biota samples during the Lava Cap Mine RI. Samples will be collected in the following general areas: background, source area, mine area, and downgradient of the mine, including areas between the mine and Lost Lake and the Lost Lake area.

EPA has requested permission from various property owners to gain access to their property to collect samples. The Lava Cap Mine field activities will be coordinated from a field office located on the Lava Cap Mine site and residents will be notified at least 24-hours in advance of accessing their property.

Specific field and laboratory activities described in the FSP include:

<u>Soil</u>

- Sampling of surface and/or subsurface soil to characterize background conditions, conditions at the mine at the mine, along Little Clipper Creek (LCC), in the tailings deposition area above Lost Lake, and around Lost Lake.

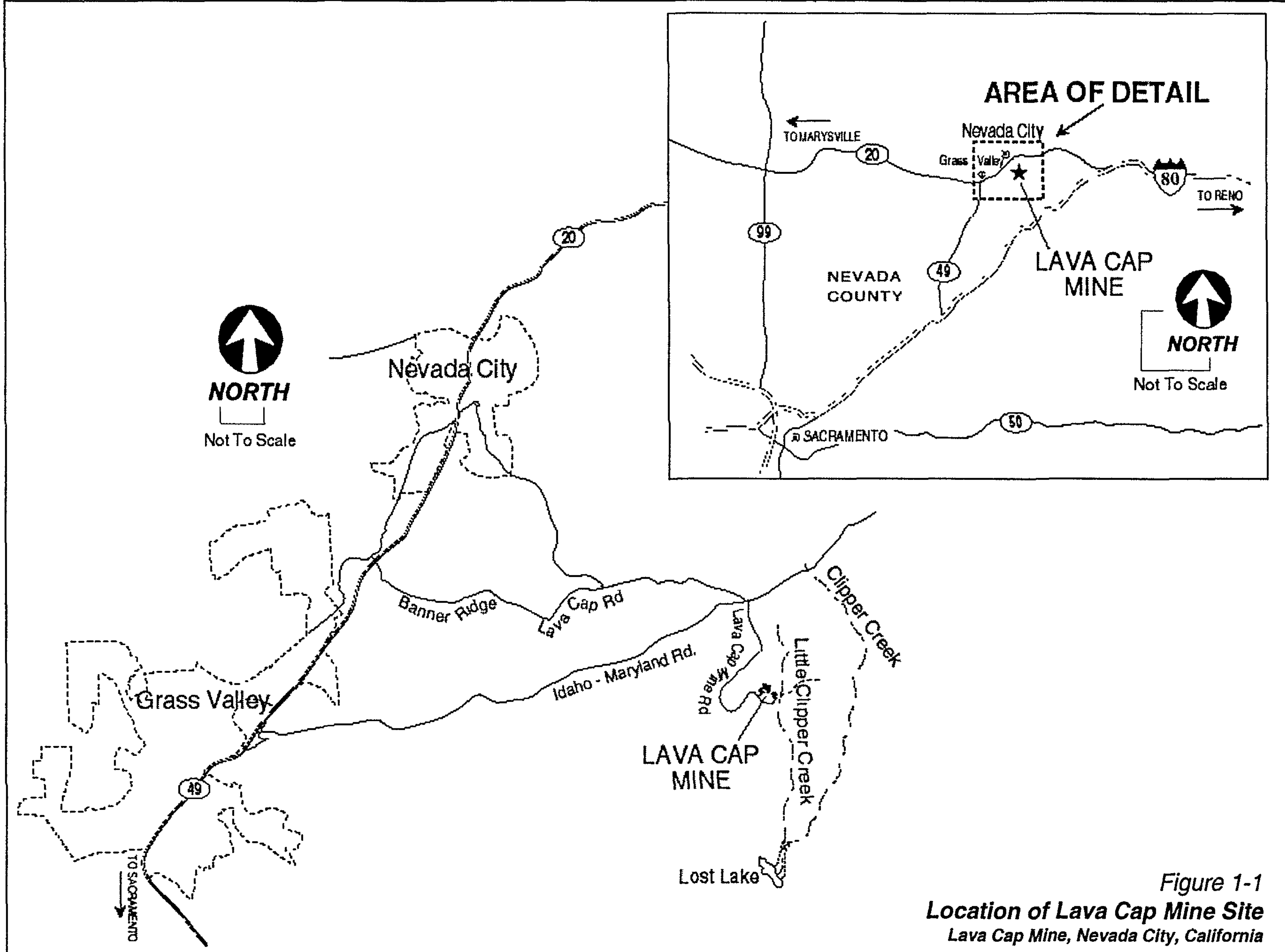

Figure 1-1

Location of Lava Cap Mine Site

Lava Cap Mine, Nevada City, California

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Groundwater

- Installation of four new groundwater monitoring wells.
- Evaluation of the groundwater elevations and groundwater flow directions.
- Sampling upgradient, mine area, and downgradient groundwater from residential wells, monitoring wells, in-situ, and mine shaft locations.

Surface Water

- Sampling and measuring mine discharge and tailings-pile seep flow rates monthly for 12 months.
- Sampling surface water in LCC (upstream, adjacent to, and downstream of the mine), Clipper Creek (CC) (upstream and downstream of Lost Lake), Lost Lake, and, potentially, in the downstream Rollins Reservoir.

Air

- Conducting air sampling to characterize potential impacts from fugitive dust transport and to assess potential impacts from dust during eventual remedial action activities.
- Sampling air at the mine, in the mine buildings, in the tailings deposition area and at Lost Lake.

Ecological

- Conducting an ecological investigation to characterize concentrations in aquatic and terrestrial biota where sufficient biomass is available (including background, at the mine, adjacent to and downstream of the mine, in the tailings deposition area, Lost Lake, and downstream of Lost Lake).
- Conducting an ecological investigation to characterize bioconcentration in biota for aquatic and terrestrial test species.
- Assessing aquatic and terrestrial habitat as part of the ecological investigation.

Miscellaneous

- Evaluation of the Lava Cap Mine log dam and the Lost Lake dam stability.
- Assessment of the thickness of waste rock and tailings piles.

Data Quality Objectives

The Data Quality Objective (DQO) process has been used to guide the RI planning for the Lava Cap Mine Site. This process provides a framework to collect data to support defensible decision making in a cost-effective manner.

The DQO process is a systematic planning process for data collection developed through the EPA total quality management activities. The DQO process represents an effort by the EPA to balance the need to minimize the cost and time of data collection with the need to collect data of sufficient quality and quantity to support defensible decision-making. To balance these competing needs, the DQO process establishes an organized, scientific methodology to guide planning by:

- Focusing on the end uses of the data;
- Making decision on the basis of risk;
- Employing statistical methods to plan for and interpret data; and
- Emphasizing collaboration among the decision-makers during the planning process.

The results of the DQO process are the DQOs themselves - a series of statements leading to an RI design that results from the application of the seven DQO steps specified by the EPA. The purpose of the DQOs is to:

- Define the type and quality of data that will be collected;
- Clarify the objectives of the investigation; and
- Specify acceptable limits of uncertainty.

DQOs are applicable to all stages of collecting environmental data and provide a framework for the entire RI planning process.

The DQO process comprises a series of seven steps (and subordinate tasks) to produce a scientifically based investigative design (EPA, 1994). The seven steps are shown in Figure 1-2. Table 1-1 summarizes the overall DQOs for the Lava Cap Mine RI. The specific DQOs for specific locations are located in Appendix A of this document and Section 3 in the QAPP (EPA, 1999).

DATA QUALITY OBJECTIVES PROCESS

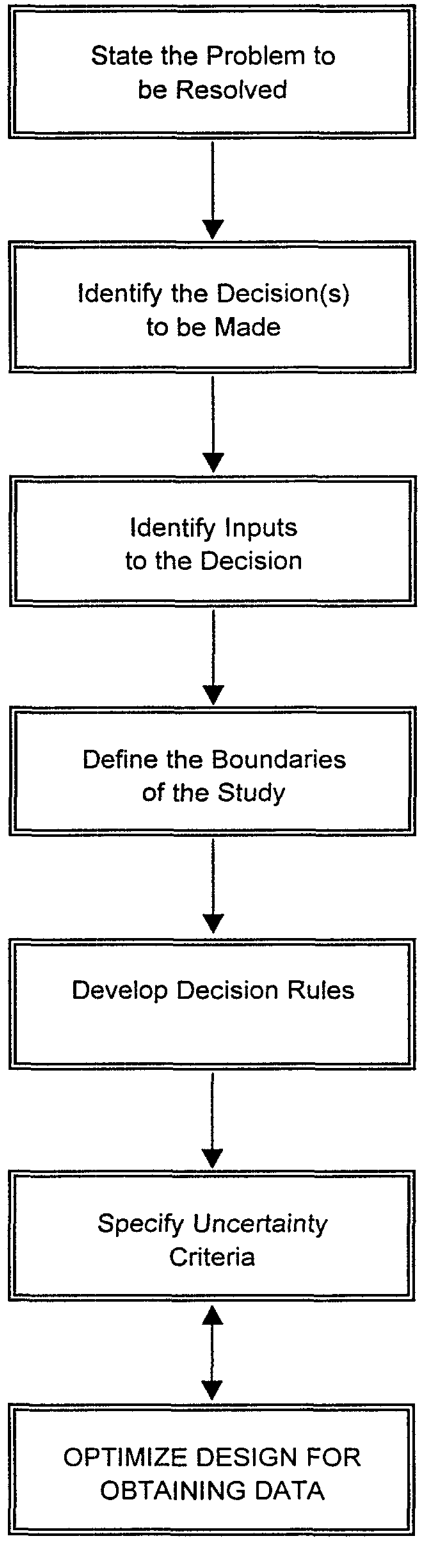


FIGURE 1-2
DATA QUALITY OBJECTIVES PROCESS
Lava Cap Mine, Nevada City, California

Figure1_1.xls

Table 1-1
Lava Cap Mine Superfund Site General Data Quality Objectives
Field Sampling Plan
Lava Cap Mine RI/FS

Problem Statement	The nature and extent of contamination and the conceptual site model at the Lava Cap Mine Superfund Site have not been adequately defined.
Decision to be Made	Have releases occurred at the Lava Cap Mine Superfund Site that pose a potential threat to human health and/or the environment?
Inputs to the Decision	• EPA Level III analytical data from surface soil, subsurface soil, sediment, surface water, groundwater, air, aquatic and terrestrial biota (fish, invertebrates, mammals and plants). • Background values for surface and subsurface soil, sediment, surface water, groundwater, and air. • Visual observations and measurements. • Results from the Screening Human Health Risk Assessment. • Results from the Ecological Risk Assessment.
Study Boundaries	• Media boundaries (surface soil, subsurface soil, sediment, surface water, groundwater, air, aquatic and terrestrial biota). • Temporal boundaries (wet season, dry season).
Decision Rules	• If constituent concentrations are below EPRGs, PRGs, MCLs, and/or background levels, then no COPECs/COPCs are present and no further action will be required. • If constituent concentrations exceed EPRGs, PRGs, MCLs, and/or background levels, then the specific compounds will be COPECs/COPCs and risk management decisions will be used to determine appropriate action.
Limits of Uncertainty	• Analytical data must meet the project specifications for precision, accuracy, representativeness , completeness and comparability. • Multiple background locations are being sampled for all media to ensure a representative background data set. • Maximum chemical concentrations will be used for the Human Health Risk Assessment. • Uncertainty and sensitivity analyses will be performed on data to assess whether uncertainties are acceptable for Ecological Risk Assessment decisions.
Optimize the Design	• Use judgemental or biased sampling, field screening sampling, focused sampling, and random sampling techniques to gather data. • Use the following field methods: GPS surveying, 24-hour composite particulate air sampling, biota sampling, and sampling from surface soil (including field screening), shallow soil borings, deep soil borings, in situ groundwater, residential wells, groundwater monitoring wells, surface water, and sediment. • Perform an ecological habitat assessment.

Note: The specific DQOs for the Lava Cap Mine RI/FS are included in Appendix A and in the QAPP in Table 1.

COPC = Contaminant of potential concern.
COPEC = Contaminant of potential ecological concern.
EPRGs = Ecological preliminary remediation goals.
PRGs = Preliminary remediation goals.
MCLs = maximum contaminant levels.
GPS = global positioning satellite.

2 Site Background

This section includes brief summaries of site history, physical conditions at the site (e.g., geology, groundwater and surface water conditions, and demographics), and previous sampling activities.

2.1 Site History

The Lava Cap Mine occupies approximately 30 acres in a rural residential area of the Sierra Nevada foothills. A location map for Lava Cap Mine is provided as Figure 2-1. The Lava Cap Mine vicinity and watershed basins are shown in Figure 2-2. The mine is bordered on the north, south, east and west by forest area and low-density residential area. There are several structures on the mine property including the former mill, former cyanide treatment facility, a number of miscellaneous old mine buildings and two residences.

Gold and silver mining activities were initiated at the site in 1861. From 1861 to 1918, processing of the ore and disposal of the waste rock, overburden, and tailings occurred at the Banner Mine, located approximately 1.5 miles north of the Lava Cap Mine.

The Lava Cap Mine was inactive from 1918 to 1933 or 1934, at which time mining activities were resumed and a flotation plant was built to process the ore at the Lava Cap Mine property. The gold and silver concentrates from the flotation plant were shipped to two smelters, one in California and the other in Washington. In 1940, a cyanide plant was built to recover the concentrates at the mine itself. However, this operation proved to be relatively ineffective. From 1941 to 1943, the cyanide plant only handled the middlings and tailings (these are intermediate products generated during processing of the source rock into ore-containing concentrates), as opposed to the higher-grade ore-containing concentrates, from the flotation plant. The middlings and tailings were ground to a very fine size (i.e., able to pass through a 400-mesh screen). These fines were then vat-leached with cyanide to remove the residual gold and silver. Slurries from the flotation and cyanidation processes were deposited in a ravine on the mine property. Where the ravine steepened and narrowed a log dam approximately 60 feet high was built to hold the tailings in place. The timing of log dam construction is unknown, but it likely occurred in the 1890s in response to regulations requiring mine tailings to be held onsite. The waste rock and overburden were also deposited on the mine property, in two piles located between the mine shaft and the tailings pond that formed above the log dam.

Arsenic has been detected in samples collected from the tailings pile at concentrations of 997 milligrams/kilogram (mg/kg) and 1,100 mg/kg (Bechtel, 1994 and Vector, 1989). Arsenic has been detected in the two waste rock piles at concentrations ranging from 1,490 mg/kg to 2,200 mg/kg (Bechtel, 1994 and Vector, 1989). The EPA Region IX non-cancer risk screening preliminary remediation goal (PRG) for arsenic is residential soil is 21 mg/kg. PRGs are risk-based concentrations used as tools to guide evaluation and cleanup of contaminated sites. EPA is using PRGs to streamline and standardize all stages of the risk decision-making process.

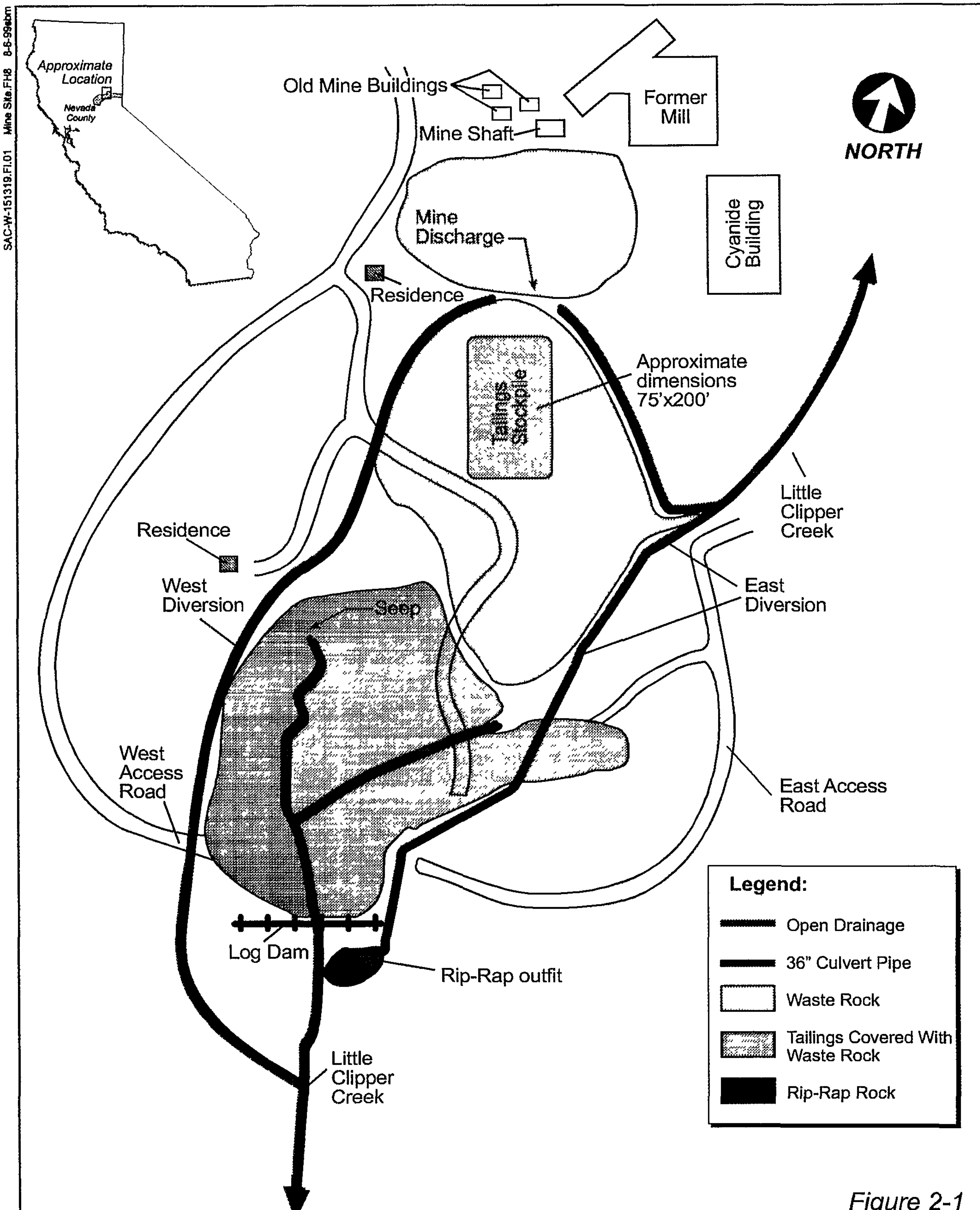
Arsenic has also been detected at concentrations ranging from 260 micrograms/liter (μg/L) to 660 μg /L in the mine drainage that emanates from the caved adit, which is located between the two waste rock piles (Cole/Mills Associates, 1985). During mining operations, the adit was used primarily to facilitate draining the upper mine workings at the Lava Cap Mine. The drinking water standard (maximum contaminant level [MCL]) for arsenic is 50 μg/L.

During a major winter storm in January 1997, the upper half of the log dam collapsed, releasing over 10,000 cubic yards of tailings into LCC. In May 1997, staff from the California Department of Toxic Substances Control (DTSC), the California Department of Fish and Game and the Nevada County Department of Environmental Health inspected the mine and downgradient areas. Extensive deposits of tailings were observed in LCC, in CC below the confluence with LCC, and Lost Lake. The tailings were also observed in wetland areas contiguous with these water bodies, in some cases completely covering the vegetation. Lost Lake is a private lake located approximately 1.25 miles downstream of the Lava Cap Mine. The DTSC issued a fact sheet warning of potential hazards from contact with Lost Lake sediments. The fact sheet was based on March and April 1997 sampling results that indicated the presence of arsenic in Lost Lake water at concentrations up to 28.4 μg/L and in shoreline soils at concentrations up to 1,130 mg/kg. Subsequent sampling detected much higher concentrations of arsenic in Lost Lake water. During July 1997, arsenic was detected in Lost Lake at concentrations as high as 600 μg/L (DTSC, unpublished data).

In October 1997, the EPA Region 9 Emergency Response Office determined that conditions associated with the tailings release from the Lava Cap Mine site met the National Contingency Plan (NCP) section 300.415(b)(2) criteria for a removal action. During October and November 1997, 4,000 cubic yards of tailings were removed from just upstream of the damaged log dam and stockpiled on the waste rock pile immediately to the north of the tailings pile. The stockpiled tailings were placed on a liner and covered with a clay cap that was then covered by a layer of waste rock to help protect the cap. The oversteepened slopes of the tailings pile immediately behind the dam were graded and the entire tailings pile was covered with waste rock. Stream diversions were also created around the tailings pile. In February 1998, the EPA conducted additional work at the mine to stabilize another tailings release and further improve drainage. In the summer of 1998, the removal action was completed, including placement of a clay cap over the approximately 4,000 cubic yards of stockpiled tailings. All work related to the removal action took place at the Lava Cap Mine site.

As part of the removal action, the EPA performed a visual assessment of the exposed timbers in the lower half of the dam (i.e., approximately 30 feet in height) and determined them to be in good condition.

In 1998, EPA evaluated the potential to human health and the environment posed by the Lava Cap Mine site. Based on this evaluation, EPA formally listed the Lava Cap Mine site on the National Priorities List (NPL) in February 1999 allowing Superfund funding to be spent on investigation and cleanup of the site.



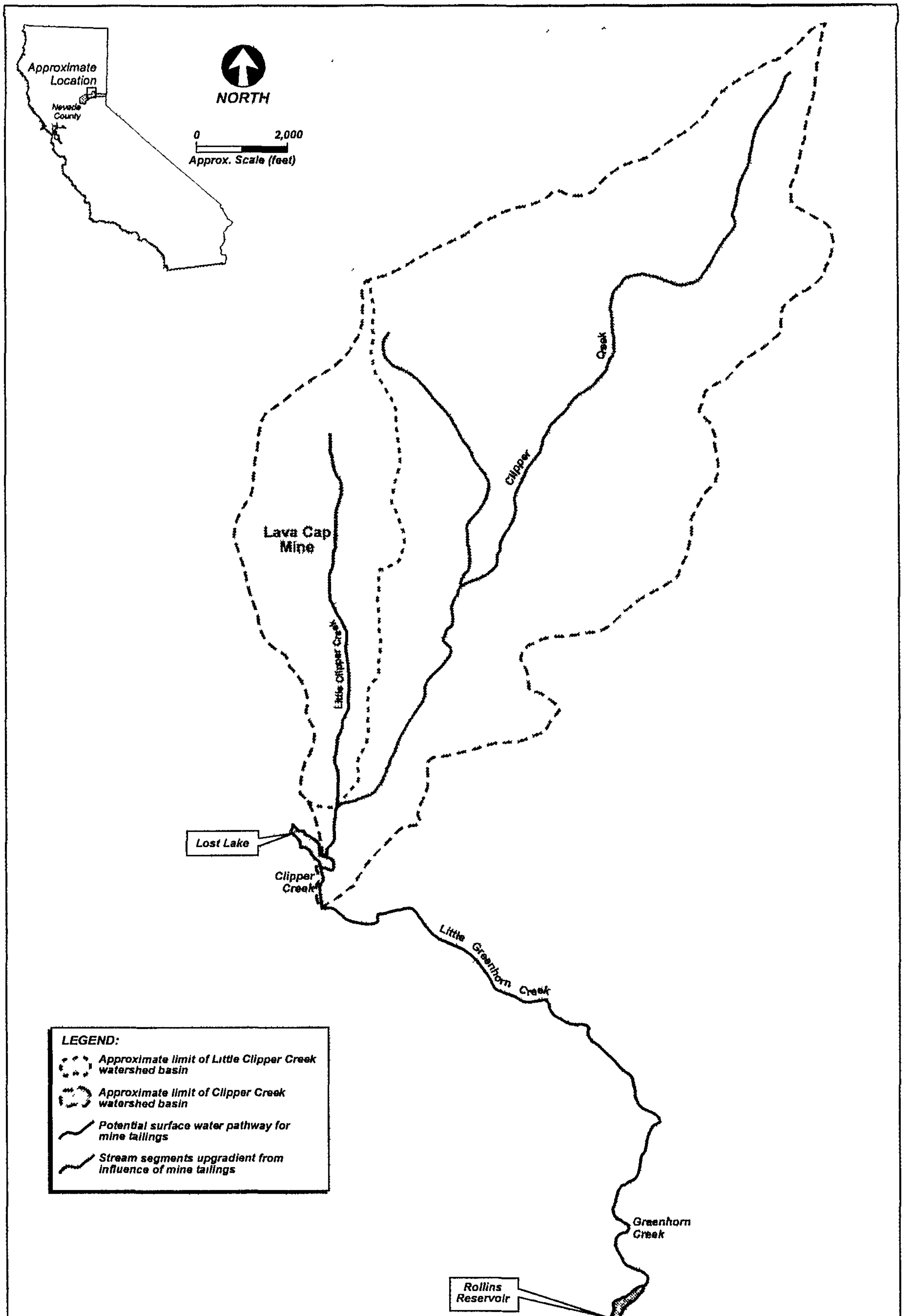
Note: Not to scale.

1. Base figure derived from plan produced by EPA field personnel during a February 20, 1998 site visit.

Figure 2-1

Lava Cap Mine

Lava Cap Mine, Nevada City, California



NOTES:
1) Base map is derived from 7.5-minute series topographic maps for Chicago Park and North Bloomfield quadrangles
2) Approximate limits of watersheds determined by consideration of surface topographic features.

Figure 2-2
Watershed Basins
Lava Cap Mine, Nevada City, California

SAC-W-151319.FL01 PROJECT AREA FH8 6-10-98sbm

2.2 Site Conditions

This section includes brief summaries of the geology, groundwater conditions, surface water conditions, climate, ecology and demographics in the Lava Cap Mine vicinity. These brief summaries were taken from previous documents prepared by others regarding the Lava Cap Mine.

2.2.1 Geology

The Lava Cap Mine is located within the Sierra Nevada physiographic province, which is characterized by intrusive and volcanic igneous rocks and metamorphosed sedimentary rocks that have been faulted and fractured. In general, these rocks are highly weathered at the surface, with a well developed soil profile.

The sequence of rock types in the Lava Cap Mine area, in order of increasing age, includes (Cole/Mills Associates, 1985):

- Mine deposits, including waste rock and tailings
- Tertiary volcanic breccias commonly referred to as "lava"
- Zones of Tertiary conglomerates or "gravels"
- Cretaceous igneous intrusive rocks, including diorites and granodiorites
- Jurassic to Triassic metamorphosed volcanic rocks
- Paleozoic to Upper Jurassic metamorphic rocks, including argillites, slates, conglomerates, thin-bedded cherts and other metasediments.

Overlying these rocks in selected areas are localized stream alluvium, slope colluvium and surface soils.

The mine is developed exclusively in the Paleozoic-Upper Jurassic metasedimentary rocks (composed primarily of Paleozoic argillites and slates), that are overlaid by volcanic rocks. Gold-bearing quartz veins averaging 5 feet in width occur along reverse faults that dip about 51 degrees to the east (Cole/Mills Associates, 1985).

Rocks found near the surface in areas surrounding the mine include: metasediments; metavolcanics; volcanic flow breccia and tuffs or "lava" 200 feet or greater in thickness; and Cretaceous and Jurassic granitic rocks, mainly quartz diorite to granodioritic in composition. Observations of road cuts leading to Lava Cap Mine, the volcanic flow breccia consists of poorly sorted angular to subangular pebbles and cobbles in a volcanic ash matrix (Cole/Mills Associates, 1985).

2.2.2 Groundwater Conditions

Groundwater flow is primarily to the southwest (Cole/Mills Associates, 1985). It has been estimated that about 300 wells exist within a 1.5 mile radius of the mine (Hydrosearch, 1984). Shallow domestic wells (less than 200 feet deep) have an average yield of 18 gallons per minute (gpm). Deep domestic wells penetrate 300 to 570 feet and produce from 0.25 to 140 gpm. (Cole/Mills Associates, 1985)

Groundwater in the Lava Cap Mine vicinity is contained primarily in secondary openings (fissures, faults, and joints) of consolidated and crystalline rocks. These rocks include sedimentary rocks of varying degree of metamorphism, igneous intrusives, and capping volcanic rocks. The degree of fracturing in the metasedimentary rocks is an important factor in assessing groundwater conditions. Well logs and geologic maps show that domestic wells surrounding the Lava Cap Mine have been developed in all of the above-mentioned rocks.

2.2.3 Surface Water Conditions

Lava Cap Mine property is entirely within the LCC drainage basin. LCC is the dominant surface water drainage to the south from the Lava Cap Mine. The upper reaches of LCC are seasonally dry (ephemeral) and become perennial about halfway across the property where it is fed by discharge from the mine. Rainfall and mine drainage percolates through the Lava Cap Mine waste rock and tailings prior to flowing into LCC, however stream diversions were created around the tailings pile during 1997. LCC flows into CC approximately 1 mile downgradient from Lava Cap Mine. Clipper Creek, after passing through Lost Lake, joins Little Greenhorn Creek. Little Greenhorn Creek then joins Greenhorn Creek that flows into Rollins Reservoir (Figure 2-2) (Cole/Mills Associates, 1985).

From April through August 1984, surface water flow measurements were made by Hydro-Search. Background flow in LCC (upgradient of the Lava Cap Mine) ranged from 95 gpm in April to 0 gpm in late May through August 1984. The Lava Cap Mine adit flow ranged from 130 gpm in early April 1984 to 47 gpm in August 1984 (Cole/Mills Associates, 1985).

The discharge of groundwater into the mine during the mining operation is reported to have been about 35 gpm. The discharge of water from the mine is via a caved adit on the haulage level, and is projected from flow measurements to decline to about 20 gpm by the end of the dry season (September – October) (Hydrosearch, 1984).

2.2.4 Climate and Ecology

Annual precipitation is approximately 53 inches (based on 100-year average) in Nevada City, California. Approximately 90 percent of this precipitation (normally rainfall with occasional snowfall) falls during the 6-month period between November and April. Because the Lava Cap Mine Site is about 700 feet higher in elevation than Nevada City, the annual precipitation at the site is approximately 10 percent higher (58 inches per year) (Cole/Mills Associates, 1985).

Average temperature in Nevada City is around 50 degrees F with maximum summer temperatures in the 90's and maximum winter temperatures in the 30's and 40's.

Nevada County is located in the Mountain Counties Air Basin. Air pollution is imported from the Bay Area and the Sacramento Valley. Very little air quality data exists for Nevada

County. The major source of air pollutants in Nevada County is Highway 20/49 (Cole/Mills Associates, 1985).

The Lava Cap Mine site is located on the southern slope of Banner Ridge at the 2840 foot elevation. The area surrounding the mine site is covered with dense trees of the Sierra Nevada Transition Zone.

California red-legged frog, a federally designated Category 2 species of special concern, was observed in an onsite wetland by a biologist in 1984 (Bechtel, 1994).

2.2.5 Demographics

Nevada County covers a land area of 978 square miles and its 1998 population was 91,117 (California Department of Finance, 1999). Communities near the Lava Cap Mine project site include Nevada City (population 2,880) and Grass Valley (population 9,475). The major regional population and industrial centers near the Grass Valley/Nevada City area include Reno (91 miles northeast), South Lake Tahoe (94 miles southeast), and Sacramento (60 miles southwest).

Over the past 20 years, Nevada County has transitioned from a traditional, predominantly resource based rural county, to a much more varied and diverse population and economic base. This has been reflected in the land use pattern, with increased commercial and industrial uses, as well as a greater diversity of residential uses (Nevada County, 1995).

2.3 Sampling History

This section presents a summary of historical sampling activities performed at the Lava Cap Mine, based on review of available reports and analytical data. Table 2-1 provides a summary of arsenic concentrations detected at the Lava Cap Mine and vicinity, including downgradient areas such as Lost Lake. Some of the sample results provided in the following text are not included in Table 2-1 because insufficient information is available on the sample location.

In February 1978 Keystone Copper Company submitted a National Pollutant Discharge Elimination System (NPDES) permit application to the California Regional Water Quality Control Board (RWQCB) because they wanted to discharge 63 million gallons of mine water to LCC. In response to this permit application, the RWQCB conducted a site inspection in May 1978. During this site inspection a mine discharge water sample had an arsenic concentration of 660 μg/L (Bechtel, 1994).

In response to property owners' August 1979 complaints of high volumes of sediments in LCC, the RWQCB and the California Department of Fish and Game collected water samples in September 1979. Analytical results showed arsenic as high as 1,860 μg/L in LCC below the tailings dam (Bechtel, 1994). Because of these September 1979 results, the RWQCB issued a Cleanup and Abatement Order to Keystone Copper Company for the Lava Cap Mine Site in October 1979.

In May and June 1982, the RWQCB collected water samples at Lava Cap Mine (exact locations not known). In May 1982, the arsenic concentration near the property boundary was 26 µg/L. June 1982 analytical results showed arsenic as high as 540 µg/L in the mine tailings area (Bechtel, 1994).

Franco-Nevada Mining Corporation attempted to re-open the mine in 1984. Franco-Nevada contracted with Hydrosearch, Inc. to collect upgradient, mine area, and downgradient surface water samples in April, May, and June 1984. The upgradient arsenic results were non-detect. Arsenic concentrations in the mine discharge ranged from 490 to 660 µg/L (Hydrosearch, 1984). Arsenic concentrations decreased with downgradient distance.

In 1985 and 1990 surface water samples were collected by the site owner for arsenic analysis. The exact locations where these samples were collected are not known. Analytical results indicated that arsenic was present in the surface water at concentrations ranging from 22 to 630 µg/L.

In January 1989, waste rock and mine tailings were sampled for arsenic and lead analyses by the site owner. Arsenic and lead were detected in the waste rock at concentrations of 2,200 mg/kg and 4,100 mg/kg, respectively. Arsenic and lead were detected in the mine tailings at concentrations of 1,100 mg/kg and 50 mg/kg, respectively.

Bechtel conducted a field sampling event at the Lava Cap Mine in May 1994 under the direction of EPA. Sediment samples from the two onsite wetland areas (since eliminated) had arsenic and lead present at concentrations up to 7,070 mg/kg and 1,140 mg/kg, respectively. Sediment samples collected upgradient of the site (background locations) had arsenic and lead concentrations up to 20 mg/kg and 16.9 mg/kg, respectively. Soil samples from Lava Cap Mine waste rock and tailings had arsenic and lead at concentrations up to 1,900 mg/kg and 206 mg/kg, respectively. Soil samples collected upgradient of the site (background locations) had arsenic and lead concentrations up to 373 mg/kg and 60.9 mg/kg, respectively (Bechtel, 1994).

Since the dam collapse in January 1997, DTSC has sampled surface water, sediment, and surface soil periodically from 1997 through 1999. Surface water arsenic concentrations in LCC have remained steady over time however concentrations in Lost Lake have fluctuated between events. There is one small pond at the confluence of LCC and CC that has had high arsenic concentrations ranging from 706 to 2,070 µg/L. Soil sample arsenic results around Lost Lake private property indicate a decrease in concentration with an increased distance from the water's edge.

TABLE 2-1
Historic Arsenic Concentrations in Surface Soil and Surface Water at Lava Cap Mine

Surface Soil (units of mg/kg)								
	1989	**5/24/94**	**1/31/1997**	**3/14/1997**	**4/17/1997**	**5/19/97***	**5/19/1997**	**7/8/1997**
Background		11.8 to 86.3						
Mine Area wetlands		7,070						264 / 1,750
Waste rock	2,200	1,490 / 1,900				33.5 to 63.8	1,670 to ,3190	
Tailings	1,100	997				13.8 to 70.8	669 to 1,180	
Cyanide Building						16.6 to 1,320	1,060 to 15,400	
LCC below Tailings Dam			392					
Lava Cap Mine Property Border				434				
LCC / Greenhorn Road			552					
LCC / Racoon Mountain Road			511	528				
Confluence of LCC/CC				399				
Lost Lake Properties								
at water's edge					6.05 to 717			
10 to 15 feet from water's edge					9.86 to 1,130			
5 to 100 feet from water's edge					19.5 to 351			
near residence					9.43 to 11.5			
Tailings Deposition Area				433				
Lost Lake Sediment			444	432				

Surface Water (units of ug/L)																	
	5/16/78	**9/4/79**	**4/24/84**	**5/9/84**	**5/31/84**	**6/13/84**	**6/20/84**	**8/2/90**	**3/14/97**	**3/14/97****	**4/17/97**	**7/8/97**	**8/12/97**	**10/29/97**	**3/9/98**	**9/2/98**	**3/24/99**
Little Clipper Creek above Mine			<5	<5											<7.5		
Caved Adit Mine Drainage	660	590	490	600	260	580	34								410		
Seep below Caved Adit																	112
LCC approx 50' below Tailings Dam		1,860	82	110	58		42										
LCC approx 250' below Tailings Dam			55	120		78											
LCC approx 375' below Tailings Dam			71	68		58											
LCC approx 900' below Tailings Dam								45	108	69.6					125	129	122
LCC at Greenhorn Road				21	< 5	16	6										
LCC above confluence					< 5		63									114	
LCC below confluence		130			< 5		45										
Small Pond at Confluence of LCC/CC									738	706				826		2,070	552
Lost Lake									18.3	14.3	49.7						
Northern Lobe of Lost Lake									28.4	18.2	44.2	574 to 600	849	146	18.9	99.3	11.1
Southern Lobe of Lost Lake												75.9 / 81.2		42.1	15.8	41	30.9
Below Lost Lake Dam									19.2	16.1			48.6 / 48.8	86.2 / 64.3		37.9	

** Filtered Samples

3 Rationale for Sample Locations, Numbers of Samples, and Analytical Parameters

Figures 3-1, 3-2, 3-3, and 3-4A and 3-4B show the proposed sample locations by area. Samples will be collected in the following general areas: background, source area, mine area, and downgradient. Figure 3-5 is the preliminary conceptual site model for the Lava Cap Mine site. The figure shows the contaminant sources, release mechanisms, exposure media, exposure routes and human or ecological pathways that are the focus of the RI field activities.

The proposed sample locations, number of samples, and analytical parameters are described below by area and medium (groundwater, surface water, soil, sediment and biota). Rationale for the proposed sample locations is also provided. Table 3-1 summarizes the proposed number of sample locations by medium for the first round of Lava Cap Mine RI field activities. Table 3-1 also includes estimates of the sample locations by medium for the second and third rounds. However, for each subsequent sampling round a FSP Addendum will be prepared that will provide the specific details on additional sample locations and numbers of samples for Rounds 2 and 3. In particular, the biota and bioassay locations may be modified based on the analytical results of Round 1.

To meet the overall objectives stated in Section 1 and the DQOs presented in the QAPP (EPA, 1999), the soil and sediment samples from the Lava Cap RI will initially be analyzed for metals and cyanide and the water samples will be analyzed for metals, cyanide, and general chemistry (alkalinity, anions, hardness, and total dissolved solids [TDS]). Select soil samples will also be analyzed for explosives and total organic carbon (TOC). In future sampling events, the list of analyses and analytes may be reduced based on the analytical results from the initial sampling rounds. For example, if initial sampling demonstrates that only a few metals are present at elevated concentrations, subsequent samples would be analyzed for a shorter list of metals.

Technical specifications for analytical methods are presented in Appendix B. Analytical requirements for and assessment of investigation-derived wastes (IDW) from field operations (drill cuttings, decontamination water, and well development water) are discussed in Section 3.5.

3.1 Background Activities

Samples will be collected to provide a basis for comparing samples directly impacted by Lava Cap Mine activities to environmental conditions in the surrounding area. Samples will be collected in two separate areas that are assumed to have not been influenced by Lava Cap Mine operations or releases. One area is upgradient from the mine (at locations within and adjacent to LCC and west of the mine) and the other area is within CC upgradient of the confluence with LCC. Proposed sample locations are shown in Figures 3-1 and 3-3, respectively.

Samples from these background locations will provide an indication of the chemical concentrations in native media that appear unaffected by Lava Cap Mine operations. These data will be used to estimate the background chemical exposure experienced by human and ecological receptors.

3.1.1 Sampling Upgradient of the Lava Cap Mine

Soil Borings and Groundwater Samples

Two soil borings will be drilled upgradient of the mine, one to the northeast and one to the west (Figure 3-1). It is anticipated that the initial drilling in the boring to the northeast will be through volcanic rocks in the lava cap. Five samples will be collected from this boring, three in the volcanic rocks (in the upper 10 feet bgs, between 10 and 25 feet bgs and near the base) and two in the underlying sedimentary bedrock (near the top of the formation and near the water table). If the entire sedimentary bedrock formation is saturated, the second sample will be collected approximately 20 feet into the sedimentary formation. The boring to the west will likely be in sedimentary bedrock from the surface. Samples will be collected from this boring at three depths, one in the upper 10 feet bgs, a second between 10 and 25 feet bgs and one near the water table. The actual sampling depths will be based upon field observations of changes in the lithology.

In the upgradient soil boring to the west, an in-situ groundwater sample will be collected from near the water table in the sedimentary bedrock. In the soil boring to the northeast, an in-situ groundwater sample will be collected near the water table in the volcanic rocks (if saturated). This boring will be completed as an upgradient monitoring well and will be sampled in the groundwater sampling events planned. The well will be screened in the upper 20 feet of the saturated portion of the sedimentary bedrock. The final well depth will be based on lithology and conditions encountered at the time of well installation.

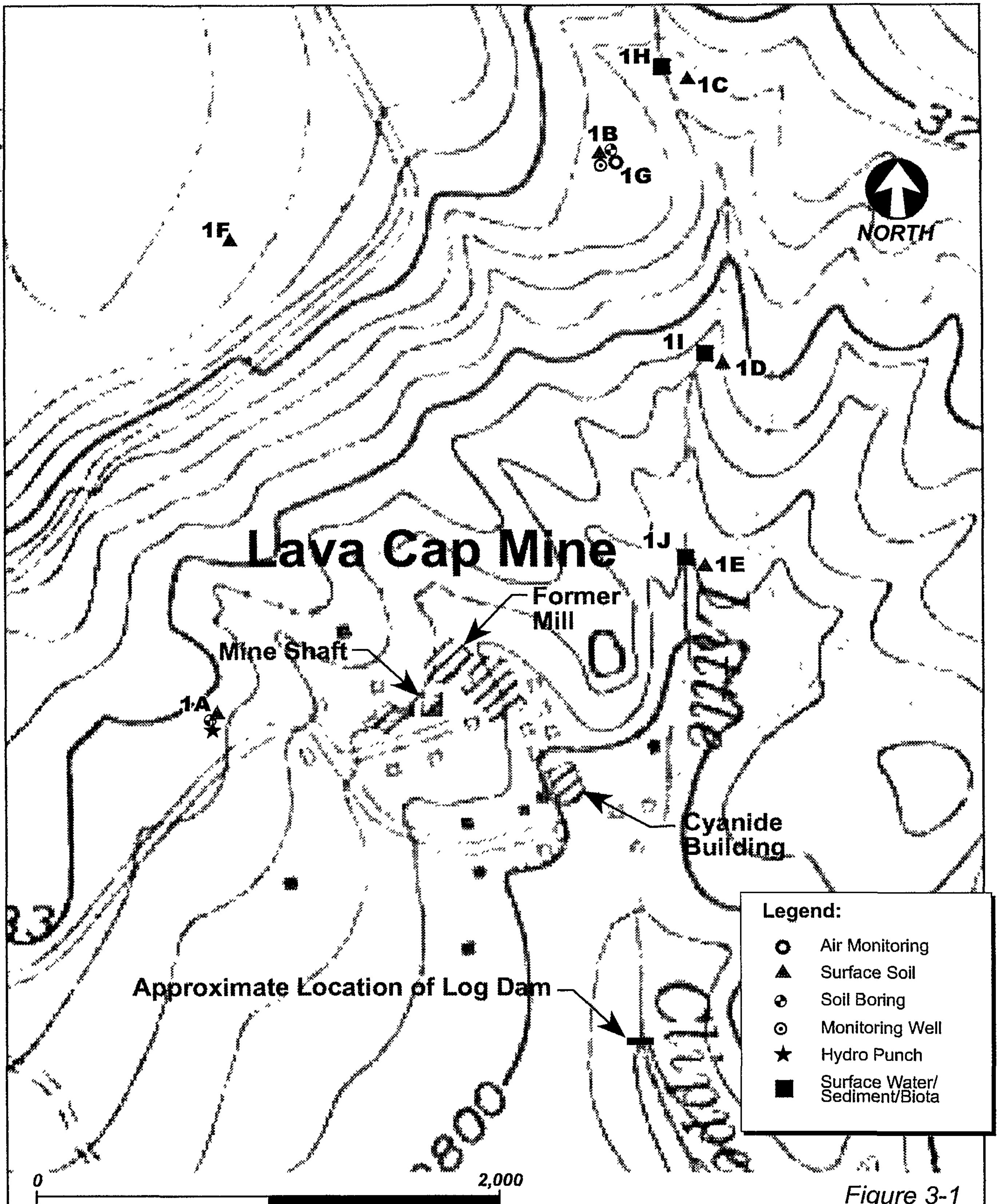
Surface Soil Samples

Three surface soil (0 to 6 inches bgs) samples will be collected upgradient from the Lava Cap Mine, but away from LCC. Two of these three locations will be co-located with the above-mentioned soil boring locations. The third location will be located northwest of the mine (Figure 3-1). Three additional surface soil samples will be collected along LCC adjacent to the locations of the surface water and sediment samples collected from the creek. As described below in the biota section, sufficient soil will be collected from these locations to create a composite sample for bioassay analysis.

Air Particulate Samples

A 24-hour composite ambient air particulate sample will be collected upwind (northwest) of the mine at the location of the upgradient monitoring well. Samples will be collected during all three sampling rounds (October 1999, January 2000, and April 2000) to characterize background air quality for metals and cyanide in the area. The background air concentrations will be compared to ambient air concentrations in potentially impacted areas

SAC-W-151319 FI 01 Proposed bkgrd sample FH8 8-10-99kth



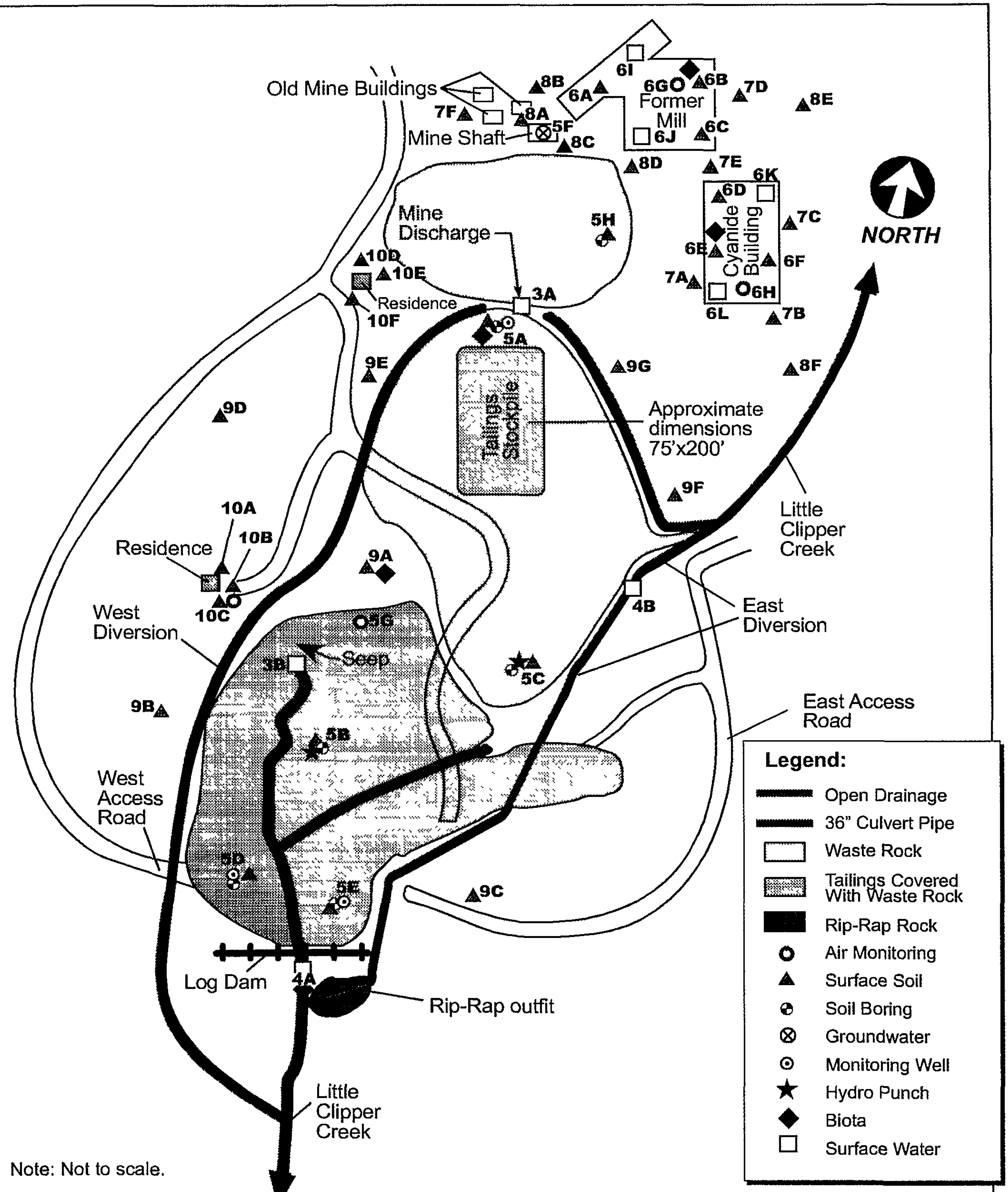
Approx. Scale (feet)

Note: Proposed mine area sample locations are shown on Figure 3-2.

Figure 3-1

Proposed Background Sample Locations Upgradient from Mine

Lava Cap Mine, Nevada City, California



Note: Not to scale.

1. Base figure derived from plan produced by EPA field personnel during a February 20, 1998 site visit.

2. Downgradient samples of surface water, sediment, soils, and biota are not shown on this figure.

3. Location of residential wells has not yet been determined.

Figure 3-2

Proposed Sample Locations at Lava Cap Mine

Lava Cap Mine, Nevada City, California

SAC-W-151319 FI.01 sample locations.FH8 8-6-99sbm

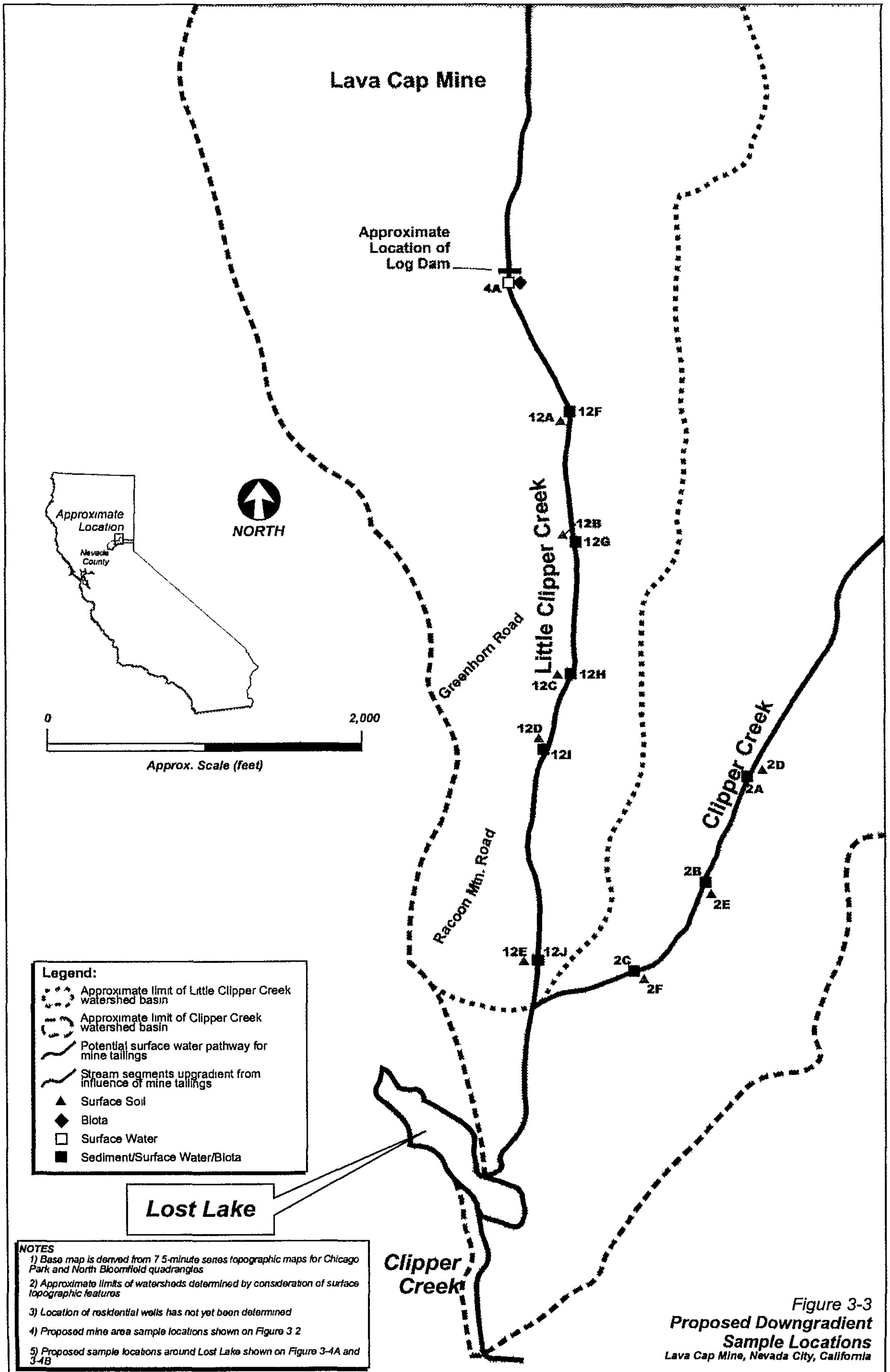
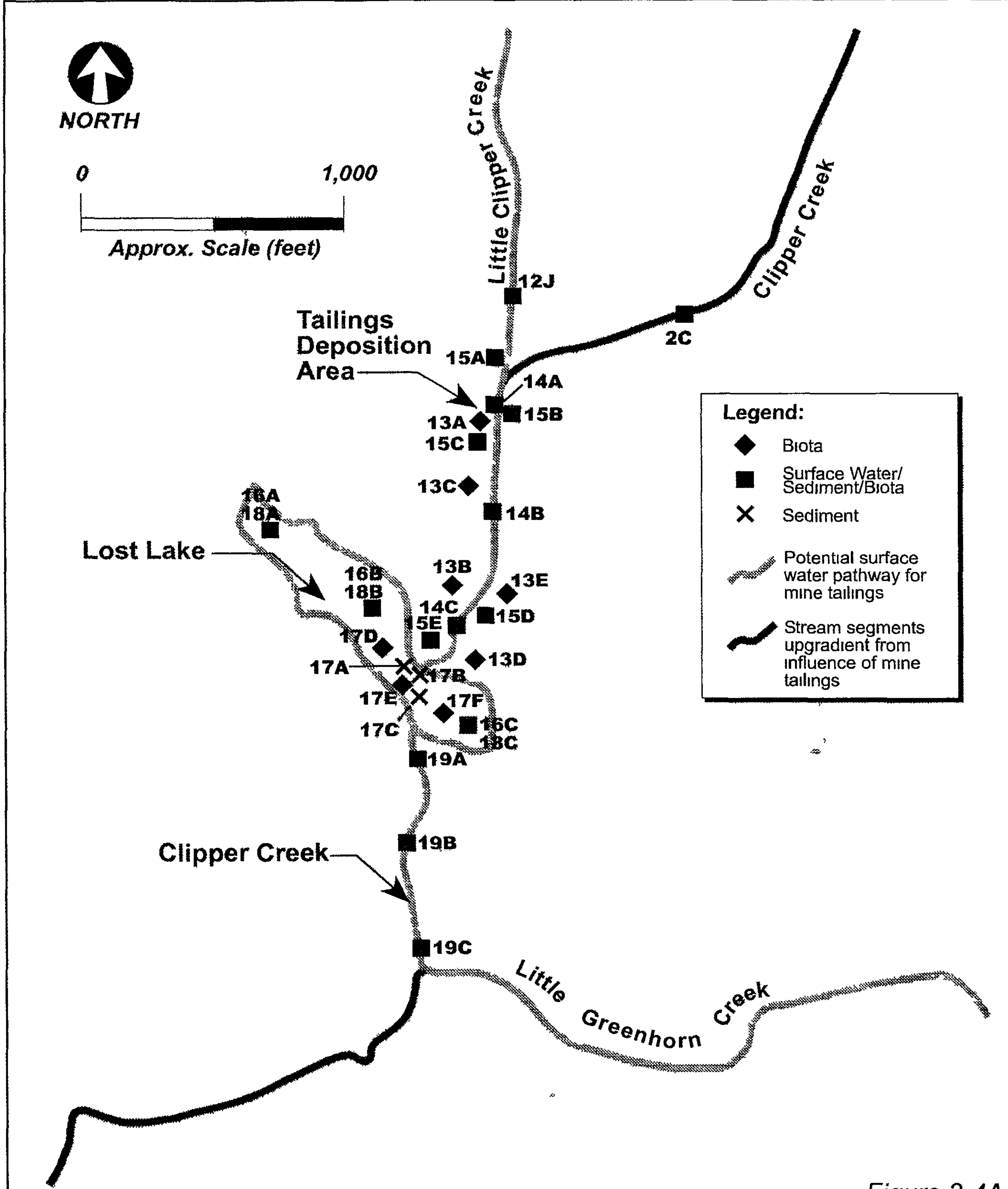


Figure 3-3
Proposed Downgradient Sample Locations
Lava Cap Mine, Nevada City, California

SAC-W-151319.FI 01 LITTLE CLIPPER CREEK FHS 8-6-99sbm



NOTES.

1) Base map is derived from 7 5 minute series topographic maps for Chicago Park and North Bloomfield quadrangles

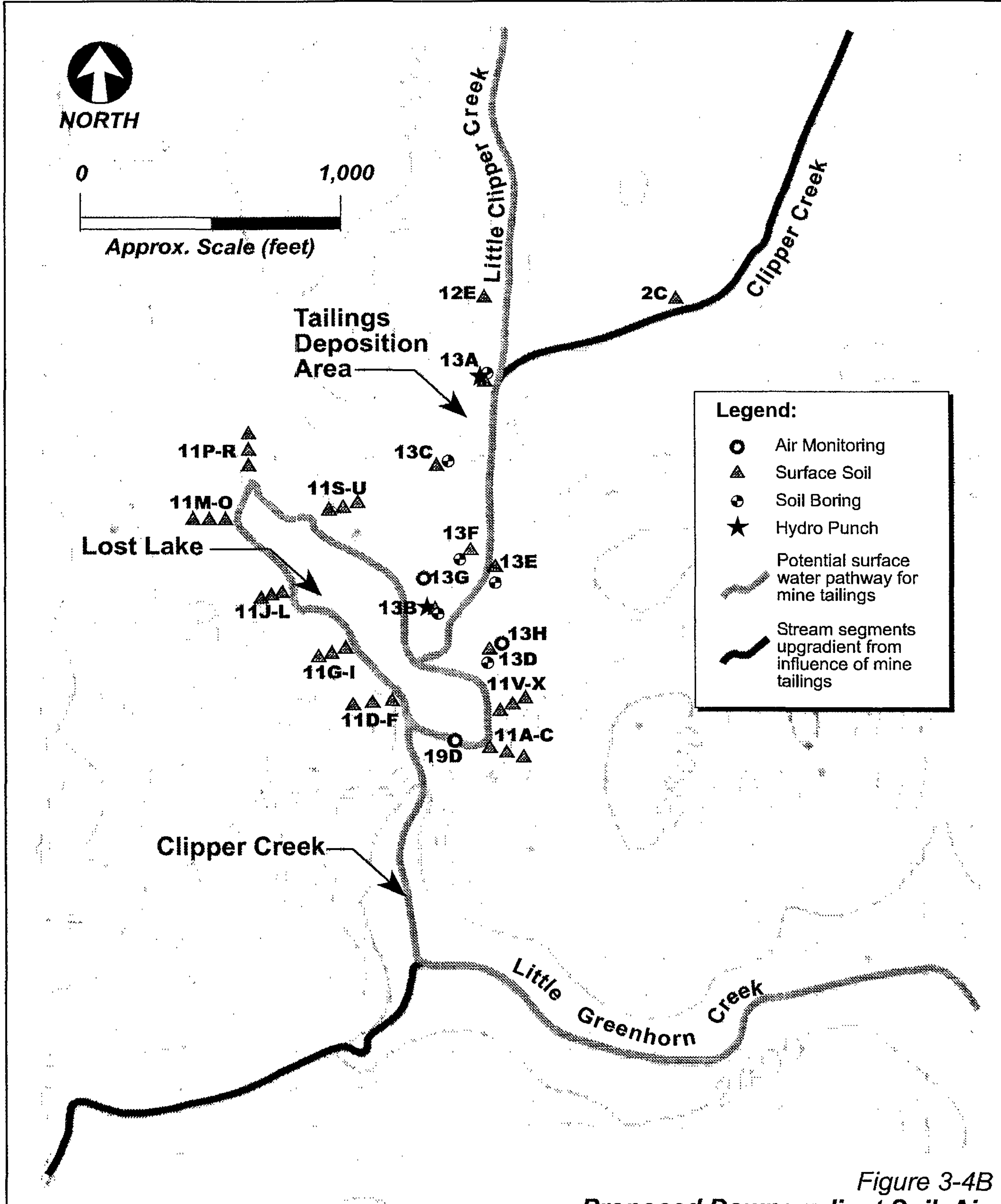
2) Location of residential wells has not yet been determined

Figure 3-4A

Proposed Downgradient Surface Water, Biota and Sediment Sample Locations around Lost Lake

Lava Cap Mine, Nevada City, California

SAC W 151319 FI 01 BIOTA AND SEDIMENT SAMPLES FH8 8 10-99sbm



NOTES:

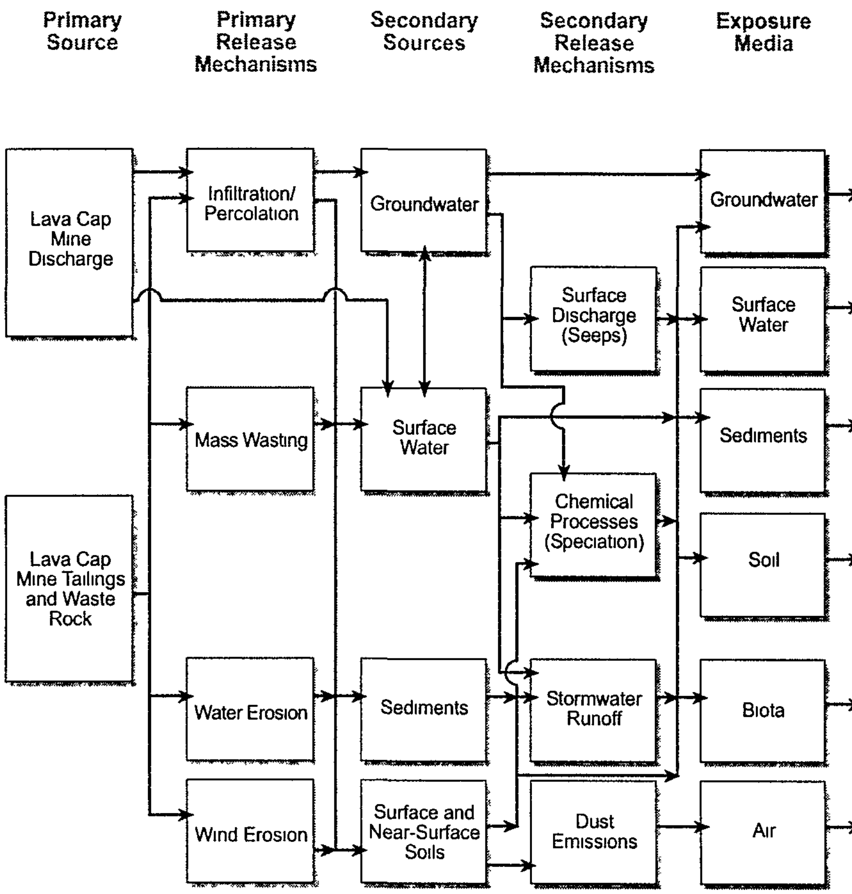
1) Base map is derived from 7.5-minute series topographic maps for Chicago Park and North Bloomfield quadrangles.

2) Location of residential wells has not yet been determined.

Figure 3-4B

Proposed Downgradient Soil, Air, and Groundwater Sample Locations around Lost Lake

Lava Cap Mine, Nevada City, California



Exposure Media	Exposure Routes	Potential Ecological Receptors: Terrestial Upland	Terrestial Wetland	Aquatic	Potential Human Receptors: Current Residential	Future Construction Worker	Current Recreational
Groundwater	Ingestion	▲	▲	▲	■	●	▲
	Dermal Contact	▲	▲	▲	■	●	▲
	Root/Foliar Uptake	■	■	■	▲	▲	▲
Surface Water	Ingestion	■	■	■	■	●	■
	Dermal Contact	●	■	■	■	■	■
	Root/Foliar Uptake	●	■	■	▲	▲	▲
Sediments	Dermal Contact	●	●	■	■	●	■
	Ingestion	●	●	■	■	●	■
	Root Uptake	●	■	●	▲	▲	▲
Soil	Ingestion	■	▲	▲	■	■	●
	Dermal Contact	■	▲	▲	■	■	■
	Inhalation	●	▲	▲	■	■	■
	Root Uptake	■	▲	▲	▲	▲	▲
Biota	Ingestion	■	■	■	■	▲	■
Air	Dermal Contact	●	▲	▲	●	●	●
	Ingestion	●	●	▲	■	■	■
	Inhalation	●	▲	▲	■	■	■
	Foliar Uptake	●	▲	▲	▲	▲	▲

Legend:

▲ = Incomplete Exposure Pathway

■ = Potentially Complete Exposure Pathway

● = Possibly Complete Exposure Pathway. Likely not significant or insufficient data for quantitive analysis.

Figure 3-5

Preliminary Conceptual Site Model

Lava Cap Mine, Nevada City, California

TABLE 3-1

Planned Number of Environmental Samples for the Lava Cap Mine RI (October 1999 through September 2000)

														Surface Water Bioassay		Sediment Bioassay	Soil Bioassay	
Location	Surface Soil	Subsurface Soil	Air	Ground-water	Mine Discharge	Surface Water	Sediment	Fish	Aquatic Plant	Aquatic Invertebrate	Terrestrial Plant	Terrestrial Invertebrate	Small Mammal/ Bullfrogs	Fathead Minnow test	Cerio-daphnia test	Hyalella Test	Earthworm Test	Nutsedge Test
Round 1 (October 1999)																		
BACKGROUND																		
Upgradient of mine	6	8	1	2		3	3											
Clipper Creek upstream of Little Clipper Creek	3					3	3											
SOURCE AREA																		
Within waste rock/tailings area	6	18	1	6														
Within mine buildings	6		2			4												
Mine discharge adit and seep					2													
Base of log dam						1												
MINE AREA																		
Around mine buildings (biased to areas of runoff)	6																	
Around mine buildings (randomly located)	6																	
Outside waste rock area, some near bunkers	7					1												
Residences near mine	6		1	2														
DOWNGRADIENT																		
Little Clipper Creek below dam but above Clipper Creek	5					5	5											
Tailings deposition area	6 (plus field screening)	12	2	2														
Clipper Creek through tailings deposition area						3	3											
Tailings deposition area pools						5	5											
Residences near Lost Lake	24 (plus field screening)			13														
Lost Lake			1			3	6											
Clipper Creek below Lost Lake						3	3											
Number of Environmental Sample Locations - Round 1	*81*	*38*	*8*	*25*	*2*	*31*	*28*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Round 2 (January 2000)																		
BACKGROUND																		
Upgradient of mine			1	1		3												
Clipper Creek upstream of Little Clipper Creek						3												
SOURCE AREA																		
Within waste rock/tailings area			1	4														
Within mine buildings			2															
Mine discharge adit and seep					2													
Base of log dam						1												
MINE AREA																		
Around mine buildings (biased to areas of runoff)																		
Around mine buildings (randomly located)																		
Outside waste rock area, some near bunkers						1												
Residences near mine			1	2														
DOWNGRADIENT																		
Little Clipper Creek below dam but above Clipper Creek						5												
Tailings deposition area			2															
Clipper Creek through tailings deposition area						3												
Tailings deposition area pools						5												
Residences near Lost Lake				13														
Lost Lake			1			3												
Clipper Creek below Lost Lake						3												
Rollins Reservoir (Contingent)	4					3												
Number of Environmental Sample Locations - Round 2	*4*	*0*	*8*	*20*	*2*	*30*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

TABLE 3-1

Planned Number of Environmental Samples for the Lava Cap Mine RI (October 1999 through September 2000)

														Surface Water Bioassay		Sediment Bioassay	Soil Bioassay	
Location	Surface Soil	Subsurface Soil	Air	Ground-water	Mine Discharge	Surface Water	Sediment	Fish	Aquatic Plant	Aquatic Invertebrate	Terrestrial Plant	Terrestrial Invertebrate	Small Mammal/ Bullfrogs	Fathead Minnow test	Cerio-daphnia test	Hyalella Test	Earthworm Test	Nutsedge Test
Round 3 (April 2000)																		
BACKGROUND																		
Upgradient of mine			1			3		2	3	3	3	3	1	1	1	1	1	1
Clipper Creek upstream of Little Clipper Creek						3		2		3	3	3	1	1	1	1	1	1
SOURCE AREA																		
Within waste rock/tailings area			1										1					
Within mine buildings			2										2					
Mine discharge adit and seep					2													
Base of log dam						1								1	1			
MINE AREA																		
Around mine buildings (biased to areas of runoff)																		
Around mine buildings (randomly located)																		
Outside waste rock area, some near bunkers						1											1	1
Residences near mine			1															
DOWNGRADIENT																		
Little Clipper Creek below dam but above Clipper Creek						5		5	5	5	5	5	1				1	1
Tailings deposition area			2								5	5	4	1	1		3	3
Clipper Creek through tailings deposition area						3				3				1	1	1		
Tailings deposition area pools						5				5								
Residences near Lost Lake																		
Lost Lake			1			3		12	6	3				3	3	6		
Clipper Creek below Lost Lake						3				3				1	1	1		
Rollins Reservoir (Contingent)																		
Number of Environmental Sample Locations - Round 3	*0*	*0*	*8*	*0*	*2*	*27*	*0*	*21*	*14*	*25*	*16*	*16*	*10*	*9*	*9*	*10*	*7*	*7*
Monthly Sampling (November and December 1999; February, March, May, June, July, August, and September 2000)																		
SOURCE AREA																		
Mine discharge adit and seep					2													
Base of log dam*						1												
Number of Environmental Sample Locations - per Monthly Event	*0*	*0*	*0*	*0*	*2*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

*This sampling may only continue monthly through April 2000 to characterize potential impacts from transport of fugitive dust containing Lava Cap Mine contaminants.

Surface Water and Sediment

Three surface water and sediment samples will be collected from the upstream section of LCC for background information. Actual sampling locations within LCC will be selected in the field based on best professional judgement of representative areas of sediment accumulation, if present. Surface water and sediment locations will be co-located where possible. Surface water locations will be sampled in all three rounds (October 1999, January 2000, and April 2000) to provide an estimate of seasonal variability. There is the potential that some of these upgradient surface water locations will be dry in the October 1999 event. Because three events are planned, it is anticipated that sufficient data will be generated to assess background surface water conditions even if some locations are dry during the first round. Adequate surface water and sediment sample volumes will be collected to conduct bioassay, as described below in the biota section.

Biota

Biota samples from locations in upgradient LCC will provide an indication of the chemical concentrations and bioavailability in areas uninfluenced by mine operations. These data also will provide a direct measure of the background chemical exposure experienced by ecological receptors. To provide an indication of bioconcentration among aquatic receptors, fish and aquatic invertebrates will be collected at three sample locations if they are sufficiently abundant to obtain the required biomass. The fish samples will be composited to form one sample for each of two species, if present. At least three individual whole body samples are needed per composite.

For the aquatic invertebrate sampling, the biomass may not be sufficient for analysis at all locations. If insufficient biomass is available, invertebrate samples will be composited from the three upgradient locations. In addition, background values derived from non-site-specific sources, such as databases and published literature, may be considered as sources of background levels for the identified COCs.

To provide an indication of bioconcentration among terrestrial receptors, terrestrial plants and soil invertebrates will be collected at three locations. Small mammals will also be collected within the area by placing traps along visible runways. A minimum of three individuals of a common species will be collected for one composite small mammal sample. To relate chemical concentrations in biota to those in abiotic media, abiotic and biota samples will be co-located whenever possible.

Aquatic plant locations will be co-located with sediment sample locations where possible. The plant sampling approach is to address different plant types/parts where available: submergent - whole plant; riparian (e.g. willows) - new growth; and cattails - rhizomes and leaves separately.

Bioassays serve as a direct measure of the toxicity of media from the field. Tests performed at reference locations provide an indication of background toxicity and bioavailability of chemicals. Results from these tests will be compared to those from the mine and downgradient locations to determine relative increase in toxicity and bioavailability in mine area and downgradient media as compared to reference media. So that bioassay results may be related to chemical concentrations in abiotic media, media for bioassays will be collected concurrently with media for chemical analyses. Abiotic media from the multiple sampling locations will be composited prior to use for the bioassays. The abiotic media selected are those media (soils, surface water and sediment) to which ecological receptors (e.g., plants and invertebrates) could reasonably be exposed and for which there are available toxicity tests and reference data for evaluating the significance of the concentrations. *Ceriodaphnia* and fathead minnow, *Hyalella* spp., and earthworm and nutsedge bioassays will be performed for composited surface water, sediment, and surface soils, respectively.

3.1.2 Sampling Clipper Creek above confluence with Little Clipper Creek

Samples from this area will serve as background samples because CC is in an adjacent watershed that has not been impacted by the Lava Cap Mine operations or other mining operations (only a single, minor gold prospect has been identified in the CC drainage).

Abiotic media to be collected include surface water and sediment from three sample locations. Sampling locations will be selected in the field based on best professional judgement of representative accumulation areas. The surface water locations will be re-sampled twice, once in fall and once in winter, to provide an estimate of seasonal variability.

To provide an indication of bioconcentration among aquatic receptors, aquatic invertebrates and fish will be collected at three locations. Because limited quantities of fish are expected in CC, the fish collected from all three locations will be composited to form either one or two samples, depending on the volume of fish recovered. To provide an indication of bioconcentration among terrestrial receptors, terrestrial plants and invertebrates will be collected at three locations. Small mammals will be trapped to form a composite sample of a common species. To relate chemical concentrations in biota to those in abiotic media, abiotic and biota samples will be co-located where possible. Abiotic media from the multiple sampling locations will be composited prior to use for a single bioassay per test species. *Ceriodaphnia* and fathead minnow, *Hyalella* spp., and earthworm and nutsedge bioassays will be performed for composited surface water, sediment, and surface soils, respectively, from the CC background area.

3.1.3 Habitat Assessment

During the initial RI field activities (scheduled to begin in October 1999), information critical to the Ecological Risk Assessment will be gathered. This information will include a general characterization of terrestrial and aquatic habitats, potential ecological receptors, and an assessment of areas of potential impacts (e.g., evidence of plant stress). The data from this initial assessment, along with the Round 1 analytical results from the abiotic media, will be used to assess the need for (and location of) more quantitative methods of assessing potential impacts to biota from site-related contaminants.

For the aquatic Ecological Risk Assessment, a characterization of substrate composition, particle size, pebble counts, percent fines, substrate embeddedness, and gradient will be assessed using a modified EPA Rapid Bioassessment Procedures (RBP) (EPA, 1997 and Harrington, 1995 or latest). This information will assist in distinguishing physical habitat limitations (i.e., impacts of something smothering the substrate with fines) versus direct chemical contamination, and will provide another means to compare impacted areas to areas that have not been impacted. The RBP includes evaluation of a number of diversity and abundance indices for invertebrates. The RBP physical habitat assessments will be focused on the stream segments where invertebrates are collected for analysis of diversity and abundance.

Results of the terrestrial habitat assessment will be used to determine which organisms may potentially be affected by Lava Cap Mine contaminants. This information combined with the aquatic assessment will be used to determine the representative ecological receptors appropriate for the Ecological Risk Assessment. This information will be used to ensure that the types of biotic samples collected are representative of food items (or foraging guilds) for the selected representative receptors.

3.2 Source Area Activities

Field activities will be performed in the source area at the Lava Cap Mine to characterize potential sources of contamination. The source area will be characterized during the Lava Cap Mine RI by:

- Summarizing site history and previous investigation data;
- Evaluating the potential for and magnitude of continuing sources (log dam stability, mine drainage characterization, potential for leaching);
- Estimating the volume and extent of source areas; and
- Evaluating source area concentrations and contaminants of potential ecological concern (COPECs)/contaminants of potential concern (COPCs).

The source-area component of the Lava Cap RI includes evaluation of log dam stability and waste rock and tailings pile thickness and conducting air, surface soil, subsurface soil, surface water, groundwater, and mine drainage sampling to characterize conditions in the source areas.

3.2.1 Log Dam Stability

To evaluate the potential for a future significant release, the stability of the Lava Cap Mine log dam will be evaluated. The technical approach for evaluating log dam stability will be developed after initial investigations at the site and documented in a separate technical memorandum. The assessment of dam stability will be performed by a California registered civil and geotechnical engineer with experience in evaluating dam safety. If the technical expert concludes that the log dam is potentially unstable, then recommendations will be made for more extensive evaluations. Requirements for additional sampling will be documented in an addendum to this FSP.

3.2.2 Mine Discharge Sampling

To characterize the volume and concentration of continuing sources, water samples will be collected monthly for 12 months from the two mine discharge points (the caved-in adit and the tailings pile seep, as shown in Figure 3-2). Flow rates will be measured and samples will be collected for metals, cyanide, and general chemistry analyses. In addition, as with all of the other surface water samples, field parameters (pH, conductivity, temperature, oxidation-reduction potential [known as Eh or redox], turbidity, and dissolved oxygen) will be recorded. These sample results will characterize the magnitude and concentration of the continuing source and help define the COPECs/COPCs for the Lava Cap Mine RI. Temporal variability will be assessed using the monthly sampling results for these locations.

3.2.3 Surface Water Sampling at Base of Log Dam

Surface water samples will be collected at the base of the log dam monthly for seven months (from October 1999 through April 2000, encompassing the three rounds of field activities). These data will be compared to the monthly samples collected at the upstream seep location. If the data are substantially different from the data from the seep, monthly sampling at the base of the log dam may be continued concurrent with the seep and adit mine discharge sampling. Sufficient surface water will be collected for *Ceriodaphnia* and fathead minnow bioassays during the first sampling event (October 1999).

3.2.4 Waste Rock/Tailings Area Sampling

Six mine area soil borings will be drilled in the waste rock/tailings piles for lithology and surface soil, subsurface soil, and groundwater samples (Figure 3-2). These soil borings are intended to provide information on the volume and extent of the source. Analysis of the waste rock/tailings will also provide information on source material concentrations. Prior sampling activities at the mine site have indicated that concentrations in the waste rock and tailings are not highly variable. If significant variability is detected in the initial sampling activities described herein, additional characterization of the source materials will be conducted. For this FSP, waste rock/tailings are being considered soil and will be sampled and analyzed as such.

The proposed mine area soil boring locations are as follows:

- Four soil borings in the southern portion of the waste rock/tailings area. Surface soil will be collected at each boring. Subsurface soil will be collected at three depths in these borings (one in the tailings, one near the interface with native soil, one in the underlying native soil). The two borings farthest south will be completed as downgradient monitoring wells.
- One soil boring near the mine discharge point (caved-in adit). Surface and subsurface soil will be collected at similar locations as described above for the other borings in the waste rock/tailings area. This soil boring will be completed as a monitoring well.
- One soil boring in the upper waste rock area near the mine shaft and mine buildings. Surface and subsurface soil will be collected at the same depths as described above for the other borings in the waste rock/tailings area.

To characterize aquifer conditions in the mine area, groundwater samples will be collected from three monitoring wells, two soil borings, and the mine shaft. A total of six mine area groundwater sample locations are planned in the waste rock/tailings area. The proposed sample locations are as follows:

- One groundwater sample from the mine shaft;
- One monitoring well near the mine discharge point (caved-in adit);
- Two downgradient monitoring wells in the tailings pile; and
- One in-situ groundwater sample from each of the two borings not completed as monitoring wells in the southern portion of the waste rock/tailings area.

The monitoring wells will be sampled during two separate events (Rounds 1 and 2 planned for October 1999 and January 2000). Initially, only a single sampling event is planned at the other three locations.

To characterize potential source area transport of fugitive dust, air sampling (24-hour composites) will occur in one location in the waste rock/tailings area. Air sampling will occur during all three sampling rounds (October 1999, January 2000, and April 2000).

Small mammals will be collected by placing traps near each mine discharge point and in the center of the waste rock/tailings area. If this trapping is unsuccessful, traps will be moved to the nearest favorable habitat. A minimum of three individuals will be collected for one composite sample. The goal will be to sample the same species as in the background areas. This sample will determine the bioconcentration by small mammals within the waste rock area.

3.2.5 Mine Buildings Sampling

Activities associated with historic mining operations are likely to have resulted in residual contamination within the existing abandoned buildings (principally the Former Mill and Cyanide Buildings). These buildings are currently open to the environment, with accumulation of soil and water present within the buildings. Previous sampling by DTSC of waste materials within the Cyanide Building detected elevated arsenic levels.

In addition, because they are open to the environment, small mammals are likely to reside within and around the abandoned buildings. These small mammals represent a prey source for barn owls and other predators that could also use these buildings.

Six surface soil samples will be collected from within the mine buildings (three from each building). In addition, two samples of ponded water will be collected from each building. If insufficient water is present during the first round in October 1999, the ponded water sampling will be delayed until the January 2000 sampling round. These results will be used to determine potential risks to humans, small mammals, and their predators.

To determine the bioconcentration by small mammals, a minimum of three individuals will be collected within the both the Former Mill and Cyanide Buildings by placing traps along visible runways and other structures. These small mammals will be composited into one sample from each of the two main mine buildings. No additional biota sampling or bioassays will be conducted in the mine buildings.

To characterize potential transport of fugitive dust inside the buildings, one 24-hour composite air sample will be collected in the Former Mill Building and one in the Cyanide Building. Air sampling at these two locations will occur during all three sampling rounds. The three rounds are currently planned for October 1999, January 2000, and April 2000.

3.3 Mine Area Sampling

Samples collected outside of the waste rock-covered areas will provide an indication of lateral contaminant movement that may have occurred as a result of wind, water, and mechanical transport processes at the mine. The analytical results will help define the extent of contamination at the mine. In addition, several bunkers that were used historically to store explosives for the mining operations are located in the hillside east of the Tailings Stockpile. Soil samples near the bunkers will be used to assess if explosives or explosives breakdown products are present.

Sample collection from twenty-five surface soil locations in the mine vicinity (Figure 3-2), but away from the identified source areas is proposed. The locations are as follows:

- Six samples around mine buildings in biased areas of surface runoff
- Six samples around mine buildings in random areas
- Seven samples outside of the waste rock areas on the mine property, with a few of these locations near the explosive storage areas
- Six samples around the two residences located at the mine near the waste rock areas (three samples around each residence).

Adequate surface soil volume will be collected from one location outside of the waste rock area and near the bunkers to conduct earthworm and nutsedge bioassay tests.

One groundwater sample will be collected from each of the two residential wells located on the mine site during two separate sampling events. These samples will be used to evaluate groundwater quality at the mine and assess potential risks to residents. In addition, well construction information (total depth, screened interval, and construction date) will be gathered for these wells.

To characterize potential transport of fugitive dust near the on-site residences, a 24-hour composite air sample will be collected near the southernmost residence (see Figure 3-2). Air sampling near this residence will occur during all three sampling rounds (currently planned for October 1999, January 2000, and April 2000). Based on the results of this outdoor air sampling, EPA may conduct indoor air sampling at the on-site residences.

3.4 Downgradient Sampling

Downgradient sampling will define the extent of contamination downgradient from the mine by evaluating the:

- volume of mine tailings present downgradient of the mine;
- concentrations of COPECs/COPCs in downgradient media; and
- the potential for further downgradient impacts by assessing the stability of Lost Lake Dam.

There are five general downgradient sample collection areas (Figures 3-3 and 3-4), including:

- LCC below the log dam, but upgradient of the confluence with CC
- The tailings deposition area between the LCC/CC confluence and Lost Lake
- Lost Lake and surrounding shoreline
- CC below Lost Lake
- Rollins Reservoir.

The specific sampling proposed in each of these areas is detailed below.

3.4.1 Sampling in LCC below the Lava Cap Mine Log Dam

This area serves as the link between the contaminant source area and the downstream deposition and accumulation areas, including Lost Lake. Because of the steep gradient, significant tailings deposition is not expected along LCC. The portion of LCC between the log dam and the confluence with CC is approximately 1 mile in length. During the RI field activities, this area will be visually assessed and up to five samples will be collected for the following media: surface soil, surface water, sediment, fish, aquatic and terrestrial plants, and aquatic and terrestrial invertebrates. Considering existing conditions in LCC, there may not be sufficient sample volume at all five locations to collect fish and aquatic invertebrate samples. The sample locations will be determined based on the visual assessment of field conditions. A small mammal sample will also be collected and will be a composite of at least three individuals collected in traps along LCC. This sample will be used to evaluate the bioconcentration by small mammals within this area.

To evaluate potential soil toxicity, earthworm and nutsedge bioassays will be performed on soil composited from all five sampling locations within the LCC area between the log dam and the tailings deposition area. Bioassays on surface water and sediment will not be performed for this area as it is assumed that the bioassay results from upstream (below the log dam) and downstream (in the deposition area) will bracket this area.

3.4.2 Tailings Deposition Area Sampling

A considerable percentage of the mine tailings released during the log dam failure were deposited below the confluence of LCC and CC and upstream of Lost Lake. This area is termed the tailings deposition area (a large percentage of the released tailings also ended up in Lost Lake). The tailings deposition area is currently vegetated with both woody and herbaceous plants, with plants growing directly in the tailings. This area provides considerable wildlife habitat (e.g., deer tracks, frogs, and birds have been observed in the area). Evidence of human activity (e.g., campfires) is also present in the area. Samples from this area will be used to evaluate risks to human and ecological receptors that may be present.

Screening-level analyses will be performed on samples from approximately 20 surface soil locations within the tailings deposition area. These screening-level sample locations will be along transects perpendicular to CC to assess concentration trends across the tailings deposition area. The screening-level results will also assist in selecting the locations of soil borings for analytical sampling. Confirmation samples will be collected at 10 percent (two) of the screening-level sample locations. Initially, it is expected that the screening-level samples will be analyzed at an off-site laboratory with short turnaround times (less than one week). However, a field-portable X-ray fluorescence (XRF) instrument may also be used to perform field screening.

Six soil borings will be drilled within the tailings deposition area. Boring locations will be selected in the field considering locations with elevated constituent concentrations (based on the screening results) and the need for a representative distribution of sampling points across the entire deposition area. Surface soil and two subsurface soil samples will be collected from each boring to evaluate the distribution of contaminants with depth. Lithology will be recorded during drilling to document the depth of tailings. In-situ groundwater samples will be collected from two of the six soil borings. The borings for groundwater sampling will be biased towards locations with higher concentrations of metals based on the screening results. The four soil boring locations without groundwater sampling may be completed using hand-auger techniques. Earthworm and nutsedge bioassays will be performed on surface soil from three of the sample locations in the tailings deposition area to evaluate potential soil toxicity.

Three surface water, sediment, and aquatic invertebrate samples will be collected from CC downstream of the confluence with LCC (combined flow of LCC and CC above Lost Lake). To evaluate potential surface water and sediment toxicity in the tailings deposition area, fathead minnow, *Ceriodaphnia*, and *Hyalella* bioassays will be performed on surface water or sediment composited from all three sampling locations within this area.

Surface water, sediment, and aquatic invertebrate samples will be collected from up to five surface water pools (if present) in the tailing deposition area. This standing water has a higher potential for concentration of contaminants and use by ecological receptors. Previous sampling conducted by DTSC (unpublished data) has detected significantly elevated concentrations of metals in one of these pools. To assess potential surface water toxicity in pools within the tailings deposition area, fathead minnow and *Ceriodaphnia* bioassays will be performed on surface water composited from the pools sampled in this area. Based on field observations, the pools in the tailings deposition area may be an important microhabitat for frogs. Sampling of bullfrogs will be performed to evaluate potential impacts in the deposition area. The bullfrog sample will be a composite from at least three individuals collected within the area.

Five terrestrial plant and invertebrate samples and three small mammal samples will be collected in the tailing deposition zone. The plant and invertebrate samples will be co-located with five of the surface soil sample locations. The small mammal samples will be composites of at least three individuals collected in traps within the tailings deposition area. These samples will assess the bioconcentration or bioaccumulation of arsenic and other metals by small mammals within this area.

Twenty-four hour composite air particulate samples will be collected from two locations to characterize air quality and particulate transport in the tailings deposition area. One sample will be collected from the western portion of the deposition area and one from the eastern portion (see Figure 3-4B). Air sampling is planned for all three sampling rounds (October 1999, January 2000, and April 2000). These air particulate results will be used to characterize human health risk through transport of fugitive dust downgradient of Lava Cap Mine near Lost Lake. Based on the results of the air sampling in the deposition area, the need for additional air sampling inside residences in the Lost Lake vicinity will be assessed.

3.4.3 Lost Lake and Surrounding Shoreline Sampling

Surface water flow continues to transport tailings into the Lost Lake basin. Based on historic canyon topography prior to Lost Lake Dam installation and on current water depths (less than 10 feet), it is estimated that tailings and sediment accumulations in Lost Lake could be up to 50 feet deep. Multiple residences are located along Lost Lake. In addition, Lost Lake provides habitat for fish, wildlife, plants, and invertebrates. Samples from this area will be used to evaluate risks to human and ecological receptors that may be present.

Field screening will be performed at approximately 40 surface soil locations along the shore of Lost Lake (confirmation samples will be collected at 10 percent [4] of these locations). The screening-level sample locations will consist of transects at approximately 300 foot spacing around the entire lake perimeter. Each transect will consist of approximately four samples. Samples will be collected near the current lakeshore and at approximately 10, 25, and 50 feet above the lakeshore. If elevated concentrations are detected in the 50-foot sample, additional samples may be collected approximately 75 feet above the lakeshore. The screening-level results will be used to help select appropriate locations for collection of samples for full laboratory analysis. Sample locations for full laboratory analysis will be selected in areas with elevated constituent concentrations based on the screening results, taking into account the need for the sampling to characterize the entire shoreline of Lost Lake. For planning purposes, it is assumed that sampling for full laboratory analysis will occur at approximately eight properties, with three surface soil samples at each property (stepping upgradient from the lakeshore). Thus, 24 surface soil samples for offsite laboratory analyses of metals and cyanide will be collected on the residential property around Lost Lake.

To evaluate groundwater quality and potential risks to human health around Lost Lake and in the LCC watershed, samples will be collected from residential wells in the area. It is assumed that this sampling will involve 13 residential wells. All wells will be sampled during two separate sampling events

Three surface water samples and six sediment samples will be collected from Lost Lake for analysis and toxicity testing. Three of the sediment samples will be collected within the CC delta and three of the samples will be collected away from the CC delta. Three whole-body composite samples of fish will be analyzed for each of two common species. In addition, three composite fillet samples will be analyzed for each of two species that are likely to be eaten by humans. Two kinds of aquatic plants (with roots and vegetation analyzed separately, three samples each) and three samples of aquatic invertebrates will also be collected for analysis. These samples will be used to evaluate human and ecological risk associated with Lost Lake.

To evaluate potential surface water ecological toxicity, fathead minnow and *Ceriodaphnia* bioassays will be performed on Lost Lake surface water from all three sampling locations within the lake.

To evaluate the distribution and toxicity of contaminants in sediment within Lost Lake, six bioassays will be performed on sediment samples from both within and outside the CC delta areas.

A 24-hour composite air sample will be collected on residential property near Lost Lake Dam during each of the three sampling rounds to characterize air quality away from the mine and tailings deposition area. These air results will be used to help assess the extent of Lava Cap Mine contaminant migration through transport of fugitive dust.

To assess the potential likelihood for a future significant release, the stability of the Lost Lake dam will be evaluated. The technical approach for evaluating dam stability will be developed after initial investigations at the site and documented in a separate technical memorandum. The assessment of dam stability will be performed by a California registered civil and geotechnical engineer with experience in evaluating dam safety. If the technical expert concludes that the dam is potentially unstable, then recommendations will be made for more extensive evaluations. Requirements for additional sampling will be documented in an addendum to this FSP.

3.4.4 Sampling Clipper Creek below Lost Lake

Samples will be collected from CC downgradient of Lost Lake to evaluate the magnitude of contaminant migration beyond Lost Lake. These data will also be used to evaluate the potential contaminant loading from Lava Cap Mine through CC into Little Greenhorn Creek. Sampling will consist of three surface water, sediment, and aquatic invertebrate (or fish as an alternate) samples in CC downstream of Lost Lake but upstream of Little Greenhorn Creek.

To evaluate potential surface water and sediment toxicity, fathead minnow, *Ceriodaphnia*, and *Hyalella* bioassays will be performed on surface water and sediment composited from all three sampling locations within CC downgradient of Lost Lake.

3.4.5 Rollins Reservoir – Contingent Sampling

If elevated concentrations of the Lava Cap Mine COPCs are detected in Clipper Creek downstream of Lost Lake, samples will be collected from Rollins Reservoir to evaluate if and to what degree contamination has traveled downstream to Rollins Reservoir. Up to four surface soil samples would be collected at the north end of Rollins Reservoir in the public campground/beach area. In addition, up to three surface water samples would be collected in Rollins Reservoir. Fish sample locations may also need to be added in Rollins Reservoir if elevated concentrations are detected in samples from Lost Lake.

It should be noted that a number of creeks drain into Rollins Reservoir and these could have impacts from other mining activities (not related to Lava Cap Mine). If elevated contaminant concentrations are detected in Rollins Reservoir, additional investigation will likely be necessary to better define the source of the contamination.

3.5 Investigation Derived Waste Sampling

Wastes from drilling operations (drill cuttings) will be sampled and analyzed to determine whether they are hazardous. The drill cuttings will be analyzed for TCLP metals; technical specifications for this determination are discussed in Sections 4 and 5. It is anticipated that drill cuttings will be containerized in three roll-off bins and that a composite sample of drill cuttings will be required from each bin.

Well development and equipment decontamination water will be sampled and analyzed to determine whether concentrations in excess of MCLs are present. These analyses will be used as the basis for selecting waste disposal alternatives (see Section 5). It is anticipated that there will be two tanks for storage of IDW water (one for decontamination water and one for well development/ sample collection water). Collection of one composite water sample from each tank is assumed

3.6 Number of Samples

Table 3-1 summarizes the assumed number of environmental samples, by medium, for the Lava Cap Mine RI field activities. This table shows the sampling planned for Round 1 (scheduled for October 1999) and estimates of the minimum sampling activities for the next two rounds and the monthly source area sampling. Prior to the second and third rounds of field activities (planned for January and April 2000), a FSP Addendum will be prepared that provides details on additional sample locations and numbers of samples.

Field quality assurance (QA) samples will be collected in the form of field duplicate, field blank or equipment blank, and matrix spike/matrix spike duplicate (MS/MSD) samples. At a minimum, field duplicate samples will be collected at a 10 percent frequency for each analysis/matrix combination. Equipment blank samples will be collected to check for possible cross-contamination between samples. For water, equipment blank samples will be collected daily. For soil sampling activities an equipment blank sample (of water) will be collected once a week. Laboratory quality control (QC) samples (MS/MSDs) will be collected for all analyses during each sampling event. One MS/MSD sample will be collected for every 20 samples (or once per week, whichever is greater) collected for each matrix, including field duplicates and blanks. Table 3-2 summarizes the assumed total number of samples for each analysis/matrix (including QC samples) during the initial sampling event of the Lava Cap RI. The first sampling event is planned for October 1999. Similar tables have not been prepared for the second and third rounds of RI field activities because the total number of samples to be included in those rounds is uncertain at this time.

Table 3-2
Sample Collection Summary
(Round 1 Sampling Event - October 1999)
Field Sampling Plan
Lava Cap Mine RI/FS

Matrix	Environmental Samples	Field Duplicates	Blanks	MS/MSDs	Total Samples
Soil/Sediment	151	16	0	9	176
Water	58	6	26[a]	7	97
Air Filter	8	1	0	0	9

[a]Five of the water matrix equipment blanks are from soil sampling activities.

3.7 Laboratory Analyses

Laboratory analysis of the soil/sediment samples for metals and cyanide with low detection limits will be used to characterize the source area and assess the extent and magnitude of contamination associated with the Lava Cap Mine. Selected soil samples around the explosives bunkers will also be analyzed for explosives and TOC.

Laboratory analysis of the water samples for metals, cyanide, and general chemistry (alkalinity, anions, hardness, and TDS) will be used to characterize the source area and assess the extent and magnitude of contamination associated with the Lava Cap Mine.

More detail on the requested analyses is provided in Section 4. Technical specifications for analytical methods are presented in Appendix B.

4 Request for Analysis

This section presents the request for analyses (RFAs) for the environmental samples and IDW characterization samples to be generated during the Lava Cap RI.

4.1 Analytical Parameters

Tables 4-1a and 4-1b summarize the analytical parameters, test methods, and target detection limits for the environmental samples to be collected in each matrix. Tables 4-1c and 4-1d summarize the analytical parameters, test methods, and target detection limits for the IDW characterization for the soil and water matrixes, respectively. Technical specifications for the analytical methods are provided in Appendix B.

Tables 4-2a and 4-2b summarize information required in the field regarding the specific analyses requested, preservatives, container requirements, and holding times for the environmental samples by matrix for Round 1 (October 1999). Table 4-2c provides a cross-reference description of the location identifiers used in Tables 4-2a and 4-2b.

4.2 Schedule

The initial round of RI activities is tentatively scheduled to begin in early October 1999 and continue for approximately four to five weeks. This includes sampling of soil (surface and subsurface), sediment, air, surface water and groundwater and gathering other information critical to the Ecological Risk Assessment, such as site-specific characterization of terrestrial and aquatic habitats and potential ecological receptors. However, Round 1 does not include collection of any biota samples.

The second and third rounds of RI field activities, tentatively scheduled for January and April 2000, will include collection of bioassay and biota samples and re-sampling of all surface water locations. Also, a second set of samples from all of the groundwater wells (monitoring and residential) will be collected during the second round of RI sampling in January 2000. In addition to the planned sampling, the first round sampling results will be used to assess whether additional samples should be collected during the second or third rounds of RI field activities. Separate brief FSP addenda, including RFAs, will be prepared for each subsequent sampling event.

Sampling of the mine discharge (three locations initially, then potentially reduced to two) will be monthly for a period of 12 months, occurring the first week of each month.

Table 4-1a
Analytical Parameters, Methods, and Detection Limits
(Matrix = Soil/Sediment/Air Filter and Tissue)
Field Sampling Plan
Lava Cap Mine RI/FS

Parameter	Method	Reporting Limit[a] (mg/kg)
Cyanide	SW9010B	1.0
Metals		
-Aluminum	SW6020	1.0
-Antimony	SW6020	0.1
-Arsenic	SW6020 (SW6010A[b])	0.1 (40[b])
-Barium	SW6020	0.1
-Beryllium	SW6020	0.1
-Cadmium	SW6020	0.1
-Calcium	SW6010A	1000
-Chromium (total)	SW6020	0.1
-Cobalt	SW6020	0.1
-Copper	SW6020	0.1
-Iron	SW6020	20
-Lead	SW6020	0.1
-Magnesium	SW6010A	1000
-Manganese	SW6020	0.1
-Mercury	SW7471A	0.02
-Nickel	SW6020	0.1
-Potassium	SW6010A	1000
-Selenium	SW6020	0.1
-Silver	SW6020	0.1
-Sodium	SW6010A	1000
-Thallium	SW6020	0.1
-Vanadium	SW6020	0.1
-Zinc	SW6020	1.0
Explosives	SW8330	1.0
Total Organic Carbon(TOC)	SW9060	100

[a] Reporting limits as specified in Section 3 of the QAPP (EPA, 1999).

[b] If the screening-level analyses for arsenic are performed at an off-site laboratory, method SW601A will be used with a reporting limit of 40 mg/kg.

Table 4-1b
Analytical Parameters, Methods, and Detection Limits
(Matrix = Water)
Field Sampling Plan
Lava Cap Mine RI/FS

Parameter	Method[b]	Reporting Limit[a] (µg/L)
Cyanide	SW9010B	5.0
Metals		
-Aluminum	SW6020	5.0
-Antimony	SW6020	0.2
-Arsenic	SW6020	0.2
-Barium	SW6020	0.2
-Beryllium	SW6020	0.2
-Cadmium	SW6020	0.2
-Calcium	SW6010A	5000
-Chromium (total)	SW6020	5.0
-Cobalt	SW6020	0.2
-Copper	SW6020	0.2
-Iron	SW6020	100
-Lead	SW6020	0.2
-Magnesium	SW6010A	5000
-Manganese	SW6020	0.2
-Mercury	SW7470A	0.03
-Nickel	SW6020	0.2
-Potassium	SW6010A	5000
-Selenium	SW6020	0.2
-Silver	SW6020	0.2
-Sodium	SW6010A	5000
-Thallium	SW6020	0.2
-Vanadium	SW6020	0.2
-Zinc	SW6020	5.0
Inorganic Constituents		
-Chloride	300.0[c]	1.0 mg/L
-Sulfate	300.0[c]	1.0 mg/L
-Orthophosphate	300.0[c]	1.0 mg/L
Hardness	130.1[c]	10 mg/L
Alkalinity[d]	310.1[d]	3.0 mg/L
Total Dissolved Solids (TDS)	160.1[d]	10 mg/L
Ph	Field/manual	N/A
Electrical Conductivity	Field/manual	N/A
Temperature	Field/manual	N/A
Oxidation-reduction potential	Field/manual (closed cell meter)	N/A
Turbidity	Field/manual	N/A
Dissolved Oxygen	Field/manual	N/A

[a] Reporting limits as specified in Section 3 of the QAPP (EPA, 1999).
[b] Accuracy and precision values are given in Section 4 of the QAPP (EPA, 1999).
[c] Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, revised March 1983.
[d] Alkalinity includes analyses for Carbonate, Bicarbonate, and Total Alkalinity.

Table 4-1c
Analytical Parameters, Methods, and Detection Limits
(Matrices = Drill Cuttings and Drilling Mud)
Field Sampling Plan
Lava Cap Mine RI/FS

Parameter	Method	Reporting Limit
TCL Metals[a]	TCLP (1311)[b]/CLP[c]	TCLP levels or CLP, the lower of the two
Total Petroleum Hydrocarbons	CA LUFT [d]	5 mg/kg
Flashpoint	1010 [b]	5° F
pH	9045 [b]	0.1 pH units

[a] Quantification of analytes shall occur after extraction using the toxicity characteristic leaching procedure (TCLP). All Target Compound List (TCL) and Target Analyte List (TAL) compounds will be reported, in addition to TCLP analytes.

[b] TCLP Method 1311/SW-846, EPA Test Methods for Evaluating Solid Waste, 3rd Edition, Update I. Analytical methods are from SW-846 3rd edition and Update I.

[c] Contract laboratory program (CLP) procedures (methods and quality assurance/quality control [QA/QC]) to be used with reduced documentation for cost-effectiveness. Documentation will consist of only QC summary forms (accuracy, precision, and blank summaries).

[d] CA LUFT = California Leaking Underground Fuel Tank (State of California, 1988).

Table 4-1d
Analytical Parameters, Methods, and Detection Limits
(Matrices = Decontamination and Well Development Water)
Sampling and Analysis Plan
Lava Cap Mine RI/FS

Parameter	Method	Reporting Limit
Metals and Cyanide	See Table 4-1b	See Table 4-1b

Table 4-2a
Analyses Requested – Round 1 Sampling Event – October 1999
(Matrix = Soil/Sediment/Air Filter)
Field Sampling Plan
Lava Cap Mine RI/FS

Specific Analyses Requested				Metals (SW6010A or SW6020)	Mercury (SW7471A)	Cyanide (SW9010B)	Explosives (SW8330)	Total Organic Carbon (SW9060)
Preservatives				Cool to 4°C		Cool to 4°C	Cool to 4°C	Cool to 4°C
Analytical Holding Time				6 months (except 28 days for mercury)		14 days	14 days	28 days
Contract Holding Time				35 days (except 26 days for mercury)		14 days	14 days	26 days
Number of Containers				1x8-oz glass jar (except for air filter - 1x1-gallon re-sealable plastic bag)		1x4-oz glass jar	1x4-oz glass jar	1x4-oz glass jar
Location	Sample ID	Schedule	Conc.	Samples				
1c		Week 1	Low	1		1		
1d		"	"	1		1		
1e		"	"	1		1		
1f		"	"	1		1		
1g		"	"	1		1		
10a		"	"	1		1		
10b		"	"	1		1		
10c	(soil)	"	"	1		1		
10c	(air)	"	"	1		1		
10d		"	"	1		1		
10e		"	"	1		1		
10f	Dup.	"	"	2		2		
11a		"	"	1		1		
11b		"	"	1		1		
11c		"	"	1		1		
11d		"	"	1		1		
11e		"	"	1		1		
11f		"	"	1		1		
11g		"	"	1		1		
11h	Lab. QC	"	"	1		1		
Week 1 Subtotal				*21*		*21*	*0*	*0*
1h	Dup.	Week 2	"	2		2		
1i		"	"	1		1		
1j		"	"	1		1		

Table 4-2a
Analyses Requested – Round 1 Sampling Event – October 1999
(Matrix = Soil/Sediment/Air Filter)
Field Sampling Plan
Lava Cap Mine RI/FS

Specific Analyses Requested				Metals (SW6010A or SW6020)	Mercury (SW7471A)	Cyanide (SW9010B)	Explosives (SW8330)	Total Organic Carbon (SW9060)
Preservatives				Cool to 4°C		Cool to 4°C	Cool to 4°C	Cool to 4°C
Analytical Holding Time				6 months (except 28 days for mercury)		14 days	14 days	28 days
Contract Holding Time				35 days (except 26 days for mercury)		14 days	14 days	26 days
Number of Containers				1x8-oz glass jar (except for air filter - 1x1-gallon re-sealable plastic bag)		1x4-oz glass jar	1x4-oz glass jar	1x4-oz glass jar
Location	Sample ID	Schedule	Conc.	Samples				
2a		"	"	1		1		
2b		"	"	1		1		
2c		"	"	1		1		
2d		"	"	1		1		
2e		"	"	1		1		
2f		"	"	1		1		
11i	Dup.	"	"	2		2		
11j		"	"	1		1		
11k		"	"	1		1		
11l		"	"	1		1		
11m		"	"	1		1		
11n		"	"	1		1		
11o		"	"	1		1		
11p		"	"	1		1		
11q	Lab. QC	"	"	1		1		
11r	Dup.	"	"	2		2		
11s		"	"	1		1		
11t		"	"	1		1		
11u		"	"	1		1		
11v		"	"	1		1		
11w		"	"	1		1		
11x		"	"	1		1		
12a		"	"	1		1		
12b		"	"	1		1		

Table 4-2a
Analyses Requested – Round 1 Sampling Event – October 1999
(Matrix = Soil/Sediment/Air Filter)
Field Sampling Plan
Lava Cap Mine RI/FS

Specific Analyses Requested				Metals (SW6010A or SW6020)	Mercury (SW7471A)	Cyanide (SW9010B)	Explosives (SW8330)	Total Organic Carbon (SW9060)
Preservatives				Cool to 4°C		Cool to 4°C	Cool to 4°C	Cool to 4°C
Analytical Holding Time				6 months (except 28 days for mercury)		14 days	14 days	28 days
Contract Holding Time				35 days (except 26 days for mercury)		14 days	14 days	26 days
Number of Containers				1x8-oz glass jar (except for air filter - 1x1-gallon re-sealable plastic bag)		1x4-oz glass jar	1x4-oz glass jar	1x4-oz glass jar
Location	Sample ID	Schedule	Conc.	Samples				
12c	Dup.	"	"	2		2		
12d		"	"	1		1		
12e		"	"	1		1		
12f		"	"	1		1		
12g		"	"	1		1		
12h		"	"	1		1		
12i		"	"	1		1		
12j		"	"	1		1		
20a	Lab. QC	"	"	1		1		
20b	Dup.	"	"	2		2		
20c		"	"	1		1		
20d		"	"	1		1		
Week 2 Subtotal				*44*		*44*	*0*	*0*
14a		Week 3	"	1		1		
14b		"	"	1		1		
14c		"	"	1		1		
15a		"	"	1		1		
15b		"	"	1		1		
15c		"	"	1		1		
15d		"	"	1		1		
15e	Dup.	"	"	2		2		
17a		"	"	1		1		
17b		"	"	1		1		
17c		"	"	1		1		

Table 4-2a
Analyses Requested – Round 1 Sampling Event – October 1999
(Matrix = Soil/Sediment/Air Filter)
Field Sampling Plan
Lava Cap Mine RI/FS

Specific Analyses Requested				Metals (SW6010A or SW6020)	Mercury (SW7471A)	Cyanide (SW9010B)	Explosives (SW8330)	Total Organic Carbon (SW9060)
Preservatives				Cool to 4°C		Cool to 4°C	Cool to 4°C	Cool to 4°C
Analytical Holding Time				6 months (except 28 days for mercury)		14 days	14 days	28 days
Contract Holding Time				35 days (except 26 days for mercury)		14 days	14 days	26 days
Number of Containers				1x8-oz glass jar (except for air filter - 1x1-gallon re-sealable plastic bag)		1x4-oz glass jar	1x4-oz glass jar	1x4-oz glass jar
Location	Sample ID	Schedule	Conc	Samples				
18a		"	"	1		1		
18b		"	"	1		1		
18c		"	"	1		1		
19a	Lab QC	"	"	1		1		
19b		"	"	1		1		
19c	Dup	"	"	2		2		
19d		"	"	1		1		
5d		"	"	4		4		
5e	Dup	'	"	5		5		
Week 3 Subtotal				*29*		*29*	*0*	*0*
1a	Lab QC	Week 4	'	4		4		
1b	Dup	"	"	7		7		
5a		"	"	4		4		
5b	Dup	"	"	5		5		
5c		"	"	4		4		
5g		"	"	1		1		
5h		"	"	4		4		
13a	Lab QC	"	"	3		3		
13b	Dup	"	"	4		4		
Week 4 Subtotal				*36*		*36*	*0*	*0*
13c		Week 5		3		3		
13d		"	"	3		3		
13e	Dup	-		4		4		
13f		"	"	3		3		

Table 4-2a
Analyses Requested – Round 1 Sampling Event – October 1999
(Matrix = Soil/Sediment/Air Filter)
Field Sampling Plan
Lava Cap Mine RI/FS

Specific Analyses Requested				Metals (SW6010A or SW6020)	Mercury (SW7471A)	Cyanide (SW9010B)	Explosives (SW8330)	Total Organic Carbon (SW9060)
Preservatives				Cool to 4°C		Cool to 4°C	Cool to 4°C	Cool to 4°C
Analytical Holding Time				6 months (except 28 days for mercury)		14 days	14 days	28 days
Contract Holding Time				35 days (except 26 days for mercury)		14 days	14 days	26 days
Number of Containers				1x8-oz glass jar (except for air filter - 1x1-gallon re-sealable plastic bag)		1x4-oz glass jar	1x4-oz glass jar	1x4-oz glass jar
Location	Sample ID	Schedule	Conc	Samples				
13g		"	"	1		1		
13h		"	"	1		1		
6a	Dup	"	"	2		2		
6b	Lab QC	"	"	1		1		
6c		"	"	1		1		
6d		"	"	1		1		
6e		"	"	1		1		
6f		"	"	1		1		
6g	Dup	"	"	2		2		
6h		"	"	1		1		
7a		"	"	1		1		
7b		"	"	1		1		
7c		"	"	1		1		
7d		"	"	1		1		
7e		"	"	1		1		
7f		"	"	1		1		
8a		"	"	1		1		
8b	Dup	"	"	2		2		
8c	Lab QC	"	"	1		1		
8d		"	"	1		1		
8e		"	"	1		1		
8f		"	"	1		1		
9a		"	"	1		1	1	1
9b		"	"	1		1	1	1

Table 4-2a
Analyses Requested – Round 1 Sampling Event – October 1999
(Matrix = Soil/Sediment/Air Filter)
Field Sampling Plan
Lava Cap Mine RI/FS

Specific Analyses Requested				Metals (SW6010A or SW6020)	Mercury (SW7471A)	Cyanide (SW9010B)	Explosives (SW8330)	Total Organic Carbon (SW9060)
Preservatives				Cool to 4°C		Cool to 4°C	Cool to 4°C	Cool to 4°C
Analytical Holding Time				6 months (except 28 days for mercury)		14 days	14 days	28 days
Contract Holding Time				35 days (except 26 days for mercury)		14 days	14 days	26 days
Number of Containers				1x8-oz glass jar (except for air filter - 1x1-gallon re-sealable plastic bag)		1x4-oz glass jar	1x4-oz glass jar	1x4-oz glass jar
Location	Sample ID	Schedule	Conc.	Samples				
9c		"	"	1		1	1	1
9d		"	"	1		1	1	1
9e	Dup	"	"	2		2	2	2
9f		"	"	1		1	1	1
9g	Lab. QC	"	"	1		1	1	1
Week 5 Subtotal				*46*		*46*	*8*	*8*
TOTAL SAMPLES				**176**		**176**	**8**	**8**

Notes.
Location identifiers are defined in Table 4-2c.
Lab QC samples will be twice the normal sample volume.
Dup. = Duplicate sample collected.

Table 4-2b
Analyses Requested – Round 1 Sampling Event – October 1999
(Matrix = Water)
Field Sampling Plan
Lava Cap Mine RI/FS

Specific Analyses Requested				Metals (SW6010A or SW6020)	Mercury (SW7470A)	Cyanide (SW9010B)	Hardness (E130 1)	Anions (E300)	TDS (E160.1)	Alkalinity (E310.1)
Preservatives				Total -- HNO_3 to pH<2, cool to 4°C (Dissolved -- Filter 0 45 µm, HNO_3 to pH<2, cool to 4°C)		NaOH to pH> 12, cool to 4°C	H_2SO_4 to pH< 2, cool to 4°C	Cool to 4°C		
Analytical Holding Time				6 months (except 28 days for mercury)		14 days	7 days	28 days (2 days for orthophosphate)	7 days	7 days
Contract Holding Time				35 days (except 26 days for mercury)		14 days	5 days	25 days (2 days for orthophosphate)	7 days	5 days
Number of Containers				1x1-liter poly bottle		1x500-milliliter poly bottle	1x100-milliliter poly bottle	1x1-liter poly bottle		
Location	Sample ID	Schedule	Conc	Samples						
3a		Week 1	Low	1		1	1	1		
3b	Lab QC	"	"	1		1	1	1		
5f		"	"	1 (1)		1	1	1		
Blank	Soil EB	"	"	1		1				
Blank	Water EB	"	"	1		1	1	1		
Week 1 Subtotal				*5 (1)*		*5*	*4*	*4*		
1h		Week 2	"	1		1	1	1		
1I		"	"	1		1	1	1		
1j		"	"	1 (1)		1	1	1		
2a		"	'	1		1	1	1		
2b	Dup	"	"	2		2	2	2		
2c		"	"	1		1	1	1		
4a		"	'	1 (1)		1	1	1		
12f		"	"	1		1	1	1		
12g		"	"	1		1	1	1		
12h		"	"	1 (1)		1	1	1		
12i		"	"	1		1	1	1		
12j	Lab QC	"	"	1		1	1	1		
4b	Dup	"	"	2		2	2	2		
Blank	Soil EB	"	"	1		1				
Blank	Field	"	"	1		1	1	1		

Table 4-2b
Analyses Requested – Round 1 Sampling Event – October 1999
(Matrix = Water)
Field Sampling Plan
Lava Cap Mine RI/FS

Specific Analyses Requested				Metals (SW6010A or SW6020)	Mercury (SW7470A)	Cyanide (SW9010B)	Hardness (E130.1)	Anions (E300)	TDS (E160.1)	Alkalinity (E310.1)
Preservatives				Total -- HNO_3 to pH<2; cool to 4°C (Dissolved -- Filter 0.45 µm, HNO_3 to pH<2; cool to 4°C)		NaOH to pH> 12; cool to 4°C	H_2SO_4 to pH< 2, cool to 4°C	Cool to 4°C		
Analytical Holding Time				6 months (except 28 days for mercury)		14 days	7 days	28 days (2 days for orthophosphate)	7 days	7 days
Contract Holding Time				35 days (except 26 days for mercury)		14 days	5 days	25 days (2 days for orthophosphate)	7 days	5 days
Number of Containers				1x1-liter poly bottle		1x500-milliliter poly bottle	1x100-milliliter poly bottle	1x1-liter poly bottle		
Location	Sample ID	Schedule	Conc.	Samples						
Blank	Field	"	"	1		1	1	1		
Blank	Field	"	"	1		1	1	1		
Blank	Field	"	"	1		1	1	1		
Blank	Field	"	"	1		1	1	1		
Week 2 Subtotal				*21* (3)		*21*	*20*	*20*		
14a		Week 3	"	1		1	1	1		
14b		"	"	1		1	1	1		
14c		"	"	1		1	1	1		
15a		"	"	1 (1)		1	1	1		
15b	Lab QC	"	"	1		1	1	1		
15c		"	"	1		1	1	1		
15d		"	"	1		1	1	1		
15e		"	"	1		1	1	1		
16a		"	"	1 (1)		1	1	1		
16b	Dup.	"	"	2		2	2	2		
16c		"	"	1		1	1	1		
19a		"	"	1		1	1	1		
19b		"	"	1		1	1	1		
19c	Lab QC	"	"	1		1	1	1		
Blank	Soil EB	"	"	1		1				
Blank	Field	"	"	1		1	1	1		

Table 4-2b
Analyses Requested – Round 1 Sampling Event – October 1999
(Matrix = Water)
Field Sampling Plan
Lava Cap Mine RI/FS

Specific Analyses Requested				Metals (SW6010A or SW6020)	Mercury (SW7470A)	Cyanide (SW9010B)	Hardness (E130.1)	Anions (E300)	TDS (E160.1)	Alkalinity (E310.1)
Preservatives				Total -- HNO_3 to pH<2, cool to 4°C (Dissolved -- Filter 0.45 µm; HNO_3 to pH<2; cool to 4°C)		NaOH to pH> 12; cool to 4°C	H_2SO_4 to pH< 2; cool to 4°C	Cool to 4°C		
Analytical Holding Time				6 months (except 28 days for mercury)		14 days	7 days	28 days (2 days for orthophosphate)	7 days	7 days
Contract Holding Time				35 days (except 26 days for mercury)		14 days	5 days	25 days (2 days for orthophosphate)	7 days	5 days
Number of Containers				1x1-liter poly bottle		1x500-milliliter poly bottle	1x100-milliliter poly bottle	1x1-liter poly bottle		
Location	Sample ID	Schedule	Conc	Samples						
Blank	Field	"	"	1		1	1	1		
Blank	Field	"	"	1		1	1	1		
Blank	Field	"	"	1		1	1	1		
Blank	Field	"	"	1		1	1	1		
Week 3 Subtotal				*21* (2)		*21*	*20*	*20*		
1a		Week 4	"	(1)		1	1	1		
1b		"	"	1 (1)		1	1	1		
5a	Dup.	"	"	2 (2)		2	2	2		
5b		"	"	(1)		1	1	1		
5c		"	"	(1)		1	1	1		
5d		"	"	1 (1)		1	1	1		
5e		"	"	1 (1)		1	1	1		
13a	Lab QC	"	"	(1)		1	1	1		
13b		"	"	(1)		1	1	1		
Blank	Soil EB	"	"	1		1				
Blank	Water EB	"	"	(1)		1	1	1		
Blank	Water EB	"	"	1		1	1	1		
Blank	Water EB	"	"	(1)		1	1	1		
Blank	Water EB	"	"	1		1	1	1		
Blank	Water EB	"	"	(1)		1	1	1		

Table 4-2b
Analyses Requested – Round 1 Sampling Event – October 1999
(Matrix = Water)
Field Sampling Plan
Lava Cap Mine RI/FS

Specific Analyses Requested				Metals (SW6010A or SW6020)	Mercury (SW7470A)	Cyanide (SW9010B)	Hardness (E130.1)	Anions (E300)	TDS (E160.1)	Alkalinity (E310.1)
Preservatives				Total -- HNO_3 to pH<2, cool to 4°C (Dissolved -- Filter 0 45 µm; HNO_3 to pH<2; cool to 4°C)		NaOH to pH> 12; cool to 4°C	H_2SO_4 to pH< 2, cool to 4°C	Cool to 4°C		
Analytical Holding Time				6 months (except 28 days for mercury)		14 days	7 days	28 days (2 days for orthophosphate)	7 days	7 days
Contract Holding Time				35 days (except 26 days for mercury)		14 days	5 days	25 days (2 days for orthophosphate)	7 days	5 days
Number of Containers				1x1-liter poly bottle		1x500-milliliter poly bottle	1x100-milliliter poly bottle	1x1-liter poly bottle		
Location	Sample ID	Schedule	Conc.	Samples						
Week 4 Subtotal				*8 (13)*		*16*	*15*	*15*		
10g	Lab. QC	Week 5	"	1		1				
10h		"	"	1		1				
11aa		"	"	1		1				
11ab		"	"	1		1				
11ac	Dup.	"	"	2		2				
11ad		"	"	1		1				
11ae		"	"	1		1				
11af		"	"	1		1				
11ag		"	"	1		1				
11ah		"	"	1		1				
11ai		"	"	1		1				
11aj		"	"	1		1				
11ak		"	"	1		1				
11al	Dup.	"	"	2		2				
11am	Lab. QC	"	"	1		1				
6i.		"	"	1		1	1	1		
6j		"	"	1		1	1	1		
6j		"	"	1		1	1	1		
6k		"	"	1		1	1	1		
Blank	Soil EB	"	"	1		1				

Table 4-2b
Analyses Requested – Round 1 Sampling Event – October 1999
(Matrix = Water)
Field Sampling Plan
Lava Cap Mine RI/FS

Specific Analyses Requested				Metals (SW6010A or SW6020)	Mercury (SW7470A)	Cyanide (SW9010B)	Hardness (E130.1)	Anions (E300)	TDS (E160.1)	Alkalinity (E310.1)
Preservatives				Total -- HNO_3 to pH<2, cool to 4°C (Dissolved -- Filter 0 45 µm, HNO_3 to pH<2, cool to 4°C)		NaOH to pH> 12, cool to 4°C	H_2SO_4 to pH< 2, cool to 4°C	Cool to 4°C		
Analytical Holding Time				6 months (except 28 days for mercury)		14 days	7 days	28 days (2 days for orthophosphate)	7 days	7 days
Contract Holding Time				35 days (except 26 days for mercury)		14 days	5 days	25 days (2 days for orthophosphate)	7 days	5 days
Number of Containers				1x1-liter poly bottle		1x500-milliliter poly bottle	1x100-milliliter poly bottle	1x1-liter poly bottle		
Location	Sample ID	Schedule	Conc	*Samples*						
Blank	Field	"	"	1		1				
Blank	Fi	'	"	1		1				
Blank	Fi	"	"	1		1				
Blank	Field	"	"	1		1				
Blank	Field	"	"	1		1	1	1		
Week 5 Subtotal				*27*		*27*	*5*	*5*		
TOTAL SAMPLES				**82 (19)**		**90**	**64**	**64**		

Notes.
Location identifiers are defined in Table 4-2c.
Lab QC samples will be twice the normal sample volume.
Dup. = Duplicate sample collected.
EB = Equipment blank.
Anions include chloride, orthophosphate, and sulfate.
(1) = dissolved metals sample, field filtered.

TABLE 4-2c
Cross-Reference List of Sample Locations and Descriptions[1]
Field Sampling Plan
Lava Cap Mine RI/FS

Location ID	Location Description
1a	Surface soil, subsurface soil, and in situ groundwater from soil boring upgradient of mine
1b	Surface and subsurface soil from soil boring and groundwater from monitoring well upgradient of mine
1c	Surface soil, terrestrial plant, and terrestrial invertebrate samples from location upgradient of mine; Composite of 1c, 1d, 1e – surface soil for earthworm and nutsedge bioassay tests, and small mammal sample
1d	Surface soil, terrestrial plant, and terrestrial invertebrate samples from location upgradient of mine
1e	Surface soil, terrestrial plant, and terrestrial invertebrate samples from location upgradient of mine
1f	Surface soil from soil location upgradient of mine
1g	Air sample from location upgradient of mine
1h	Surface water, sediment, fish, aquatic plant, and aquatic invertebrate from location in LCC upgradient of mine; Composite of 1h,1i,1j – surface water for fathead minnow and *Ceriodaphnia* bioassays and sediment for *Hyalella* bioassay
1i	Surface water, sediment, aquatic plant, and aquatic invertebrate from location in LCC upgradient of mine
1j	Surface water, sediment, fish, aquatic plant, and aquatic invertebrate from location in LCC upgradient of mine
2a	Surface water, sediment, aquatic invertebrate, terrestrial plant, and terrestrial invertebrate from CC upgradient of LCC confluence; Composite of 2a, 2b, 2c – surface water for fathead minnow and *Ceriodaphnia* bioassays and sediment for *Hyalella* bioassay
2b	Surface water, sediment, fish, aquatic invertebrate, terrestrial plant, and terrestrial invertebrate from CC upgradient of confluence with LCC
2c	Surface water, sediment, fish, aquatic invertebrate, terrestrial plant, and terrestrial invertebrate from CC upgradient of confluence with LCC
2d	Surface soil from near CC upgradient of LCC confluence; Composite of 2d, 2e, 2f – surface soil for earthworm and nutsedge bioassays and small mammal sample
2e	Surface soil from near CC upgradient of confluence with LCC
2f	Surface soil from near CC upgradient of confluence with LCC
3a	Water from caved-in adit at the mine
3b	Water from waste rock/tailings area seep
4a	Surface water from base of log dam at the mine, surface water for fathead minnow and *Ceriodaphnia* bioassays
4b	Surface water from LCC in mine area
5a	Surface and subsurface soil from soil boring location and groundwater from monitoring well within the waste rock/tailings area at the mine near adit; Composite of 5a, 5b, 5c, 5d, 5e – small mammal sample from waste rock/tailings area
5b	Surface soil, subsurface soil, and groundwater from soil boring location within the waste rock/tailings area
5c	Surface soil, subsurface soil, and groundwater from soil boring location within the waste rock/tailings area
5d	Surface and subsurface soil from soil boring location and groundwater from monitoring well within the waste rock/tailings area
5e	Surface and subsurface soil from soil boring location and groundwater from monitoring well within the waste rock/tailings area
5f	Groundwater sample from mine shaft
5g	Air sample from waste rock/tailings area
5h	Surface soil and subsurface soil from soil boring location within the waste rock/tailings area
6a	Surface soil from within the Former Mill building
6b	Surface soil from within the Former Mill building; Composite of 6a, 6b, and 6c for small mammal sample
6c	Surface soil from within the Former Mill building
6d	Surface soil from within the Cyanide building
6e	Surface soil from within the Cyanide building; Composite of 6d, 6e, and 6f for small mammal sample
6f	Surface soil from within the Cyanide building
6g	Air sample from within the Former Mill building
6h	Air sample from within the Cyanide building
6i	Ponded water from within the Former Mill building
6j	Ponded water from within the Former Mill building
6k	Ponded water from within the Cyanide building
6l	Ponded water from within the Cyanide building
7a	Surface soil from biased location around the buildings at the mine
7b	Surface soil from biased location around the buildings at the mine
7c	Surface soil from biased location around the buildings at the mine
7d	Surface soil from biased location around the buildings at the mine

TABLE 4-2c
Cross-Reference List of Sample Locations and Descriptions[1]
Field Sampling Plan
Lava Cap Mine RI/FS

Location ID	Location Description
7e	Surface soil from biased location around the buildings at the mine
7f	Surface soil from biased location around the buildings at the mine
8a	Surface soil from random location around the buildings at the mine
8b	Surface soil from random location around the buildings at the mine
8c	Surface soil from random location around the buildings at the mine
8d	Surface soil from random location around the buildings at the mine
8e	Surface soil from random location around the buildings at the mine
8f	Surface soil from random location around the buildings at the mine
9a	Surface soil from location outside of the waste rock/tailings area at the mine; Composite of 9a, 9b, 9c – surface soil for earthworm and nutsedge bioassay tests
9b	Surface soil from location outside of the waste rock/tailings area at the mine
9c	Surface soil from location outside of the waste rock/tailings area at the mine
9d	Surface soil from location outside of the waste rock/tailings area at the mine
9e	Surface soil from location outside of the waste rock/tailings area at the mine
9f	Surface soil from location outside of the waste rock/tailings area at the mine
9g	Surface soil from location outside of the waste rock/tailings area at the mine
10a	Surface soil from location around residence at the mine
10b	Surface soil from location around residence at the mine
10c	Surface soil and air sample from location around residence at the mine
10d	Surface soil from location around residence at the mine
10e	Surface soil from location around residence at the mine
10f	Surface soil from location around residence at the mine
10g	*Groundwater sample from residential well at the mine*
10h	Groundwater sample from residential well at the mine
11a to 11x	Surface soil from location on property around Lost Lake
11aa to 11am	Groundwater sample from residential wells not located at the mine
12a	Surface soil, terrestrial plant, and terrestrial invertebrate from LCC below log dam but above CC confluence; Composite of 12a, 12b, 12c, 12d, 12e – surface soil for earthworm and nutsedge bioassay tests, and small mammal sample
12b	Surface soil, terrestrial plant, and terrestrial invertebrate from LCC below log dam but above CC confluence
12c	Surface soil, terrestrial plant, and terrestrial invertebrate from LCC below log dam but above CC confluence
12d	Surface soil, terrestrial plant, and terrestrial invertebrate from LCC below log dam but above CC confluence
12e	Surface soil, terrestrial plant, and terrestrial invertebrate from LCC below log dam but above CC confluence
12f	Surface water, sediment, fish, aquatic plant, and aquatic invertebrate from LCC below log dam but above CC confluence
12g	Surface water, sediment, fish, aquatic plant, and aquatic invertebrate from LCC below log dam but above CC confluence
12h	Surface water, sediment, fish, aquatic plant, and aquatic invertebrate from LCC below log dam but above CC confluence
12i	Surface water, sediment, fish, aquatic plant, and aquatic invertebrate from LCC below log dam but above CC confluence
12j	*Surface water, sediment, fish, aquatic plant, and aquatic invertebrate from LCC below log dam but above CC confluence*
13a	Surface soil, subsurface soil, groundwater, terrestrial plant, and terrestrial invertebrate from the tailings deposition area
13b	Surface soil, subsurface soil, groundwater, terrestrial plant, and terrestrial invertebrate from the tailings deposition area
13c	Surface soil, subsurface soil, terrestrial plant, and terrestrial invertebrate from tailings deposition area; surface soil for earthworm and nutsedge bioassay tests, and small mammal sample
13d	Surface soil, subsurface soil, terrestrial plant, and terrestrial invertebrate from tailings deposition area; surface soil for earthworm and nutsedge bioassay tests, and small mammal sample
13e	Surface soil, subsurface soil, terrestrial plant, and terrestrial invertebrate from tailings deposition area; surface soil for earthworm and nutsedge bioassay tests, and small mammal sample
13f	Surface soil and subsurface soil from tailings deposition area
13g	Air sample from location in the western portion of the tailings deposition area
13h	Air sample from location in the eastern portion of the tailings deposition area
14a	Surface water, sediment, and aquatic invertebrate from location in CC through the tailings deposition area; Composite of 14a, 14b, 14c – surface water for fathead minnow and *Ceriodaphnia* bioassays and sediment for *Hyalella* bioassay
14b	*Surface water, sediment, and aquatic invertebrate from location in CC through the tailings deposition area*
14c	Surface water, sediment, and aquatic invertebrate from location in CC through the tailings deposition area
15a	Surface water, sediment, and aquatic invertebrate from pool in the tailings deposition area; composite of 15a, 15b, 15c, 15d, and 15e for bullfrog sample and fathead minnow and *Ceriodaphnia* bioassays
15b	Surface water, sediment, and aquatic invertebrate from pool in the tailings deposition area
15c	Surface water, sediment, and aquatic invertebrate from pool in the tailings deposition area

TABLE 4-2c
Cross-Reference List of Sample Locations and Descriptions[1]
Field Sampling Plan
Lava Cap Mine RI/FS

Location ID	Location Description
15d	Surface water, sediment, and aquatic invertebrate from pool in the tailings deposition area
15e	Surface water, sediment, and aquatic invertebrate from pool in the tailings deposition area
16a	Surface water, fish (2 species), aquatic plant, and aquatic invertebrate from Lost Lake; surface water for fathead minnow and *Ceriodaphnia* bioassays
16b	Surface water, fish (2 species), aquatic plant, and aquatic invertebrate from Lost Lake; surface water for fathead minnow and *Ceriodaphnia* bioassays
16c	Surface water, fish (2 species), aquatic plant, and aquatic invertebrate from Lost Lake; surface water for fathead minnow and *Ceriodaphnia* bioassays
17a	Sediment samples from Lost Lake within the CC delta
17b	Sediment samples from Lost Lake within the CC delta
17c	Sediment samples from Lost Lake within the CC delta
17d	Fish (2 species), aquatic plant samples from Lost Lake within the CC delta; sediment for *Hyalella* bioassay
17e	Fish (2 species), aquatic plant samples from Lost Lake within the CC delta; sediment for *Hyalella* bioassay
17f	Fish (2 species), aquatic plant samples from Lost Lake within the CC delta; sediment for *Hyalella* bioassay
18a	Sediment from Lost Lake outside of the CC delta; sediment for *Hyalella* bioassay
18b	Sediment from Lost Lake outside of the CC delta; sediment for *Hyalella* bioassay
18c	Sediment from Lost Lake outside of the CC delta; sediment for *Hyalella* bioassay
19a	Surface water, sediment, and aquatic invertebrate from CC downgradient of Lost Lake; Composite of 19a,19b,19c - surface water for fathead minnow and *Ceriodaphnia* bioassays and sediment for *Hyalella* bioassay
19b	Surface water, sediment, and aquatic invertebrate from CC downgradient of Lost Lake
19c	Surface water, sediment, and aquatic invertebrate from CC downgradient of Lost Lake
19d	Air sample at residential property near Lost Lake dam
20a	Contingent surface soil from public campground/beach around Rollins Reservoir
20b	Contingent surface soil from public campground/beach around Rollins Reservoir
20c	Contingent surface soil from public campground/beach around Rollins Reservoir
20d	Contingent surface soil from public campground/beach around Rollins Reservoir
20e	Contingent surface water from Rollins Reservoir
20f	Contingent surface water from Rollins Reservoir
20g	Contingent surface water from Rollins Reservoir

Notes: [1]Although the location descriptions describe the planned biota and bioassay sampling, none of these activities are planned for Round 1 of the RI.
Sample locations are shown in Figures 3-1 through 3-4B.

5 Field Methods and Procedures

This section of the FSP provides information on the field activities associated with the RI at the Lava Cap Mine site. Topics covered in the following sections include: sample collection, disposal of contaminated materials, equipment decontamination, sample containers, sample preservation, sample packaging and shipment, sample documentation, and QC samples.

5.1 Sample Collection

This section provides field methods for the following:

- Surface Soil Sampling
- Field Screening with X-Ray Fluorescence
- Installation of Soil Borings
- Subsurface Soil Sampling
- Monitoring Well Installation
- Groundwater Sampling
  - In-situ
  - Monitoring Wells
  - Residential Wells
- Surface Water
- Ambient Air Sampling
- Sediment Sampling
- Characterization of Terrestrial and Aquatic Habitat
- Aquatic Plant Sampling
- Aquatic Invertebrate Sampling
- Fish Sampling
- Terrestrial Plant Sampling
- Terrestrial Invertebrate Sampling
- Small Mammal Sampling

Photographs will be taken at each sample location to document field conditions at the time of sampling. Sample locations will be marked in the field with stakes or flagging. Global positioning satellite (GPS) instruments will be used to accurately locate each sample location. This is in accordance with the EPA Region IX Locational Data Policy, that establishes principles for data collection and documentation. A Geographic Information System (GIS) approach will be used to organize all types of data collected. If the steep, forested topography causes problems with the handheld GPS instruments, standard land surveying techniques will be implemented.

Each type of field activity is addressed in the following subsections.

5.1.1 Surface Soil Sampling

Surface soil samples will be collected as discrete grab samples. Surface soil samples will be collected using a decontaminated stainless-steel trowel. Samples will be collected from the soil surface between the depths of approximately 0 to 6 inches bgs. Samples will be placed in a decontaminated stainless-steel bowl and homogenized with the trowel. Vegetation, sticks, stones and other debris will be removed from the sample. The trowel will be used to transfer the soil to the appropriate sample containers.

5.1.2 Field Screening with X-Ray Fluorescence Analyzer

Selected soil samples from around Lost Lake and in the Tailings Deposition Area are planned for screening-level analysis of metals. One method that may be used to perform the screening is by XRF spectrometry using a field-portable XRF analyzer. If implemented, it is assumed that the XRF spectrometry will be performed using a Niton Model XL 702 Bulk Sample Analyzer instrument. Field-screening data generated using XRF would allow rapid characterization of the general extent of metals contamination around Lost Lake and in the tailings deposition area. XRF-generated data could be used to guide locations for collection of samples to be analyzed at an offsite laboratory with lower detection limits.

If field-screening with an XRF instrument is used, as a QC check, confirmation samples for offsite laboratory analysis will be collected at 10 percent of the field screening locations analyzed with the XRF instrument. Niton's XL702 is sample matrix independent and can be used to perform in-situ analyses for screening or used with a mini-lab to provide more quantitative sample analysis. For the Lava Cap Mine work, the instrument would be used with the mini-lab to analyze prepared samples. Sample preparation includes homogenizing the soil sample to ensure consistent particle size and increase the accuracy of the analysis. For a silica-type matrix, the XL702 detection limits for a one-minute reading are:

Element	**Concentration (ppm)**
Lead	30
Mercury	80
Arsenic	40
Chromium	500
Cobalt	300
Copper	150

Iron	400
Manganese	400
Molybdenum	20
Nickel	250
Zinc	90

Excerpts from the Niton Model XL702 Field Portable X-Ray Fluorescence Analyzer User's Guide are provided in Appendix C. Prior to use in the field, the operator will become familiar with all of the pertinent portions of the User's Guide and will have a complete copy of the guide in his possession at all times while operating the instrument. The manufacturer's recommended procedures for calibration and overall QC, as described in the User's Guide, will be followed to ensure maximum performance of this field screening tool.

5.1.3 Installation of Soil Borings

Soil borings in unconsolidated soils (e.g., in the deposition area near Lost Lake) may be drilled to the required depth using continuous flight hollow-stem augers. However, boring into consolidated bedrock formations will be necessary at the mine and in upgradient areas. Soil borings into consolidated materials will be advanced using either air rotary, air rotary casing hammer or dual-tube percussion drilling techniques. Except for four of the soil borings in the deposition area near Lost Lake, all borings will be advanced into the water table. Based on the depth to water in the mine shaft (approximately 100 feet bgs), it is assumed that the water table could be more than 100 feet bgs upgradient of the mine.

For the background borings, even if water is present in the volcanic rocks (the lava cap), the borings will be advanced through the volcanic rocks and into the sedimentary bedrock. Based on information presented in a report prepared by Hydro-Search (Hydro-Search, 1984), none of the boring locations will be affected by the historic subsurface mine workings.

Prior to initiating any subsurface drilling activities, utility clearance will be performed. In addition to the required Underground Service Alert (USA) notification and clearances, non-intrusive (geophysical) utility clearances may be completed by a subcontractor. The need for a utility clearance subcontractor will be determined based on the amount of utility information available on the private properties where drilling is planned. If used, the utility clearance subcontractor will identify locations of underground lines, tanks, or other below ground items that might cause a hazard during drilling. Any utilities found will be marked on the ground by spray painting along the centerline of the utility.

Continuous cores will be collected from all soil borings for lithologic description and collection of soil samples (described below). The cores will be logged onsite by the field geologist/hydrogeologist. Preparation of soil boring logs is described in the next subsection. In-situ groundwater samples (described below) will also be collected from selected soil borings. After the borings have been advanced to total depth and all necessary samples collected, the borings will either be completed as monitoring wells or backfilled with grout then abandoned.

The drill rig and any other equipment (e.g., augers or drive casing) that will be used downhole will be steam cleaned between each boring. All steam cleaning water will be containerized and stored onsite with other liquid wastes as described below in Section 5.3

Soil Boring Logs

A log of soil lithology will be completed by the on-site geologist for each soil boring installed. The log will include descriptions of all subsurface materials encountered during drilling as well as information on the drilling company, drilling method, name of the geologist preparing the log and boring location. A more detailed Standard Operating Procedure for preparation of soil boring logs is included in Appendix D. The materials will be classified and logged in accordance with the American Society for Testing and Materials (ASTM) Method D-2488. The soil lithology shall be recorded on the boring log in the following order:

- Predominant lithologic type with major modifiers (e.g., gravelly sand, silty sand clayey silt, silty clay)
- Color
- Grain size
- Minor modifiers (e.g., some silt, trace clay, etc.)
- Relative moisture content (e.g., dry, damp, moist, etc.)
- Other descriptive terminology as appropriate. Examples of this include relative density or consistency, bedding observations, distinctive mineralogy, sorting or grading.
- Visual evidence of soil contamination

Examples of the format to be used for lithologic descriptions are shown below:

> Clayey sand (SC): yellowish brown, fine to medium, well-rounded to subrounded, quartz, about 3 percent pebbles, low plasticity.
>
> Sand (SW): yellowish brown, fine to coarse, angular to subangular, moist, quartz
>
> Silty Clay (CL): light brown, very fine, minor sand, damp, medium hardness, low plasticity

In addition to continuously logging the subsurface materials encountered, pertinent information regarding drilling operations will be recorded on the log form. Examples may include drilling rate, rig down time, drilling problems, depths of soil samples collected. All soil boring logs will be signed and dated by the on-site geologist preparing the log.

5.1.4 Subsurface Soil Sampling

Continuous cores will be collected from all of the soil borings. These undisturbed cores will be used for lithologic logging and, at the appropriate depths, for collection of soil samples.

In the background borings, it is anticipated that the initial drilling in the boring to the northeast will be through volcanic rocks in the lava cap. Five samples will be collected from this boring, three in the volcanic rocks (in the upper 10 feet bgs, between 10 and 25 feet bgs and near the base) and two in the underlying sedimentary bedrock (near the top of the formation and near the water table). If the entire sedimentary bedrock formation is saturated, the second sample will be collected approximately 20 feet into the sedimentary formation. The boring to the west will likely be in sedimentary bedrock from the surface. Samples will be collected from this boring at three depths, one in the upper 10 feet bgs, a second between 10 and 25 feet bgs and one near the water table. The actual sampling depths will be based upon field observations of changes in the lithology.

For borings drilled through the waste rock/tailings, one sample will be collected in the upper 10 feet bgs, one other sample will be collected near the base of the waste rock/tailings, and one sample collected in the native formation near the water table. The specific depths to be sampled will be based on visual observation of the soil cores retrieved from the borehole.

In the borings installed in the deposition area above Lost Lake, one subsurface soil sample will be collected in the upper 10 feet bgs, one sample will be collected from 25 feet bgs and one sample collected near the water table.

At the selected sample depths, soil will be transferred from the core into a stainless steel bowl using a stainless steel knife or trowel. The soil will be homogenized in the bowl then placed into the appropriate sample containers.

5.1.5 Monitoring Well Installation

Well construction will comply with California Department of Water Resources, California Department of Health Services, and Nevada County Department of Health Services requirements. The monitoring wells will be constructed of 4-inch-diameter threaded schedule 40 PVC casing and will be constructed in 10- to 12-inch diameter boreholes. The wells will be installed approximately 18 feet into the water table. The water table is potentially greater than 100 feet bgs above the mine, but is likely less in the waste rock/tailings area and in the deposition area near Lost Lake.

The blank well casing will consist of 10- or 20-foot sections of Schedule 40 PVC casing. Each monitoring well will have 20 feet of well screen that extends approximately 15 feet below and 5 feet above the water table. The screen will be Schedule 40 PVC with a slot size of either 0.010 or 0.020 inch, depending on lithologic conditions. A 3-foot sump will be attached to the bottom of the screen.

Gravel pack will be tremmied around the screen interval, extending up from the bottom of the borehole to approximately 5 feet above the well screen. Gravel pack material will consist of thoroughly washed hard, durable, siliceous sand. The size and gradation of the gravel pack, as well as the screen slot size, will be assessed by the site geologist/ hydrogeologist based on field examination of formation samples. Following placement, the well will be surged to ensure that the gravel pack contains no voids caused by bridging.

Approximately three feet of finer-grained transition sand will be placed above the gravel pack to prevent grout from invading the gravel pack material. Approximately three feet of bentonite transition seal will be placed above the transition sand. If the seal is below the water table, bentonite chips will be used. If the seal is above the water table, either bentonite chips or bentonite slurry will be used.

An annular grout seal consisting of cement grout, with a small amount of bentonite powder to reduce shrinking and cracking, will be installed from the top of the transition sand to the ground surface.

Well development will be performed following well completion. Wells will be developed as soon as is practical after completion, but no sooner than 24 hours after the concrete grout has been installed. Development will be by bailing, swabbing and, potentially, pumping. Well development will continue until at least ten well volumes have been removed from the well, field parameters (including turbidity) have stabilized, and the water is deemed clear by CH2M HILL field personnel.

Initial well development will involve bailing to remove accumulated solids from the well. Bailing will continue until water is relatively clear and no solids remain in the well. Swabbing will then be initiated, working from the top of the screen down. Each interval will be swabbed for 5 to 10 minutes until the entire length of screen has been swabbed. This will be followed by additional cycles of bailing and swabbing until the water is clear.

If the well produces sufficient water, a pump will be installed to complete the well development process. The well will be pumped at a flow rate approximately equal to the yield of the well (i.e., drawdown should stabilize). The pump will be shutdown periodically to surge the well. Cycles of pumping and surging will continue until field parameters stabilize, no "slug" of dirty water occurs at pump startup, and the water is deemed clear by CH2M HILL field personnel.

5.1.6 Groundwater Sampling

Three types of groundwater samples will be collected: in-situ samples from soil borings (and the mine shaft), samples from new monitoring wells, and samples from residential wells. For all groundwater sampling, field parameters will be measured to provide information on groundwater characteristics and determine when groundwater samples can be collected. The following parameters will be recorded for all groundwater samples: pH, temperature, electrical conductivity, oxidation-reduction potential (also known as Eh or redox), dissolved oxygen, and turbidity.

In-Situ Groundwater Sampling

In-situ groundwater samples will be collected from soil borings (described above) using HydroPunch® or equivalent samplers. The soil borings will be advanced until soil cores indicate saturation. At that point, drilling tools or the auger plug will be removed from the boring. The HydroPunch® or equivalent sampler will be connected to center rods and lowered to the total depth of the borehole. The sampler will be driven 3 to 4 feet into the soil by applying a downward pressure on the center rods using the drill rig. After driving the sampler the desired depth, the outer shell of the sampler will be retracted exposing the inner sample chamber screen. A water level indicator will be lowered into the hole to determine the height of water column in the sample chamber as it fills. When an adequate volume of groundwater has flowed into the chamber, the water level indicator will be removed and a decontaminated small-diameter bailer will be lowered through the rods and into the chamber to collect the groundwater. This will continue until sufficient sample volume has been collected to measure field parameters and fill all of the required sample bottles.

The groundwater sample from the mine shaft will be collected by lowering a disposable bailer into the shaft to retrieve a sample. The first bailer of water will be used to measure field parameters. The bailer will then be lowered into the shaft repeatedly until sufficient sample volume has been retrieved. A second field parameters reading will be collected from the final bailer of water.

For dissolved metals samples, which require field filtration, a disposable 0.45 micron filter will be used in conjunction with either a vacuum pump or peristaltic pump to filter the sample. The filtered sample will be transferred to a sample bottle containing nitric acid. Samples for analyses of total metals will be collected directly into a sample bottle containing nitric acid at the same time all of the other sample bottles are being filled.

Monitoring Well Sampling

Groundwater samples will be collected from the new monitoring wells to be installed as part of the RI field activities at the Lava Cap Mine site. Groundwater samples will be collected using the low-flow, minimal drawdown procedure (also known as the "micropurge" technique) described in EPA 1996. Low-flow, minimal drawdown sampling techniques minimize sediment disruption in the well and oxygen exchange with the atmosphere. These are particularly important factors when collecting samples for metals analyses. Using the low-flow technique, the well is purged at a low flow rate (a rate that does not significantly lower the water level within the casing) with a pump placed in the screened interval. At the Lava Cap Mine site, the goal will be to use a pumping rate of less than 0.5 gallons/minute with drawdown of less than 0.5 feet during purging. However, these targets may need to be modified in the field if any of the monitoring wells produce water at very low rates.

At each monitoring well, a portable submersible pump will be lowered slowly into the well to the middle of the screened interval. Care will be taken to minimize both disturbance of solids in the well and excessive mixing of the stagnant water in the casing above the screen. Pumping will continue until the field parameters of pH, redox potential, electrical conductivity, dissolved oxygen, and turbidity stabilize to within specified criteria for three successive readings. The criteria for stabilized readings are: ± 0.1 pH units, ± 3 percent for conductivity, ± 10 millivolts for redox potential, and ± 10 percent for turbidity and dissolved oxygen.

Field parameters should be measured every three to five minutes. Parameters are considered stabilized when all parameters meet the stabilization criteria for three successive readings. Stabilized readings indicate that a groundwater sample that is representative of the native formation groundwater can be collected. An electric sounder will be used to take water level measurements. The volume of water extracted will be recorded throughout purging whenever field parameters are measured. The samples, including those for total metals analyses, will be collected by filling sample bottles directly from a sampling port in the pump discharge tubing.

If any of the monitoring wells do not yield sufficient water to maintain a continuous, low pumping rate, those wells will be sampled using a bailer. The bailer will be used to bail the well dry. After sufficient water has recovered in the well to conduct sampling activities, the bailer will be lowered into the well multiple times to collect water for field parameter measurements and filling sample bottles. The samples, including those for total metals analyses, will be collected by filling sample bottles directly from the bailer or directly from a sampling spigot in the pump discharge tubing.

For bailer sampling, field filtering of dissolved metals samples will be performed as described above for in-situ groundwater samples. If sample collection is performed with a pump, a disposable in-line filter (0.45 micron) will be connected to the sample tubing and the acidified sample bottle filled directly from the pump discharge.

Residential Well Sampling

Wellhead samples will be collected from selected residential wells in the Lava Cap Mine site vicinity. This will include residential wells in the mine area, areas along Little Clipper Creek, and areas around and adjacent to the Lost Lake area. These samples will be collected from as close to the wellhead as possible. If no spigot is available at the wellhead or the pressure tank, an outdoor water faucet will be used for sampling. It is assumed that all of the residential wells to be sampled will be in a normal operating status and substantial volumes will have been pumped from the well recently. Thus, there will be no attempt to estimate and pump, three well volumes prior to sampling.

If the sample can be collected from near the wellhead, the well pump will be run for 10 minutes and field parameters measured. At the end of 10 minutes, the groundwater sample bottles, including those for total metals analyses, will be filled directly from the spigot. A disposable in-line filter will be used to filter dissolved metals samples and the sample bottle will be filled directly from the in-line filter.

There are several conditions where additional pumping (i.e., longer than 10 minutes) may be appropriate prior to sample collection. These include:

- the residence being currently unoccupied and the well not pumping recently;
- the sampling point being downstream of a large pressure tank;
- the well flow rate being very low; or
- unstable field parameters.

The need for additional pumping will be determined in the field by the sample team leader. Well construction (if available), flow rate, purge volume, sampling location, field parameters and other pertinent information will be recorded during residential well sampling. If possible, a water level measurement will be made. However, many residential wells do not have ready access at the wellhead for a sounder.

5.1.7 Surface Water

Surface water samples will be collected from several streams; Lost Lake and ,potentially, Rollins Reservoir; tailings deposition area ponds; and accumulated water inside the abandoned mine buildings. Surface-water sampling in streams will progress from farthest downstream sampling point to the farthest upstream sampling point so that sampling activities do not disturb downstream sample locations.

Samples will be collected either straight into the appropriate sample bottles (if the samples are unpreserved) or using a decontaminated sample collection container or dipper for samples requiring preservation or filtering.

The dipper or sample bottle will be submerged as close as possible (accounting for field safety) to the center of the flow. The dipper or bottle will be submerged with minimal surface disturbance. The mouth of the container will face upstream, allowing it to be filled slowly and continuously. If a dipper is used, the water will be poured gently into the sample bottle with minimum entry disturbance. Samples for dissolved metals analyses will be poured directly into the disposable filter container as described above for in-situ groundwater samples.

After all sample bottles have been filled, the final dipper will be used to record field parameters. The surface water flow rate (in cubic feet per second [cfs]) will be estimated at each sampling location by multiplying the estimated flow velocity by the estimated cross-sectional area of the stream at the sample location. The flow velocity will be estimated using a float placed in the stream and measuring the time it takes to traverse a known distance.

The procedures for collection of surface water samples in Lost Lake and Rollins Reservoir will be similar, except sampling activities will be performed from an inflatable raft and samples will be collected from approximately 6 inches beneath the surface of the lake.

Because of the shallow water depths anticipated, the ponded water samples from the abandoned mine building and tailings deposition area will be collected using a dipper and transferring the water from the dipper to the sample bottles, as described above.

5.1.8 Ambient Air Sampling

Ambient air sampling will be conducted at the Lava Cap Mine site to assess whether fugitive dust released from the site is contaminated with metals and/or cyanide. The sampling will be conducted using the total suspended particulate matter sampling method contained in Title 40, CFR, Part 50, Appendix B. This method requires the use of a high volume (hi-vol) ambient air sampler to pull a known quantity of sample (air) (typically 200 liters/min) through a glass-fiber mat filter that collects the suspended particulate matter. The sampler will be set-up to run for 24 hours to collect each sample. The glass fiber mat filter will conditioned and labeled at the laboratory prior to being shipped to the field for sampling. Conditioning involves desiccating and weighing the filter. At the end of the 24-hour sampling period, the filters will be collected from the sampler and placed in resealable plastic bags for shipment to the lab.

5.1.9 Sediment Sampling

Sediment samples will be collected from the upper three inches of soil underlying and in contact with a surface water body. From an ecological standpoint, sediment is more accurately defined as the exposure point for benthic invertebrate receptors. The distribution and abundance of benthic receptors is primarily a function of oxygen levels and substrate type. If abundant benthic receptors are apparent deeper than the upper three inches of sediment, this will be noted in the field logbook.

When both surface water and sediment samples are being collected from the same location, the surface water sample will be collected first. Sediment samples will be placed into a stainless steel bowl after collection and mixed thoroughly with a stainless steel spoon or trowel. Rocks, sticks, and other debris will be removed from the sample, then the sediment is placed into the appropriate sample containers.

Two sampling methods will be used for collection of sediment samples. Samples from Lost Lake will be collected using a dredge. A dredge is a clamshell-type scoop device designed to be lowered to the bottom of a surface water body for collecting sediment samples. The preferred dredge is a Ponar dredge, designed to generate less turbulence. Samples from the creeks will be collected using a stainless steel scoop or spoon.

For the dredge, the boat will be positioned at the selected sampling location. The dredge will be lowered to the bottom of Lost Lake and into the lake-bottom sediments along the sample line with the sampler jaws open. After the dredge is situated in the sediments at the bottom of the lake, the jaws will be closed to collect the sediment sample. The dredge is then raised to the surface and the sample released into a stainless steel bowl. If dredge sample recovery is poor, multiple trips may be needed to collect sufficient sample volume at each location

The stainless steel scoop will be used to collect the sediment samples from the creek beds. The scoop will collect sediment from approximately the upper 3 inches. If the sampler wades into the creek to collect the sample, the sample location will be approached from downstream. While facing upstream into the current, the sediment will be scooped from the stream bottom in the upstream direction. The collected sediment will be placed into the stainless steel bowl for sample preparation.

5.1.10 Characterization of Terrestrial and Aquatic Habitat

A qualitative survey of habitat quality and general wildlife utilization patterns will be conducted to supplement the other field investigation activities. The objective of this survey is to document the existing habitat quality in the project area, and to provide sufficient information to evaluate impacts (if any) to overall habitat quality attributable to the release of contaminants from the Lava Cap Mine. Dominant plant species will be identified in each identified habitat type. In addition, visual and auditory observations of avian wildlife species, as well as signs of stressed vegetation will be recorded. Incidental observations of other wildlife species or wildlife sign (e.g., burrows, tracks, scat, rubs, etc.) will be recorded during the performance of the surveys. Photo-documentation of each habitat type will be compiled for reference and for the documentation of future changes or improvements in habitat quality for the site. The locations of each area surveyed will be identified through survey or GPS methods and marked with appropriately labeled flagging tape or other semi-permanent method.

In addition to site surveys, public records and appropriate literature will be surveyed to determine the existence or potential utilization of the study area by species of special status, as designated by State or Federal natural resource management agencies.

Aquatic habitats will be characterized by conducting a brief habitat inventory and survey. Aquatic habitat information will be obtained by conducting a walking survey through the project area. Information gathered will include descriptions of the habitat types (i.e. pool, riffle, run) and specific habitat characteristics such as riffle frequency. Habitat data that will be collected include substrate type and composition, embeddedness, and sediment deposition. Other parameters assessed will include in-stream cover (type and quantity), bank vegetation, and stability, and characteristics of the adjacent riparian zone.

Other factors such as channel alterations, point sources of waste discharges, and sources of impacts and changes in habitat character will be noted. Channel morphology characteristics including stream gradient, thalweg and pool depths and sinuosity will be described. All habitat parameters and characteristics will be obtained to assist in evaluating and discerning impacts to aquatic communities from contaminants and changes in physical habitat structure.

5.1.11 Aquatic Plant Sampling

Aquatic plants will be collected for bioconcentration analyses at selected locations. For riparian vegetation, the soft portions (i.e., non-woody tissue) that are above the sediment or waterline will be collected for analysis. In the case of cattails or reeds, samples of the root material in addition to leaf tissue may also be collected for analysis. For submergent vegetation, the entire plant may be collected. Dominant plant species will be identified and recorded in the field; voucher specimens will be collected for confirmation. Observations of plant vigor will be noted. Plant samples will be collected by hand, using plant shears with stainless-steel blades. Samples will be placed in resealable plastic bags and frozen. Only those samples with sufficient volumes for analysis will be saved for chemical analysis.

5.1.12 Aquatic Invertebrate Sampling

Aquatic macroinvertebrates may be captured using a variety of equipment including hand collection, kick nets, dip nets, or shovels. Field conditions at each sample location will be evaluated to select the most appropriate of these sampling methods. Individual specimens will be sieved and washed from the sediment with ambient water, placed in clean containers, and frozen for whole body analysis of contaminants. Only those samples with sufficient weight for analyses will be saved for chemical analysis. Samples will be stored in resealable plastic bags and frozen for storage and shipment.

Samples will be sorted into species and up to three of the most common species will be collected as single samples per species from any given station. Only those species with sufficient biomass for chemical analysis will be collected. Voucher specimens will be collected for each species sampled and stored in glass containers with alcohol.

5.1.13 Fish Sampling

Fish will potentially be captured using a variety of methods and equipment including electrofishing, seines and dip nets. The final choice of fish collection method will be dictated by field conditions at each sample location. The collected fish will be sorted by species and placed in clean containers. Samples will be frozen for whole body or filet analysis of contaminants. Only those samples with sufficient volumes for analyses will be saved for chemical analysis. Samples will be stored in resealable plastic bags and shipped frozen.

The focus for ecological receptors will be on small fish (under approximately 6 inches in length) that will be handled and stored as discussed above. Larger fish will be sampled by taking filet samples for analysis; these will be used to evaluate potential human exposure. All samples will be cooled in the field and frozen as soon as possible. One voucher specimen for each species will be retained and preserved in a glass container with alcohol.

5.1.14 Terrestrial Plant Sampling

The aboveground portions of plants will be collected and analyzed for the parameters specified in Section 4. The choice of which plant types to choose for sampling will be based on their representativeness for the site, co-occurrence in background areas, and evidence of use for food as indicated by browsed shoots or partially eaten leaves.

Attempts will be made to obtain sufficient mass of tissue for at least two plant species (one herbaceous and one woody). Edible portions of the plant species will be analyzed (i.e., leaves and browsable twigs and shoots). Plant samples will be collected by hand and placed into resealable plastic bags. Non-woody material will be collected from the plants using clippers. Each sample will be composited within a taxonomic group (genus or species) from at least three plants to provide at least the minimum wet weight biomass to satisfy the laboratory requirements for analysis. Samples will be stored in resealable plastic bags, then frozen for storage and shipment to the laboratory.

5.1.15 Terrestrial Invertebrate Sampling

Insects and other terrestrial invertebrates (such as earthworms, snails, spiders, or sow bugs) will be collected at the specified sample locations. The invertebrates will be analyzed for whole-body tissue chemistry. If feasible, the invertebrates will be collected from areas located in immediate proximity to locations where soil, sediment or surface water samples are also collected.

It may be difficult to obtain a sufficient biomass of invertebrates for chemical analysis. Therefore, it is likely that broad taxonomic groups may be included in individual samples for chemical analyses. However, attempts will be made to obtain sufficient mass of terrestrial invertebrates for composite samples of a particular taxonomic group (e.g., earthworms). If sufficient biomass of an appropriate taxonomic group is not available, then composite samples may be collected that are made up of mixed terrestrial invertebrates in the sample area.

Soil-dwelling invertebrates (such as earthworms) will be collected for analysis from selected sample locations, if present. Soil- or sediment-dwelling invertebrates will be sorted using stainless steel forceps or trowels and will be placed in clean stainless steel pans. Insect sweep-nets or collection by hand will be used to sample insects from vegetation where they may be eaten by insectivores (especially birds and mammals). Collection techniques may also include pitfall traps, if needed to get sufficient sample mass.

All soil invertebrates will be washed with distilled water to remove soil before placement in clean plastic whirl-packs. Samples will be separated in the field into general, lowest practical taxonomic groups such as family or phylum. Every attempt will be made to collect a sufficient wet weight of terrestrial invertebrates to meet the minimum biomass requirement for the anticipated laboratory analyses; however, it may be necessary to send smaller samples for chemical analysis based on invertebrate availability. If necessary, these smaller samples may be analyzed for a shorter list of target chemicals. Samples will be frozen for storage and shipment to the laboratory.

5.1.16 Small Mammal and Frog Sampling

Small mammals will be live-trapped using Sherman live traps. At each sample location, trap lines will be set in areas where high concentrations of contaminants could be expected (such as sediment/tailings deposition areas). Traps will be maintained daily and set for a minimum of three nights to obtain a representative sample. Frogs will be collected using nets or hand collection. Only those species identified as target species (e.g., harvest mice, house mice, or bullfrogs) will be saved for chemical analysis. Target animals will be killed by non-chemical methods. Stomach contents will be removed from each animal and animals will be placed into glass jars and frozen. All target animals will be shipped frozen. A sample will consist of 3 to 5 animals that will be composited by the laboratory.

5.2 Disposal of Investigation Derived Wastes (IDW)

Types of wastes that may be derived from the Lava Cap Mine RI activities include solids (drill cuttings), liquids (groundwater from well development and purging), decontamination fluids, and used personal protective equipment (PPE) and disposable sampling equipment.

5.2.1 Solids

The drill cuttings will be contained onsite in drums or roll-off bins. The drums or bins will have labels describing the materials contained in the container, the location the wastes were generated, and the date the wastes were placed in the drum. Drill cuttings will be sampled and analyzed to assess whether they are hazardous. To expedite disposal of wastes, a state-certified laboratory provided by the EPA will provide quick turnaround of waste analyses results. If testing indicates that the Toxicity Characteristics (TC) Rule requirements are met (i.e., none of the quantified compounds are above regulatory levels) and the pH flashpoint and total petroleum hydrocarbons (TPH) results are acceptable, the drill cuttings will be classified as non-hazardous and disposed of onsite in an area specified by the EPA. Prior to disposal, any free liquids present will be removed from the drill cuttings and stored with the remainder of the liquid wastes.

If the drill cuttings are classified as hazardous waste, the drums or bins will be hauled to a hazardous waste disposal facility approved to receive CERCLA wastes.

Samples of the drill cuttings will be collected using a decontaminated hand trowel and placed directly into the sample container (glass jar), allowing as little headspace as possible. Practical experience has shown that one composite sample collected from each roll-off bin of cuttings (containing approximately 5 cubic yards) is adequate to characterize the waste.

5.2.2 Liquids

Well development/purge water and decontamination fluids will be stored onsite in separate temporary storage containers pending results from sampling. One sample per storage container will be collected and submitted for laboratory analyses. The samples will be collected using a new, disposable polyethylene bailer to fill the appropriate sample containers, allowing no headspace.

If the contaminant levels are below state and federal MCLs, clear well development/ purge water and decontamination fluids will be disposed in a surface-water channel at the mine. Any water to be disposed in a surface-water channel will be allowed to settle sufficiently such that only clear liquids are disposed. Water or decontamination fluids that has contaminant levels exceeding MCLs will be transported offsite for treatment and disposal at a facility approved to receive CERCLA wastes.

5.2.3 Personal Protective Equipment and Disposable Sampling Equipment

Disposable PPE and sampling equipment generated during the performance of the work will be cleaned off, bagged, and placed in dumpster for disposal as municipal refuse. Any PPE or sampling equipment that potentially contains residual wastes (i.e., that can not be cleaned off) will be bagged and placed in DOT-approved 55-gallon drums (i.e., 17H). The drums will be sealed and labeled to indicate site name, drilling or sampling location, what is being stored, and date. If the associated drill cuttings are determined to be non-hazardous, the protective clothing will be disposed as municipal waste. If, the drill cuttings are classified as hazardous waste, then the associated drums of PPE will be hauled to a hazardous waste disposal facility approved to receive CERCLA wastes.

5.3 Equipment Decontamination

All field and sampling equipment that may contact samples must be decontaminated prior to initial use and after each subsequent use. The following decontamination procedure shall be used:

- Wash with non-phosphate detergent, use a brush if necessary
- Tap-water rinse
- 0.1N nitric acid rinse
- Deionized or distilled water rinse (twice)

- Air dry

Clean equipment will be stored on plastic sheeting in uncontaminated areas. Decontaminated equipment that is to be stored for more than a few hours will be covered.

5.4 Sample Containers

Sample container requirements for each requested analysis are summarized in Tables 4-2a through 4-2c. Sample containers will be either laboratory-provided and certified clean by the laboratory or purchased new by CH2M HILL and quality control checked by the supplier. CH2M HILL will be responsible for obtaining the appropriate sampling containers prior to initiating sampling activities.

Samples of aquatic and terrestrial plant and invertebrate tissue and fish will be contained in 1-gallon or smaller resealable plastic bags. Small mammal samples will be placed in glass jars.

Surface soil and sediment bioassay samples will be placed in large capacity, heavy-duty (thick) plastic vinyl bags and double-bagged. Surface water bioassay samples will be collected in 5-gallon plastic containers.

5.5 Sample Preservation

Sample preservation requirements for each analysis are presented in Tables 4-2a through 4-2c. No preservation is required for particulate filter samples of ambient air. All soil and sediment will be cooled to 4° Celsius with ice immediately after sample collection, no other preservation is required. Aquatic and terrestrial plant and invertebrate tissue samples, along with fish and small mammals samples, will be frozen after collection. Preservation of surface water and groundwater samples is discussed below.

Groundwater and surface water samples collected for dissolved metals analysis will be passed through a 0.45-micron filter immediately after collection. After filtering, the sample will be placed in 1-liter polyethylene sample bottle containing nitric acid. The pH of each sample bottle will be checked with pH paper to ensure that the pH is less than 2. If necessary, additional nitric acid will be added to bring the pH down to less than 2. If possible, disposable 0.45-micron in-line filters will be used for samples collected from residential wells. Following pH adjustment, samples will be cooled to 4 degree C.

Water samples to be analyzed for cyanide will be placed into 1-liter polyethylene bottles containing sodium hydroxide (NaOH). The pH of each sample bottle will be checked with pH paper to ensure that the pH is above 12. If necessary, additional NaOH will be added to raise the pH to above 12. Following pH adjustment, samples will be cooled to 4° C.

Samples to be analyzed for chloride, sulfate, alkalinity and TDS will be placed in a 500-ml polyethylene bottle and cooled to 4° C. Samples to be analyzed for hardness will be placed in a 250-ml polyethylene bottle containing sulfuric acid. The pH of each sample bottle will be checked with pH paper to ensure that the pH is below 2. If necessary, additional sulfuric acid will be added to lower the pH to below 2. Following pH adjustment, samples will be cooled to 4° C.

5.6 Sample Packaging and Shipment

This section describes how samples will be packaged and shipped.

5.6.1 Sample Containers

Immediately following sample collection, the filled sample bottles will be sealed with custody seals, placed in plastic resealable bags, and placed in a cooler containing ice. All glass bottles will be bubble-wrapped prior to placement into the plastic bags.

The tissue, invertebrate, fish, and small mammal samples will be double-bagged and frozen, then placed in coolers with dry ice.

5.6.2 Preparation of Sample Coolers

- Remove all previous labels from the cooler.
- Seal all drain plugs with tape (inside and outside).
- Place a cushioning layer of recyclable cornstarch popcorn or bubble wrap at the bottom of the cooler.
- Prepare double-bagged ice in resealable plastic bags.

5.6.3 Packing Samples in Coolers

- Place the chain-of-custody (COC) form in a resealable plastic bag.
- Place samples in an upright position in the cooler.
- Fill the void space between samples with recyclable cornstarch popcorn (or equivalent), double-bagged ice or bubble wrap.
- Place ice on top of and between the samples.
- Fill the remaining voids with recyclable cornstarch popcorn (or equivalent) or double-bagged ice.

5.6.4 Sealing the Cooler

Coolers will be packed with packing material surrounding the bottles to prevent breakage during transport. Ice will be sealed in plastic bags to prevent melting ice from soaking the packing material. Sample documentation will be enclosed in sealed plastic bags taped to the underside of the cooler lid. Coolers will be secured with packing tape and custody seals as described below.

- Tape the cooler lid with strapping tape, encircling the cooler several times.

- Place COC seals on two sides of the lid (one in front, and one on the side) and cover with tape to prevent inadvertent breaking of the seals.
- Place "This Side Up" arrows on the sides of the cooler.

5.6.5 Sample Shipping

The coolers will be shipped to the appropriate laboratory by overnight courier. If possible, samples will be shipped on the day of sample collection. Samples collected late in the day may be shipped on the following day. If samples are shipped to an outside laboratory, not arranged through the EPA's Region IX Quality Assurance Office (QAO), the laboratory should be notified that the samples are being shipped.

If laboratory services are arranged through the EPA's QAO, the Region IX Regional Sample Control Coordinator (RSCC) must be contacted at 415 744-1498 within 24 hours of sample shipment and provide the following information:

- Sampling contractor's name
- Site name
- Case number
- Total number(s) by concentration and matrix of samples shipped to each laboratory
- Carrier, air bill number(s), method of shipment (priority next day)
- Shipment date and intended laboratory receipt date
- Irregularities or anticipated problems associated with the samples
- Whether the current shipment is the final shipment or if additional samples will be shipped under the same case number

For Friday shipments, the RSCC must be contacted prior to 12 noon Friday to coordinate with laboratories that will receive sample shipments on Saturday. Samples will only be shipped on Friday if the laboratory provides assurance that analytical holding times will not be exceeded.

5.7 Field Documentation

5.7.1 Field Log Book

All field activities will be recorded in a bound and numbered field log book. Each field crew will be assigned a field log book, as will the field manager. All field log book entries must be dated, legible, written in permanent ink, and contain accurate and inclusive documentation of project activities. Language should be objective and factual. Entries should include (if applicable):

- Names of all personnel, including names and affiliation of any visitors

- Log of daily activities and significant events, including discussions resulting in pertinent field decisions
- General description of weather conditions
- Sample location, type and depth
- Sample methodology and sample number
- Date and time of sample collection
- Sample collector
- Reference to photographs taken
- Field observations and descriptions of problems encountered or changes made to the original sampling plan
- QC sample (duplicate or blank) sample location and sampling method
- Field instrument calibration information
- Documentation of equipment decontamination
- Name, address, and telephone number of the contracted analytical laboratory
- Time left site
- Signature of person making log entries and date, including initials on each page of the log book.

Any necessary corrections will be made as single lines through the error, then signed and dated by the person making the correction

5.7.2 Daily Field Report

A daily field report will be completed by the field manager for each day of field activity. This report will summarize field activities completed that day, including samples collected, and important events or field decisions made. The daily report will be provided to the EPA WAM and the Site Manager each day.

5.7.3 Chain-of-Custody Paperwork

Chain-of-custody forms will be filled out for all samples collected. A chain-of-custody form will be completed and included with each sample shipment; the laboratory copy will be delivered with the cooler, and the duplicate copy will be retained by the sampling team member. All chain-of-custody forms and custody seals will be signed and dated by the sampling team member.

Additional EPA sample paperwork requirements and forms are described in Appendix E.

5.7.4 Sample Labels

Each sample container will be labeled. The following information will be written on each sample container label with a permanent marker. Sample labels will be covered with clear plastic tape:

- Sample number
- Case number (if applicable)
- Type of analysis requested
- Preservative used
- Date and time collected

All sample numbers and locations (including blanks and duplicates) will be recorded in the field notebook.

5.8 Quality Control Samples

QC samples will be collected or prepared to assist in determining data reliability. These QC samples include field duplicates, blank samples, background samples and laboratory QC samples (for matrix spike [MS] and matrix spike duplicate [MSD] analyses). QC samples are normally collected from locations that are suspected to be of moderate contamination. QC samples will be collected immediately following collection and using the same procedures as the collection of the target or "normal" sample.

5.8.1 Field Duplicate Samples

The field duplicate is an independent sample collected as close as possible to the original sample from the same source and is used to document sampling precision. Duplicates will be labeled and packaged in the same manner as normal samples so that the laboratory cannot distinguish between normal samples and duplicates. Field duplicates for water samples will be collected by alternately filling sample and sample duplicate containers at a location of known or suspected contamination. Each duplicate will be taken using the same sampling and preservation method as other samples.

Field duplicate sample containers for surface and subsurface soil samples will be filled using a soil sample that has been homogenized in a stainless steel bowl.

Field duplicates will be collected at minimum frequency of one in every 10 samples. Table 3-2 presents the number of field duplicate samples expected to be collected during Round 1 of the RI field activities.

5.8.2 Blank Samples

One blank sample will be submitted each day that water sampling is conducted. One equipment blank sample will also be collected each week that soil sampling is performed.

Blank samples are collected to verify that contamination is not introduced to samples during collection, handling, or shipping of the samples. Blanks will be prepared and labeled in the same manner as the field samples and sent "blind" to the laboratory. If sampling equipment is decontaminated and reused in the field or when a sample collection vessel (e.g., a bailer or beaker) will be used, an equipment blank will be collected. Otherwise a field blank (also called a field bottle blank) will be collected. Metal-free (deionized or distilled) water will be used for preparing blank samples.

Equipment Blank

An equipment blank is collected by pouring the appropriate water into the decontaminated sampling equipment or vessel, then transferring the water to the sample bottles. For groundwater samples the sampling equipment could be either a decontaminated or a new bailer, for surface water samples the equipment may be a decontaminated beaker, and soil sampling equipment would include a decontaminated stainless-steel trowel and bowl. The same preservation methods, packaging and sealing procedures as those used during collection of normal samples will be used (including field filtering if appropriate).

Field Blank

A field blank is collected by pouring the appropriate blank water directly into the sample bottles at the sample location. Again, the same preservation methods, packaging and sealing procedures as those used during collection of normal samples will be used (including field filtering, if appropriate).

5.8.3 Background Samples

Background samples will be collected for all media to be investigated as part of the RI field activities at the Lava Cap Mine site. Background samples will be collected in the same manner as described in Section 5.1 for the normal environmental samples. Background sample locations are described in Section 3.

5.8.4 Confirmation Samples

Confirmation samples will be collected as part of field screening surface soil sampling and submitted to the laboratory. These confirmation samples will be used to verify the surface soil analyses performed in the field using the portable XRF analyzer. Confirmation samples will be collected at a rate of 10 percent of the field screening samples. The number of confirmation samples is described in Section 3.

5.8.5 Laboratory QC Samples

Laboratory QC samples will be collected to perform MS and matrix spike duplicate MSD analyses. An MS is an aliquot of a sample spiked with a known concentration of target analyte(s). An MS analysis provides a measure of the method accuracy. The MSD is a laboratory split sample of the MS and is used to determine the precision of the method.

Twice the normal sample volume will be collected for laboratory QC samples. Laboratory QC samples will be labeled as such on sample bottles and paperwork and will be collected at a frequency of 1 in every 20 samples (or one per week, whichever is greater) collected. Table 3-2 presents the number of lab QC (MS/MSD) samples expected to be collected during Round 1 of the RI field activities.

5.9 Corrective Actions

If warranted, based on the analytical results from field QC samples, corrective actions will be initiated. Corrective actions for field QC that do not meet QC requirements are briefly discussed in the following subsections.

5.9.1 Equipment Blanks

Equipment blank data (including "field blank" data) will be reviewed for positive detection of target compounds about the quantitation limit. Positive detections less than five times the quantitation limit will be evaluated for qualification because of laboratory contamination. If the equipment blank is not associated with a contaminated method blank, the laboratory will be contacted to confirm the detection and ensure that the detection is not a typographical or transcription error. If the detection is a typographical error, a new data sheet will be issued and no further corrective action will be required. If the detection is confirmed by the laboratory and is above quantitation limits, the quality assurance officer, site manager and field manager will be contacted immediately to begin corrective action. One corrective action may include adding an additional solvent rinse to the decontamination process. After corrective actions have been initiated, an equipment blank will be collected to monitor the effectiveness of the corrective action and an expedited analysis will be performed. Results of the expedited analysis will be reviewed to verify that the corrective actions initiated in the field have been adequate. If the corrective action has not been successful, the quality assurance officer will be contacted and a field audit will be performed immediately.

5.9.2 Field Duplicates

Field duplicate analytical data will be reviewed for agreement with the original sample result. Detections above the quantitation limit will be used to calculate the relative percent difference (RPD) between the two results. If the RPD is outside of the acceptable limits (described in the QAPP), then the laboratory will be contacted to confirm the detection and ensure that the reported concentrations are correct. If the detections are determined to be a typographical error, new data sheets will be issued and no further corrective action will be required. If the reported concentrations are confirmed by the laboratory and are more than five times the quantitation limits, the quality assurance officer, site manager and field manager will be contacted immediately to begin a corrective action for groundwater samples from wells or surface water samples. Corrective action will not be initiated for soil, sediment or in-situ groundwater samples that do not agree because the source of the disagreement is probably matrix heterogeneity. After corrective actions have been initiated, a confirmation water sample will be collected and an expedited analysis will be performed.

Results of the expedited analysis will be reviewed to confirm that the corrective actions initiated in the field have been adequate. If the corrective action has not been successful, the quality assurance officer will be contacted and a field or laboratory audit will be performed immediately.

6 References

Bechtel. *Site Inspection, Lava Cap Mine, 14501 Lava Cap Mine Rd., Nevada City, CA 95959.* Prepared for EPA Region IX. November 20, 1994.

California Department of Finance. Information from their website http://www.dof.ca.gov. 1999.

Cole/Mills Associates. *Final Environmental Impact Report for the Rezoning and Use Permit Application of Franco-Nevada Mining Corporation, Inc. at Banner-Lava Cap Mine, Nevada County, California.* Prepared for the Nevada County Planning Department. January 1985.

Harrington, J. *California Stream Bioassessment Procedure (Benthic Macroinvertebrate Field Sampling and Macroinvertebrate Laboratory and Data Analysis).* California Department of Fish and Game, Water Pollution Control Laboratory-Aquatic Bioassessment Laboratory, Rancho Cordova, CA. March, 1995.

Hydro-Search, Inc. *Hydrologic Effects of Lowering Water Levels During Exploration – Banner-Lava Cap Mine, Nevada City, California.* June 29, 1984.

EPA. See U.S. Environmental Protection Agency.

Nevada County. Nevada County General Plan. December 1995.

U.S. Environmental Protection Agency. *Guidance for the Data Quality Objectives Process. EPA QA/G-4.* U.S. EPA Office of Research and Development, Washington D.C. EPA/600/R-96/055. September 1994.

———. *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures.* U.S. EPA Office of Research and Development, Office of Solid Waste and Emergency Response, EPA/540/S-95/504. April 1996.

———. *Revisions to Rapid Bioassessment Protocols for Use in Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish.* U.S. EPA, Washington D.C. 1997.

———. *Quality Assurance Project Plan for the RI/FS, Lava Cap Mine Superfund Site.* Prepared for EPA Region IX by CH2M HILL. August 1999.

Vector Engineering, Inc. *Preacquisition Site Assessment for the Banner Mine and the Banner Lava Cap Mine.* Prepared for Steve Elder. July 1989.

Appendix A

Lava Cap Mine RI/FS

Data Quality Objectives

TABLE A-1
Lava Cap Mine Data Quality Objectives

Location	Step 1: Statement of Problem	Step 2: Identify the Decision	Step 3: Inputs to the Decision	Step 4: Study Boundaries	Step 5: Decision Rules	Step 6: Limits of Uncertainty	Step 7: Optimize the Sampling Design
Background	Need to define background levels upgradient of the mine and in CC upstream of the confluence with LCC.	What are background concentrations of the COPECs/COPCs in this area?	Validated analytical data with the MDL below the EPRGs, PRGs, and/ or MCLs for the following media: – Surface soil – Subsurface soil – Groundwater – Surface water – Sediment – Air – Fish and aquatic plants – Aquatic invertebrates – Terrestrial plants and invertebrates – Small mammals Visual observations and measurements: – Lithology – Water quality readings – Habitat assessment Bioassay results	Upgradient of mine CC upgradient of confluence with LCC Early sampling (initial investigation phase) in order to evaluate data from other locations Temporal (seasonal) variability: – Surface water and air will be sampled three times and groundwater wells will be sampled twice	Ensure that background data set is statistically significant If background concentrations exceed EPRGs, PRGs, and/or MCLs, then the background concentration will be the action level for the site. If background concentrations do not exceed EPRGs, PRGs, and/or MCLs, then the appropriate regulated level will be the action level for the site.	Multiple background locations are being sampled for all media to ensure a representative background data set Sampling both upgradient of the mine and upgradient in CC watershed Performing background bioassay tests	Surface soil samples will be collected upgradient of the mine and in the upgradient section of CC. Surface soil will also be collected for bioassay tests. Soil borings will be drilled upgradient of the mine. Subsurface soil will be collected at multiple depths in each boring. One of the soil borings will be completed as an upgradient monitoring well. Hydropunch groundwater samples will be collected from the soil boring(s) not completed as monitoring wells. Surface water and sediment samples will be collected in the upgradient sections of both LCC and CC. Samples will also be collected for bioassay tests. In addition, fish, aquatic invertebrate and plant, terrestrial invertebrate and plant, and small mammal samples will be collected. A 24-hour composite air sample will be collected upgradient of the mine during three separate sampling events. An ecological habitat assessment will be performed.
Source Area	Need to characterize conditions in the source area: • Summarize site history and previous investigation data • Determine volume and extent of the source • Determine source area concentrations and COPECs/COPCs • Determine potential for continual source (mine drainage, dam stability, potential for leaching)	What are the COPECs/COPCs? Do the COPECs/ COPCs exceed action levels/background? Is there a significant continual source present? What is the stability of the log dam? Is there a potential for a future significant release?	Potential receptors: human and ecological EPRGs, PRGs, MCLs, and background levels for COPECs/COPCs Visual observations and measurements: – Lithology – Log dam stability – Volume of source – Mine discharge adit and seep flow rates – Water quality readings – Habitat assessment Validated analytical data with the MDL below the EPRGs, PRGs, MCLs, and/or background levels for the following media: – Surface soil – Subsurface soil – Groundwater – Mine discharge	Area of the mine (including within old mine buildings), waste rock, and tailings pile (including the mine discharge adit and seep) Log dam Vertically to determine depth to groundwater and air impacts Temporal (seasonal) variability: – Surface water and air will be sampled three times and groundwater wells will be sampled twice	If constituent concentrations are below EPRGs, PRGs, MCLs, and/or background levels, then no COPECs/COPCs are present and no further action will be required. If constituent concentrations exceed EPRGs, PRGs, MCLs, and/or background levels, then the specific compounds will be COPECs/COPCs and risk management decisions will be used to determine appropriate action. If technical experts determine that the log dam is potentially unstable, then consider additional evaluations.	Some sample locations will be biased inside the mine buildings Direct field readings/ observations and analytical sampling monthly for one year at the mine discharge locations Sampling of groundwater twice to determine if seasonal trends exist. Surface water bioassay at the base of the log dam Air sample within each of the two primary remaining mine buildings	Surface soil samples will be collected from within the mine buildings and the waste rock areas. Soil borings will be drilled and logged within the waste rock area. Subsurface soil will be collected at multiple depths in these borings. The two borings furthest south will be completed as downgradient monitoring wells. Hydropunch groundwater samples will be collected from the soil borings not completed as monitoring wells. One soil boring will be drilled and logged near the mine discharge point (caved-in adit). Subsurface soil will be collected at multiple depths. This soil boring will be completed as monitoring well. A groundwater sample will be collected from the mine shaft. Samples will be collected from the two presumed mine discharge points (caved-in adit and seep) and at the base of the log dam monthly for up to 12 months. The flow rates will also be determined. Bioassay tests will be conducted with the water from the base of the log dam. Surface water from the ponded water areas in the mine buildings will be sampled once. Small mammal samples will be collected from within the mine buildings and the waste rock area near the mine discharge point.

TABLE A-1
Lava Cap Mine Data Quality Objectives

Location	Step 1: Statement of Problem	Step 2: Identify the Decision	Step 3: Inputs to the Decision	Step 4: Study Boundaries	Step 5: Decision Rules	Step 6: Limits of Uncertainty	Step 7: Optimize the Sampling Design
			– Surface water – Air – Small mammals Bioassay results Screening HHRA and ERA results				24-hour composite air samples will be collected from the mine buildings during three separate sampling events. In addition, an air sample will be collected within the waste rock/tailings area. Log dam stability will be evaluated. An ecological habitat assessment will be performed.
Mine Area	Need to define the extent of impacts from the source (the extent of the impacted area) at the mine	What is the extent of contamination in the mine area? Which media are affected in the mine area? Do the COPECs/COPCs exceed action levels/background? Are residential wells in the mine area affected?	Potential receptors: human and ecological EPRGs, PRGs, MCLs, and background levels for COPECs/COPCs Visual observations and measurements: – Water quality readings – Habitat assessment Validated analytical data with the MDL below the EPRGs, PRGs, MCLs, and/or background levels for the following media: – Surface water – Groundwater – Surface soil – Air Bioassay results Screening HHRA and ERA results	Mine areas outside of the source (waste rock and tailings areas) including the residences at the mine Area that could have been potentially impacted by the source (including surface water drainage accumulation areas, areas around residences, areas where wind deposition could have occurred) Temporal (seasonal) variability: – groundwater wells will be sampled twice and surface water/air will be sampled three times	If constituent concentrations are below EPRGs, PRGs, MCLs, and/or background levels, then no COPECs/COPCs are present and no further action will be required. If constituent concentrations exceed EPRGs, PRGs, MCLs, and/or background levels, then the specific compounds will be COPECs/COPCs and risk management decisions will be used to determine appropriate action.	Some sample locations will be biased around buildings and near the bunkers (where explosives were stored) Sampling of groundwater twice and surface water/air three times to determine if seasonal trends exist. Performing bioassay tests	Surface soil samples will be collected from around the mine buildings (biased in areas of surface water runoff and randomly located), outside of the waste rock area (randomly located), and near the residences in the mine area. Soil outside of the waste rock area will be collected for soil bioassay tests. Groundwater samples will be collected from the residential wells in the mine area during two separate sampling events. A 24-hour composite air sample will be collected from the mine area residences during three sampling events. Surface water samples will be collected from LCC during three sampling events. An ecological habitat assessment will be performed.
Downgradient	Need to define extent of downgradient contamination from the mine: • Determine the volume of tailings present downgradient • Determine downgradient concentrations of the COPECs/COPCs • Determine potential for	What is the extent of the downgradient contamination? Which media are affected downgradient? Do the COPECs/COPCs exceed action levels/background? Are downgradient residential wells affected?	Potential receptors: human and ecological EPRGs, PRGs, MCLs, and background levels for COPECs/COPCs Visual observations and measurements: – Lithology – Water quality readings – Lost Lake dam stability – Habitat assessment Validated analytical data with the MDL below the EPRGs, PRGs,	LCC below the log dam to confluence with CC CC to Lost Lake Tailings deposition area Lost Lake, including the shoreline and the Lost Lake dam CC between Lost Lake and Greenhorn Creek Rollins reservoir,	If screening-level concentrations are elevated, then adjust planned surface soil locations for analytical sampling around Lost Lake. If constituent concentrations are below EPRGs, PRGs, MCLs, and/or background levels, then no COPECs/COPCs are present and no further action will be required.	Some sample locations will be biased in the tailings deposition area Screening-level samples to assist in optimally placing the analytical sampling locations Sampling of surface water and groundwater twice to determine if seasonal trends exist. Sediment samples within and outside of	Surface soil samples will be collected from the residential property with Lost Lake shoreline. These sample locations will be determined following a screening-level survey. Surface soil samples will be collected from the tailings deposition area (locations will be determined following the screening-level sampling) and along LCC between the log dam and the tailings deposition area. Surface soil will be collected for bioassay tests. Terrestrial plant and invertebrate samples will also be collected. Soil borings will be sampled along CC between the confluence with LCC and Lost Lake. Subsurface soil will be collected at multiple depths in these borings to determine depth of tailings and concentrations of contaminants with depth. Hydropunch groundwater samples will be collected from some of these soil borings.

TABLE A-1
Lava Cap Mine Data Quality Objectives

Location	Step 1: Statement of Problem	Step 2: Identify the Decision	Step 3: Inputs to the Decision	Step 4: Study Boundaries	Step 5: Decision Rules	Step 6: Limits of Uncertainty	Step 7: Optimize the Sampling Design
	further downgradient impact (Lost Lake dam stability)		MCLs, and/or background levels for the following media: – Surface soil – Subsurface soil – Air – Groundwater – Surface water – Sediment – Fish and aquatic plants – Aquatic invertebrates – Terrestrial plants and invertebrates – Small mammals Bioassay results Screening HHRA and ERA results Screening-level data	including the public beach/campground Temporal (seasonal) variability: – surface water and air will be collected three times and groundwater wells will be sampled twice Will require access to private property	If constituent concentrations exceed EPRGs, PRGs, MCLs, and/or background levels, then the specific compounds will be COPECs/COPCs and risk management decisions will be used to determine appropriate action. If technical experts determine that Lost Lake dam is potentially unstable, then consider additional evaluations.	the delta in Lost Lake Performing bioassay tests	Groundwater will be collected from up to 13 downgradient residential wells during two separate sampling events. Surface water and aquatic invertebrates will be collected in downgradient areas: – LCC below the log dam – CC through the tailing deposition area – Deposition area pools – Lost Lake – CC below Lost Lake – Rollins Reservoir (contingent) Surface bioassay tests will be performed. Fish and aquatic plant samples will be collected in LCC and Lost Lake. Sediment will be collected in downgradient areas: – LCC below the log dam – CC through the tailing deposition area – Deposition area pools – Lost Lake and the CC delta area – CC below Lost Lake Sediment will be collected for bioassay tests. Terrestrial plant and invertebrate samples will also be collected from around CC below Lost Lake. Small mammal samples will be collected, from the area around LCC below the log dam and within the tailings deposition area. Bullfrog samples will be collected from the deposition area pools. 24-hour composite air samples will be collected, from the tailings deposition area and near the Lost Lake dam. Lost Lake dam stability will be evaluated. An ecological habitat assessment will be performed. If upgradient samples indicate that it is warranted, surface soil samples will be collected at the north end of Rollins Reservoir in the public campground/beach area.

Notes:
COPC = Contaminant of potential concern.
COPEC = Contaminant of potential ecological concern.
LCC = Little Clipper Creek.
CC = Clipper Creek.
EPRGs = Ecological preliminary remediation goals.
ERA = ecological risk assessment
HHRA = human health risk assessment.
PRGs = Preliminary remediation goals.
MCLs = maximum contaminant levels.

TABLE A-2

Soil Preliminary Remediation Goals (in mg/kg) for Lava Cap Mine RI/FS

Analyte	Residential Soil	Industrial Soil	Ecological Soil	Ecological Sediment	Ecological Tissue	Ecological endpoint	Ecological Reference
Aluminum	75000	100000			3.8		
Antimony	30	750	**5**		**0.25**	plant	Efroymson et al. 1997
Arsenic	21 (noncancer)	3	9.9	42	**0.25**	wildlife, plant	Efroymson et al. 1997
Barium	5200	100000	283		19	wildlife	Efroymson et al. 1997
Beryllium	150	3400	**10**		2.4	plant	Efroymson et al. 1997
Cadmium	9 (CAL-mod)	930	**4**	4.2	3.5	wildlife, plant	Efroymson et al. 1997
Calcium							
Chromium (total)	210	450	**0.4**	159		earthworm	Efroymson et al. 1997
Cobalt	3300	29000	**20**			plant	Efroymson et al. 1997
Copper	2800	70000	**60**	77.7	55	earthworm	Efroymson et al. 1997
Iron	22000	100000					
Lead	130 (CAL-mod)	1000	**40.5**	110	**0.9**	wildlife	Efroymson et al. 1997
Magnesium							
Manganese	3100	45000			320		
Mercury	22	560	**0.00051**	0.7	**0.005**	wildlife	Efroymson et al. 1997
Nickel	150 (CAL-mod)	37000	**30**	38.5	64	plant	Efroymson et al. 1997
Potassium							
Selenium	370	9400	**0.21**		**0.4**	wildlife	Efroymson et al. 1997
Silver	370	9400	**2**	1.8		plant	Efroymson et al. 1997
Sodium							
Thallium			**1**		**0.02**	plant	Efroymson et al. 1997
Vanadium	520	13000	**2**		**0.7**	plant	Efroymson et al. 1997
Zinc	22000	100000	**8.5**	270	12	wildlife	Efroymson et al. 1997
Cyanide	1100	21000			235		
TNT				13 *	5		

* mg TNT/kg organic carbon in sediment

References:

Efroymson, R., B.E. Sample, G.W. Suter II and D.S. Jones. 1997. Preliminary remediation goals for ecological endpoints: 1997 Update. Oak Ridge National Laboratory. ES/ER/TM-162/R2.

Notes:

1) Organic carbon should be measured in sediment to compare to TNT sediment value.
2) For mercury in soil - ecological PRG is based on methylmercury. Biota will be used as a measure of bioavailability for mercury instead of soil.
3) Values in bold are lower than the CLP CRDL.

TABLE A-3

Water Preliminary Remediation Goals (in ug/L) for Lava Cap Mine RI/FS

Analyte	Ecological PRG	Primary U.S. EPA MCL	Primary CA MCL	Secondary MCL	Ecological Reference
Aluminum	87		1000	200	NOAA 1998
Antimony	30	**6**	**6**		NOAA 1998
Arsenic	190 (As+3)	50	50		NOAA 1998
Barium	**4**	2000	1000		Efroymson et al 1997
Beryllium	5 3	**4**	**4**		NOAA 1998
Cadmium	**1.1**	5	5		NOAA 1998
Calcium					
Chromium (total)	**11**	100	50		
Cobalt	**23**				Efroymson et al 1997
Copper	**12**	1300	1300	1000	NOAA 1998
Iron	1000			300	NOAA 1998
Lead	**3.2**	15	15		NOAA 1998
Magnesium					
Manganese				50	
Mercury	**0.012**	2	2		NOAA 1998
Nickel	160		100		NOAA 1998
Potassium					
Selenium	**5**	50	50		NOAA 1998
Silver	**0.12**				NOAA 1998
Sodium					
Thallium	40	**2**	**2**		NOAA 1998
Vanadium	**20**				Efroymson et al 1997
Zinc	110			5000	NOAA 1998
Cyanide	**5.2**	200	200		NOAA 1998
TNT	130				Talmage and Opresko 1996

References

RWQCB 1998 A Compilation of Water Quality Goals March

NOAA 1998 Screening Quick Reference Tables October 14, 1998 Revision, All values are chronic freshwater for unfiltered water AWQCs

Efroymson, R , B E Sample, G W Suter II and D S Jones 1997 Preliminary remediation goals for ecological endpoints 1997 Update Oak Ridge National Laboratory

Talmage, S S , and D M Opresko 1996 Ecological criteria document for 2,4,6-Trinitrotoluene (Cas No 118-96-7) Oak Ridge National Laboratory Draft Document

Notes

Hardness and pH will be measured as some AWQC are pH and hardness dependent

Values in bold are lower than the CLP CRDL

Appendix B

Technical Specifications for Laboratory Analyses

Analysis of Water for Hardness by Method 130.1

Analyte

Hardness

Sample Matrices

Water.

Analytical Procedure and Quantitation Limits

Follow the procedures specified in the method for analysis.

The contract required detection limit (CRDL) is 10 mg/L.

Contract Holding Times

The contract required holding time is 5 days from the date of sample collection.

Calibration Standards:

- Purchase from the National Institute for Standards and Technology (NIST), or
- Produce internally using standards that are certified by or directly traceable to NIST, or
- Purchase from a commercial supplier who has more than 5 years' experience in the preparation and certification of inorganic standards.

Calibration Procedure and Criteria

1. Perform initial calibration before initial sample analysis, whenever modifications are made to the analytical system during an analytical run, or when continuing calibration fails to meet the acceptance criteria. At least a blank and three standards must be used for initial calibration. The standard concentrations must bracket the expected sample concentrations. The correlation coefficient of the of the linear regression must be ≥ 0.995, otherwise, recalibrate the system.

2. A calibration verification standard at the mid-point concentration is to be analyzed at the beginning of each analytical run following initial calibration, after each group of 10 samples, and at the end of the analytical run. Each analyte in each continuing calibration verification standard must be within $\pm 10\%$ of the expected value.

3. If the above criteria are not met, the source of the problem should be eliminated, and the system re-calibrated. All affected samples must be reanalyzed

Internal Quality Control Checks, Control Limits, and Corrective Actions

1. Analyze one LCS with each analytical batch. Recoveries of 75-125% are required. If the percent recovery is not within the control limits, terminate the analysis, correct the problem, and reanalyze all associated samples.

2. Analyze one method blank with each analytical batch. The hardness must not exceed the CRDL. If it does, eliminate the contamination source, and reanalyze all affected samples.

3. Analyze one set of MS/MSD with each batch of 20 or fewer samples. The recoveries should be within 75-125% of the expected value, and the RPD should be within $\pm$20%. If these limits are exceeded, but the LCS result is acceptable, flag the data; otherwise reanalyze the MS/MSD and all affected samples.

Data Calculations and Reporting Units

1. Calculate results as specified in the method. Report results in terms of $CACO_3$ in mg/L. The concentration shall be reported to two significant figures if the result is less than 10 mg/L; and to three significant figures if the value is greater than or equal to 10 mg/L.

2. All records of analysis, dilutions, and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Deliverables

Appropriate CLP (USEPA Contract Laboratory Program)- forms are required. Deliverables for each Sample Delivery Group (SDG) should include, but are not limited to, the following:

- An SDG narrative that includes a signature of the laboratory manager (or his or her designee), laboratory name, contract number, SDG number, a description of any problems encountered during the processing of the resolution of these problems, a list of correct sample ID numbers, the corresponding laboratory sample ID numbers, a differentiation between the initial analyses and any reanalyses, a formula (including definitions) showing how the results were calculated, and an example of an actual calculation for a sample in the SDG.

- Modified CLP inorganics Form 1 for all environmental and QC samples and method blanks that lists the tabulated results. The header of Form 1 should include analysis and preparation methods used, matrix, units, sample volume, dilution factor, and dates of receipt and analysis. Form 1s for any reanalyses must be included.
- Modified CLP inorganics Form 2 which summarizes the concentrations, expected concentrations, and percent recoveries of all initial and continuing calibration verification standards.
- Modified CLP inorganics Form 5 which summarizes the MS/MSD expected concentrations, recoveries, and relative percent differences
- Modified inorganics CLP Form 7 which summarizes the LCS concentrations, expected concentrations, and percent recoveries.
- Standards preparation logs for all standards used for either calibration or spiking, which include source, traceable lot number, and concentrations.

QC Requirements Summary:

QC Required Analysis	Frequency of QC	Limits (% or Conc.)
Method Blank	1 per batch of 20 or fewer samples	$<$CRDL
MS/MSD	1 per batch of 20 or fewer samples	75-125%R, $\leq$20% RPD
LCS	1 per batch of 20 or fewer samples	75-125% R
Equipment Blank	1 per week	$<$CRDL

Action Required if Limits are Exceeded:

If above control limits are exceeded, take appropriate actions to identify the problem, perform corrective action as specified above, and reanalyze the affected samples. Corrective action should be taken before additional samples are analyzed.

Analysis of Water for Total Dissolved Solids by Method 160.1

Analyte

TDS

Sample Matrices

Water.

Analytical Procedure and Quantitation Limits

Follow the procedures specified in the method for analysis. Weigh solid residue to a constant weight, which is defined as two consecutive weight measurements differing by less than 0.5 mg, or less than 4%, whichever is smaller.

Use sample aliquots of 100 mL. If the residue in a sample is greater than 200 mg, repeat the analysis using a smaller sample aliquot.

The contract required detection limit (CRDL) is 10 mg/L.

Contract Holding Times

The contract required holding time is 5 days from the date of sample collection.

Calibration Standards:

Not applicable.

Calibration Procedure and Criteria

Calibrate the analytical balance using NIST-traceable standard weights that bracket the expected sample weights. The difference between the measured weight and the standard weight must be less than 0.5 mg.

Internal Quality Control Checks, Control Limits, and Corrective Actions

1. Analyze one LCS with each analytical batch. Recoveries of 75-125% are required. If the percent recovery is not within the control limits, terminate the analysis, correct the problem, and reanalyze all associated samples.

2. Analyze one method blank with each analytical batch. The alkalinity must not exceed the CRDL. If it does, eliminate the contamination source, and reanalyze all affected samples.

3. Analyze one set of duplicates with each batch of 20 or fewer samples. The RPD should be within ±20%. If the limit is exceeded, but the LCS result is acceptable, flag the data; otherwise reanalyze the duplicates and all affected samples.

Data Calculations and Reporting Units

1. Calculate results as specified in the method. Report results in mg/L. The concentration shall be reported to two significant figures if the result is less than 10 mg/L; and to three significant figures if the value is greater than or equal to 10 mg/L.

2. All records of analysis, dilutions, and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Deliverables

Appropriate CLP (USEPA Contract Laboratory Program)- forms are required. Deliverables for each Sample Delivery Group (SDG) should include, but are not limited to, the following:

- An SDG narrative that includes a signature of the laboratory manager (or his or her designee), laboratory name, contract number, SDG number, a description of any problems encountered during the processing of the resolution of these problems, a list of correct sample ID numbers, the corresponding laboratory sample ID numbers, a differentiation between the initial analyses and any reanalyses, a formula (including definitions) showing how the results were calculated, and an example of an actual calculation for a sample in the SDG.

- Modified CLP inorganics Form 1 for all environmental and QC samples and method blanks that lists the tabulated sample results. The header of Form 1 should include analysis and preparation methods used, matrix, units, sample volume, dilution factor, and dates of receipt and analysis. Form 1s for any reanalyses must be included.

- Modified CLP inorganics Form 6 which summarizes the duplicate results and relative percent differences.

- Modified inorganics CLP Form 7 which summarizes the LCS concentrations, expected concentrations, and percent recoveries.

QC Requirements Summary:

QC Required Analysis	Frequency of QC	Limits (% or Conc.)
Method Blank	1 per batch of 20 or fewer samples	<CRDL
Duplicates	1 per batch of 20 or fewer samples	$\leq$20% RPD
LCS	1 per batch of 20 or fewer samples	75-125% R
Equipment Blank	1 per week	<CRDL

Action Required if Limits are Exceeded:

If above control limits are exceeded, take appropriate actions to identify the problem, perform corrective action as specified above, and reanalyze the affected samples. Corrective action should be taken before additional samples are analyzed.

Analysis of Water for Anions by Method 300.0

Analyte

Chloride, Sulfate, and Orthophosphate

Sample Matrices

Water.

Analytical Procedure and Quantitation Limits

Follow the procedures specified in the method for analysis.

The contract required detection limit (CRDL) is1.0 mg/L for all analytes..

Contract Holding Times

The holding time for orthophosphate-P is 48 hours from the time of sample collection. The holding time for chloride and sulfate is 28 days from the date of sample collection.

Calibration Standards:

- Purchase from the National Institute for Standards and Technology (NIST), or
- Produce internally using standards that are certified by or directly traceable to NIST, or
- Purchase from a commercial supplier who has more than 5 years' experience in the preparation and certification of inorganic standards.

Calibration Procedure and Criteria

1. Perform initial calibration before initial sample analysis, whenever modifications are made to the analytical system during an analytical run, or when continuing calibration fails to meet the acceptance criteria. At least a blank and three standards must be used for initial calibration. . The standard concentrations must bracket the expected sample concentrations. The correlation coefficient of the of the linear regression must be $\geq$0.995, otherwise, recalibrate the system.

2. A calibration verification standard at the mid-point concentration is to be analyzed at the beginning of each analytical run following initial calibration, after each group of 10 samples, and at the end of the analytical run. Each analyte in each continuing calibration verification standard must be within $\pm$10% of the expected value.

3. If the above criteria are not met, the source of the problem should be eliminated, and the system re-calibrated. All affected samples must be reanalyzed

Internal Quality Control Checks, Control Limits, and Corrective Actions

1. Analyze one LCS with each analytical batch. Recoveries of 75-125% are required. If the percent recovery is not within the control limits, terminate the analysis, correct the problem, and reanalyze all associated samples.

2. Analyze one method blank with each analytical batch. The blank concentrations must not exceed the CRDL. If it does, eliminate the contamination source, and reanalyze all affected samples.

3. Analyze one set of MS/MSD with each batch of 20 or fewer samples. The recoveries should be within 75-125% of the expected value, and the RPD should be within $\pm$20%. If these limits are exceeded, but the LCS result is acceptable, flag the data; otherwise reanalyze the MS/MSD and all affected samples.

Data Calculations and Reporting Units

1. Calculate results as specified in the method. Report results in mg/L. The concentration shall be reported to two significant figures if the result is less than 10 mg/L; and to three significant figures if the value is greater than or equal to 10 mg/L.

2. All records of analysis, dilutions, and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Deliverables

Appropriate CLP (USEPA Contract Laboratory Program)- forms are required. Deliverables for each Sample Delivery Group (SDG) should include, but are not limited to, the following:

- An SDG narrative that includes a signature of the laboratory manager (or his or her designee), laboratory name, contract number, SDG number, a description of any problems encountered during the processing of the resolution of these problems, a list of correct sample ID numbers, the corresponding laboratory sample ID numbers, a differentiation between the initial analyses and any reanalyses, a formula (including definitions) showing how the results were calculated, and an example of an actual calculation for a sample in the SDG.

- Modified CLP inorganics Form 1 for all environmental and QC samples and method blanks that lists the tabulated results. The header of Form 1 should include analysis and preparation methods used, matrix, units, sample volume, dilution factor, and dates of receipt and analysis. Form 1s for any reanalyses must be included.

- Modified CLP inorganics Form 2 which summarizes the concentrations, expected concentrations, and percent recoveries of all initial and continuing calibration verification standards.

- Modified CLP inorganics Form 5 which summarizes the MS/MSD expected concentrations, recoveries, and relative percent differences

- Modified inorganics CLP Form 7 which summarizes the LCS concentrations, expected concentrations, and percent recoveries.

- Standards preparation logs for all standards used for either calibration or spiking, which include source, traceable lot number, and concentrations.

QC Requirements Summary:

QC Required Analysis	Frequency of QC	Limits (% or Conc.)
Method Blank	1 per batch of 20 or fewer samples	<CRDL
MS/MSD	1 per batch of 20 or fewer samples	75-125%R, ≤20% RPD
LCS	1 per batch of 20 or fewer samples	75-125% R
Equipment Blank	1 per week	<CRDL

Action Required if Limits are Exceeded:

If above control limits are exceeded, take appropriate actions to identify the problem, perform corrective action as specified above, and reanalyze the affected samples. Corrective action should be taken before additional samples are analyzed.

Analysis of Water for Alkalinity by Method 310.1

Analyte

Alkalinity

Sample Matrices

Water

Analytical Procedure and Quantitation Limits

Follow the procedures specified in the method for analysis. Do not use titrant volumes greater than 50 mL. Reanalyze any sample requiring more than 50 mL of titrant, selecting a smaller aliquot of sample, or performing the titration with a higher normality standard acid.

The contract required detection limit (CRDL) is 3.0 mg/L.

Contract Holding Times

The contract required holding time is 5 days from the date of sample collection.

Calibration Standards:

- Purchase from the National Institute for Standards and Technology (NIST), or
- Produce internally using standards that are certified by or directly traceable to NIST, or
- Purchase from a commercial supplier who has more than 5 years' experience in the preparation and certification of inorganic standards.

Calibration Procedure and Criteria

Not applicable.

Internal Quality Control Checks, Control Limits, and Corrective Actions

1. Standardize the pH meter each day using at least 2 buffers which bracket the end points. Standardize the titrant in duplicate prior to sample analysis, and use the average concentration for sample calculations.

2. Analyze one LCS with each analytical batch. Recoveries of 75-125% are required. If the percent recovery is not within the control limits, terminate the analysis, correct the problem, and reanalyze all associated samples.

3. Analyze one method blank with each analytical batch. The alkalinity must not exceed the CRDL. If it does, eliminate the contamination source, and reanalyze all affected samples.

4. Analyze one set of MS/MSD with each batch of 20 or fewer samples. The recoveries should be within 75-125% of the expected value, and the RPD should be within ±20%. If these limits are exceeded, but the LCS result is acceptable, flag the data; otherwise reanalyze the MS/MSD and all affected samples.

Data Calculations and Reporting Units

1. Calculate results as specified in the method. Report results as Alkalinity as $CaCO_3$ in mg/L. The concentration shall be reported to two significant figures if the result is less than 10 mg/L; and to three significant figures if the value is greater than or equal to 10 mg/L..

2. All records of analysis, dilutions, and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Deliverables

Appropriate CLP (USEPA Contract Laboratory Program)- forms are required. Deliverables for each Sample Delivery Group (SDG) should include, but are not limited to, the following:

- An SDG narrative that includes a signature of the laboratory manager (or his or her designee), laboratory name, contract number, SDG number, a description of any problems encountered during the processing of the resolution of these problems, a list of correct sample ID numbers, the corresponding laboratory sample ID numbers, a differentiation between the initial analyses and any reanalyses, a formula (including definitions) showing how the results were calculated, and an example of an actual calculation for a sample in the SDG.

- Modified CLP inorganics Form 1 for all environmental and QC samples and method blanks that lists the tabulated sample results. The header of Form 1 should include analysis and preparation methods used, matrix, units, sample volume, dilution factor, and dates of receipt and analysis. Form 1s for any reanalyses must be included.

- Modified CLP inorganics Form 5 which summarizes the MS/MSD expected concentrations, recoveries, and relative percent differences

- Modified inorganics CLP Form 7 which summarizes the LCS concentrations, expected concentrations, and percent recoveries.

- Calculations for titrant concentration from the standardization

- Standards preparation logs for all standards used for either calibration or spiking, which include source, traceable lot number, and concentrations.

QC Requirements Summary

QC Required Analysis	Frequency of QC	Limits (% or Conc.)
Method Blank	1 per batch of 20 or fewer samples	<CRDL
MS/MSD	1 per batch of 20 or fewer samples	75-125%R, ≤20% RPD
LCS	1 per batch of 20 or fewer samples	75-125% R
Equipment Blank	1 per week	<CRDL

Action Required if Limits are Exceeded

If above control limits are exceeded, take appropriate actions to identify the problem, perform corrective action as specified above, and reanalyze the affected samples. Corrective action should be taken before additional samples are analyzed.

Analysis of Water,
by SW846 Methods 6010A, 6020, 7470A, and 7471A

Analyte

The following metals:

-Aluminum
-Antimony
-Arsenic
-Barium
-Beryllium
-Cadmium
-Calcium
-Chromium (total)
-Cobalt
-Copper
-Iron
-Lead
-Magnesium
-Manganese
-Mercury
-Nickel
-Potassium
-Selenium
-Silver
-Sodium
-Thallium
-Vanadium
-Zinc

Sample Matrices

Water, soil/sediment, biota, and air filter.

Analytical Procedure and Quantitation Limits

Follow the procedures specified in the appropriate method for digestion and analysis. The contract required detection limits (CRDL) are in Tables 3-4a and 3-4b of the main body of the FSP.

Contract Holding Times

The contract required holding time is 26 days for mercury, and 35 days for all other analytes from the date of sample receipt by the laboratory.

Calibration Standards:

- Purchase from the National Institute for Standards and Technology (NIST), or
- Produce internally using standards that are certified by or directly traceable to NIST, or
- Purchase from a commercial supplier who has more than 5 years' experience in the preparation and certification of inorganic standards.

Calibration Procedure and Criteria

Set up and calibrate the according to the method, with the following specifications:

1. Perform initial calibration before initial sample analysis, every 24 hours of analysis, whenever modifications are made to the analytical system during an analytical run, or when continuing calibration fails to meet the acceptance criteria. At least a blank and three standards must be used for initial calibration for method 7470A/7471A. At least one calibration standard must be used for initial calibration for method 6010A or method 6020. For method 6020, mass calibration and resolution checks must be performed as specified in section 7.5 of the method prior to initial calibration.
2. A calibration verification standard at the mid-point concentration is to be analyzed at the beginning of each analytical run following initial calibration, after each group of 10 samples, and at the end of the analytical run.
3. Each analyte in each continuing calibration verification standard must be within $\pm 20\%$ of the expected value for mercury, and within $\pm 10\%$ of the expected value for the rest of the analytes.
4. Analyze a calibration blank immediately following each calibration verification standard. No analytes must be detected at or above the CRDL.
5. An interference check standard is to be analyzed for method 6010a and method 6020 at the beginning and end of each analytical run, or twice during an 8-hour period, whichever is more frequent. Each analyte must be recovered within $\pm 20\%$ of the expected value.
6. If the above criteria are not met, the source of the problem should be eliminated, and the system re-calibrated. All affected samples must be reanalyzed.

Internal Quality Control Checks, Control Limits, and Corrective Actions

1. Analyze method blanks at a frequency of one per analytical batch of 20 or fewer samples of the same matrix. The method blanks must be free of all target analytes at or above the CRDL.

2. Analyze matrix spikes and matrix spike duplicates (MS/MSD) at mid-point concentration at the frequency of 1 per batch of 20 or fewer samples. The accuracy and precision criteria in Tables 3-4a through 3-4c should be met.

3. Analyze an LCS with each analytical batch. The accuracy limits in tables 3-4a through 3-4c must be met.

4. Perform a 1:5 dilution test on at least one sample with each new matrix. The result of the 1:5 dilution should be within $\pm$10% of the undiluted sample result if the latter is at least 25 times the MDL. If the 1:5 dilution result does not meet the acceptance criteria, perform a post-digestion spike analysis on the undiluted sample digestate. The post-digestion spike recovery should be within 75-125% of the expected value; otherwise, reanalyze the sample and associated field samples using the method of standard additions, or flag the data.

5. If above control limits, with the exception of those for the MS/MSD and post-digestion spike, are exceeded, take appropriate actions to correct the problems and re-analyze the affected samples. If the MS/MSD or post-digestion spike limits are exceeded, but the LCS results are acceptable, flag the data; otherwise, re-extract and reanalyze the matrix spiked samples and all associated field samples.

Data Calculations and Reporting Units

1. Adjust the sample concentration to the dilution used as directed in the method. The sample results are to be reported in milligrams per kilogram (mg/kg) on the dry-weight basis for soil/sediment, and air filer samples, and on a wet-weight basis for tissue samples. Report water results in μg/L.

2. All records of analysis, dilutions, and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Deliverables

Appropriate CLP (USEPA Contract Laboratory Program)- forms are required. Deliverables for each Sample Delivery Group (SDG) should include, but are not limited to, the following:

- An SDG narrative that includes a signature of the laboratory manager (or his or her designee), laboratory name, contract number, SDG number, a description of any problems encountered during the processing of the resolution of these problems, a list of correct sample ID numbers, the corresponding laboratory sample ID numbers, a differentiation between the initial analyses and any reanalyses, a formula (including definitions) showing how the results were calculated, and an example of an actual calculation for a sample in the SDG.

- Modified CLP inorganics Form 1 for all environmental and QC samples that lists the tabulated sample results. The header of Form 1 should include analysis and preparation methods used, matrix, units, sample volume, dilution factor, and dates of receipt and analysis. Form 1s for any reanalyses must be included.

- Modified CLP inorganics Form 2 which summarizes the concentrations, expected concentrations, and percent recoveries of all initial and continuing calibration verification standards.

- Modified CLP inorganics Form 3 which summarizes the calibration and method blank results.

- Modified CLP inorganics Form 4 which summarizes the concentrations, expected concentrations, and percent recoveries of the initial and ending interference check standards.

- Modified CLP inorganics Form 5 which summarizes the MS/MSD expected concentrations, recoveries, and relative percent differences. A separate Form 5 should be submitted for post-digestion spikes, if analyzed.

- Modified inorganics CLP Form 7 which summarizes the LCS concentrations, expected concentrations, and percent recoveries.

- Modified inorganics CLP Form 8 which summarizes standard addition results, if the method of standard additions is used.

- Modified inorganics CLP Form 9 which summarizes the dilution test results.
- Digestion logs showing sample sizes, dilutions, and spike addition (concentrations and volumes).
- Standards preparation logs for all standards used for either calibration or spiking, which include source, traceable lot number, and concentrations.

QC Requirements Summary

QC Required Analysis	Frequency of QC	Limits (% or Conc.)
Method Blank	1 per batch of 20 or fewer samples	<CRDL
MS/MSD	1 per batch of 20 or fewer samples	75-125%R, ≤20% RPD for water; ≤35% RPD for all others
LCS	1 per batch of 20 or fewer samples	75-125% R
Equipment Blank	1 per week	<CRDL

Action Required if Limits are Exceeded

If above control limits are exceeded, take appropriate actions to identify the problem, perform corrective action as specified above, and reanalyze the affected samples. Corrective action should be taken before additional samples are analyzed.

Analysis of TNT in Soil/Sediment by SW846 Method 8330

Analyte

TNT

Sample Matrices

Soil/sediment.

Analytical Procedure and Quantitation Limits

Follow SW846 Method 8330 for extractions and analyses. The contract required detection limit (CRDL) is 1.0 mg/kg or lower.

Contract Holding Times

Contract required holding times are 10 days for extraction and 14 days for the analysis of extracts, from the date of sample receipt by the laboratory.

Calibration Standards:

- Purchase from the National Institute for Standards and Technology (NIST), or
- Produce internally using standards that are certified by or directly traceable to NIST, or
- Purchase from a commercial supplier who has more than 5 years' experience in the preparation and certification of semivolatile organic standards.

Calibration Procedure and Criteria

Calibrate the high performance liquid chromatograph (HPLC) according to section 7.3 of method SW8330, with the following specifications:

1. Five-point initial calibration at concentrations bracketing the expected sample concentrations, with the lowest standard at the concentration of the CRDL or lower is required.

2. A continuing calibration standard at the mid-point concentration is to be analyzed at the beginning of each analytical run, after each group of 10 samples, and at the end of the analytical run.

3. A maximum relative standard deviation (percent RSD) in calibration factors (CF) for initial calibration standards of ±20% is required. To use the average calibration factor for quantitation, the %RSD must not exceed ±15%, otherwise use the curve.

4. The analyte in each continuing calibration standard must be within ±15% of the expected value.

5. If the above criteria are not met, the source of the problem should be eliminated, and the system re-calibrated. All affected samples must be reanalyzed.

Internal Quality Control Checks, Control Limits, and Corrective Actions

1. Analyze method blanks at a frequency of one per analytical batch of 20 or fewer samples of the same matrix. The method blanks must be free of the target analyte at or above the CRDL.

2. A surrogate at mid-point concentration must be spiked into the standards, samples, method blanks, and QC samples. Recoveries of 65 to 135 % are required.

3. Sample extracts containing the target analyte at concentrations above the initial calibration range are to be diluted and re-analyzed. Report the results and documentation for both analyses.

4. Analyze matrix spikes and matrix spike duplicates (MS/MSD) at mid-point concentration at the frequency of 1 per batch of 20 or fewer samples. Recoveries of 65 to 135 % are required with a relative percent difference (RPD) of not more than ±50%.

5. Analyze at least one LCS with each analytical batch. The target analyte must be recovered within 65-135% of the expected value.

6. If above control limits, with the exception of those for the MS/MSD, are

exceeded, take appropriate actions to correct the problems and re-analyze the affected samples. If the MS/MSD limits are exceeded, but the LCS results are acceptable, flag the data; otherwise, re-extract and reanalyze the MS/MSD and all affected samples.

Data Calculations and Reporting Units

1. Calculate the sample concentration as directed in 7 of method SW8000. The sample results are to be reported in milligrams per kilogram (mg/kl) on the dry-weight basis.

2. All records of analysis, dilutions, and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Deliverables

Appropriate CLP (USEPA Contract Laboratory Program)- forms are required. Deliverables for each Sample Delivery Group (SDG) should include, but are not limited to, the following:

- An SDG narrative that includes a signature of the laboratory manager (or his or her designee), laboratory name, contract number, SDG number, a description of any problems encountered during the processing of the resolution of these problems, a list of correct sample ID numbers, the corresponding laboratory sample ID numbers, a differentiation between the initial analyses and any reanalyses, a formula (including definitions) showing how the results were calculated, and an example of an actual calculation for a sample in the SDG.

- Modified CLP Organics Form 1 for all environmental and QC samples that lists the tabulated sample results. The header of Form 1 should include analysis and preparation methods used, matrix, units, sample volume, dilution factor, and dates of receipt and analysis. Form 1s for any reanalyses or diluted analyses must be included.

- Modified CLP Organics Form 2 which summarizes the surrogate recoveries.

- Modified CLP Organics Form 3 which summarizes the LCS and MS/MSD expected concentrations, recoveries, and MS/MSD relative percent differences (one Form 3 each for LCS and MS/MSD).

- Modified Organics CLP Form 4 which summarizes the samples associated with each laboratory method blank.

- Modified CLP Organics Form 6 that includes individual calibration factors, mean calibration factor, and relative standard deviation (%RSD).
- Modified CLP Organics Form 7 that includes standard concentrations, and percent drifts.
- Raw data that include chromatograms and integration reports/data system printouts. Peak areas or heights, concentrations, and retention times must be clearly indicated.
- Injection logs showing dilutions, spikes, and surrogates addition (concentrations and volumes).
- Standards preparation logs for all standards used for either calibration or spiking, which include source, traceable lot number, and concentrations.

QC Requirements Summary

QC Required Analysis	Frequency of QC	Limits (% or Conc.)
Method Blank	1 per batch of 20 or fewer samples	<CRDL
MS/MSD	1 per batch of 20 or fewer samples	65-135%R, ≤50% RPD
LCS	1 per batch of 20 or fewer samples	65-135% R
Surrogate	Added to each standard sample, and QC sample	65-135% R
Equipment Blank	1 per week	<CRDL

Action Required if Limits are Exceeded

If above control limits are exceeded, take appropriate actions to identify the problem, perform corrective action as specified above, and reanalyze the affected samples. Corrective action should be taken before additional samples are analyzed.

Analysis for Cyanide by Method SW9010B

Analyte

Cyanide

Sample Matrices

Water, Soil/Sediment, Air Filter, Biota

Analytical Procedure and Quantitation Limits

Follow the procedures specified in the method for analysis.

The contract required detection limit (CRDL) is 5.0 μg/L for water, and 1.0 mg/kg for soil/sediment and air filter.

Contract Holding Times

The holding time is 14 days from the time of sample collection for all media.

Calibration Standards:

- Purchase from the National Institute for Standards and Technology (NIST), or
- Produce internally using standards that are certified by or directly traceable to NIST, or
- Purchase from a commercial supplier who has more than 5 years' experience in the preparation and certification of inorganic standards.

Calibration Procedure and Criteria

1. Perform initial calibration before initial sample analysis, whenever modifications are made to the analytical system during an analytical run, or when continuing calibration fails to meet the acceptance criteria. At least a blank and three standards must be used for initial calibration. The standard concentrations must bracket the expected sample concentrations. The correlation coefficient of the of the linear regression must be $\geq$0.995, otherwise, recalibrate the system.

2. A calibration verification standard at the mid-point concentration is to be analyzed at the beginning of each analytical run following initial calibration, after each group of 10 samples, and at the end of the analytical run. Each analyte in each continuing calibration verification standard must be within $\pm$10% of the expected value.

3. If the above criteria are not met, the source of the problem should be eliminated, and the system re-calibrated. All affected samples must be reanalyzed

Internal Quality Control Checks, Control Limits, and Corrective Actions

1. Analyze one LCS with each analytical batch. Recoveries of 75-125% are required. If the percent recovery is not within the control limits, terminate the analysis, correct the problem, and reanalyze all associated samples.

2. Analyze one method blank with each analytical batch. The blank concentrations must not exceed the CRDL. If it does, eliminate the contamination source, and reanalyze all affected samples.

3. Analyze one set of MS/MSD with each batch of 20 or fewer samples. The recoveries should be within 75-125% of the expected value, and the RPD should be within $\pm$20%. If these limits are exceeded, but the LCS result is acceptable, flag the data; otherwise reanalyze the MS/MSD and all affected samples.

Data Calculations and Reporting Units

1. Calculate results as specified in the method. Report results in μg/L for water samples and in mg/kg for all other media. The concentration shall be reported to two significant figures if the result is less than 10 μg/L or 10 mg/kg, and to three significant figures if the value is greater than or equal to 10 μg/L or 10 mg/kg

2. All records of analysis, dilutions, and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Deliverables

Appropriate CLP (USEPA Contract Laboratory Program)- forms are required. Deliverables for each Sample Delivery Group (SDG) should include, but are not limited to, the following:

- An SDG narrative that includes a signature of the laboratory manager (or his or her designee), laboratory name, contract number, SDG number, a description of any problems encountered during the processing of the resolution of these problems, a list of correct sample ID numbers, the corresponding laboratory sample ID numbers, a differentiation between the initial analyses and any reanalyses, a formula (including definitions) showing how the results were calculated, and an example of an actual calculation for a sample in the SDG.

- Modified CLP inorganics Form 1 for all environmental and QC samples and method blanks that lists the tabulated results. The header of Form 1 should include analysis and preparation methods used, matrix, units, sample volume, dilution factor, and dates of receipt and analysis. Form 1s for any reanalyses must be included.

- Modified CLP inorganics Form 2 which summarizes the concentrations, expected concentrations, and percent recoveries of all initial and continuing calibration verification standards.

- Modified CLP inorganics Form 5 which summarizes the MS/MSD expected concentrations, recoveries, and relative percent differences

- Modified inorganics CLP Form 7 which summarizes the LCS concentrations, expected concentrations, and percent recoveries.

- Standards preparation logs for all standards used for either calibration or spiking, which include source, traceable lot number, and concentrations.

QC Requirements Summary:

QC Required Analysis	Frequency of QC	Limits (% or Conc.)
Method Blank	1 per batch of 20 or fewer samples	<CRDL
MS/MSD	1 per batch of 20 or fewer samples	75-125%R, ≤20% RPD
LCS	1 per batch of 20 or fewer samples	75-125% R
Equipment Blank	1 per week	<CRDL

Action Required if Limits are Exceeded:

If above control limits are exceeded, take appropriate actions to identify the problem, perform corrective action as specified above, and reanalyze the affected samples. Corrective action should be taken before additional samples are analyzed.

Analysis for Total Organic Carbon by Method SW9060

Analyte

TOC

Sample Matrices

Soil/Sediment

Analytical Procedure and Quantitation Limits

Follow the procedures specified in the method for analysis.

The contract required detection limit (CRDL) is 100 mg/kg.

Contract Holding Times

The holding time is 26 days from the time of sample collection for all media.

Calibration Standards:

- Purchase from the National Institute for Standards and Technology (NIST), or
- Produce internally using standards that are certified by or directly traceable to NIST, or
- Purchase from a commercial supplier who has more than 5 years' experience in the preparation and certification of inorganic standards.

Calibration Procedure and Criteria

1. Perform initial calibration before initial sample analysis, whenever modifications are made to the analytical system during an analytical run, or when continuing calibration fails to meet the acceptance criteria. At least a blank and three standards must be used for initial calibration. The standard concentrations must bracket the expected sample concentrations. The correlation coefficient of the of the linear regression must be $\geq$0.995, otherwise, recalibrate the system.

2. A calibration verification standard at the mid-point concentration is to be analyzed at the beginning of each analytical run following initial calibration, after each group of 10 samples, and at the end of the analytical run. Each analyte in each continuing calibration verification standard must be within $\pm$10% of the expected value.

3. If the above criteria are not met, the source of the problem should be eliminated, and the system re-calibrated. All affected samples must be reanalyzed

Internal Quality Control Checks, Control Limits, and Corrective Actions

1. Analyze all field and QC samples in duplicate, and report the average result.

2. Analyze one LCS with each analytical batch. Recoveries of 75-125% are required. If the percent recovery is not within the control limits, terminate the analysis, correct the problem, and reanalyze all associated samples.

3. Analyze one method blank with each analytical batch. The blank concentrations must not exceed the CRDL. If it does, eliminate the contamination source, and reanalyze all affected samples.

4. Analyze one set of MS/MSD with each batch of 20 or fewer samples. The recoveries should be within 75-125% of the expected value, and the RPD should be within $\pm$20%. If these limits are exceeded, but the LCS result is acceptable, flag the data; otherwise reanalyze the MS/MSD and all affected samples.

Data Calculations and Reporting Units

1. Calculate results as specified in the method. Report results in mg/kg on a dry weight basis. The concentration shall be reported to two significant figures if the result is less than 10 mg/kg, and to three significant figures if the value is greater than or equal to 10 mg/kg

2. All records of analysis, dilutions, and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Deliverables

Appropriate CLP (USEPA Contract Laboratory Program)- forms are required. Deliverables for each Sample Delivery Group (SDG) should include, but are not limited to, the following:

- An SDG narrative that includes a signature of the laboratory manager (or his or her designee), laboratory name, contract number, SDG number, a description of any problems encountered during the processing of the resolution of these problems, a list of correct sample ID numbers, the corresponding laboratory sample ID numbers, a differentiation between the initial analyses and any reanalyses, a formula (including definitions) showing how the results were calculated, and an example of an actual calculation for a sample in the SDG.

- Modified CLP inorganics Form 1 for all environmental and QC samples and method blanks that lists the tabulated results. The header of Form 1 should include analysis and preparation methods used, matrix, units, sample volume, dilution factor, and dates of receipt and analysis. Form 1s for any reanalyses must be included.
- Modified CLP inorganics Form 2 which summarizes the concentrations, expected concentrations, and percent recoveries of all initial and continuing calibration verification standards.
- Modified CLP inorganics Form 5 which summarizes the MS/MSD expected concentrations, recoveries, and relative percent differences
- Modified inorganics CLP Form 7 which summarizes the LCS concentrations, expected concentrations, and percent recoveries.
- Standards preparation logs for all standards used for either calibration or spiking, which include source, traceable lot number, and concentrations.

QC Requirements Summary:

QC Required Analysis	Frequency of QC	Limits (% or Conc.)
Method Blank	1 per batch of 20 or fewer samples	<CRDL
MS/MSD	1 per batch of 20 or fewer samples	75-125%R, ≤20% RPD
LCS	1 per batch of 20 or fewer samples	75-125% R
Equipment Blank	1 per week	<CRDL

Action Required if Limits are Exceeded:

If above control limits are exceeded, take appropriate actions to identify the problem, perform corrective action as specified above, and reanalyze the affected samples. Corrective action should be taken before additional samples are analyzed.

U. S. ENVIRONMENTAL PROTECTION AGENCY REGION 9
Environmental Services Branch
75 Hawthorne Street
San Francisco, CA 94105
Phone: 415/744-1498

Site Name:	
Case/RAP No.:	

REGIONAL ANALYTICAL PROGRAM CLIENT REQUEST FORM

The extraction of liquid, solid, and multiphasic wastes for organic and inorganic analytes by the Toxicity Characteristic Leaching Procedure (TCLP), SW-846 Method 1311 (Revision 0, July 1992).

1. **Definition and number of work units involved (specify whether whole samples or fraction; specify sample matrices; and specify concentration level):**

2. **Estimated date(s) of collection (provide a sampling schedule):**

3. **Estimated date(s) and method of shipment:**

   Overnight courier - samples are to be shipped on the day of collection for next day delivery including Saturday deliveries. Laboratory must be capable of accepting Saturday deliveries.

4. **Number of days analysis and data required after laboratory receipt of samples:**

   a. The contract required holding times are presented below.

Parameter	From: Sample Receipt To: TCLP Extraction
Metals, except mercury	26 days
Mercury	26 days
Semivolatiles	10 days
Pesticides	10 days
Herbicides	10 days

   b. The technical holding times are presented below.

Parameter	From: Field Collection

	To: TCLP Extraction
Metals, except mercury	180 days
Mercury	28 days
Semivolatiles	14 days
Pesticides	14 days
Herbicides	14 days

c. Data packages and all other deliverables are required within 35 days from receipt of last sample in each sample delivery group (SDG).

d. A SDG is defined as the following, whichever is most frequent:

- Each case of field samples received;
- Each 20 field samples within a case; or
- Each 14 calendar day period during which field samples in a case are received.

5. **Analytical protocol required (attach copy if other than a protocol currently used in this program):**

a. Perform the following TCLP procedures:

1) Follow the procedures outlined in Section 7.1 of SW-846 Method 1311 for the preliminary TCLP evaluations.

2) Follow the procedures outlined in Section 7.2 of SW-846 Method 1311 for TCLP extraction of nonvolatiles.

3) Follow the procedures outlined in Section 7.2.14 of SW-846 Method 1311 for preservation of all aliquots of the TCLP extracts.

b. Analyze TCLP extracts using the follwing analytical methods:

1. The analysis of TCLP extracts for chlorinated herbicides by SW-846 Method 8151 (se attached Client Request Form).

2. The analysis of TCLP extracts for chlorinated pesticides following protocols outlined in the U.S. EPA Contract Laboratory Program (CLP) Statement of Work (SOW) for Organic Analysis (OLM03.1 or more recent version).

3. The analysis of TCLP extracts for semivolatile organic compounds (SVOCs) following protocols outlined in the U.S. EPA Contract Laboratory Program (CLP) Statement of Work (SOW) for Organic Analysis (OLM03.1 or more recent version).

4. The analysis of TCLP extracts for metals following protocols outlined in the U.S. EPA Contract Laboratory Program (CLP) Statement of Work (SOW) for Inorganic Analysis (ILM03.0 or ILM04.0).

6. **Special technical instructions (if outside protocol requirements, specify compound names, CAS numbers, detection limits, etc.):**

   a. Calibration Procedure and Criteria: Not applicable for TCLP extraction.

   b. Internal Quality Control Checks, Control Limits, and Corrective Actions:

      1. Extract a TCLP blank once per SDG, whenever samples are extracted, or one per type of extraction fluid used, whichever is most frequent. Analyze the TCLP blank on each type of instrumentation system used to analyze samples. The concentration of any target compound in the TCLP blank must be less than the contract required quantitation limit (CRQL) or contract required detection limit (CRDL).

         If a TCLP blank exceeds these acceptance criteria, consider the TCLP extraction process to be out-of-control. Investigate the source of the contamination. Take and document appropriate corrective measures before proceeding with further sample analysis. Re-extract and reanalyze all samples processed with a TCLP blank that is out-of-control at no additional cost to the Region.

      2. The quality control (QC) requirement listed above is the minimum required. It is impossible to address all analytical situations that might be experienced by a laboratory during the analysis of environmental samples. The laboratory is expected to adhere to good laboratory practices when analyzing samples. If the laboratory has questions concerning the analyses of samples not addressed in this document, the Region must be notified IMMEDIATELY. The Laboratory Manager, or designee, must address any problem and its resolution in the SDG narrative.

7. **Analytical results required (if known, specify format for data sheets, QA/QC reports, Chain-of-Custody documentation, etc.) If not completed, format of results will be left to program discretion.**

   a. Data Calculations and Reporting Units:

      1. Use the equation in Section 7.1.1.9 of SW-846 Method 1311 to calculate percent solids. Report percent solids to the nearest whole percentage point.

      2. Use the equation in Section 7.1.2.3 of SW-846 Method 1311 to calculate percent dry solids. Report percent dry solids to the nearest whole percentage point.

      3. Use the equation in Section 7.2.11 of SW-846 Method 1311 to calculate weight of extraction fluid to add to the extraction vessel for onvolatile TCLP extraction.

      4. If the individual phases are not miscible and are to be analyzed separately, determine the volume of the individual phases to ±0.5%. After performing the analytical determinations separately, use the equation in Section 7.2.14 of SW-846 Method 1311 to combine the results mathematically with a simple volume-weighted average.

5. Adhere to the following rules for rounding results:

   a) If the number following those to be retained is less than 5, round down;
   b) If the number following those to be retained is greater than 5, round up; or
   c) If the number following the last digit to be retained is equal to 5, round down if the digit is even, and round up if the digit is odd.

6. All records of extraction, analysis, dilutions, and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

b. **Documentation and Deliverables**:

Deliverables (in the form of a purge file - i.e., original documents) for each SDG shall include the following items:

1. A copy of the CRF, as provided by the Region (so that any additions or revision authorized by the Region will be known). Only the technical portion of the CRF is required.

2. Bench sheets for TCLP preliminary evaluations and extractions which include the following information: beginning and end dates of TCLP extraction, beginning and end times of TCLP extraction, EPA sample number, laboratory sample ID, initial pH, adjusted pH, percent solids, sample weight, extract fluid type, and final pH.

3. Any internal laboratory sample or sample extract transfer records and tracking sheets.

8. **Data Requirements**:

Not applicable for TCLP extraction. CLP data packages or the equivalent are required following the analyses, by appropriate methods (see item 7a.) of TCLP extracts.

U. S. ENVIRONMENTAL PROTECTION AGENCY REGION 9
Environmental Services Branch

75 Hawthorne Street
San Francisco, CA 94105
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Site Name:
Case/RAP No.:

REGIONAL ANALYTICAL PROGRAM CLIENT REQUEST FORM

The analysis of low and medium concentration water and soil samples for total petroleum hydrocarbons (TPH), quantitated as gasoline and diesel by the California LUFT Manual (October 1989).

1. **Definition and number of work units involved (specify whether whole samples or fraction; specify sample matrices; and specify concentration level):**

2. **Estimated date(s) of collection (provide a sampling schedule):**

3. **Estimated date(s) and method of shipment:**

   Overnight courier - samples are to be shipped on the day of collection for next day delivery including Saturday deliveries. Laboratory must be capable of accepting Saturday deliveries.

4. **Number of days analysis and data required after laboratory receipt of samples:**

   a. Gasoline

      1. The contract required holding time for analysis is five (5) days from the date of sample receipt by the laboratory for unpreserved water samples, and ten (10) days from the date of sample receipt for preserved water samples and soil samples.

      2. The technical holding time for analysis is seven (7) days from the date of sample collection for unpreserved water samples, and fourteen (14) days from the date of sample collection for preserved water samples and soil samples.

   b. Diesel

      1. The contract required holding time for extraction is ten (10) days from the date of sample receipt for water and soil samples. The contract required holding time for analysis is forty (40) days from the date of sample extraction.

      2. The method technical holding time for extraction is fourteen (14) days from the date of sample collection for water and soil samples. The technical holding time for analysis is forty (40) days from the date of sample extraction.

c. Data packages and all other deliverables are required within 35 days from receipt of last sample in each sample delivery group (SDG).

d. A SDG is defined as the following, whichever is most frequent:

- Each case of field samples received;
- Each 20 field samples within a case; or
- Each 14 calendar day period during which field samples in a case are received.

5. **Analytical protocol required (attach copy if other than a protocol currently used in this program):**

a. Perform all determinations following the procedures outlined in the State of California document, "Leaking Underground Fuel Tank (LUFT) Field Manual: Guidelines for Site Assessment, Cleanup, and Underground Storage Tank Closure," (October 1989).

b. Determine the percent moisture of all soil samples.

c. Determine the pH of all water samples to verify that samples collected for TPH as gasoline determination have been preserved to a pH of 2 or less.

d. Preparation

1. Gasoline - Sample introduction by purge-and-trap, following SW-846 Method 5030A (Revision 1, July 1992) is the preferred method of sample introduction. Sample introduction by the headspace method, following the California LUFT Manual, Appendix C, Section 6.f.(2), is a less preferred method, but may be used with prior approval from the Region. Sample introduction by direct injection is <u>not</u> an option, unless prior approval has been received from the Region.

2. Diesel - Follow the California LUFT Manual, Appendix C, Section 6.b. for sample extraction.

e. Analysis

Follow the procedures outlined in the California LUFT Manual, Appendix C, Section 6.f using gas chromatography/flame ionization detection (GC/FID) for the analysis of TPH as gasoline or diesel. A list of the required target compounds with corresponding contract required quantitation limits (CRQLs) is provided in Section 8 of this Regional Analytical Program (RAP) Client Request Form (CRF).

f. Identification and Quantitation

The identification of multicomponent analytes is based primarily on recognition of patterns of peaks displayed on a chromatogram within a retention time (RT) window determined by the analysis of diesel and gasoline standards. However, there may be instances where the pattern does not precisely match. In these cases, an unknown hydrocarbon pattern may be tentatively identified and quantitated "as gasoline" or "as diesel". Note these tentative identifications in the SDG narrative.

6. **Special technical instructions (if outside protocol requirements, specify compound names, CAS numbers, detection limits, etc.):**

a. <u>Calibration Procedure and Criteria</u>:

1. Follow the procedures outlined the California LUFT Manual, Appendix C, Section 6.f. for external standard calibration.

2. Perform an initial calibration with at least 5 levels of standards prepared per the California LUFT Manual, Appendix C, Sections 5.a and 5.b. The standards must include gasoline or diesel and the surrogate compound. The initial calibration must include a low standard at the concentration of the CRQL or lower. The concentrations of the remaining standards should correspond to the range of expected concentrations in the field samples or should define the analytical working range of the GC.

3. Sum the areas of five to seven peaks within the RT range characteristic of the petroleum product and use this sum to calculate the calibration factor (CF). Alternatively, sum the area of <u>all</u> peaks within the characteristic RT range and use this total area to calculate the CF. The percent relative standard deviation (%RSD) between CFs for gasoline or diesel and the surrogate compound in the initial calibration must not exceed 20%.

4. Alternatively, prepare calibration curves instead of calculating CFs following the protocols outlined in Section 7.4.2.2 of SW-846 Method 8000A (Revision 1, July 1992). A linear fit is required. Perform a linear regression of the instrument response versus the concentration of the standards and produce the slope and intercept terms for a linear equation in the form of:

   $y = ax + b$

   where:

   y = instrument response
   a = slope of the line
   x = concentration of the calibration standard
   b = the intercept

   The correlation coefficient (r) generated by the regression must be greater than or equal to 0.99 for gasoline or diesel and the surrogate compound. If calibration curves are used, provide sufficient documentation so that all analytical results can be recalculated, as specified in Section 7.a of this CRF. Provide the equation for the line generated by the data system.

5. Determine a RT window for each characteristic peak in gasoline or diesel and for the surrogate compound. Calculate the mean and standard deviation (σ_{n-1}) of the 5 retention times for each peak from the 5 concentration levels in the initial calibration. Calculate the window as the mean RT ± 3 times the standard deviation.

6. Analyze a mid-point calibration verification standard at the beginning of each 12-hour time period in which samples are analyzed, after each group of 10 samples, and at the end of the analytical sequence.

7. The percent difference (%D) between the calculated amount and nominal amount for gasoline or diesel and the surrogate compound in the calibration verification standards must be within $\pm 25.0\%$.

8. The RTs for each of the peaks in the calibration verification standards must be within the RT windows determined from the initial calibration.

9. Gasoline and diesel in the low concentration standard must have a signal-to-noise ratio of 5:1 or greater. If this requirement cannot be met, the laboratory must submit a method detection limit (MDL) study as part of the data package, in order to validate its ability to achieve the CRQLs. The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero.

b. **Internal Quality Control Checks, Control Limits, and Corrective Actions**:

1. When calibration standard measurements exceed the quality control (QC) requirements for the initial calibration or the calibration verification, terminate analysis, correct the problem, and recalibrate the instrument.

   The calibration verification standard reflects the conditions under which the analysis of all samples was performed. Associated samples are considered to be both the samples following the calibration verification and the preceding samples up to the previous calibration verification. Reanalyze all samples associated with an out-of-control calibration verification standard.

2. Method blanks -

   a. Gasoline - Analyze a method blank in each 12-hour time period in which samples are analyzed and after the analysis of unusually concentrated samples.

   b. Diesel - Extract and analyze a method blank once per SDG or whenever samples are extracted and analyzed, whichever is most frequent. Analyze the method blank on each GC/FID system used to analyze samples.

   The concentration of any target compound in the method blank must be less than the CRQL. If a method blank exceeds these acceptance criteria, consider the analytical system to be out-of-control. Investigate the source of the contamination. Document any corrective measures taken before proceeding with further sample analysis. Re-extract and reanalyze all samples processed with a method blank that is out-of-control at no additional cost to the Region.

3. Surrogates -

   a. Gasoline - Spike all field and QC samples with 4-bromofluorobenzene and 1,1,1-trifluorotoluene at a concentration equal to the midpoint of the initial calibration range.

   b. Diesel - Spike all field and QC samples with hexacosane or ortho-terphenyl at a concentration equal to the midpoint of the initial calibration range.

   Surrogate recoveries of 75-125% for water samples and 60-125% for soil samples are required, unless documentation (such as control charts) is available to support a different range of recoveries. Submit, as part of the data package, all supporting documentation for surrogate recoveries, and historical surrogate recovery data, if necessary.

If the control limits are exceeded, take appropriate actions to identify the problem by reanalyzing the affected samples. If reanalysis does not solve the problem, the affected sample must be re-extracted and reanalyzed. If re-extraction and reanalysis solves the problem, then the problem was within the laboratory's control. Therefore, submit only data from the analyses with surrogate recoveries within QC limits. If re-extraction and reanalysis of the sample does not solve the problem, then submit the surrogate recovery data and sample analysis data from the initial analysis of both sample extracts.

4. Prepare and analyze matrix spike and matrix spike duplicate (MS/MSD) samples at the frequency of one per SDG. Spike each target compound at a concentration level near the midpoint of the initial calibration range.

   Recoveries of 65-135% are required. Relative percent differences (RPDs) must not exceed 30%. Flag MS/MSD results that exceed these criteria and note noncompliant MS/MSD results in the SDG narrative. No corrective action measures are required due to noncompliant MS/MSD results.

5. Laboratory control samples (LCS) -

   a. Gasoline - Analyze a LCS in each 12-hour time period in which samples are analyzed.

   b. Diesel - Extract and analyze a LCS once per SDG or whenever samples are extracted and analyzed.

   Spike each target compound at a concentration level near the midpoint of the initial calibration range. Recoveries of 80-120% are required. Re-extract and reanalyze all samples processed with a LCS that is out-of-control at no additional cost to the Region.

6. Dilute and reanalyze samples which contain analytes at concentrations above the initial calibration range. If dilution is necessary, adjust the dilution so that the analyte is determined at a concentration in the upper half of the calibration range. Report the results and submit documentation for both the diluted and undiluted analyses.

7. The QC requirements listed above are the minimum required. It is impossible to address all analytical situations that might be experienced by a laboratory during the analysis of environmental samples. The laboratory is expected to adhere to good laboratory practices when analyzing samples. If the laboratory has questions concerning the analyses of samples not addressed in this document, the Region must be notified IMMEDIATELY. The Laboratory Manager, or designee, must address any problem and its resolution in the SDG narrative.

7. **Analytical results required (if known, specify format for data sheets, QA/QC reports, Chain-of-Custody documentation, etc.) If not completed, format of results will be left to program discretion.**

   a. Data Calculations and Reporting Units:

   1. Use the average CF from the initial calibration to calculate the concentrations of target and surrogate compounds in the field and QC samples. Use the equation in Section 7.8.1 of

SW-846 Method 8000A (Revision 1, July 1992).

If calibration curves are prepared from the initial calibration, calculate the concentrations using linear regression with the following equation:

$$x = (y - b)/a$$

The terms are defined in Section 6.a.4 of this CRF.

2. Report results for water samples in concentration units of milligrams per liter (mg/L). Report results for soil samples in concentration units of milligrams per kilogram (mg/kg) on a dry-weight basis. Report all results to two significant figures. Report percent moisture to the nearest whole percentage point.

3. Adhere to the following rules for rounding results:

   a) If the number following those to be retained is less than 5, round down;
   b) If the number following those to be retained is greater than 5, round up; or
   c) If the number following the last digit to be retained is equal to 5, round down if the digit is even, and round up if the digit is odd.

4. All records of analysis, dilutions, and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

b. <u>Documentation and Deliverables</u>:

Deliverables (in the form of a purge file, i.e., original documents) for each SDG shall include the following items:

1. All original shipping documents and sample tracking reports, including signed chain-of-custody forms, airbills, and traffic reports.

2. A completed and signed document inventory on a modified Organics Complete SDG File (CSF) Inventory Sheet (CLP Form DC-2).

3. All original sample receipt documents, including sample log-in information on a modified CLP Form DC-1, an SDG cover sheet, and any other sample receipt records.

4. A copy of the CRF, as provided by the Region (so that any additions or revision authorized by the Region will be known). Only the technical portion of the CRF is required.

5. Any telephone logs referring to the samples.

6. An SDG narrative, signed by the laboratory manager or designee, certifying the accuracy and validity of all data reported. The SDG narrative must contain: laboratory name; RAP number; EPA sample numbers in the SDG, differentiating between initial analyses and reanalyses; SDG number; the corresponding laboratory sample identification (ID) numbers; and contract number. The SDG narrative must provide a description of all GC columns used for analysis, including brand name, the internal diameter in millimeters (mm), the

length in meters, coating material, and film thickness. The SDG narrative must describe the trap used for TPH as gasoline analysis including trap name, and type and amount (in centimeters) of packing material. The SDG narrative must describe any administrative or technical problems encountered, such as QC, sample shipment, or analytical problems, and the resolution of these problems. The SDG narrative must include an explanation for any manual integrations or manual edits. The SDG narrative must include a formula (including definitions) showing how the results were calculated and an example of an actual calculation for a sample in the SDG.

7. Include the following information in the header for each data reporting form: laboratory name; contract number; laboratory code; RAP number; and SDG number.

8. Tabulated sample results for all field and QC samples on a modified CLP Form 1. Include both compound name and Chemical Abstract Service (CAS) registry number. Clearly specify concentration units and qualifiers. Include the following additional information in the header: EPA sample number, percent moisture, matrix, laboratory sample ID, laboratory file ID, validated time of sample receipt (VTSR), date extracted, date analyzed, extraction method, sample weight in grams (g) or sample volume in milliliters (mL), concentrated extract volume in microliters (µL), injection volume (µL), and dilution factor.

9. Raw sample data must include the following items for all analyses:

   a) GC chromatogram labeled with EPA sample number, injection volume, date and time of injection, instrument ID, GC column ID, and scaling factor.

   b) GC quantitation reports or data system printouts, including: RT and corresponding peak area or height for each peak detected and EPA sample number. Clearly annotate all manual edits or integrations.

   c) Any manual worksheets

10. Surrogate recoveries on a modified CLP Form 2 with calculated values rounded to the nearest whole percentage point. List QC limits and flag all values outside of QC limits with an asterisk. Include GC column ID with internal diameter in the header.

11. MS/MSD results on a modified CLP Form 3 with calculated recoveries rounded to the nearest whole percentage point and RPD values to 2 significant figures. List QC limits and flag all values outside of QC limits with an asterisk. Include the concentration of spike added to the sample, the sample concentration, and the MS and MSD concentrations. Include the EPA sample number in the header.

12. LCS results on a modified CLP Form 3 with calculated recoveries rounded to the nearest whole percentage point. List QC limits and flag all values outside of QC limits with an asterisk. Include the concentration of spike added to the LCS and the LCS concentration. Include the EPA sample number in the header.

13. Method blank summary on a modified CLP Form 4 summarizing

the samples associated with each laboratory method blank. Include EPA sample number, laboratory sample ID, and date of analysis for each sample associated with the referenced blank. Include the following additional information in the header: blank EPA sample number, blank laboratory sample ID, blank laboratory file ID, matrix, method blank date of extraction, method blank date and time of analysis, instrument ID, and GC column ID with internal diameter.

14. Instrument calibration data for each GC instrument and GC column used for analysis.

    a) Initial calibration

        1) Summaries on modified CLP Form 6 including: CF for each concentration level; mean CF for each compound; and %RSD value for each compound. Include the following additional information in the header: GC instrument ID, GC column ID with internal diameter, concentration levels for each standard, and analysis date. Clearly indicate peaks selected for quantitation.

        2) If calibration curves are used, then include: graph, correlation coefficient, and equation of the line for each target and surrogate compound.

        3) Summaries on modified CLP Form 6 including: RT for each peak of each concentration level, and mean RT and RT window for each peak of each compound. Include the following additional information in the header: GC instrument ID, GC column ID with internal diameter, concentration levels for each standard, and analysis date. Clearly indicate peaks selected for quantitation.

        4) Raw data including: GC chromatograms and GC quantitation reports or data system printouts with peak areas or heights, concentrations, and RTs clearly indicated. Clearly indicate peaks selected for quantitation.

    b) Calibration verification

        1) Summaries on modified CLP Form 7 including nominal amount; calculated amount; %D value; and RT and RT window for each peak of each compound. Include the following additional information in the header: date of associated initial calibration; GC column ID with internal diameter; EPA sample number and laboratory sample ID for the calibration verification standard; and date and time of analysis of the calibration verification standard.

        2) Raw data including: GC chromatograms and GC quantitation reports or data system printouts with peak areas or heights, concentrations, and RTs clearly indicated. Clearly indicate peaks selected for quantitation.

15. Analytical sequence information on a modified CLP Form 8 for each GC instrument and GC column used for analysis.

a) Include EPA sample number, laboratory sample ID, date and time analyzed, and surrogate RT for all standards and field and QC samples associated with the initial calibration reported in the header.

b) Include the following additional information in the header: GC column ID with internal diameter, date of initial calibration, and instrument ID.

16. Raw QC data must include the following items:

a) Blank data, in chronological order:

1) Tabulated results on a modified CLP Form 1
2) GC chromatogram
3) GC quantitation reports or data system printouts
4) Any manual worksheets

b) MS/MSD data, in chronological order:

1) Tabulated results on a modified CLP Form 1
2) GC chromatogram
3) GC quantitation reports or data system printouts
4) Any manual worksheets

c) LCS data, in chronological order:

1) Tabulated results on a modified CLP Form 1
2) GC chromatogram
3) GC quantitation reports or data system printouts
4) Any manual worksheets

17. All instrument printouts resulting from sample screening, with RTs, integrated peak areas or heights, and CFs.

18. Bench sheets for sample preparation including method, date, and spike and surrogate solution identification and volume and concentration added.

19. Bench sheets for percent moisture determination and dilutions.

20. Bench sheets for sample analysis including instrument ID and date and time of analysis.

21. Standard preparation logs, for all standards used for either calibration or spiking, which include source, traceable lot number, and concentrations of all compounds.

22. Any internal laboratory sample or sample extract transfer records and tracking sheets.

8. **Data Requirements:**

The required target compounds with corresponding contract required quantitation limits (CRQLs) are provided below.

Compound	Water (mg/L)	Soil (mg/Kg)
Gasoline - Purge-and-Trap	0.5	10.0
Gasoline - Headspace	5.0	5.0
Diesel	0.5	10.0

9. **Other (use additional sheets or attach supplementary information, as needed):**

Attached is a copy of the "U. S. EPA Region 9 Laboratory QC Summary Report" form.

a. This form is to be completed by the Laboratory Manager or designee and submitted with each data package.

b. The form is to reflect the conditions contained within the data package with which it is submitted.

c. Laboratories may make additional copies of this form as needed.

d. A separate form is to be completed and attached to the Regional copy (original) of each data package submitted. This form is to be placed directly behind the SDG narrative.

e. This form will be used to identify areas of noncompliance with the required QC limits that may results in resampling or reduction in payment.

f. Answers to questions are designed so that a YES answer indicates compliance and requires no further explanation. A NO answer indicates noncompliance and requires a short explanation. If a lengthy explanation is required (or desired), write <u>See SDG Narrative</u> in the blank space and include the explanation in the SDG narrative.

U. S. ENVIRONMENTAL PROTECTION AGENCY REGION 9
Environmental Services Branch

75 Hawthorne Street
San Francisco, CA 94105
Phone: 415/744-1498

SITE NAME:
CASE/RAP NO.:

REGIONAL ANALYTICAL PROGRAM CLIENT REQUEST FORM

The determination of pH in low/medium concentration soil samples following SW-846 Method 9045C (Revision 3, January 1995) protocols.

1. **Definition and number of work units involved (specify whether whole samples or fraction; specify sample matrices; and specify concentration levels):**

2. **Estimated date(s) of collection (provide a sampling schedule):**

3. **Estimated date(s) and method of shipment.**

   Overnight courier - samples are to be shipped on the day of collection for next day delivery including Saturday deliveries. Laboratory must be capable of accepting Saturday deliveries.

4. **Number of days analysis and data required after laboratory receipt of samples:**

   a. The contract required analysis holding time specifies determination of pH within twenty-four (24) hours of sample receipt by the laboratory.

   b. Data packages and all other deliverables are required within 35 days from receipt of last sample in each sample delivery group (SDG). A SDG is defined as the following, whichever is most frequent:

      - Each case of field samples received; or
      - Each 20 field samples within a case; or
      - Each 14 calendar day period during which field samples in a case are received.

5. **Analytical protocol required (attach copy if other than a protocol currently used in this program):**

   a. Follow SW-846 Method 9045 protocols for pH determination. There is no contract required detection limit (CRDL) for the determination of pH.

   b. Refer to Sections 7.2 and 7.3 of SW-846 Method 9045 for the pH measurement of soil and waste samples, respectively.

6. **Special technical instructions (if outside protocol requirements, specify compound names, CAS numbers, detection limits, etc.):**

   a. Calibration Procedure and Criteria:

1. The meter and electrode system are to be standardized as instructed in the operation manuals of the respective pH meters and accessories being used. Special attention to care of the electrodes is recommended.

2. Calibrate the instrument/electrode system on each day that pH determination is performed. The calibration must include a minimum of two points that bracket the expected pH of the samples and are approximately three pH units or more apart.

3. Repeat adjustments on successive portions of the two buffer solutions until readings are within 0.05 pH units of the buffer solution value.

4. Rinse thoroughly and gently wipe the electrodes after each reading.

b. **Internal Quality Control Checks, Control Limits and Corrective Actions**:

1. The measured pH values are to be corrected when sample temperature differs by more than 2°C from the buffer solution. Refer to the manufacturer's instructions for instruments equipped with automatic or manual compensators that electronically adjust for temperature differences.

2. Analyze laboratory duplicates at a frequency of one per sample delivery group. A difference of $<\pm 0.1$ pH unit is required.

3. Check the pH of at least one buffer solution after every 10 samples. Repeat measurement on successive volumes of the buffer solution until values differ by less than 0.1 pH units. Two or three measurements are usually sufficient.

4. pH measurement errors may be caused by the following:

   a. Samples with very low or very high pH
   b. Temperature fluctuations
   c. pH electrodes becoming coated with an oily material that will not rinse off.

5. The QC requirements listed above are the minimum required. It is impossible to address all analytical situations that might be experienced by a laboratory during the analysis of environmental samples. The laboratory is expected to adhere to good laboratory practices when analyzing samples. Notify the Region IMMEDIATELY if questions not addressed in this document arise concerning the analysis of samples. The Laboratory Manager, or designee, must address any problems and resolutions in the SDG narrative.

7. **Analytical results required (if known, specify format for data sheets, QA/QC reports, Chain-of-Custody documentation, etc.) If not completed, format of results will be left to program discretion.**

a. Data Calculations and Reporting Units:

1. Read pH meters directly in pH units. Report pH values to the nearest 0.1 unit, and temperature to the nearest °C. Report the results for soil samples as "soil pH measured in water at ___ °C" and for waste samples, report the results as "waste pH measured in water at ___ °C."

2. Raw data are to be organized systematically and each page is to be numbered.

b. **Documentation and Deliverables**:

All documentation and deliverables required in Exhibit B of the Contract Laboratory Program (CLP) Statement of Work (SOW) for Inorganics Analysis ILM03.0 or ILM04.0 must be submitted. Deliverables (in the form of a purge file - i.e., original documents) for each SDG shall include the following items:

1. All original shipping documents and sample tracking reports, including signed chain-of-custody forms, airbills, and traffic reports.

2. A completed and signed document inventory form on a modified Inorganics Complete SDG File (CSF) Inventory Sheet (CLP Form DC-2).

3. All original sample receiving documents, including sample log-in information (CLP Form DC-1), an SDG cover sheet, and any other sample receipt forms.

4. A copy of the RAP CRF, as provided by the Region (so that any additions or revisions authorized by the Region will be known). Only the technical portion of the CRF is required.

5. Any telephone logs referring to the samples.

6. A Cover Page, signed by the laboratory manager or designee, certifying the accuracy and validity of all data reported. The cover page must contain the following information: laboratory name; laboratory code; contract number; case/RAP number; SDG number; EPA sample numbers of all samples in the SDG; laboratory sample identification (ID) numbers, and the definition of any laboratory qualifiers used to flag the data.

7. A Case Narrative, describing any administrative or technical problems encountered such as QC, sample shipment, or analytical problems, and the resolution of these problems.

8. Include the following information in the header for each data reporting form: laboratory name; contract number; laboratory code; case/RAP number; SDG number; and reporting units.

9. Tabulated sample results for all environmental and laboratory QC samples on a modified CLP Form 1 with parameter name and any laboratory qualifiers. Include the following additional information in the header: EPA sample number, laboratory sample ID, matrix, level, date received, and reporting units.

10. Blank data (laboratory preparation blank) on a modified CLP Form 3 with any laboratory qualifiers. Include in the header the laboratory method blank matrix and reporting units.

11. Duplicate results on a modified CLP Form 6 with the sample pH units, duplicate pH units, control limits, calculated relative percent difference (RPD), and laboratory qualifier (if applicable). Include the following additional information in the header: EPA sample number, matrix, level, and the reporting units.

12. Sample preparation information on a modified CLP Form 13 including the preparation date, mass, and volume for each EPA sample number. Identify the analytical method in the header.

13. Analysis run logs on a modified CLP Form 14 with the time of analysis, the dilution factor (if applicable). Include the following additional information in the header: instrument ID, method number, and start and end date of the sequence.

14. Raw sample, buffer, and laboratory QC data, including:

    a) tabulated results
    b) instrument output including date and time of analysis and EPA sample number
    c) bench records tabulating calibration standards, samples, and laboratory duplicates
    d) any laboratory worksheets

15. Bench sheets for sample preparation including the date, sample weight, and a description of any significant sample changes during preparation.

16. Buffer preparation logs for all solutions used for calibration, which include source, traceable lot number, date of preparation, and pH of buffers. Identify the primary and secondary buffer salts used.

17. Any internal laboratory sample or sample extract transfer records and tracking sheets.

8. **Data Requirements:**

Parameter	Detection Limit
pH	Not Applicable

9. **Other (use additional sheets or attach supplementary information, as needed):**

Attached is a copy of the "U. S. EPA Region 9 Laboratory QC Summary Report" form. This form is to be completed by the Laboratory Manager or his/her designee and submitted with each data package. The form is to reflect the conditions contained within the data package with which it is submitted. Laboratories may make additional copies of this form as needed.

a. A separate form is to be completed and attached to the Regional copy (original) of each data package submitted. This form is to be placed directly behind the case narrative.

b. The Laboratory Quality Control Summary Report form is to be completed by the Laboratory Manager, or designee.

c. This form will be used to identify areas of noncompliance with the required QC limits that may result in re-sampling or reduction in payment.

d. The questions are designed so that a "YES" answer indicates compliance and requires no further explanation. A "NO" answer indicates non-compliance and requires a short explanation. If a lengthy explanation is required (or desired), write See SDG Narrative in the blank space and include the explanation in the case narrative.

Appendix C

Niton XL702 Field Portable X-Ray Fluorescence Analyzer

User's Guide Excerpts

NITON® corporation

NITON Corporation

XL-309

&

*700*series

User's Guide Version 5.0 (HTML)

The information in this User's Guide is furnished for informational purposes only, is subject to change without notice, and should not be construed as a commitment by NITON Corporation. NITON Corporation assumes no liability for any errors, inaccuracies or ommissions that may appear in this book.

* XL-309 and 700 Series User's Guide

* XL-309 Lead Detector

* 700 Series Multi-element Analyzer

Produced in the United States of America

Registration: NITON Corporation manufactures the XL-309 and 700 Series under the authority of the State of Rhode Island, *License #3A-105-01*. NITON XL-309 and 700 Series have been evaluated for safety in *Sealed Source and Device Evaluation Sheet RI-164-D-101-S.*

NITON corporation

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- (781) 275-9275 or (800) 875-1578
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- Service Department:
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- North Kingstown, RI 02852
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- Fax: (401) 295-2090
- email support@niton.com

Contents

NITON Corporation

XL-309

&

*700*series

User's Guide Version 5.0 (HTML) Chapter 2

Chapter 2: Operating your NITON

NITON **XL-309** and **700 Series** Spectrum Analyzers are hand-held, portable XRF detectors, designed to make fast, accurate measurements. The **XL-309** measures concentrations of lead, while **700 Series** instruments measure concentrations of many different elements simultaneously. NITON instruments measure the precision of each reading, store up to 3,000 readings with complete x-ray spectra, and download data quickly to a PC.

NITON designed the radioactive source and shielding of our analyzers with one guiding principle in mind: properly used, these will not expose the NITON user to levels of radiation significantly above natural background levels.

Note: The accuracy and precision of the data you collect with your NITON XRF will largely depend on your familiarity with the instrument and your knowledge of the media you are testing.

Our free factory training is designed to give you the basic tools to use our instruments. This User Guide supplements our training. You can use it as both a quick reference and a detailed operating manual for any of our XRF analyzers.

This is your NITON XRF Spectrum Analyzer

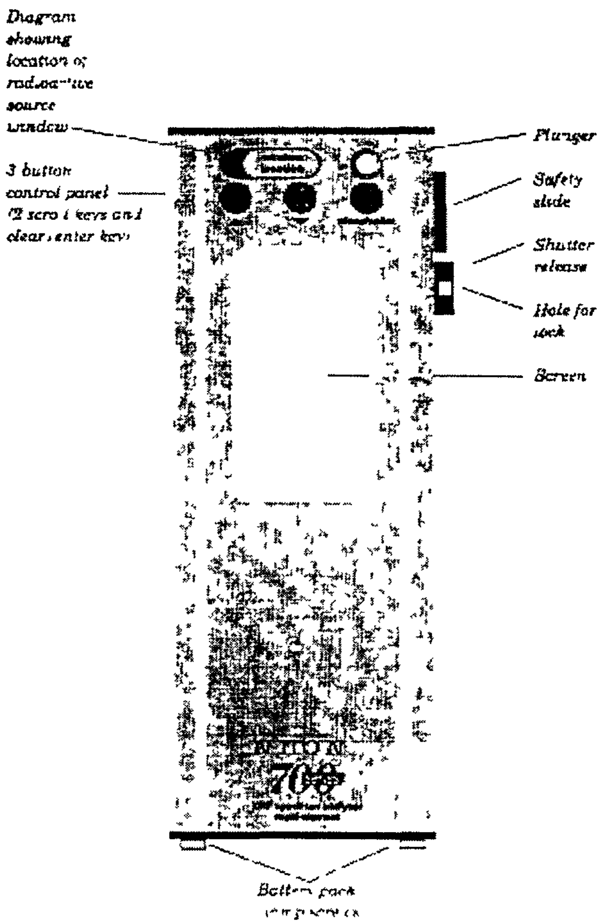
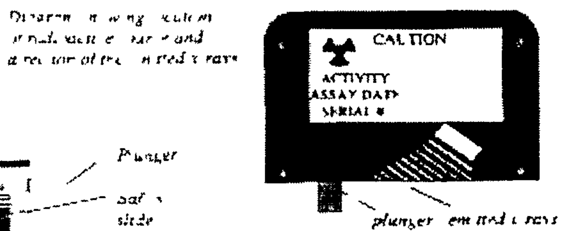


Fig 2.01 Front view of the NITON 700

Fig 2.02
Top view of the your NITON



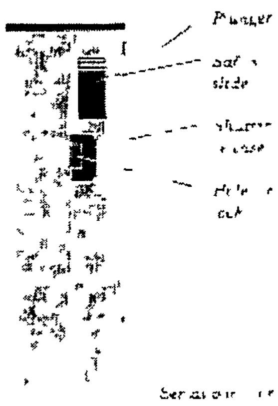


Fig 2.03
Right side view of your NITON

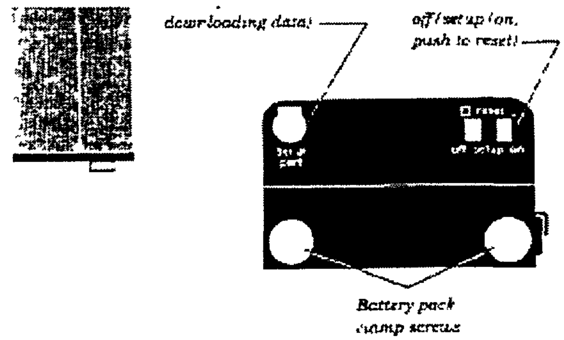


Fig. 2.04
Back view of your NITON

NITON Spectrum Analyzers operate in the following modes:

Modes of operation, by model

Model	Bulk Mode	Thin Sample Mode	Paint Modes
• 701	• No	• Yes	• No
• 701-A	• No	• Yes	• Yes
• 702	• Yes	• No	• No
• 702-A	• Yes	• No	• Yes
• 703	• Yes	• Yes	• No
• 703-A	• Yes	• Yes	• Yes
• XL-309	• Opt (lead only)	• Opt (lead only)	• Yes

Turning on your NITON

1. Turn on the instrument. Depress and slide the On/Off switch on the bottom of the instrument to the on position (Figure 2.04). Sometimes the instrument's battery saving features momentarily delay start up. If your NITON does not turn on immediately, turn it off, wait a few seconds, and turn it on again. Each time the NITON is turned on, the Main menu appears (Figure 2.05).

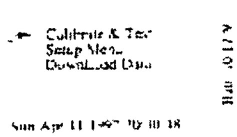


Fig 2.05 Main Menu

Press Clear/enter to Calibrate test immediately in the mode when the XL was turned off

2. The control panel consists of three buttons (Figure 2.06). These buttons allow you to navigate all of your NITON's screens and menus. Press the Clear/Enter button to *select* the function indicated by the screen arrow. When you turn on your NITON, the Screen arrow is on

Calibrate & test.

Note: You can begin to test immediately in whatever mode you *last* tested in by pressing the Clear/Enter button.

Note: You can begin to test immediately in whatever mode you *last* tested in by pressing the Clear/Enter button.

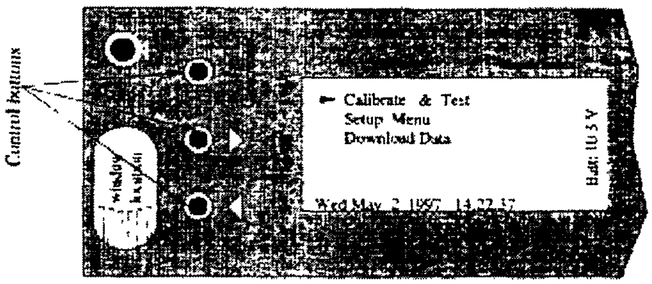


Fig 2.06 Top View of XL showing the 3 control buttons

Getting started

The XL-309 and 700 Series Instruments are highly sophisticated, electronic spectrum analyzers. The more familiar you are with your NITON's operation, the better your measurements and reports will be. Here, in brief, is an outline of how to do various kinds of testing using your NITON. More detailed information is offered in subsequent chapters.

1. Turn on the instrument. When testing in Bulk Sample or Thin Sample modes, leave your NITON on for fifteen minutes prior to testing. *This is not necessary if you are going to test in any of the Paint Modes*. Go to the Setup Menu (Figure 2.07) and set the .mode you wish to test in.

Setup Menu
Test Soil, Bulk Samples
Setup thin Sample Mode
→ Setup Paint Mode
Instrument Specification
Set Time
Illuminate Screen
EXIT to Main Menu

Fig 2.07 Setup Menu

2. Press Clear/Enter to begin self-calibration.

3. When the NITON beeps, calibration is complete. You are now ready to test. For instructions on how to take a measurement, depending on the nature of the media you will be measuring, turn to one of the following chapters: Chapter 3: Analyzing Bulk Samples; Chapter 4: Analyzing Thin Samples; or Chapter 5: Analyzing Lead Paint.

Note: Check your instrument's calibration with testing standards before and after testing and at least once per hour during testing.

The Setup Menu

Setup Menu
Test Soil, Bulk Samples
Setup thin Sample Mode
Setup Paint Mode
→ Instrument Specification
Set Time
Illuminate Screen
EXIT to Main Menu

Fig 2.06 Setup Menu

Press Clear/Enter to bring up the Instrument Specification screen

Use the Setup Menu (Figure 2.08) to check your instrument specification; to set the date and time; to illuminate the screen continously; or to select a different testing mode. Select the Setup Menu from the Main Menu with the Arrow buttons; enter the Setup Menu by pressing Clear/Enter.

Instrument Specification

Sun Apr 4 [illegible] 17 19 37
Serial # XL309 [illegible]
[illegible]

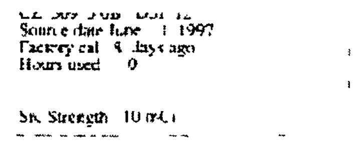


Fig 2.09 Instrument Specifications

To check the source strength of your instrument and other useful information, select the Instrument Specification screen (Figure 2.09) from the Setup Menu with the Arrow buttons. Press Clear/Enter. The screen displays the following information:

1. The Day, Month, Date, Year and Time (hours, minutes and seconds).

2. The Instrument Serial Number

3. The instrument Model; and the versions of Firmware and DSP software installed on the instrument.

4. The Source Date, the assay date of the $cadmium_{109}$ source.

5. The number of days since the last factory calibration of the instrument.

6. The Hours used, the number of hours the instrument has been used since the last factory calibration.

7. The Source Strength, the current strength of the instrument's $cadmium_{109}$ source, in millicuries (mCi).

To exit the Instrument Specification screen to the Main Menu, press the Clear/Enter button.

Setting the time and date on your NITON

NITON sets the date and time (EST) on each instrument before it is shipped. Reset as needed when changing time zones, daylight savings time begins and ends, or whenever the time or

date is wrong.

Caution: Check the Date and Time displayed on the Ready to Test screen. If they are not correct, reset them before taking any measurements. Your readings will not be accurate unless the date and time are correct.

To reset the date and time from the Setup Menu, do the following steps:

1. Use the the Arrow buttons to scroll to Set Time (Figure 2.10 a,b).

2. Press Clear/Enter to select it. The Date and Time appear as follows:

Month-Day-Year-Hour-Minute-Second

Setup Menu
Test Soil Bulk Samples
Setup thin Sample Mode
Setup Paint Mode
Instrument Specification
► Set Time
Illuminate Screen
EXIT to Main Menu

Fig 2.10a Setup Menu Set Time

Press Clear/enter to bring up the Set Time screen

Sat Apr 1997 13 31 44

Fig 2.10b Set Time screen

Month-Day-Year-Hour-Minute-Second

The cursor starts at **Month** and moves to the right. To change the time and date, move from left to right on the screen. For example, To change the **hour** and **seconds**:

1. Press **Clear/Enter** three times to move the cursor to **Hour**.

2. Use the **Arrow buttons** to change the hour to the desired hour. Press **Clear/Enter**.

3. The cursor automatically moves to the next field: **Minute**. Use the **Arrow buttons** to change the minutes to the desired minutes. Press **Clear/Enter** again to move the cursor to **Second**.

4. Use the **Arrow buttons** to change the seconds to the desired seconds. Press **Clear/Enter.**

5. After selecting **Seconds**, the **Main Menu** screen is again displayed, set to **Calibrate & Test.**

Note: If the year is incorrect, set it first. Use Clear/Enter **to move to the year position and the** Arrow buttons **to set the year. Then press** Clear/Enter ***five*** **more times and set the remaining fields as described above.**

Lighting the LCD screen

In its default mode, your instrument's LCD screen remains back-lit for 15 seconds after any of the three buttons is pressed. You can light the screen any time the instrument is turned on by pressing any of the three buttons. When working in a dark place, you also have the option of lighting the screen continuously.

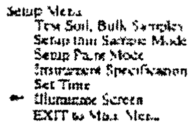


Fig. 2.11: Setup Menu Illuminate Screen

Take the following steps to either light the screen continuously, or turn off continuous screen lighting if it is currently activated:

1. Use the **Arrow buttons** to select **Illuminate Screen** from the **Setup Menu (Figure 2.11**).

2. Press the **Clear/Enter button** to turn continous screen lighting on or off. The instrument will then return automatically to the **Main Menu**.

Overview of test modes

The **Setup Menu** allows you to choose the pre-programmed test mode best suited for the type of testing that you will be doing. A full chapter is devoted to each mode later in this User's Guide.

Note: The Setup Menu shows all NITON analyzer modes for all instruments. If you select a test mode which is not available on your NITON instrument, a reminder message will be displayed on the sceen.

Please contact NITON instrument sales at (800) 875-1578 or your local NITON sales representative to enquire about upgrading your NITON analyzer to add capabilities.

Use the **Arrow buttons** to select the mode you wish to test in. Press **Clear/Enter** to select the mode.

The Bulk Sample mode

Bulk Sample Mode can be used to measure concentrations of contaminants in any fairly homogeneous, fine-grained medium such as soil, ground-up paint chips, a liquid or many other kinds of bulk materials.

To test in Bulk Sample Mode:

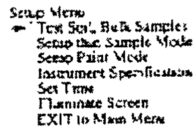


Fig 2.12 Setup Menu
Bulk Samples

1. Use the **Arrow buttons** to select

Test Soil, Bulk Samples

from the **Setup Menu** (**Figure 2.12**). Press the **Clear/Enter** button.

2. The instrument will return to the **Main Menu** ready to **Calibrate & Test** in Bulk Sample Mode. Press the **Clear/Enter** button.

3. The instrument will initiate self-calibration. This will take one to two minutes. When self-calibration is complete, the instrument will **beep** and display the **Ready to Test** screen for Bulk Sample Mode (**Figure 2.13**).

4. See **Chapter 3: Testing Bulk Samples** for details on how to test particular kinds of bulk samples.

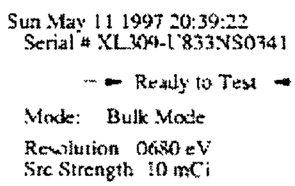


Fig. 2.13 Ready to Test. Bulk Mode

The Thin Sample modes

Thin Sample Modes can be used to measure concentrations of contaminants in a variety of thin layers, including deposits on dust wipes, filters and many other substrates, including, for example, thin layers of uranium on concrete.

Caution: The Standard Thin Sample Mode should not be used for quantitative lead-paint testing. Use only the three Paint Testing modes to test lead-based paint.

There are five Thin Sample Testing modes, each designed for a different type of test media:

1. **37 mm CE Filters**: Used for 37 mm diameter filters (fiberglass or cellulose-ester) used in personal exposure monitoring. This mode can also be used for 37 mm filters used to analyze dust in Dust

Vacuum Methods. In this Thin Sample Mode, three measurements are taken, weighted, and summed for each filter.

2. **TSP/PM Filters**: Used for the larger filters to monitor the concentration of metals in air. In this mode, the instrument averages the measurements you take on the filters.

3. **Dust Wipes**: Used for dust wipes to take samples by wiping surfaces following HUD guidelines for risk assessment and clearance testing for lead in dust.

4. **Standard Thin Sample**: Used for taking single measurements of samples or coatings. In this mode, results are displayed, in micrograms/cm^2.

5. **User-Definable Thin Samples**: User-definable testing gives you the flexibility to specify custom thin sample measurement protocols.

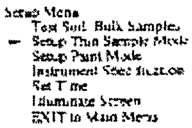


Fig 2.14 Setup Menu
Thin Sample Mode

Testing in the Thin Sample Modes:

1. Use the **Arrow buttons** to select

Setup Thin Sample Mode

from the **Setup Menu**. Press **Clear/Enter**.

2. The **Choose Operation Mode for Thin Samples** screen will appear (**Figure 2.14**)

3. Use the **Arrow buttons** to select the mode appropriate for the kind of thin samples you are going to test. Press **Clear/Enter**.

4. The **Choose Operation Mode for Thin Samples** screen will *highlight* the thin sample mode you have selected and the cursor will move to **Exit to Main Menu** (**Figure 2.15**). Press the **Clear/Enter** button to return to the **Main Menu**. Press the **Clear/Enter** button again to initiate **Calibration & Testing** in the thin sample mode you have selected.

5. The instrument will initiate self-calibration. This takes one to two minutes. When calibration is complete, the instrument will **beep** and display the **Ready to Test** screen for the thin sample mode you have selected (**Figure 2.16**).

6. See **Chapter 4: Testing Thin Samples**, for details on how to test thin samples.

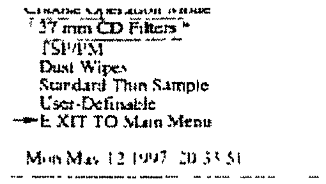


Fig 2.15 Operation Mode
Select 37 mm CD Filters

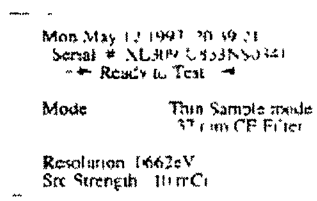


Fig 2.16 Ready to Test
37 mm Filter Mode

The Paint modes

All three **Paint Modes** can be used interchangeably to measure lead concentrations in paint in mg/cm^2. In all paint modes, NITON analyzers simultaneously measure and analyze both K-shell and L-shell lead x-rays to determine (1) the numerical value of the lead in mg/cm^2 present in the sample; (2) the 95% confidence interval; and (3) whether the sample has a lead concentration that is **greater-than-or-equal-to** ("**Positive**") or **less-than** ("**Negative**") the lead **Action-level** (in mg/cm^2) that has been entered.

Standard Paint Mode

In **Standard Paint Mode**, the instrument reads until a 95% confident reading of "**Positive**" or "**Negative**" versus the **Action-level** is achieved. Then the instrument displays either **Positive** or **Negative**, the **Result** in mg/cm^2, and displays **Surface lead** for all **Positive** readings where the lead is not shielded by overlying layers of non-leaded paint.

In **Standard Paint Mode**, testing times will vary somewhat from sample to sample. The instrument will measure *only* until a 95% confident reading of "**Positive**" or "**Negative**" (versus the **Action-level** you have set) has been attained. Most readings take 10 seconds or less.

Standard Mode + Spectra

Standard Mode + Spectra is identical to **Standard Paint Mode** except that the x-ray spectrum is displayed with each reading.

K & L + Spectra Mode

In **K & L + Specra Mode**, the instrument displays the complete test information *continuously*, from the beginning of each reading, including the K-shell reading with two-sigma confidence interval, the L-shell reading with two-sigma confidence interval, the combined reading (Pb) with two-sigma confidence interval, and the full x-ray spectrum. With each reading, a **Null** result is displayed until a **Positive** or **Negative** result is determined.

In **K & L Mode + Spectra**, you may continue readings indefinitely after a "**Positive**" or "**Negative**" result is obtained, until you have attained a desired measurement time or degree of precision.

Note: In all paint testing modes, if a test is stopped *before* a "Positive" or "Negative" determination has been made, you will get a "Null" test result.

Testing in the Paint Modes:

Standard Paint Mode
Standard Mode + Spectra
K & L Readings + Spectra
← Setup Paint Protocol
Exit to Main Menu

Fig 2.17 Setup Paint Mode Arrow on Paint Protocol

1. Use the **Arrow buttons** to select

Setup Paint Mode

from the **Setup Menu**. Press **Clear/Enter**. The **Setup Paint Mode** menu screen will appear (**Figure 2.17**)

2. Use the **Arrow buttons** to select

Set up Paint Protocol

. Press **Clear/Enter**. The **Paint Protocol** screen will appear (**Figure 2.18**)

3. Use the **Arrow buttons** to adjust the times for the **1st beep**, the **2nd beep** and the **3rd beep** signals for **K & L Mode + Spectra** and to set the **Action level**. Use the **Clear/Enter** button to enter each selection.

1st beep	3 sec
2nd beep	10 sec
3rd beep	30 sec
Action level	1.0

Figure 2.18 Paint protocol screen

4. When the **Action-level** has been entered, the **Setup Paint Mode** screen will re-appear (**Figure 2.17**). Now use the **Arrow buttons** to select a Paint Testing Mode. Press **Clear/Enter**.

5. The **Main Menu** will appear, with the instrument ready to **Calibrate & Test** in the paint mode you have selected. Press**Clear/Enter**.

6. The instrument will self-calibrate in one to two minutes. When self-calibration is complete, the instrument will **beep** and display the **Ready to Test** screen for the paint mode you have selected (**Figure 2.19**).

7. See **Chapter 5: Testing Paint Samples**, for detailed descriptions of all three paint testing modes.

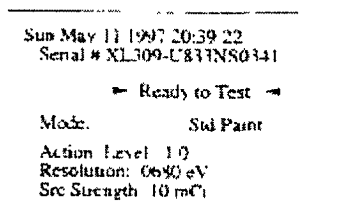


Fig. 2.19 Ready to Test Paint Mode

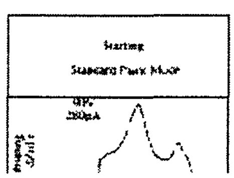
Calibrating your NITON

Your NITON has been thoroughly calibrated at the factory. To further assure the best Quality Assurance/Quality Control, your NITON performs a second self-calibration check every time you turn on or reset the instrument.

In addition, NITON has provided you with several standard samples so you may check both calibrations. These tests against known standards insure that the instrument is functioning properly and buttress your results with a permanent record of regular calibrations.

Instrument self-calibration

When the **screen arrow** (->) is on **Calibrate & test**, press **Clear/Enter** to start the self-calibration process (**Figure 2.20**). Self-calibration takes one to two minutes. When it is completed, the instrument will beep and the **Ready to Test screen** will appear.



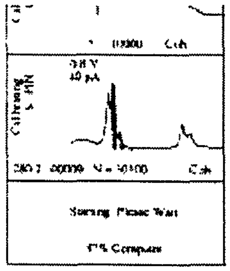


Fig. 2.20 Self Calibrating Process [illegible] seen during the self calibration

Caution:

The ready to test screen

The **Ready to Test screen** (**Figure 2.19**) displays the following fields:

1.The current **Date** and **Time**.

Caution: Check the Date and Time. If they are not correct, reset them before taking any measurements (see page 10). **Your readings will not be accurate unless the date and time are correct.**

2. The instrument **Serial Number**.

3. The indication that the instrument is **Ready to Test**

4. The testing mode the instrument is ready to test in.

5. The **Action-level** the instrument will use to make either a "Positive" or "Negative" determination of lead in paint testing. The **Action-level** is only used in paint testing modes.

6. The **Energy Resolution**. The lower the number (in eV), the better the instrument will perform.

Caution: If you try to calibrate the instrument and it does not calibrate successfully, push the Reset Button on the bottom of the instrument and recalibrate. If your NITON does not calibrate successfully in three attempts, please call the NITON Service Department at (401) 294-1234.

7. The **Source Strength** (**Src Strength**). The Source Strength indicates the current activity of the $cadmium_{109}$ source in your instrument, in millicuries. Your NITON compensates automatically for the decay of the source.

Re-calibrating your NITON during testing

To insure the accuracy and precision of your NITON, it is recommended that you re-calibrate hourly during testing. To recalibrate:

Press the **reset** button on the bottom of your NITON.

or turn the NITON off, then on, and press the **Clear/Enter** button.

Note: Occasionally, your NITON may refuse to take further readings and the screen will display the following message:

YOU MUST RECALIBRATE.

Typically, this will occur when there is a sudden, very large change in the ambient temperature. When this occurs, recalibrate and continue testing.

How to use your NITON standard samples

NITON provides sets of standard samples for each testing mode. These are used to check the calibration of the instrument:

1. For **Bulk Sample Mode**, there is a set of three NIST soil standards

2. For **Thin Sample Mode** there is a set of three thin film standards: lead, copper, and iron.

3. For **Lead Paint Mode**, there is a set of government-traceable lead paint films.

Note: Although the standards do not contain every element our multi-element analyzers test for, when an instrument correctly measures the standards you have have received with your 700, your NITON will correctly measure the other elements.

Test the standards regularly. First, immediately after the instrument finishes self-calibration. Then test the standard samples appropriate to the type of tests you are conducting, and once every 1-2 hours thereafter.

Warning: Tampering with the 5,500 ppm lead-in-soil standard may cause exposure to lead dust. Keep all standards out of reach of children.

Caution: Never tamper with Test Standards. They should not be used unless they are completely intact.

Soil and Thin Film standards

To test soil or thin film standards, place the sample in the test platform receptacle and proceed to test as with any prepared sample. The NITON standard soil samples provided with your instrument contain known amounts of several elements. Do not contaminate the thin film samples with your fingerprints. Handle them by the edges with clean hands.

Lead paint standards

1. Place the NITON standard with the colored side face up. Choose the RED strip labelled 1.0 +/- 0.1. Take a reading of that standard. Place the instrument on the standard so that the instrument window is fully on the standard. Your NITON should display a value between 0.9 and 1.1 mg/cm^2 and should indicate **Surface lead**.

2. Place the same standard with the colored side down. Take a reading of the standard (buried beneath the equivalent of 5-6 coats of non-lead paint). Your NITON should still display a value between 0.9 and 1.1 mg/cm^2 and should not display **Surface lead**.

Note: If your instrument is testing high on Standard samples, check the surface the Standards are resting on. The surface may contain lead.

When you test the Standard samples, your instrument should give readings which approximate the certified values. Your instrument should give consistent readings for each sample.

Downloading data

Your NITON stores up to 3,000 measurements plus their spectra. You can download this data to a computer for reporting or insertion in a database.

Note: Downloading data does not erase readings. To make room for the next set of data, erase readings after verifying that the data was downloaded successfully (see next section).

The RS-232 port, on the back of your NITON, accommodates a 4-pin LIMO connector. A LIMO to 9-pin RS-232 connector cable is provided with your NITON. Your NITON can communicate with either a "dumb" or an "intelligent" terminal, such as a VT100 connected to a mainframe computer or a PC-compatible computer.

Fast data dump

You can download up to 3,000 measurements, their descriptions, and spectra (4-90 keV) in *minutes* using the high-speed compressed format, **NITON/Mid-Hudson Downloading Software**, provided with your instrument.

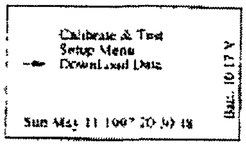


Fig 2.21 Main Menu
DownLoad Data

1. Connect your NITON to your computer with the RS-232 port cable that is provided.

2. Using the **Arrow buttons**, select **Download Data** from the **Main Menu** and press **Clear/Enter** (**Figure 2.21**).

3. Select **Fast Data Dump** from the **Download Data menu** (**Figure 2.22**)and press **Clear/Enter**. Select the first to the last readings you wish to download. The **default** setting will download all readings currently stored in memory.

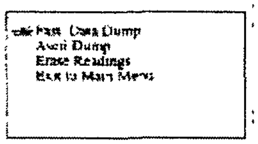


Fig 2.22 Download Data
Fast Data Dump

4. When the instrument finishes downloading, it will return to the **Main Menu**.

ASCII data dump

For users who wish to download data in ASCII format, the NITON can dump its data as an ASCII file to any terminal emulator program.

1. Connect the NITON to your computer with an RS-232 cable.

2. In the **Download Data screen**, press the **Arrow buttons** to scroll to **ASCII dump (Figure 2. 23).** Press **Clear/Enter**.

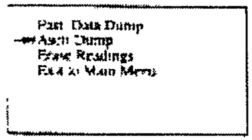


Fig. 2.23 Download Data Ascii Dump

3. When the instrument finishes downloading, it will return to the **Main Menu**.

Erasing readings

If you do not erase your data, the NITON will continue to record data until the memory is completely full. Then the NITON will start to overwrite older data. Any data that is overwritten in this way will be lost.

Your NITON can store data on up to 3,000 measurements in all **Paint modes**, or 1,000 readings in **Bulk Sample** or **Thin Sample modes.**

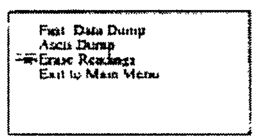


Fig. 2.24 Download Data Erase Readings

Note: Download your data before the memory is completely full. Clear the memory after downloading.

The erase readings function is designed to protect you from accidentally erasing readings. To erase readings:

1. In the **Download Data** menu, use the **Arrow buttons** to scroll to **Erase Readings** (**Figure 2.24**). Press **Clear/Enter.**

2. The **Erase Readings** screen (**Figure 2.25**) appears with the following choices:

ERASE all readings

-> CANCEL do not erase

EXIT to Main Menu

The screen arrow defaults on **Cancel do not erase**, so that if you select it by mistake, you will not erase any readings.

3. To **Erase Readings**, use the **Up-Arrow button** to go to **ERASE all readings**. Then press **Clear/Enter**. When you enter either **ERASE all readings** or **CANCEL do not erase** your instrument will return to the **Main Menu**, ready to take and store more readings.

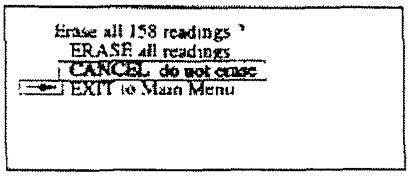


Fig. 2.25 Erase Readings Screen
Default is: CANCEL, do not erase

Battery packs and battery charger

Fully charged, each Nickel Metal Hydride battery pack gives eight or more hours of continuous use. It takes about 2.5 hours to fully recharge a spent battery pack if the batteries have been recently used. If the NITON has not been used for several weeks, or if the batteries are completely discharged, they must be pre-charged before they can be recharged. See **Battery Charger**, below.

NITON Battery packs can be recharged at least 500 times. They are warranted to be free of defect when shipped. They are not further covered by manufacturers' warranty. When they need to be replaced, new battery packs may be purchased from NITON.

Note: Before beginning a test, be certain the battery pack has sufficient charge. It is always a good idea to carry a spare battery pack.

Caution: NITON's Nickel Metal Hydride battery packs discharge at a rate of about 2% per day when not in use.

Battery pack routine maintenance

Some guidelines:

* Don't leave battery packs on the charger *all* the time. Overnight recharging is recommended.

* For longest battery lifetimes, use a battery until completely discharged, and then recharge.

* Don't recharge a fully charged battery pack. If you want to charge a partially charged battery, run the Discharge cycle before recharging.

* Store the charger and battery packs in a cool, but not cold, place, away from direct sunlight.

* When a battery pack is not used for a long period of time, it will lose its charge completely. Fully recharge it before use.

Note: The lithium battery inside your NITON will prevent any loss of data if you need to change the battery pack before downloading readings.

Changing battery packs

Removing a battery pack

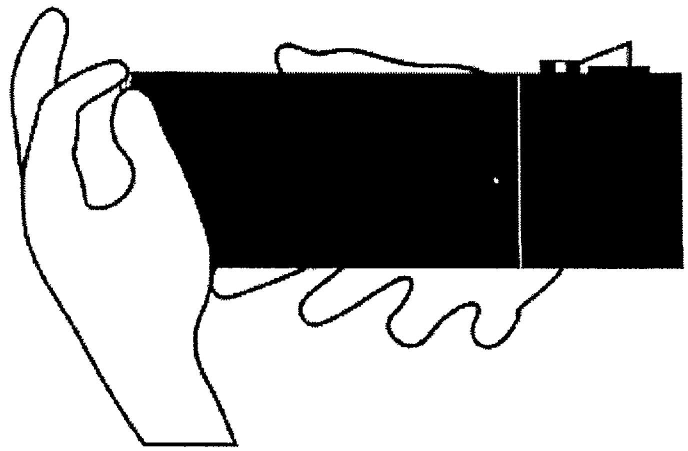


Fig 2.26
Loosen clamp screws
to remove the battery pack
The clamp screws stay
attached to the battery pack

1. Avoid changing the battery pack outdoors. Moisture and dirt can damage a battery.

2. Rest the NITON on a clean surface.

3. Loosen the (2) clamp screws. They do not come off (**Figure 2.26**).

4. Pull the battery pack away from the instrument by grasping the knurled screws and gently rocking the battery pack from side to side while removing it.

Installing a battery pack

1. Rest the NITON on a clean surface, as before.

2. Slip the notch at the bottom of the battery pack into the wide slot.

3. Gently push the battery pack in, taking care that the battery pack connector is seated properly to the instrument.

4. Tighten the (2) knurled screw clamps that fit into holes on the NITON. If the screw clamps do not tighten, the connectors are not lined up properly. These screw clamps must be tight for a secure connection.

Recharging battery packs

Recharging with the AC adapter

1. Lay the battery pack on top of **Battery Charger**. Fit connectors together snugly (**Figure 2.27**).

2. Plug one end of the AC adapter into the power port on the bottom of the charger. Push the plug in, making sure it seats fully.

3. Power up the charger: Plug the other end of the AC adapter into a 110V outlet. The yellow ***Power*** light will come on and stay on throughout. The green ***Charge*** light will also come on. It will blink slowly at first, indicating that the battery is on **Pre-charge**, and then stay on with a steady light, indicating that the battery is on **Full Charge**.

4. In **Full Charge** mode, the green ***Charge*** light will stay on with a steady light while the battery is being charged. It is normal for the charger to make some noise in **Full Charge** mode.

5. In **Trickle Charge mode:** When the battery is fully charged, the charger will automatically switch to **Trickle Charge** mode and the green ***Charge*** light blinks rapidly.

Caution: Do not leave battery packs on the Battery Charger longer than necessary.

Battery charger

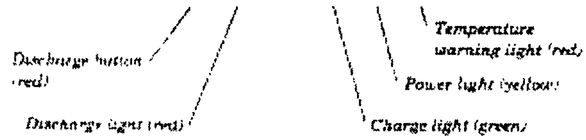


Fig. 2.27 Front view of the battery charger

Discharge cycle

Put battery packs on the **Discharge Cycle** only if they are not holding a charge; or, if they are partially charged, run the **Discharge Cycle** before recharging. It takes about eight hours to fully discharge a battery pack. To discharge a battery pack, place it on the charger and:

1. Press the red **Discharge** button. The red **Discharge light** goes on, and the green **Charge** light blinks slowly, showing charger is in **Discharge** mode.

2. After a full Discharge cycle, the charger automatically recharges the battery.

3. The red **Discharge** light goes out and the green **Charge** light will blink rapidly, showing it is in the **Trickle Mode**.

Pre-charge

If your NITON battery packs run all the way down, they must be pre-charged before they can be re-charged. The process can take up to 5 hours. A battery is pre-charging when the green **Charge** light on the battery charger is blinking slowly, and the **Discharge** and **Temperature** lights are off.

Overheating during charge

Caution: If the red Temp **light comes on repeatedly when a battery pack is on the battery charger in the Full Charge cycle, call NITON Customer Service at (401) 294-1234.**

Caution: Do not store the battery packs or battery charger in direct sunlight.

Using your vehicles 12V DC outlet

[yen] A 12V DC Adapter is provided with your NITON. Instructions are the same as for using the 110V AC Adapter. When you have seated all connections well, the yellow **Power** light will come on.

[yen] Do not use the Discharge Cycle while on the DC outlet.

[yen] Secure the charger so the power cord does not get pulled out while the vehicle is in motion.

[yen] The plug of the DC Adapter has a 5A internal fuse. To check the fuse, unscrew the cap that retains the contact from the end of the plug. Replace this fuse only with a 5A fuse of the same size. If the fuse in the 12V Adapter burns out frequently, call NITON's Service Department at (401) 294-1234.

Note: Please do not throw away spent battery packs. Return spent battery packs to NITON so

we can dispose of them properly.

Maintenance, cleaning and repairs

NITON Corporation welcomes any questions or comments you may have about your NITON analyzer. Please do not hesitate to call us at either our Main Office number: (781) 275-9275 or at our Rhode Island Service Facility number: (401) 294-1234.

Caution: All Service except exterior cleaning must be performed by NITON Corporation. Do not attempt to make repairs yourself. Opening the case of your NITON will void the instrument Warranty.

Keep your NITON clean, particularly the beryllium window on the bottom of the instrument. If the window is dirty, the performance of your NITON will be affected. Clean the window gently with cotton swabs. Clean the instrument's metal case with a soft cloth. Never use water, detergents, or solvents. These may damage the instrument.

Note: Never ship your NITON analyzer back to the factory for *any* reason without calling and obtaining a Return Authorization (RA) Number from NITON Corporation.

Storage, transport, and shipping

Storing and transporting your NITON

All NITON instruments come in waterproof, drop-proof carrying cases with padlocks. NITON instruments can be transported by car or plane or shipped as an ordinary package. There are no restrictions for tunnels or bridges. No notification is required for transportation except the following: There may be disclosure and/or licensing requirements if you take your NITON instrument across state or national boundaries. Please check with the appropriate agencies for details.

No special labelling is required on the outside of case or packaging. A compliance statement must be kept with the instrument case. *Always* transport the unit in its carrying case, and keep the NITON in its case whenever it is not being used. Store the instrument, in its case, in a secure area.

Shipping your NITON

All NITON instruments must be packed in their original padded carrying cases for shipment. Pack the NITON in its carrying case and ship in either the original carton and packing material or their equivalent.

Caution: Do not ship your instrument back to NITON for any reason without first notifying NITON Corporation and receiving a Return Authorization Number.

Caution: If you return your NITON without the carrying case you will void the instrument warranty. You will also be billed for a replacement case plus any repairs resulting from improper shipping.

Always enclose a copy of a current leak test certificate when you ship your instrument back to NITON.

Caution: NITON's license prohibits repairing or upgrading any XRF instrument without a current leak test certificate. If you return an instrument without a current leak test certificate, NITON will perform a leak test and bill you for the leak test.

Note: Keep a copy of the following statement in the NITON case whenever the instrument is shipped:

THE NITON SPECTRUM ANALYZER CONFORMS TO THE CONDITIONS AND LIMITATIONS SPECIFIED IN 49 CFR 173.422 FOR EXCEPTED RADIOACTIVE MATERIAL, INSTRUMENTS AND ARTICLES, N.O.S. UN-2910. THIS PACKAGE CONTAINS NO MORE THAN 50 mCi CADMIUM$_{109}$ IN A PLATED, SOLID, SEALED SOURCE INSTALLED IN AN X-RAY FLUORESCENCE ANALYZER.

NITON Back to the Table of Contents

NITON Corporation

XL-309

&

*700*series

User's Guide Version 5.0 (HTML) Chapter 3

3: Analyzing bulk samples

Overview

The NITON XL-309 may be used to test lead in soil and ground-up paint chips if equipped with optional Lead In Soil Analysis software and hardware. 702, 702-A, 703 and 703-A Model Spectrum Analyzers are multi-element analyzers for bulk media, thick samples of materials such as soil, sludge, and various liquids. Applications include:

- in-situ soil testing,
- in-situ materials testing (e.g., contaminated concrete)
- bagged soil sample testing
- testing sludge, sediments, liquids, and dust in cups,
- testing prepared soil samples.

Choose the **Bulk Sample mode** from the **Setup screen (Figure 3.01)**.

Note: Before testing in Bulk Sample mode, turn your NITON on at least 15 minutes prior to testing. This will give you more precise measurements.

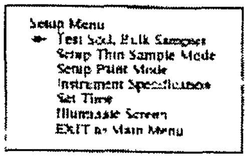


Fig 3.01 Setup Menu
Test Soil, Bulk Samples

In general, testing methods for bulk media are of two types: Field screening and testing prepared samples. Understanding the difference between these two types of analysis is crucial to getting good data.

Field screening should be used to profile an area, to locate sources of contamination, to determine the boundaries of contamination, or to gather data that will subsequently be used to design a sampling plan. Field screening is usually only approximate; field screening will correlate very well with lab analysis for a highly-homogeneous sample, but may correlate extremely poorly for a non-homogeneous sample.

Note: For performance evaluation of field XRF results by comparing them to laboratory results (done to justify XRF usage), never use in-situ testing; always gather samples and prepare them before testing.

When comparing field screening to laboratory analysis, try to compare the same samples. For best results, collect a large sample in a zipper locking storage bag. Shake the bag to mix the sample. Test the bagged sample several times using the NITON and average the readings. Then compare this average reading with lab results.

If you must test in-situ for performance evaluation, take several XRF readings bracketing a spot. Then take a sample for laboratory testing from that spot. For further discussion of field screening, see EPA Method 6200, "Field Screening Using a Field-Portable XRF." Contact NITON for a copy. The EPA accepts field screening using the NITON if the screening is performed using Method 6200. Most states accept EPA Method 6200.

The measurement screen

On NITON XL-309s with optional Lead in Soil Analysis, *only* lead is displayed in bulk sample testing. On 700 models, only the two highest-concentration elements are displayed (in ppm, with the two-sigma confidence intervals) on the first **Measurement screen (Figure 3.02a**), with the x-ray spectrum. The black bars on the spectrum display highlight the presence or absence of lead or iron in the sample. The test time is also displayed in nominal (source) seconds.

The summary screen

When you end a reading, the **Measurement Screen** is replaced by the **Summary Screen (Figure 3.02b**). On 700 models, results are displayed for 14 elements. The elements are divided into two groups: elements that were detected in the sample, and elements that were not detected. Press the **Arrow buttons** to scroll through the elements.

Detection Limit: For an element to be detected by the NITON in a given sample, the measured concentration of the sample must be at least three times the standard deviation of the measurement. This detection limit will depend on the composition of the sample.

Precision: The measurement precision for each element displayed appears to the right of the measured concentration, under the heading "+-". The **precision** of each measurment is two times the standard deviation (sigma). An element is classified **detected** if the measured concentration (in ppm) is at least 1.5 times the precision.

Detected elements are displayed as in the Measurement screen. Non-detected elements are shown as **< xx**, where **xx** is the detection limit for that sample. The detection limit for each element is calculated from each sample.

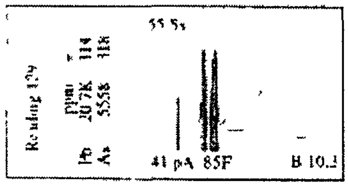


Fig. 3 02a Measurement Screen
Bulk Mode In-progress screen

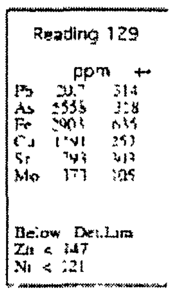


Fig. 3 02b Bulk Mode
Summary Screen

In-situ surveys

Before you take your first measurement, you must decide whether to test the bulk material

- in-situ (in-place),
- as bagged samples (or, for liquids and sludge, in cups) with a minimum of preparation, or
- in an XRF cup after careful preparation.

Note: More sample preparation (drying, milling and sieving) will yield greater accuracy. The drier, finer, and more homogeneous the particles, the better the measurements.

If you are primarily interested in determining whether an element is present (rather than in accurately measuring how much is present), direct measurement is the quickest, simplest way to proceed. Even if you intend to take samples, preliminary direct measurements will help you to survey the site. The analysis of bagged samples is another screening technique.

The NITON test guard

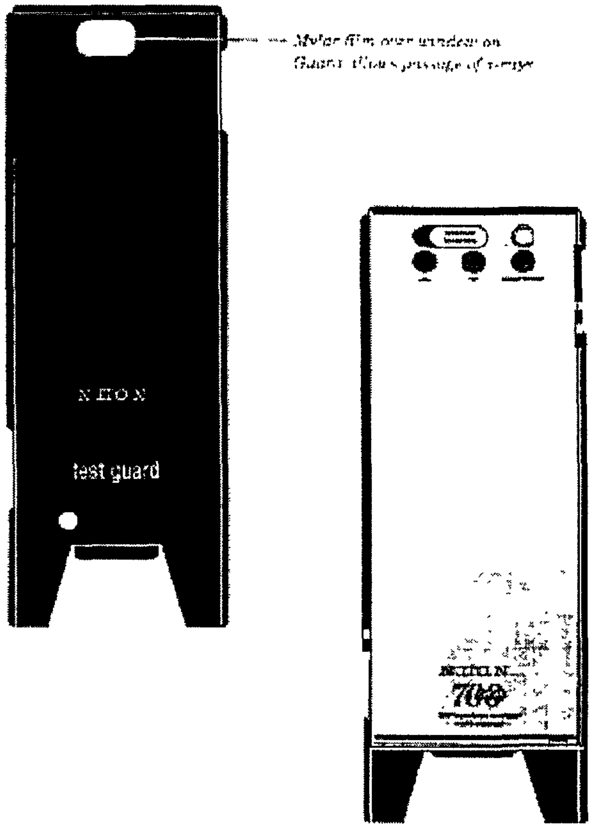


Fig 3.03
The NITON
Test Guard

The NITON **Test Guard** (**Figure 3.03**) is a formed metal plate designed to be placed directly between the ground or other bulk media and the NITON. Use the **Test Guard** for surveys of bulk media *in-situ* or for testing bulk samples in bags. The **Test Guard** shields the unit from contamination and damage.

Testing in-situ

Warning: When taking samples from a site where toxic chemicals may be present, always use gloves and respiration equipment for your own protection.

1. Select a measurement site. Lead-in-soil from paint, for instance, will be concentrated within a few feet of the painted structure. Valid results will depend on a sufficient and appropriate selection of sites to sample.

2. Clear any surface debris or vegetation. Use a flat area so that the NITON will contact the test medium. The finer and more homogeneous the material, the more accurate the measurement. (You can increase your accuracy when testing soil by loosening the soil and letting it dry in the sun before testing.)

Fig 3.04a
Place your NITON
on the Test Guard

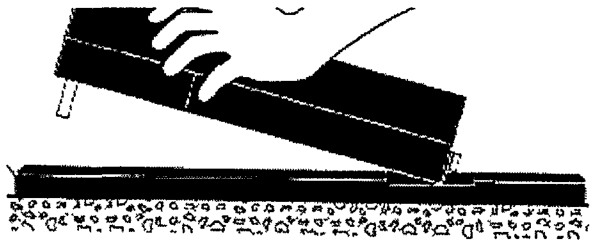
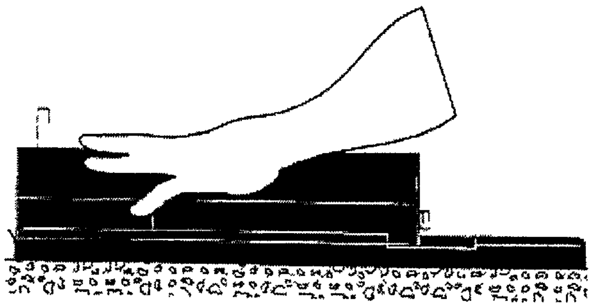


Fig 3.04b
Firmly press your NITON
flat against the surface



3. Place the test guard on ground. Keep the top of the test guard clean.

4. Hold the NITON in one hand.

Warning: Always treat radiation with respect. Do not put your hand on the end plate of the NITON while measuring. Never point the NITON at yourself or anyone else when the shutter is open.

5. Push the safety slide (that locks the shutter release) out from under the shutter release. If the slide is still tucked in, you cannot press in the release nor will the instrument fit on the test guard correctly.

6. Place the NITON on the test guard so that the rectangular opening on the test guard is under the window of the NITON, squeeze the shutter release, and firmly press the instrument flat against the surface of the test guard (**Figure 3.04 a,b**). If you don't squeeze the shutter release, the plunger will not depress. If the plunger is not fully depressed, the window is not fully open and the NITON cannot measure accurately. The back of the unit must be flush with the test guard.

Note: During the measurement, you do not need to squeeze the shutter release continuously. Hold the NITON firmly against the test guard surface and it will continue to read. Once you lift the instrument, the plunger will back out the bottom, the shutter will close, and the test will be finished.

7. Watch for indications to decide when the test has reached the desired level of accuracy. A typical screening test will last 20-30 source seconds.

Warning: In the unlikely event that the plunger gets stuck in the open position, simply push it closed. Then call the NITON Service Department at (401) 294-1234.

In-situ depth profiling

An XRF soil test examines only the top millimeter or so of soil. To do depth profiling, simply remove a vertical slice of soil and test several samples from different depths. Doing so rapidly yields information about the depth of contamination.

Analysis of bagged bulk samples

Sometimes it is convenient to collect samples in plastic bags. Without further preparation of the sample, you can screen the site by testing each bag. Because you are testing through a bag, test results will tend to be 5-10% lower than test results obtained from direct analysis.

Taking bagged samples

1. Before sampling a site, size it up for differences in soil characteristics. Valid results depend on a sufficient and appropriate selection of sites to sample. Consider the site's topography, texture, drainage, color of topsoil, and past use.

2. Take a composite sample from each predetermined area. Do not combine samples from areas with different compositions or history. **A composite sample made up of samplings from two distinctly different areas is not representative of either area.**

Mix the sample. If it is too large, reduce the sample. Some techniques for reduction and homogenization are described in the section on analysis of prepared samples.

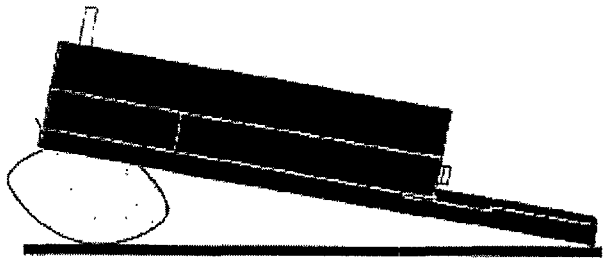
3. Fill a clean plastic bag with 50-100 grams of soil and close it securely (with a twist tie). The accuracy of your measurements will be limited by the thickness of the plastic in the bag you use. 1 mil-thick Polyethylene bags offer a reasonable compromise between accurate readings and bag durability. Be sure to label each bag with your name and the location of the sample site.

Testing samples in bags

Shape the bag of soil to form a continuous uniform layer of at least 1 cm. (0.4 inch) thickness. Place the NITON test guard on the bag (**Figure 3.05**). Then follow testing in-situ instructions.

Warning: Do not hold bagged bulk samples in your hand during testing.

Fig 3.05
To test a bag of soil, firmly press your NITON plus Test Guard flat against the surface of the bag (which should rest on a firm surface not on your hand)



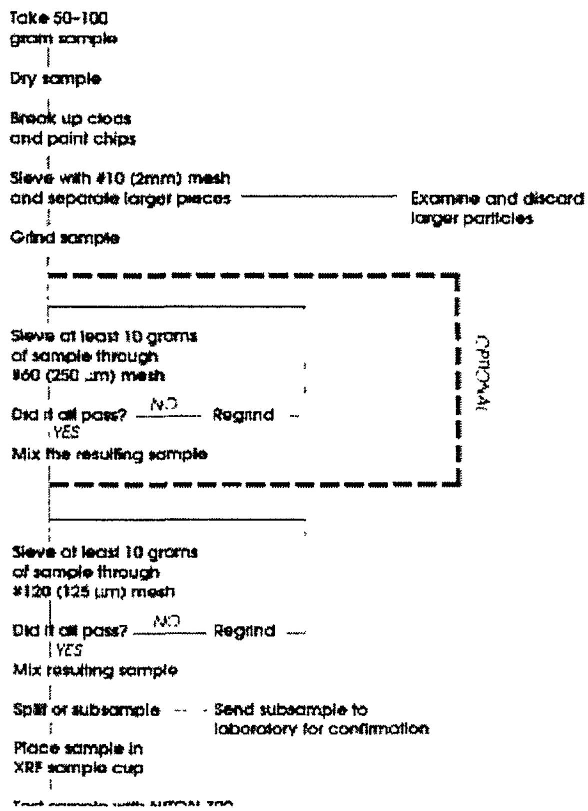
Analysis of prepared bulk samples

Prepared sample analysis is the most accurate method for determining the concentration of elements in a bulk medium using your NITON. Sample preparation will minimize the effects of moisture, large particle size and variations in particle size.

Warning: For your protection, when taking samples from a site where toxic chemicals may be present, always use gloves and respiration equipment.

NITON recommends a specific sample protocol. Following this protocol for preparing and testing samples is vital for achieving a level of accuracy comparable with laboratory results. See **Figure 3.06** for a flow chart of the protocol.

Fig 3.06 Flow chart of sample preparation protocol recommended by NITON
Use of the #60 mesh sieve is optional.



Test sample with NITON 700

Taking bulk samples

Note: When testing for lead-in-soil in a residential setting, it is standard practice to sample the top 4 to 6 inches of soil.

The soil probe or sampling tube is a very convenient sampling tool. It not only allows speed but it makes more accurate composite samples than any other tool as it may always be inserted to a marked depth and it removes the same amount of soil at each insertion. There are core sampling devices that remove an intact cylinder of undisturbed material.

A shovel, spade, dibble, narrow (1-1/2 inch) garden trowel, or other sampling tool can do the job. Take a half-inch soil slice. A satisfactory soil auger may be made by welding a 1-1/4 or 1-1/2 inch wood bit into a 1/2 inch pipe equipped with a T-handle.

Take 50-100 gram sample to insure that you have a sample large enough to be representative and unbiased after mixing, grinding, and straining it.

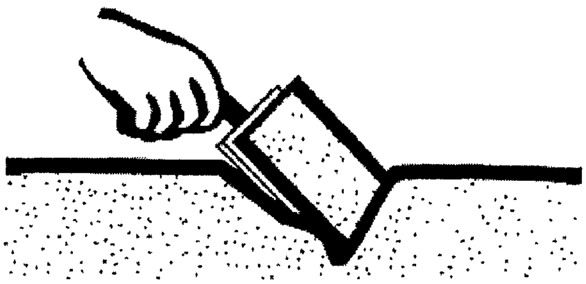
1. Before sampling a site, evaluate it for differences in soil characteristics. Valid results depend on a sufficient and appropriate selection of sites to sample. Test results may be worthless, even highly misleading, unless the samples tested actually represent the area.

Consider topography, texture, drainage, color of topsoil, and past use. Lead, for instance, is usually concentrated near a building with lead paint (within 4-6 feet).

2. If the individual samplings are taken with a spade or trowel, (**Figure 3.07**) reduce the samples by taking a vertical slice (so it is representative of the entire spadeful) about one inch wide.

Place the reduced samples in a clean pail. Then mix the sample thoroughly by stirring and by rotating the pail at an angle of 45 degrees. Don't shake. (You do not want to stratify the sample by weight).

Fig. 3.07
Use a spade, trowel or garden dibble to take a half-inch thick slice of soil



3. Take a composite sample from each predetermined area. Do not combine samples from areas with different compositions or history. A composite sample made up of samplings from two distinctly different areas is not representative of either area.

From each predetermined area, prepare a composite sample by taking several samplings consisting of vertical columns of material approximately 1 inch in diameter. The length of each column should be about 6 inches. Lead from paint is usually concentrated within the top 1-4 inches. The elements you wish to measure and the local history will determine how deep you need to sample.

Package samples from the following areas separately: samples close to painted structures, close to roads, samples close to where various types of waste have been stored, or near pressure-treated lumber.

4. Fill a clean plastic bag and close it securely (with a twist tie). Be sure to label it with the date, the site and the location where you took the sample

Preparing bulk samples

The equipment you need to prepare samples is included in your kit. Among these are a mortar and pestle (for the XL-309 with lead-in-soil-analysis), an electrically powered grinding mill (included with 700s), and several sized-sieves.

Caution: Keep all test equipment clean to prevent contaminated samples.

The mortar, pestle, and grinding mill may be cleaned with dry paper towels. Water will also clean the mortar, pestle, and the mill's container, but be sure each is absolutely dry before you use them on another sample. The mortar and pestle may be cleansed by grinding clean dry sand in the mortar. Use the short bristle brushes (included in your Bulk Testing Kit) to clean the sieves. When Soil Grinder blades wear out, unbolt the worn blades and replace.

Cone and quartering

At various times while preparing a sample you may need to divide it. Cone and quartering is a method for splitting the sample into homogenous quarters. Slowly and carefully pour the dry material onto a flat sheet or pan forming a symmetrical cone. Using a flat thin-bladed tool, such as a knife or ruler, divide the cone into equal piles. Divide these in half again. Now you have four samples, each one-quarter the size of the original and each more homogenous than the original.

1. If the sample is moist and cohesive, dry it. To best prepare a sample for presentation to the XRF, the material should be dry and well homogenized. Ideally, the entire sample should be dried to constant weight, sieved to remove gravel and debris, and ground or milled to a fine powder.

The sample can be dried in any of several ways. Choose one of the following: Oven dry the sample for approximately 2 hours at 150° C., until the sample reaches a constant weight; air dry the sample overnight at room temperature in a shallow pan; gently stir and warm the sample in a pan over a hot plate or burner.

Oven drying is inappropriate when volatile compounds may be present in the sample. For example, lead present as tetraethyl lead would be driven off by the heat of drying. Some forms of mercury and arsenic are volatile. Air drying will preserve more of these volatile substances.

2. Grind the sample to break up dirt clods and/or paint chips.

3. Sieve with the #10 (2mm) mesh and separate out the larger pieces (stones, organic matter, metallic objects, etc. Examine the larger particles by eye (look for paint chips), but do not include in the sample.

4. Grind the sample so its particles will be finer and more homogenous. Use mortar and pestle, or an electrically powered grinding mill.

Warning: Grinding-and-sieving dried samples produces dust. Even clean soil contains silica, which may be hazardous when airborne. Prepare all samples in a ventilated area; wear a mask, gloves, and an apron; and spread a drop cloth.

5. Sieve at least 10 grams of the sample through #60 (250 um) and #120 (125 um) mesh. Re-grind the unpassed material until the required fraction is able to pass.

6. Mix the resulting sample.

Putting the sample in an XRF sample cup

The container holding the sample affects the accuracy of the measurement. Use a container with as thin-walled a window as is convenient and use the same kind of container and window for each sample. Consistency and careful attention to detail are keys to accurate measurement.

Note: The sample container should be a sample cup of a type that can be filled from the rear; that is, the side opposite the window (e.g. Chemplex #1330). NITON recommends using a 1/4 mil mylar film window (Figure 3.08). **A supply of cups and windows are included.**

1. Place a circle of mylar film on top of an XRF sample cup. The window goes on the end of the cup with the indented ring. Note that the window may be prepared ahead of time.

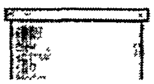
2. Secure the film with the collar. The flange inside the collar faces down and snaps into the indented ring of the cup. Inspect the installed film window for continuity and smooth, taut appearance.

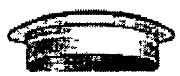
3. Set the cup, window-side down, on a flat surface. Fill it with at least three grams of the prepared sample (no more than half-full). Take care that there are no voids or layering.

4. Placing the cup film-side down on a flat surface, tamp the sample into the cup. The end of the pestle makes a convenient tamper. If you intend to re-use the sample, you can, alternatively, place a filter-paper disk on the sample before tamping it.

5. Fill the cup with polyester fiber stuffing to prevent sample movement. Use aquarium filter or pillow filling as stuffing. A small supply of stuffing comes with your bulk sample kit.

6. Fasten the cap on the cup (**Figure 3.09**). Using an indelible pen, write an identifying number on the cup. Keep a record of the sample number, the site and location, the date of the sample, and any other relevant comments.





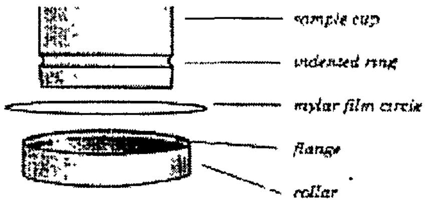


Fig 3.08 Secure the film be snapping the collar on to the cup

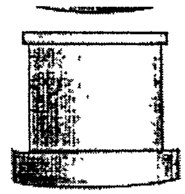


Fig 3.09 Fasten the cap on the cup

Preparing samples of liquids, sludges or dust

Liquids:

Fill an XRF sample cup with the liquid to be tested (Use no cotton). It is best if some overflows when the cap is put on, since the cup must be full.

Sludge:

Sludge can be placed directly in an XRF cup for screening. This is considered in-situ testing because no attempt has been made to prepare the sample. For more accuracy, the sludge can be dried, sieved, and ground.

Screening dust:

Use large dust samples taken from a home vacuum cleaner bag. Remove fibers, hairs, and debris. At least three grams of dust are needed to assure accurate analysis. Samples as small as one or two grams may be measured with less accuracy. Even smaller samples (0.3 to 1.0 grams) can be analyzed by applying a weight correction factor and by using a funnel to place the sample in the center of the sample cup.

Prepare in an XRF sample cup and test the same way you would with a soil sample. For risk analysis, it is advisable to use a 60-mesh sieve to isolate and test only fine particles.

The bulk testing platform

The test platform (**Figures 3.10a,b**) is an accessory fixture for holding bulk samples (such as soil or ground paint chips) in standard film-window XRF cups. This fixture snaps quickly and securely to your NITON instrument.

The platform latch screws underneath for storage. Before using the test platform, unscrew the latch and rescrew it on the end of the platform nearest the receptacle for the sample cup.

The test stand securely holds the XRF sample cup in place.

Testing the sample;

Set the NITON test platform on a flat, solid surface. Place the sample cup in the receptacle of the sampler. Included in your kit are some foam disks that you can put in the receptacle under the cup for firmer contact between the NITON and the sample cup window. Attach the NITON to the test stand and follow in-situ bulk sample instructions (**Figures 3.11 a,b**).

Fig. 3-10a
The Niton
Test Platform

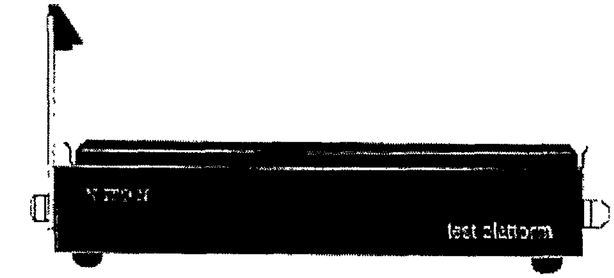
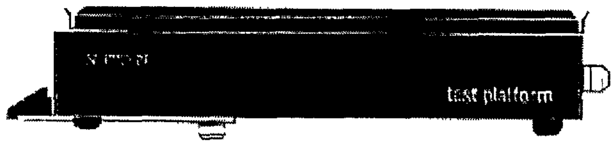


Fig. 3-10b
The Niton
Test Platform
with its latch in
the stored position



NITON Back to the Table of Contents

Appendix D

Logging of Soil Borings

Standard Operating Procedure

STANDARD PROCEDURES FOR LOGGING OF SOIL BORINGS

January 1990

CH2M HILL

CONTENTS

Date: January 1990

STANDARD PROCEDURES FOR LOGGING OF SOIL BORINGS

INTRODUCTION

The purpose of this document is to assist CH2M HILL staff in accurately recording and presenting all field data that are necessary to sufficiently describe, label, and package soil samples recovered from borings. Adherence to a standard format for recording data will help streamline our project efforts and ensure a consistent presentation of subsurface data.

All CH2M HILL staff members are encouraged to present their suggestions for clarification or improvements to these procedures. Please submit all suggestions or comments in writing to the Discipline Group Directors of Geotechnical Engineering or Groundwater Resources.

POLICY

This soil boring procedure must be used for all CH2M HILL projects in which soil boring techniques are used during field exploration. These procedures establish the minimum kinds of information that must be recorded in the field to adequately characterize recovered soil samples.

Because each of our projects is unique and because job requirements can vary widely, the minimum standards presented may need to be supplemented with additional technical descriptions or field test results. However, all soil boring field logs, regardless of special project circumstances, must include information addressed in this policy document to achieve minimum acceptable standards required by CH2M HILL.

CH2M HILL Standard Form D1586, the Soil Boring Log Form, must be used on all CH2M HILL projects for field logging (see Figure 1). All heading information must be completely filled out on each log sheet, and all technical items in each column must be addressed in the field.

The boring log should be completed in the field according to the instructions that follow. Forms should be filled out neatly and completely. Laboratory testing, if required, should be initiated immediately after completion of the field work. Field classifications of samples should be checked against the laboratory test results, and corrections should be noted in red, initialed, and dated on the field log.

Date: January 1990

INSTRUCTIONS FOR COMPLETING SOIL BORING LOG FORM D1586

Form D1586 is a standard CH2M HILL form that is available in weatherproof paper from all regional form distributors.

Following are instructions for completing the log forms in the field. See Figure 2 for an example of a field log completed according to the instructions.

Field personnel should review completed logs for accuracy, clarity, and thoroughness of detail. Samples should also be checked to see that information is correctly recorded on both jar lids and labels, and on the log sheets.

HEADING INFORMATION

Project Number. Use standard region code, contract I.D. (5-digit), and appropriate point number.

Boring Number. Enter the boring number. A numbering system should be chosen that does not conflict with information recorded for previous exploratory work done at the site. Number the sheets consecutively for each boring. If rock core log sheets are also used, continue the consecutive numbering.

Project. Fill in the name of the project or client.

Location. If stationing, coordinates, mileposts, or similar project layout information is available, indicate the position of the boring to that system using modifiers such as "approximate" or "estimated" as appropriate. If this information is not available, identify the client facility (e.g., Richland STP, center of Clarifier No. 2 site), or the town and state.

Elevation. Enter the elevation. If it is estimated from a topographic map, or if it is roughly determined using a hand level, use the modifier "approximate." It is important to tie the boring elevation to a recoverable reference point (e.g., fire hydrant, floor slab) if no other elevation data are available. Such points can be picked up later in a site survey and boring elevations can be determined. Or, if no survey is done, at least the relative boring elevation with respect to pertinent project facilities will be known.

Drilling Contractor. Enter the name of the drilling company and the city and state where the company is based.

Drilling Method and Equipment. Identify the bit size and type, drilling fluid (if used), and method of drilling (e.g., rotary, hollow-stem auger, air track). Information on the drilling equipment (e.g., CME 55, Mobile B61) is also entered.

Water Level and Date. Enter the depth below ground surface to the static water level in the borehole. Frequent water measurements are recommended. The information should be recorded in the Comments column. If free water is not encountered during drilling, or cannot be detected because of the drilling method, this information should be noted. Generally, water levels should be measured each morning before resuming drilling and at the completion of each boring. Record date and time of day (for tides, river stage) of each water level measurement.

Date of Start and Finish. Enter the dates the boring was begun and completed. Time of day may be added if several borings are performed on the same day.

Logger. Enter the first initial and full last name.

TECHNICAL DATA

Depth Below Surface. Use a depth scale that is appropriate for the sample spacing and for the complexity of subsurface conditions.

Sample Interval. Draw horizontal lines at the top and bottom depth of each sample interval. These lines should extend to the soil description column. For a very short sample interval, the bottom line can be lowered after the interval column to provide room for writing the information (see Figure 2). Enter the depth at the top and bottom of the sample interval.

Sample Type and Number. Enter the sample type and number. For instance, 1-S = first sample, split spoon. Number samples consecutively regardless of type. Enter a sample number even if no material was recovered in the sampler.

Sample Recovery. Enter the length to the nearest 0.1 foot of soil sample recovered from the sampler. Often, there will be some wash or caved material above the sample; do not include the wash material in the measurement.

Standard Penetration Test Results. In this column enter the number of blows required for each 6 inches of sampler penetration and the "N" value, which is the sum of the blows in the last two 6-inch penetration intervals. A typical standard penetration test involving successive blow counts of 2, 3, and 4 is recorded as 2-3-4 and (7). The standard penetration test is terminated if the sampler encounters refusal. Refusal is a penetration of more than 6 inches but less than 12 inches with a blow count of 100, or a penetration of less than 6 inches with a blow count of 50. A partial penetration of 50 blows for 4 inches is recorded as 50/4". See the "Standard Penetration Test Procedures" subsection for additional discussion.

Soil Description. The soil classification should follow the format described in the "Field Classification of Soil" subsection.

Comments. Include all pertinent observations (changes in drilling fluid color, rod drops, drilling chatter, rod bounce as in driving on a cobble, damaged Shelby tubes, and equipment malfunctions). Also note if casing was used, the sizes and depths installed, and if drilling fluid was added or changed. You should instruct the driller to alert you to any significant changes in drilling (changes in material, occurrence of boulders, and loss of drilling fluid). Such information should be attributed to the driller and recorded in this column.

Specific information might include the following:

- The date and the time drilling began and ended each day
- The depth and size of casing and the method of installation
- The date, time, and depth of water level measurements
- Depth of rod chatter
- Depth and percentage of drilling fluid loss
- Depth of hole caving or heaving
- Depth of change in material
- Drilling interval through a boulder
- The results of pocket penetrometer or torvane test reported as: "PP = _____ TSF" or "TV = ____TSF," respectively

The depth of piezometers and the results of in situ tests should be noted in the Comments column.

FIELD CLASSIFICATION OF SOIL

This section presents the format for the field classification of soil. In general, the approach and format for classifying soils should conform to ASTM D 2488-84, Visual-Manual Procedure for Description and Identification of Soils.

The Unified Soil Classification System is based on numerical values of certain soil properties that are measured by laboratory tests (ASTM D 2487). It is possible, however, to estimate these values in the field with reasonable accuracy using visual-manual procedures (ASTM D 2488). Also, some elements of a complete soil description, such as the presence of cobbles or boulders, changes in strata, and the relative proportions of soil types in a bedded deposit, can be obtained only in the field. Corrections and additions to the field classification can be provided, when necessary, by laboratory testing of the soil samples.

Soil descriptions should be precise and comprehensive without being verbose. The correct overall impression of the soil should not be distorted by excessive emphasis on insignificant details. In general, similarities between consecutive samples should be stressed rather than differences.

Soil descriptions must be recorded in the Soil Description column for every soil sample collected. The format and order for soil descriptions should be as follows:

1. Soil name (synonymous with ASTM D 2488-84 Group Name) with appropriate modifiers
2. Group symbol
3. Color
4. Moisture content
5. Relative density or consistency
6. Soil structure, mineralogy, or other descriptors

This order follows, in general, the format described in ASTM D 2488-84. Examples of soil descriptions are provided in Table 1.

SOIL NAME

The basic name of a soil should be identical to the ASTM D 2488-84 Group Name based on visual estimates of gradation and plasticity. The soil name should be capitalized. The only acceptable soil names are those listed in Figure 3, which are from ASTM D 2488-84.

Examples of acceptable soil names are illustrated by the following descriptions:

> A soil sample is visually estimated to contain 15 percent gravel, 55 percent sand, 30 percent fines (passing No. 200 sieve). The fines are estimated as either low or highly plastic silt. This visual classification is SILTY SAND WITH GRAVEL, with a Group Symbol of (SM).
>
> Another soil sample has the following visual estimate: 10 percent gravel, 30 percent sand, and 60 percent fines (passing the No. 200 sieve). The fines are estimated as low plastic silt. This visual classification is SANDY SILT. The gravel portion is not included in the soil name because the gravel portion was estimated as less than 15 percent. The Group Symbol is (ML).

The gradation of coarse-grained soil (more than 50 percent retained on No. 200 sieve) is included in the specific soil name in accordance with ASTM D 2488-84. There is no need to further document the gradation. However, the maximum size and angularity or roundedness of gravel and sand-sized particles should be recorded. For fine-grained soil (50 percent or more passing the No. 200 sieve), the name is modified by the appropriate plasticity/elasticity term in accordance with ASTM D 2488-84.

Interlayered soil should each be described starting with the predominant type. An introductory name, such as "Interlayered Sand and Silt," should be used. Also, the relative proportion of each soil type should be indicated (see Table 1 for example).

Where helpful, the evaluation of plasticity/elasticity can be justified by describing results from any of the visual-manual procedures for identifying fine-grained soils, such as reaction to shaking, toughness of a soil thread, or dry strength as described in ASTM D 2488-84.

GROUP SYMBOL

The appropriate group symbol from ASTM D 2488-84 (see Figure 3) must be given after each soil name. The group symbol should be placed in parentheses to indicate that the classification has been estimated.

In accordance with ASTM D 2488-84, dual symbols (e.g., GP-GM or SW-SC) can be used to indicate that a soil is estimated to have about 10 percent fines. Borderline symbols (e.g., GM/SM or SW/SP) can be used to indicate that a soil sample has been identified as having properties that do not distinctly place the soil into a specific group. Generally, the group name assigned to a soil with a borderline symbol should be the group name for the first symbol. The use of a borderline symbol should not be used indiscriminately. Every effort should be made to first place the soil into a single group.

COLOR

The basic color of a soil, such as brown, gray, or red, must be given. The color term can be modified, if necessary, by adjectives such as light, dark, or mottled. Especially note staining, iron staining, or mottling. This information may be useful to establish water table fluctuations or contamination. As an alternative, consider using the Munsel rock color chart designation.

MOISTURE CONTENT

The degree of moisture present in a soil sample should be defined as dry, moist, or wet. Moisture content can be estimated from the criteria listed on Table 2.

RELATIVE DENSITY OR CONSISTENCY

Relative density of a coarse-grained (cohesionless) soil is based on N-values (ASTM D 1586-84). If the presence of large gravel or disturbance of the sample makes determination of the in situ relative density or consistency difficult, then this item should be left out of the description and explained in the Comments column of the soil boring log.

Consistency of fine-grained (cohesive) soil is properly based on results of pocket penetrometer or torvane results. In the absence of this information, consistency can be estimated from N-values. Relationships for determining relative density or consistency of soil samples are given in Tables 3 and 4.

SOIL STRUCTURE, MINERALOGY, AND OTHER DESCRIPTORS

Discontinuities and inclusions are important and should be described. Such features include joints or fissures, slickensides, bedding or laminations, veins, root holes, and wood debris.

Significant mineralogical information should be noted. Cementation, abundant mica, or unusual mineralogy should be described, as well as other information such as organic debris or odor.

Other descriptors can be included if important for the project or for describing the sample. These include particle size, range and percentages, particular angularity, particle shape, maximum particle size, hardness of large particles, plasticity of fines, dry strength, dilatancy, toughness, reaction to HCl, and cementation.

Residual soils have characteristics of both rock and soil and can be difficult to classify. Relict rock structure should be described and the parent rock identified if possible.

STANDARD PENETRATION TEST PROCEDURES

Standard Penetration Tests (SPT) are conducted to obtain a measure of the resistance of the soil to penetration of the sampler and to recover a disturbed soil sample. Standard Penetration Tests should be conducted in accordance with ASTM D 1586-84, Penetration Test and Split Barrel Sampling of Soils.

EQUIPMENT AND CALIBRATION

Before starting the testing, the necessary equipment should be inspected for compliance with the requirements of ASTM D 1586-84. The split-barrel sampler should measure 2-inch O.D., with 1-3/8-inch I.D., and should have a split tube at least 18 inches long. The dimensions should conform with those indicated on Figure 1 of ASTM D 1586-84. The minimum size sampler rod allowed is "A" rod (1-5/8-inch O.D.). A stiffer rod, such as "N" rod (2-5/8-inch O.D.), is required for depths greater than 50 feet. The drive weight assembly should consist of a 140-pound hammer weight, a drive head, and a hammer guide that permits a free fall of 30 inches.

PROCEDURES

Standard Penetration Tests should be conducted at every change of strata or, within a continuous stratum, at intervals not exceeding 5 feet. Before driving the split-barrel sampler, all loose and foreign material should be removed from the bottom of the borehole. It may be helpful to measure the rod "stickup" to ensure that the sampler is being driven from the bottom of the borehole. The Standard Penetration Test should be performed by driving a standard split-barrel sampler 18 inches into undisturbed soil at the bottom of the borehole by a 140-pound guided hammer or ram, falling freely from a height of 30 inches.

The number of blows required to drive the sampler for three 6-inch intervals, for a total of 18 inches, should be observed and recorded on the soil boring log. The sum of the number of blows required to drive the sampler the second and third 6-inch intervals is considered the Standard Penetration Resistance (N) or the "blow-count." If the sampler is driven less than 18 inches, but more than 1 foot, the penetration resistance (N) is that for the last 1 foot of penetration. If less than 1 foot is penetrated, the log must state the number of blows and the fraction of 1 foot penetrated. It is important that the field logger observe the sampler being driven and count the blows for each sample attempt.

GENERAL CONSIDERATIONS

The following comments and suggestions should be considered when performing Standard Penetration Testing:

1. The borehole should be cleaned out before every sample attempt. Because a minor amount of caving can be expected, the borehole can be considered to be adequately cleaned if no more than 4 inches of loose or foreign material has collected at the bottom of the borehole. A greater amount of caving is sufficient cause to require the hole to be cleaned again.

2. The ball check valve in the split-barrel sampler should be cleaned and working properly for each sample. Bent, chipped, or damaged shoes should be replaced. The split-barrel halves should not be warped. In case of zero sample recovery (i.e., if the sample is lost during first attempt), a spring catcher should be used during subsequent attempts to facilitate recovery.

3. During SPT sampling, it is important that all rod connections be tight and that the hammer guide be connected securely to the drill rods. If the hammer guide connection becomes loose, much of the hammer energy may be lost because of deflection of the hammer coupling. The lifting rope should not rub against the mast. Each hammer fall should be 30 inches.

4. During SPT sampling, it is important that the drill rods be positioned at the center of the drill hole. This is necessary to preclude the development of friction between drill rods and the walls of the borehole or casing.

5. If the hammer weight is raised by means of a cathead, generally two wraps on the cathead should be used. The optimum number of wraps will vary with the condition of the rope and cathead and the weather. Most importantly, the driller should exercise care to prevent friction of the rope on the cathead during the fall of the hammer.

6. Occasionally, nonstandard procedures or equipment are used for obtaining samples (such as 3-inch O.D. split-barrel samplers, or 300-pound hammers). Any nonstandard practice should be described on the boring log form. Also, the blow counts should be clearly marked as not conforming to SPT values.

SAMPLE LABELING AND PACKAGING

The samples recovered from the borehole are an important part of the boring record and must be properly packaged and labeled. Samples that are improperly or inadequately labeled are not useful. The following description outlines the minimum requirements for packaging and labeling of samples.

Disturbed samples should be placed in jars that are marked both on the jar lid and on a label on the side of the jar. Standard CH2M HILL jar labels are available (Form No. 131, Soil Sample Labels) for this purpose. The following information should be clearly marked on the jars: job number, boring number, sample number, sample depth, blow counts, sample recovery, and date. Use an indelible marker or a metal scriber on the jar lid. If moisture content tests are anticipated, jar samples should be tightly sealed, then sent to the laboratory and the testing initiated as soon as possible (within one week). See Figure 4 for labeling details.

Boxes containing the jars should be labeled on top and on one end with the following information: job name, job number, boring number, sample numbers and sample depths, date, and name. It is helpful to start a new box for each new boring if the boxes are at least one-half full.

Shelby tubes should be cleaned of mud and moisture. When dry, use an indelible marker to label them with the following information: an arrow indicating which way is up, job number, boring number, sample number and depth, amount of recovery, and date. The top and bottom of the sample can be circumscribed on the outside of the tube with a marker.

Waxing of Shelby tubes is essential if sample testing will not occur within a few days. In all cases, lids should be placed on the ends and taped with airtight tape. Make certain that the holes in the top of the tube are sealed. The open portion of the tube above the sample should be packed to prevent shifting of the soil. Dampened newspaper is generally adequate for this purpose, but it should be separated from the soil sample by a wax seal or an inverted cap. See Figure 4 for labeling and packing details.

FIELD EQUIPMENT CHECKLIST

Table 5 lists equipment and supplies that are necessary or useful for soil boring exploration.

Date: January 1990

SELECTED REFERENCES

American Society for Testing and Material. 1989. ASTM D 1586, Standard Method for Penetration Test and Split-Barrel Sampling of Soils. Annual Book of ASTM Standards, Section 4, Vol. 04.08.

_____. 1989. ASTM D 1587, Standard Method for Thin-Walled Tube Sampling of Soils. Annual Book of ASTM Standards, Section 4, Vol. 04.08.

_____. 1989. ASTM D 2487, Standard Test Method for Classification of Soils for Engineering Purposes. Annual Book of ASTM Standards, Section 4, Vol. 04.08.

_____. 1989. ASTM D 2488, Standard Practice for Description of Soils (Visual-Manual Procedure). Annual Book of ASTM Standards, Section 4, Vol. 04.08.

American Society of Civil Engineers. 1976. Subsurface Investigation for Design and Construction of Foundations of Buildings. American Society of Civil Engineers Manual on Engineering Practice, No. 56, 53 pp.

Bell, F. G. 1981. Engineering Properties of Soils and Rocks. London: Butterworth Publishers, Inc.

Burmister, D. M. 1949. Principles and Techniques of Soil Identification. Proceedings of the Highway Research Board, pp. 402-433.

Casagrande, A. 1947. Classification and Identification of Soils. American Society of Civil Engineers Transactions, pp. 901-991.

Kovacs, W. D., L. A. Salomone, and F. Y. Yokel. 1981. Energy Measurement in the Standard Penetration Test. U.S. Dept. of Commerce, National Bureau of Standards, Building Science Series 135.

Matula, M. 1981. Rock and Soil Description and Classification for Engineering Geological Mapping. Report by the IAEG Commission on Engineering Geological Mapping. Bulletin of the International Association of Engineering Geology, No. 24, pp. 235-274.

Sowers, G. F. 1979. Introductory Soil Mechanics and Foundations: Geotechnical Engineering. MacMillan Publishing Co., New York, 4th edition. 621 pp.

U.S. Bureau of Reclamation. 1974. Earth Manual. 2nd ed. Washington, D.C.: U.S. Government Printing Office.

SFO32/010.50

Date: January 1990

Table 1
EXAMPLE SOIL DESCRIPTIONS

POORLY GRADED SAND (SP), light brown, moist, loose, fine sand size

FAT CLAY (CH), dark gray, moist, stiff

SILT (ML), light greenish gray, wet, very loose, some mica, lacustrine

WELL-GRADED SAND WITH GRAVEL (SM), reddish brown, moist, dense, subangular gravel to 0.6 inches max

POORLY GRADED SAND WITH SILT (SP-SM), white, wet, medium dense

ORGANIC SOIL WITH SAND (OH), dark brown to black, wet, firm to stiff but spongy undisturbed, becomes soft and sticky when remolded, many fine roots, trace of mica

SILTY GRAVEL WITH SAND (GM), brownish red, moist, very dense, subrounded gravel to 1.2 inches max

INTERLAYERED SILT (60 percent) AND CLAY (40 percent): SILT WITH SAND (ML), medium greenish gray, nonplastic, sudden reaction to shaking, layers mostly 1.5 to 8.3 inches thick; LEAN CLAY (CL), dark gray, firm and brittle undisturbed, becomes very soft and sticky when remolded, layers 0.2 to 1.2 inches thick

SILTY SAND WITH GRAVEL (SM), light yellowish brown, moist, medium dense, weak gravel to 1.0 inches max, very few small particles of coal, fill

SANDY ELASTIC SILT (MH), very light gray to white, wet, stiff, weak calcareous cementation

LEAN CLAY WITH SAND (CL/MH), dark brownish gray, moist, stiff

WELL-GRADED GRAVEL WITH SILT (GW-GM), brown, moist, very dense, rounded gravel to 1.0 inches max

Date: September 13, 1989

Table 2
CRITERIA FOR DESCRIBING MOISTURE CONDITION

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp, but no visible water
Wet	Visible free water, usually soil is below water table

Table 3
RELATIVE DENSITY OF COARSE-GRAINED SOIL
(Developed from Sowers, 1979)

Blows/Ft	Relative Density	Field Test
0-4	Very loose	Easily penetrated with ½-in. steel rod pushed by hand
5-10	Loose	Easily penetrated with ½-in. steel rod pushed by hand
11-30	Medium	Easily penetrated with ½-in. steel rod driven with 5-lb hammer
31-50	Dense	Penetrated a foot with ½-in. steel rod driven with 5-lb hammer
>50	Very dense	Penetrated only a few inches with ½-in. steel rod driven with 5-lb hammer

Table 4
CONSISTENCY OF FINE-GRAINED SOIL
(Developed from Sowers, 1979)

Blows/Ft	Consistency	Pocket Penetrometer (TSF)	Torvane (TSF)	Field Test
<2	Very soft	<0.25	<0.12	Easily penetrated several inches by fist
2-4	Soft	0.25-0.50	0.12-0.25	Easily penetrated several inches by thumb
5-8	Firm	0.50-1.0	0.25-0.5	Can be penetrated several inches by thumb with moderate effort
9-15	Stiff	1.0-2.0	0.5-1.0	Readily indented by thumb, but penetrated only with great effort
16-30	Very stiff	2.0-4.0	1.0-2.0	Readily indented by thumbnail
>30	Hard	>4.0	>2.0	Indented with difficulty by thumbnail

Date: September 13, 1989

Table 5
FIELD EQUIPMENT CHECKLIST FOR SOIL BORING LOGGING

Siting

___Lath, flagging, and orange spray paint
___Lumber crayon
___100-foot tape
___Brunton or Silva compass

Logging Equipment

___Soil Boring Guideline
___Clipboard
___Form D1586 on all-weather paper
___Pens/pencils
___Engineer's pocket tape measure with tape lock
___Field notebook on all-weather paper
___Squirt bottle with water
___Spatula
___HCL, 10 percent solution

Sampling and Packaging

___Jars with lids and labels (Form #131)
___Shelby tubes and plastic end caps
___Airtight tape (e.g., electrical)
___Newspaper
___Wax, stove, melting pot, and matches
___Indelible fine felt-tipped markers (e.g., "Sharpie" brand)

Test Equipment

___Pocket penetrometer
___Torvane
___Well sounder

Other

___Camera, film
___Hand lens
___Rags
___Ear protectors
___Screwdrivers
___Hard hat
___Sunscreen
___Insect repellent

CH2M HILL

PROJECT NUMBER	BORING NUMBER SHEET OF

SOIL BORING LOG

PROJECT ______________________ LOCATION ______________________

ELEVATION ______________ DRILLING CONTRACTOR ______________________

DRILLING METHOD AND EQUIPMENT ______________________________________

WATER LEVELS ______________ START __________ FINISH __________ LOGGER __________

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION

(8.30)

REV 11/89 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	SHEET
DEN 22371.G5	BL-3	1 OF 3

SOIL BORING LOG

PROJECT Howard Ave Landslide LOCATION Howard & 24th Ave, Centennial, CO
ELEVATION 5136 Feet DRILLING CONTRACTOR Kendall Explorations, Ashcan, Colorado
DRILLING METHOD AND EQUIPMENT 4"-inch H.S. Augers, Mobil B-61 rotary drill rig
WATER LEVELS 3.2 Feet, 8/5/89 START August 4, 1989 FINISH August 8, 1989 LOGGER J.A. Michner

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0					Surface material consist of 4 inches AC underlain by 6 inches of 3/4 inch minus base rock	Start Drilling @ 3:00
	2.5 – 4.0	1-S	1.5	2-3-4 (7)	POORLY-GRADED SAND WITH SILT, (SP-SM), fine, light brown, wet, loose	Driller notes water at 4 feet
5	5.0 – 6.5	2-S	0.9	WOH/12"-1	ORGANIC SILT, (OL), very dark, gray to black, wet, very soft; strong H_2S odor, many fine roots up to about 1/4 inch	Driller notes very soft drilling 4ft, dark grey, wet silty cuttings.
	8.0 – 10.0	3-ST	1.3	—	ORGANIC SILT, similar to 2-S, except includes fewer roots (by volume)	
10	10.0 – 11.5	4-S	1.3	2-2-2 (4)	SILT, (ML), very dark gray to black, wet, soft	water level @ 3.2 feet on 8/5/89 @ 0730 Driller notes rough drilling action and chatter @ 13 ft
15	15.0 – 15.5	5-S	0.5	60/6"	SILTY GRAVEL, (GM), rounded gravel up to about 1 inch maximum observed size, wet, very dense	Driller notes smoother, firm drilling @ 19 ft some angular rock chips @ bot tip of 6-S, poss boulders or rock
20	20.0 – 21.0	6-S	1.0	12-50/6"	LEAN CLAY WITH SAND, (CL), medium to light green, moist, very stiff	Driller notes very hard, slow grinding, smooth drilling action from 21 to 23 ft, possibly bedrock
	23.0 – 23.1	7-S	-0-	50/1"	NO RECOVERY	
					END SOIL BORING @ 23.1 FEET SEE ROCK CORE LOG FOR CONTINUATION OF BL-3	

Figure 2
EXAMPLE OF COMPLETED LOG FORM

REV 11/89 FORM D1586

Designation: D 2488 - 84[ε1]

Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)[1]

This standard is issued under the fixed designation D 2488, the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

[ε1] Note—Section 18 was added editorially in January 1989.

1. Scope

1.1 This practice covers procedures for the description of soils for engineering purposes.

1.2 This practice also describes a procedure for identifying soils, at the option of the user, based on the classification system described in Test Method D 2487. The identification is based on visual examination and manual tests. It must be clearly stated in reporting an identification that it is based on visual-manual procedures.

1.2.1 When precise classification of soils for engineering purposes is required, the procedures prescribed in Test Method D 2487 shall be used.

1.2.2 In this practice, the identification portion assigning a group symbol and name is limited to soil particles smaller than 3 in. (75 mm).

1.2.3 The identification portion of this practice is limited to naturally occurring soils.

Note 1—This practice may be used as a descriptive system applied to such materials as shale, claystone, shells, crushed rock, etc. (See Appendix X2).

1.3 The descriptive information in this practice may be used with other soil classification systems or for materials other than naturally occurring soils.

1.4 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For specific precautionary statements see Section 8.

1.5 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[2]

D 1452 Practice for Soil Investigation and Sampling by Auger Borings[2]

D 1586 Method for Penetration Test and Split-Barrel Sampling of Soils[2]

D 1587 Practice for Thin-Walled Tube Sampling of Soils[2]

D 2113 Practice for Diamond Core Drilling for Site Investigation[2]

D 2487 Test Method for Classification of Soils for Engineering Purposes[2]

3. Definitions

3.1 Except as listed below, all definitions are in accordance with Terminology D 653.

Note 2—For particles retained on a 3-in. (75-mm) US standard sieve, the following definitions are suggested:

Cobbles—particles of rock that will pass a 12-in. (300-mm) square opening and be retained on a 3-in. (75-mm) sieve, and

Boulders—particles of rock that will not pass a 12-in. (300-mm) square opening.

3.1.1 *clay*—soil passing a No. 200 (75-μm) sieve that can be made to exhibit plasticity (putty-like properties) within a range of water contents, and that exhibits considerable strength when air-dry. For classification, a clay is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index equal to or greater than 4, and the plot of plasticity index versus liquid limit falls on or above the "A" line (see Fig. 3 of Test Method D 2487).

3.1.2 *gravel*—particles of rock that will pass a 3-in. (75-mm) sieve and be retained on a No. 4 (4.75-mm) sieve with the following subdivisions:

coarse—passes a 3-in. (75-mm) sieve and is retained on a ¾-in. (19-mm) sieve.

fine—passes a ¾-in. (19-mm) sieve and is retained on a No. 4 (4.75-mm) sieve.

3.1.3 *organic clay*—a clay with sufficient organic content to influence the soil properties. For classification, an organic clay is a soil that would be classified as a clay, except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

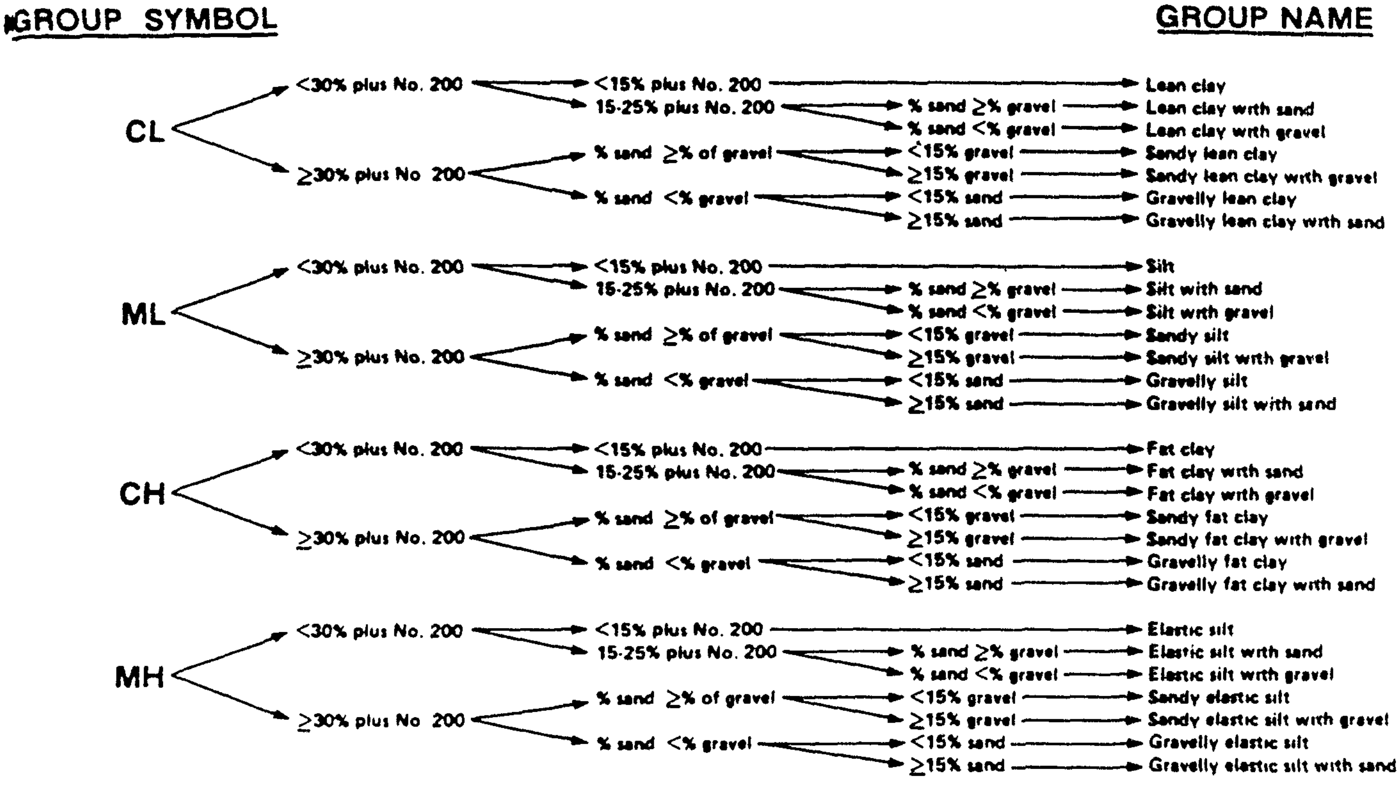
3.1.4 *organic silt*—a silt with sufficient organic content to influence the soil properties. For classification, an organic silt is a soil that would be classified as a silt except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.5 *peat*—a soil composed primarily of vegetable tissue in various stages of decomposition usually with an organic odor, a dark brown to black color, a spongy consistency, and a texture ranging from fibrous to amorphous.

[1] This practice is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.07 on Identification and Classification of Soils.

Current edition approved Oct. 3, 1984. Published December 1984. Originally published as D 2488 - 66 T. Last previous edition D 2488 - 69 (1975).

[2] *Annual Book of ASTM Standards*, Vol 04.08.



NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 1a Flow Chart for Identifying Inorganic Fine-Grained Soil (50 % or more fines)

3.1.6 *sand*—particles of rock that will pass a No. 4 (4.75-mm) sieve and be retained on a No. 200 (75-μm) sieve with the following subdivisions:

coarse—passes a No. 4 (4.75-mm) sieve and is retained on a No. 10 (2.00-mm) sieve.

medium—passes a No. 10 (2.00-mm) sieve and is retained on a No. 40 (425-μm) sieve.

fine—passes a No. 40 (425-μm) sieve and is retained on a No. 200 (75-μm) sieve.

3.1.7 *silt*—soil passing a No. 200 (75-μm) sieve that is nonplastic or very slightly plastic and that exhibits little or no strength when air dry. For classification, a silt is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index less than 4, or the plot of plasticity index versus liquid limit falls below the "A" line (see Fig. 3 of Test Method D 2487).

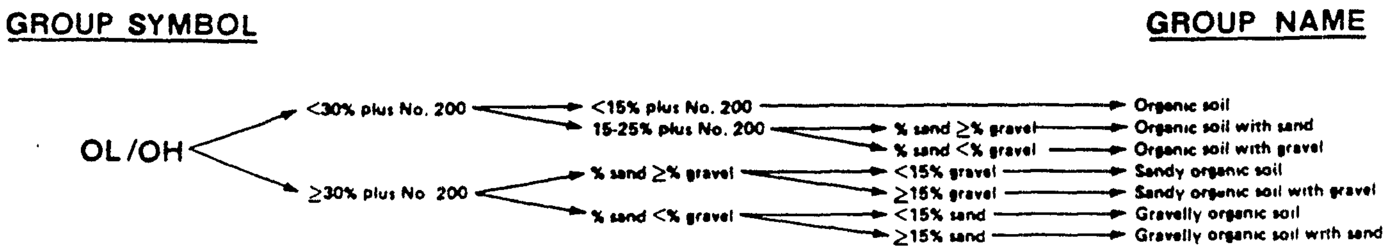
4. Summary of Practice

4.1 Using visual examination and simple manual tests, this practice gives standardized criteria and procedures for describing and identifying soils.

4.2 The soil can be given an identification by assigning a group symbol(s) and name. The flow charts, Figs. 1a and 1b for fine-grained soils, and Fig. 2, for coarse-grained soils, can be used to assign the appropriate group symbol(s) and name. If the soil has properties which do not distinctly place it into a specific group, borderline symbols may be used, see Appendix X3.

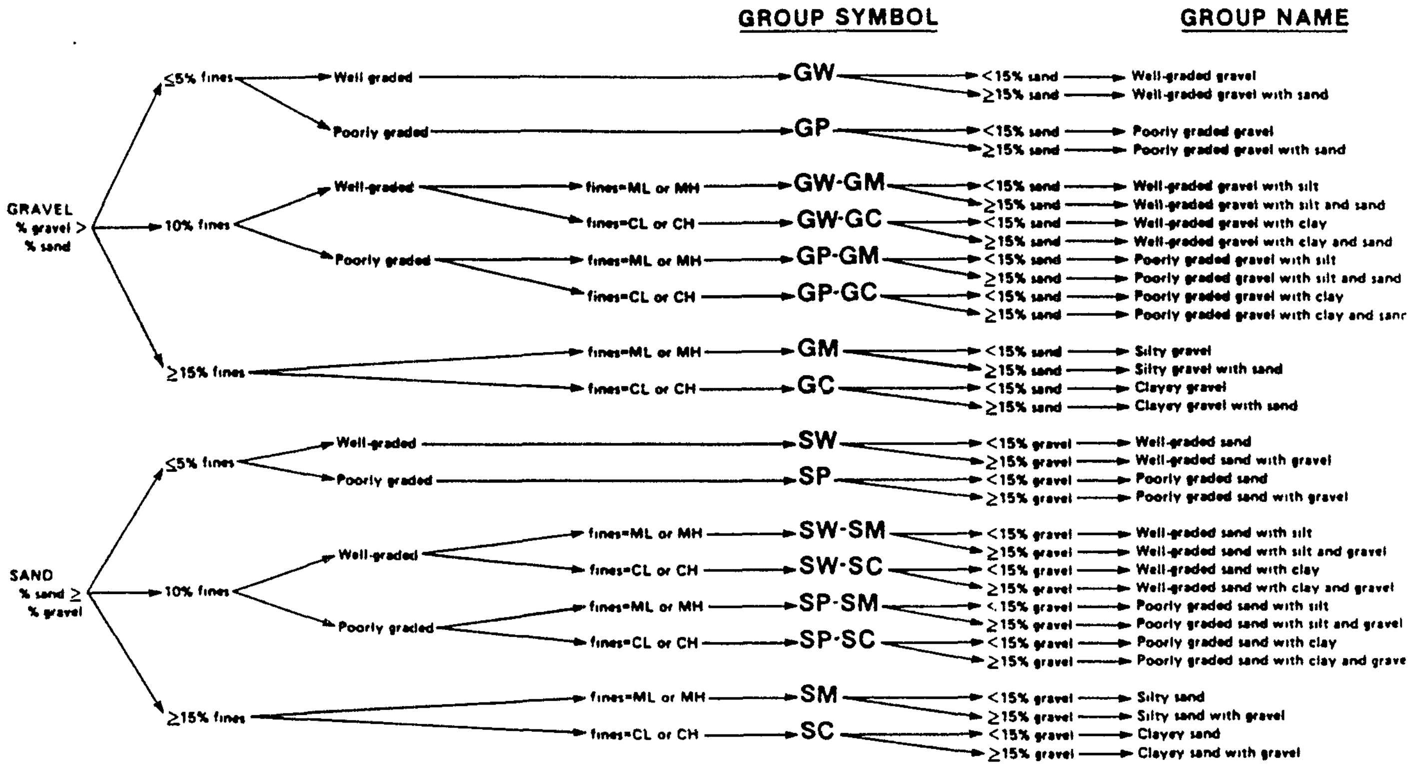
NOTE 3—It is suggested that a distinction be made between *dual symbols* and *borderline symbols*.

Dual Symbol—A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC, CL-ML used to indicate that the soil has been identified as having the properties of a classification in accordance with Test Method D 2487 where two symbols are required. Two



NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 1b Flow Chart for Identifying Organic Fine-Grained Soil (50 % or more fines)



NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 2 Flow Chart for Identifying Coarse-Grained Soils (less than 50 % fines)

symbols are required when the soil has between 5 and 12 % fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart.

Borderline Symbol—A borderline symbol is two symbols separated by a slash, for example, CL/CH, GM/SM, CL/ML. A borderline symbol should be used to indicate that the soil has been identified as having properties that do not distinctly place the soil into a specific group (see Appendix X3).

5. Significance and Use

5.1 The descriptive information required in this practice can be used to describe a soil to aid in the evaluation of its significant properties for engineering use.

5.2 The descriptive information required in this practice should be used to supplement the classification of a soil as determined by Test Method D 2487.

5.3 This practice may be used in identifying soils using the classification group symbols and names as prescribed in Test Method D 2487. Since the names and symbols used in this practice to identify the soils are the same as those used in Test Method D 2487, it shall be clearly stated in reports and all other appropriate documents, that the classification symbol and name are based on visual-manual procedures.

5.4 This practice is to be used not only for identification of soils in the field, but also in the office, laboratory, or wherever soil samples are inspected and described.

5.5 This practice has particular value in grouping similar soil samples so that only a minimum number of laboratory tests need be run for positive soil classification.

NOTE 4—The ability to describe and identify soils correctly is learned more readily under the guidance of experienced personnel, but it may also be acquired systematically by comparing numerical laboratory test results for typical soils of each type with their visual and manual characteristics.

5.6 When describing and identifying soil samples from a given boring, test pit, or group of borings or pits, it is not necessary to follow all of the procedures in this practice for every sample. Soils which appear to be similar can be grouped together; one sample completely described and identified with the others referred to as similar based on performing only a few of the descriptive and identification procedures described in this practice.

6. Apparatus

6.1 *Required Apparatus:*

6.1.1 *Pocket Knife or Small Spatula.*

6.2 *Useful Auxiliary Apparatus:*

6.2.1 *Small Test Tube and Stopper* (or jar with a lid).

6.2.2 *Small Hand Lens.*

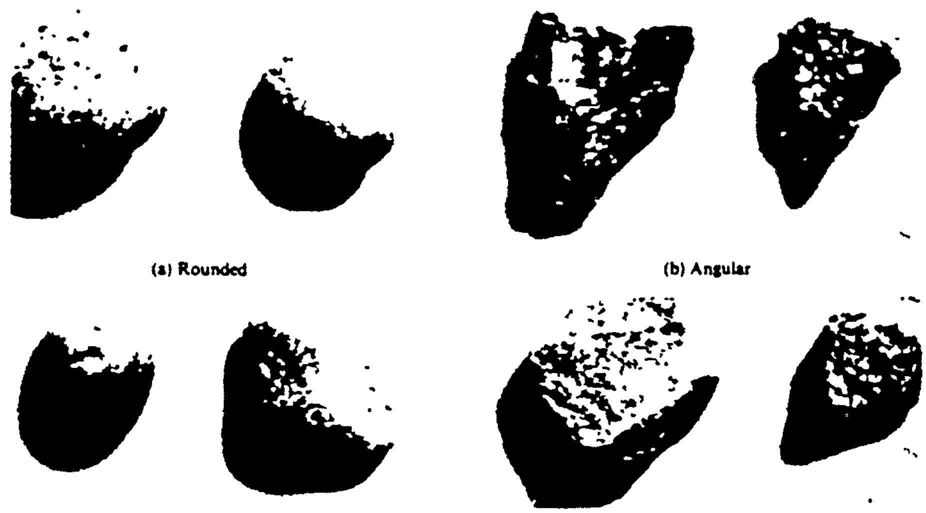
7. Reagents

7.1 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean water from a city water supply or natural source, including non-potable water.

7.2 *Hydrochloric Acid*—A small bottle of dilute hydrochloric acid, HCl, one part HCl (10 *N*) to three parts water (This reagent is optional for use with this practice). See Section 8.

8. Safety Precautions

8.1 When preparing the dilute HCl solution of one part



(a) Rounded (b) Angular

(c) Subrounded (d) Subangular

FIG. 3 Typical Angularity of Bulky Grains

concentrated hydrochloric acid (10 N) to three parts of distilled water, slowly add acid into water following necessary safety precautions. Handle with caution and store safely. If solution comes into contact with the skin, rinse thoroughly with water.

8.2 **Caution**—Do not add water to acid.

9. Sampling

9.1 The sample shall be considered to be representative of the stratum from which it was obtained by an appropriate, accepted, or standard procedure.

NOTE 5—Preferably, the sampling procedure should be identified as having been conducted in accordance with Practices D 1452, D 1587, or D 2113, or Method D 1586.

9.2 The sample shall be carefully identified as to origin.

NOTE 6—Remarks as to the origin may take the form of a boring number and sample number in conjunction with a job number, a geologic stratum, a pedologic horizon or a location description with respect to a permanent monument, a grid system or a station number and offset with respect to a stated centerline and a depth or elevation.

9.3 For accurate description and identification, the minimum amount of the specimen to be examined shall be in accordance with the following schedule:

Maximum Particle Size Sieve Opening	Minimum Specimen Size, Dry Weight
4.75 mm (No. 4)	100 g (0.25 lb)
9.5 mm (3/8 in.)	200 g (0.5 lb)
19.0 mm (3/4 in.)	1.0 kg (2.2 lb)
38.1 mm (1 1/2 in.)	8.0 kg (18 lb)
75.0 mm (3 in.)	60.0 kg (132 lb)

NOTE 7—If random isolated particles are encountered that are significantly larger than the particles in the soil matrix, the soil matrix can be accurately described and identified in accordance with the preceeding schedule.

9.4 If the field sample or specimen being examined is smaller than the minimum recommended amount, the report shall include an appropriate remark.

10. Descriptive Information for Soils

10.1 *Angularity*—Describe the angularity of the sand (coarse sizes only), gravel, cobbles, and boulders, as angular, subangular, subrounded, or rounded in accordance with the criteria in Table 1 and Fig. 3. A range of angularity may be stated, such as: subrounded to rounded.

10.2 *Shape*—Describe the shape of the gravel, cobbles, and boulders as flat, elongated, or flat and elongated if they meet the criteria in Table 2 and Fig. 4. Otherwise, do not mention the shape. Indicate the fraction of the particles that have the shape, such as: one-third of the gravel particles are flat.

10.3 *Color*—Describe the color. Color is an important property in identifying organic soils, and within a given locality it may also be useful in identifying materials of

TABLE 1 Criteria for Describing Angularity of Coarse-Grained Particles (see Fig. 3)

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

TABLE 2 Criteria for Describing Particle Shape (see Fig. 4)

The particle shape shall be described as follows where length, width, and thickness refer to the greatest, intermediate, and least dimensions of a particle, respectively.

Flat	Particles with width/thickness > 3
Elongated	Particles with length/width > 3
Flat and elongated	Particles meet criteria for both flat and elongated

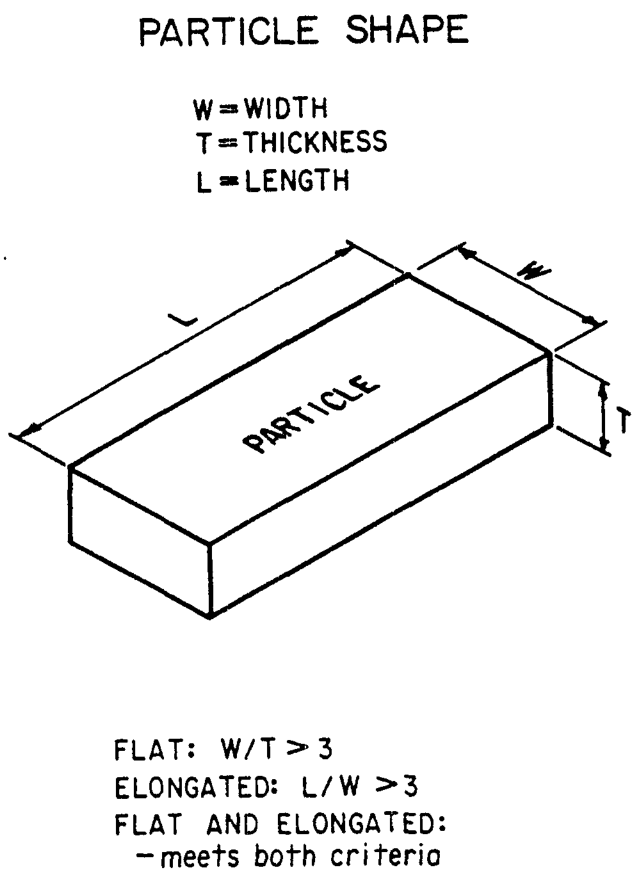


FIG. 4 Criteria for Particle Shape

TABLE 3 Criteria for Describing Moisture Condition

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

similar geologic origin. If the sample contains layers or patches of varying colors, this shall be noted and all representative colors shall be described. The color shall be described for moist samples. If the color represents a dry condition, this shall be stated in the report.

10.4 *Odor*—Describe the odor if organic or unusual. Soils containing a significant amount of organic material usually have a distinctive odor of decaying vegetation. This is especially apparent in fresh samples, but if the samples are dried, the odor may often be revived by heating a moistened sample. If the odor is unusual (petroleum product, chemical, and the like), it shall be described.

10.5 *Moisture Condition*—Describe the moisture condition as dry, moist, or wet, in accordance with the criteria in Table 3.

10.6 *HCl Reaction*—Describe the reaction with HCl as none, weak, or strong, in accordance with the critera in Table 4. Since calcium carbonate is a common cementing agent, a report of its presence on the basis of the reaction with dilute hydrochloric acid is important.

TABLE 4 Criteria for Describing the Reaction With HCl

Description	Criteria
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

TABLE 5 Criteria for Describing Consistency

Description	Criteria
Very soft	Thumb will penetrate soil more than 1 in. (25 mm)
Soft	Thumb will penetrate soil about 1 in. (25 mm)
Firm	Thumb will indent soil about ¼ in. (6 mm)
Hard	Thumb will not indent soil but readily indented with thumbnail
Very hard	Thumbnail will not indent soil

10.7 *Consistency*—For intact fine-grained soil, describe the consistency as very soft, soft, firm, hard, or very hard, in accordance with the criteria in Table 5. This observation is inappropriate for soils with significant amounts of gravel.

10.8 *Cementation*—Describe the cementation of intact coarse-grained soils as weak, moderate, or strong, in accordance with the criteria in Table 6.

10.9 *Structure*—Describe the structure of intact soils in accordance with the criteria in Table 7.

10.10 *Range of Particle Sizes*—For gravel and sand components, describe the range of particle sizes within each component as defined in 3.1.2 and 3.1.6. For example, about 20 % fine to coarse gravel, about 40 % fine to coarse sand.

10.11 *Maximum Particle Size*—Describe the maximum particle size found in the sample in accordance with the following information:

10.11.1 *Sand Size*—If the maximum particle size is a sand size, describe as fine, medium, or coarse as defined in 3.1.7. For example: maximum particle size, medium sand.

10.11.2 *Gravel Size*—If the maximum particle size is a gravel size, describe the maximum particle size as the smallest sieve opening that the particle will pass. For example, maximum particle size, 1½ in. (will pass a 1½-in. square opening but not a ¾-in. square opening).

10.11.3 *Cobble or Boulder Size*—If the maximum particle size is a cobble or boulder size, describe the maximum dimension of the largest particle. For example: maximum dimension, 18 in. (450 mm).

10.12 *Hardness*—Describe the hardness of coarse sand and larger particles as hard, or state what happens when the particles are hit by a hammer, for example, gravel-size particles fracture with considerable hammer blow, some gravel-size particles crumble with hammer blow. "Hard" means particles do not crack, fracture, or crumble under a hammer blow.

10.13 Additional comments shall be noted, such as the presence of roots or root holes, difficulty in drilling or augering hole, caving of trench or hole, or the presence of mica.

TABLE 6 Criteria for Describing Cementation

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

TABLE 7 Criteria for Describing Structure

Description	Criteria
Stratified	Alternating layers of varying material or color with layers at least 6 mm thick, note thickness
Laminated	Alternating layers of varying material or color with the layers less than 6 mm thick, note thickness
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness
Homogeneous	Same color and appearance throughout

10.14 A local or commercial name or a geologic interpretation of the soil, or both, may be added if identified as such.

10.15 A classification or identification of the soil in accordance with other classification systems may be added if identified as such.

11. Identification of Peat

11.1 A sample composed primarily of vegetable tissue in various stages of decomposition that has a fibrous to amorphous texture, usually a dark brown to black color, and an organic odor, shall be designated as a highly organic soil and shall be identified as peat, PT, and not subjected to the identification procedures described hereafter.

12. Preparation for Identification

12.1 The soil identification portion of this practice is based on the portion of the soil sample that will pass a 3-in. (75-mm) sieve. The larger than 3-in. (75-mm) particles must be removed, manually, for a loose sample, or mentally, for an intact sample before classifying the soil.

12.2 Estimate and note the percentage of cobbles and the percentage of boulders. Performed visually, these estimates will be on the basis of volume percentage.

NOTE 8—Since the percentages of the particle-size distribution in Test Method D 2487 are by dry weight, and the estimates of percentages for gravel, sand, and fines in this practice are by dry weight, it is recommended that the report state that the percentages of cobbles and boulders are by volume.

12.3 Of the fraction of the soil smaller than 3 in. (75 mm), estimate and note the percentage, by dry weight, of the gravel, sand, and fines (see Appendix X4 for suggested procedures).

NOTE 9—Since the particle-size components appear visually on the basis of volume, considerable experience is required to estimate the percentages on the basis of dry weight. Frequent comparisons with laboratory particle-size analyses should be made.

12.3.1 The percentages shall be estimated to the closest 5 %. The percentages of gravel, sand, and fines must add up to 100 %.

12.3.2 If one of the components is present but not in sufficient quantity to be considered 5 % of the smaller than 3-in. (75-mm) portion, indicate its presence by the term *trace*, for example, trace of fines. A trace is not to be considered in the total of 100 % for the components.

13. Preliminary Identification

13.1 The soil is *fine grained* if it contains 50 % or more fines. Follow the procedures for identifying fine-grained soils of Section 14.

13.2 The soil is *coarse grained* if it contains less than 50 % fines. Follow the procedures for identifying coarse-grained soils of Section 15.

14. Procedure for Identifying Fine-Grained Soils

14.1 Select a representative sample of the material for examination. Remove particles larger than the No. 40 sieve (medium sand and larger) until a specimen equivalent to about a handful of material is available. Use this specimen for performing the dry strength, dilatancy, and toughness tests.

14.2 *Dry Strength:*

14.2.1 From the specimen, select enough material to mold into a ball about 1 in. (25 mm) in diameter. Mold the material until it has the consistency of putty, adding water if necessary.

14.2.2 From the molded material, make at least three test specimens. A test specimen shall be a ball of material about ½ in. (12 mm) in diameter. Allow the test specimens to dry in air, or sun, or by artificial means, as long as the temperature does not exceed 60°C.

14.2.3 If the test specimen contains natural dry lumps, those that are about ½ in. (12 mm) in diameter may be used in place of the molded balls.

NOTE 10—The process of molding and drying usually produces higher strengths than are found in natural dry lumps of soil.

14.2.4 Test the strength of the dry balls or lumps by crushing between the fingers. Note the strength as none, low, medium, high, or very high in accorance with the criteria in Table 8. If natural dry lumps are used, do not use the results of any of the lumps that are found to contain particles of coarse sand.

14.2.5 The presence of high-strength water-soluble cementing materials, such as calcium carbonate, may cause exceptionally high dry strengths. The presence of calcium carbonate can usually be detected from the intensity of the reaction with dilute hydrochloric acid (see 10.6).

14.3 *Dilatancy:*

14.3.1 From the specimen, select enough material to mold into a ball about ½ in. (12 mm) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.

14.3.2 Smooth the soil ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally,

TABLE 8 Criteria for Describing Dry Strength

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling
Low	The dry specimen crumbles into powder with some finger pressure
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface
Very high	The dry specimen cannot be broken between the thumb and a hard surface

TABLE 9 Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing

TABLE 10 Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness

striking the side of the hand vigorously against the other hand several times. Note the reaction of water appearing on the surface of the soil. Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the reaction as none, slow, or rapid in accordance with the criteria in Table 9. The reaction is the speed with which water appears while shaking, and disappears while squeezing.

14.4 *Toughness:*

14.4.1 Following the completion of the dilatancy test, the test specimen is shaped into an elongated pat and rolled by hand on a smooth surface or between the palms into a thread about 1/8 in. (3 mm) in diameter. (If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation.) Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about 1/8 in. The thread will crumble at a diameter of 1/8 in. when the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread. After the thread crumbles, the pieces should be lumped together and kneaded until the lump crumbles. Note the toughness of the material during kneading.

14.4.2 Describe the toughness of the thread and lump as low, medium, or high in accordance with the criteria in Table 10.

14.5 *Plasticity*—On the basis of observations made during the toughness test, describe the plasticity of the material in accordance with the criteria given in Table 11.

TABLE 11 Criteria for Describing Plasticity

Description	Criteria
Nonplastic	A 1/8-in. (3-mm) thread cannot be rolled at any water content
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

14.6 Decide whether the soil is an *inorganic* or an *organic* fine-grained soil (see 14.8). If inorganic, follow the steps given in 14.7.

14.7 *Identification of Inorganic Fine-Grained Soils:*

14.7.1 Identify the soil as a *lean clay*, CL, if the soil has medium to high dry strength, no or slow dilatancy, and medium toughness and plasticity (see Table 12).

14.7.2 Identify the soil as a *fat clay*, CH, if the soil has high to very high dry strength, no dilatancy, and high toughness and plasticity (see Table 12).

14.7.3 Identify the soil as a *silt*, ML, if the soil has no to low dry strength, slow to rapid dilatancy, and low toughness and plasticity, or is nonplastic (see Table 12).

14.7.4 Identify the soil as an *elastic silt*, MH, if the soil has low to medium dry strength, no to slow dilatancy, and low to medium toughness and plasticity (see Table 12).

NOTE 11—These properties are similar to those for a lean clay. However, the silt will dry quickly on the hand and have a smooth, silky feel when dry. Some soils that would classify as MH in accordance with the criteria in Test Method D 2487 are visually difficult to distinguish from lean clays, CL. It may be necessary to perform laboratory testing for proper identification.

14.8 *Identification of Organic Fine-Grained Soils:*

14.8.1 Identify the soil as an *organic soil*, OL/OH, if the soil contains enough organic particles to influence the soil properties. Organic soils usually have a dark brown to black color and may have an organic odor. Often, organic soils will change color, for example, black to brown, when exposed to the air. Some organic soils will lighten in color significantly when air dried. Organic soils normally will not have a high toughness or plasticity. The thread for the toughness test will be spongy.

NOTE 12—In some cases, through practice and experience, it may be possible to further identify the organic soils as organic silts or organic clays, OL or OH. Correlations between the dilatancy, dry strength, toughness tests, and laboratory tests can be made to identify organic soils in certain deposits of similar materials of known geologic origin.

14.9 If the soil is estimated to have 15 to 25 % sand or gravel, or both, the words "with sand" or "with gravel" (whichever is more predominant) shall be added to the group name. For example: "lean clay with sand, CL" or "silt with gravel, ML" (see Figs. 1a and 1b). If the percentage of sand is equal to the percentage of gravel, use "with sand."

14.10 If the soil is estimated to have 30 % or more sand or gravel, or both, the words "sandy" or "gravelly" shall be added to the group name. Add the word "sandy" if there appears to be more sand than gravel. Add the word "gravelly" if there appears to be more gravel than sand. For example: "sandy lean clay, CL", "gravelly fat clay, CH", or "sandy silt, ML" (see Figs. 1a and 1b). If the percentage of sand is equal to the percent of gravel, use "sandy."

TABLE 12 Identification of Inorganic Fine-Grained Soils from Manual Tests

Soil Symbol	Dry Strength	Dilatancy	Toughness
ML	None to low	Slow to rapid	Low or thread cannot be formed
CL	Medium to high	None to slow	Medium
MH	Low to medium	None to slow	Low to medium
CH	High to very high	None	High

15. Procedure for Identifying Coarse-Grained Soils (Contains less than 50 % fines)

15.1 The soil is a *gravel* if the percentage of gravel is estimated to be more than the percentage of sand.

15.2 The soil is a *sand* if the percentage of gravel is estimated to be equal to or less than the percentage of sand.

15.3 The soil is a *clean gravel* or *clean sand* if the percentage of fines is estimated to be 5 % or less.

15.3.1 Identify the soil as a *well-graded gravel*, GW, or as a *well-graded sand*, SW, if it has a wide range of particle sizes and substantial amounts of the intermediate particle sizes.

15.3.2 Identify the soil as a *poorly graded gravel*, GP, or as a *poorly graded sand*, SP, if it consists predominantly of one size (uniformly graded), or it has a wide range of sizes with some intermediate sizes obviously missing (gap or skip graded).

15.4 The soil is either a *gravel with fines* or a *sand with fines* if the percentage of fines is estimated to be 15 % or more.

15.4.1 Identify the soil as a *clayey gravel*, GC, or a *clayey sand*, SC, if the fines are clayey as determined by the procedures in Section 14.

15.4.2 Identify the soil as a *silty gravel*, GM, or a *silty sand*, SM, if the fines are silty as determined by the procedures in Section 14.

15.5 If the soil is estimated to contain 10 % fines, give the soil a dual identification using two group symbols.

15.5.1 The first group symbol shall correspond to a clean gravel or sand (GW, GP, SW, SP) and the second symbol shall correspond to a gravel or sand with fines (GC, GM, SC, SM).

15.5.2 The group name shall correspond to the first group symbol plus the words "with clay" or "with silt" to indicate the plasticity characteristics of the fines. For example: "well-graded gravel with clay, GW-GC" or "poorly graded sand with silt, SP-SM" (see Fig. 2).

15.6 If the specimen is predominantly sand or gravel but contains an estimated 15 % or more of the other coarse-grained constituent, the words "with gravel" or "with sand" shall be added to the group name. For example: "poorly graded gravel with sand, GP" or "clayey sand with gravel, SC" (see Fig. 2).

15.7 If the field sample contains any cobbles or boulders, or both, the words "with cobbles" or "with cobbles and boulders" shall be added to the group name. For example: "silty gravel with cobbles, GM."

16. Report

16.1 The report shall include the information as to origin, and the items indicated in Table 13.

NOTE 13—*Example Clayey Gravel with Sand and Cobbles, GC*—About 50 % fine to coarse, subrounded to subangular gravel; about 30 % fine to coarse, subrounded sand; about 20 % fines with medium plasticity, high dry strength, no dilatancy, medium toughness, weak reaction with HCl, original field sample had about 5 % (by volume) subrounded cobbles, maximum dimension, 150 mm.

In-Place Conditions—Firm, homogeneous, dry, brown

Geologic Interpretation—Alluvial fan

NOTE 14—Other examples of soil descriptions and identification are given in Appendixes X1 and X2.

NOTE 15—If desired, the percentages of gravel, sand, and fines may be stated in terms indicating a range of percentages, as follows.

Trace—Particles are present but estimated to be less than 5 %

Few—5 to 10 %

Little—15 to 25 %

Some—30 to 45 %

Mostly—50 to 100 %

16.2 If, in the soil description, the soil is identified using a classification group symbol and name as described in Test Method D 2487, it must be distinctly and clearly stated in log forms, summary tables, reports, and the like, that the symbol and name are based on visual-manual procedures.

TABLE 13 Checklist for Description of Soils

1. Group name
2. Group symbol
3. Percent of cobbles or boulders, or both (by volume)
4. Percent of gravel, sand, or fines, or all three (by dry weight)
5. Particle-size range
   Gravel—fine, coarse
   Sand—fine, medium, coarse
6. Particle angularity angular, subangular, subrounded, rounded
7. Particle shape, (if appropriate) flat, elongated, flat and elongated
8. Maximum particle size or dimension
9. Hardness of coarse sand and larger particles
10. Plasticity of fines, nonplastic, low, medium, high
11. Dry strength: none, low, medium, high, very high
12. Dilatancy: none, slow, rapid
13. Toughness: low, medium, high
14. Color (in moist condition)
15. Odor (mention only if organic or unusual)
16. Moisture: dry, moist, wet
17. Reaction with HCl, none, weak, strong

For intact samples

18. Consistency (fine-grained soils only): very soft, soft, firm, hard, very hard
19. Structure stratified, laminated, fissured, slickensided, lensed, homogeneous
20. Cementation weak, moderate, strong
21. Local name
22. Geologic interpretation
23. Additional comments presence of roots or root holes, presence of mica, gypsum, etc., surface coatings on coarse-grained particles, caving or sloughing of auger hole or trench sides, difficulty in augering or excavating, etc

17. Precision and Bias

17.1 This practice provides qualitative information only, therefore, a precision and bias statement is not applicable.

18. Index Terms

18.1 Classification, soil classification, visual classification, soil description, clay, silt, sand, gravel, organic soils.

APPENDIXES

(Nonmandatory Information)

X1. EXAMPLES OF VISUAL SOIL DESCRIPTIONS

X1.1 The following examples show how the information required in 16.1 can be reported. The information that is included in descriptions should be based on individual circumstances and need.

X1.1.1 *Well-Graded Gravel with Sand (GW)*—About 75 % fine to coarse, hard, subangular gravel; about 25 % fine to coarse, hard, subangular sand; trace of fines; maximum size, 75 mm, brown, dry; no reaction with HCl.

X1.1.2 *Silty Sand with Gravel (SM)*—About 60 % predominantly fine sand; about 25 % silty fines with low plasticity, low dry strength, rapid dilatancy, and low toughness; about 15 % fine, hard, subrounded gravel, a few gravel-size particles fractured with hammer blow; maximum size, 25 mm; no reaction with HCl (Note—Field sample size smaller than recommended).

In-Place Conditions—Firm, stratified and contains lenses of silt 1 to 2 in. (25 to 50 mm) thick, moist, brown to gray; in-place density 106 lb/ft^3; in-place moisture 9 %.

X1.1.3 *Organic Soil (OL/OH)*—About 100 % fines with low plasticity, slow dilatancy, low dry strength, and low toughness; wet, dark brown, organic odor; weak reaction with HCl.

X1.1.4 *Silty Sand with Organic Fines (SM)*—About 75 % fine to coarse, hard, subangular reddish sand; about 25 % organic and silty dark brown nonplastic fines with no dry strength and slow dilatancy; wet; maximum size, coarse sand; weak reaction with HCl.

X1.1.5 *Poorly Graded Gravel with Silt, Sand, Cobbles and Boulders (GP-GM)*—About 75 % fine to coarse, hard, subrounded to subangular gravel; about 15 % fine, hard, subrounded to subangular sand; about 10 % silty nonplastic fines; moist, brown; no reaction with HCl; original field sample had about 5 % (by volume) hard, subrounded cobbles and a trace of hard, subrounded boulders, with a maximum dimension of 18 in. (450 mm).

X2. USING THE IDENTIFICATION PROCEDURE AS A DESCRIPTIVE SYSTEM FOR SHALE, CLAYSTONE, SHELLS, SLAG, CRUSHED ROCK, AND THE LIKE

X2.1 The identification procedure may be used as a descriptive system applied to materials that exist in-situ as shale, claystone, sandstone, siltstone, mudstone, etc., but convert to soils after field or laboratory processing (crushing, slaking, and the like).

X2.2 Materials such as shells, crushed rock, slag, and the like, should be identified as such. However, the procedures used in this practice for describing the particle size and plasticity characteristics may be used in the description of the material. If desired, an identification using a group name and symbol according to this practice may be assigned to aid in describing the material.

X2.3 The group symbol(s) and group names should be placed in quotation marks or noted with some type of distinguishing symbol. See examples.

X2.4 Examples of how group names and symbols can be incororated into a descriptive system for materials that are not naturally occurring soils are as follows:

X2.4.1 *Shale Chunks*—Retrieved as 2 to 4-in. (50 to 100-mm) pieces of shale from power auger hole, dry, brown, no reaction with HCl. After slaking in water for 24 h, material identified as "Sandy Lean Clay (CL)"; about 60 % fines with medium plasticity, high dry strength, no dilatancy, and medium toughness; about 35 % fine to medium, hard sand; about 5 % gravel-size pieces of shale.

X2.4.2 *Crushed Sandstone*—Product of commercial crushing operation; "Poorly Graded Sand with Silt (SP-SM)"; about 90 % fine to medium sand; about 10 % nonplastic fines; dry, reddish-brown, strong reaction with HCl.

X2.4.3 *Broken Shells*—About 60 % gravel-size broken shells; about 30 % sand and sand-size shell pieces; about 10 % fines; "Poorly Graded Gravel with Sand (GP)."

X2.4.4 *Crushed Rock*—Processed from gravel and cobbles in Pit No. 7; "Poorly Graded Gravel (GP)"; about 90 % fine, hard, angular gravel-size particles; about 10 % coarse, hard, angular sand-size particles; dry, tan; no reaction with HCl.

X3. SUGGESTED PROCEDURE FOR USING A BORDERLINE SYMBOL FOR SOILS WITH TWO POSSIBLE IDENTIFICATIONS.

X3.1 Since this practice is based on estimates of particle size distribution and plasticity characteristics, it may be difficult to clearly identify the soil as belonging to one category. To indicate that the soil may fall into one of two possible basic groups, a borderline symbol may be used with the two symbols separated by a slash. For example: SC/CL or CL/CH.

X3.1.1 A borderline symbol may be used when the percentage of fines is estimated to be between 45 and 55 %. One symbol should be for a coarse-grained soil with fines and the other for a fine-grained soil. For example: GM/ML or CL/SC.

X3.1.2 A borderline symbol may be used when the percentage of sand and the percentage of gravel are estimated to be about the same. For example: GP/SP, SC/GC, GM/SM. It is practically impossible to have a soil that would have a borderline symbol of GW/SW.

X3.1.3 A borderline symbol may be used when the soil could be either well graded or poorly graded. For example: GW/GP, SW/SP.

X3.1.4 A borderline symbol may be used when the soil could either be a silt or a clay. For example: CL/ML, CH/MH, SC/SM.

X3.1.5 A borderline symbol may be used when a fine-grained soil has properties that indicate that it is at the boundary between a soil of low compressibility and a soil of high compressibility. For example: CL/CH, MH/ML.

X3.2 The order of the borderline symbols should reflect similarity to surrounding or adjacent soils. For example: soils in a borrow area have been identified as CH. One sample is considered to have a borderline symbol of CL and CH. To show similarity, the borderline symbol should be CH/CL.

X3.3 The group name for a soil with a borderline symbol should be the group name for the first symbol, except for:

CL/CH lean to fat clay
ML/CL clayey silt
CL/ML silty clay

X3.4 The use of a borderline symbol should not be used indiscriminately. Every effort shall be made to first place the soil into a single group.

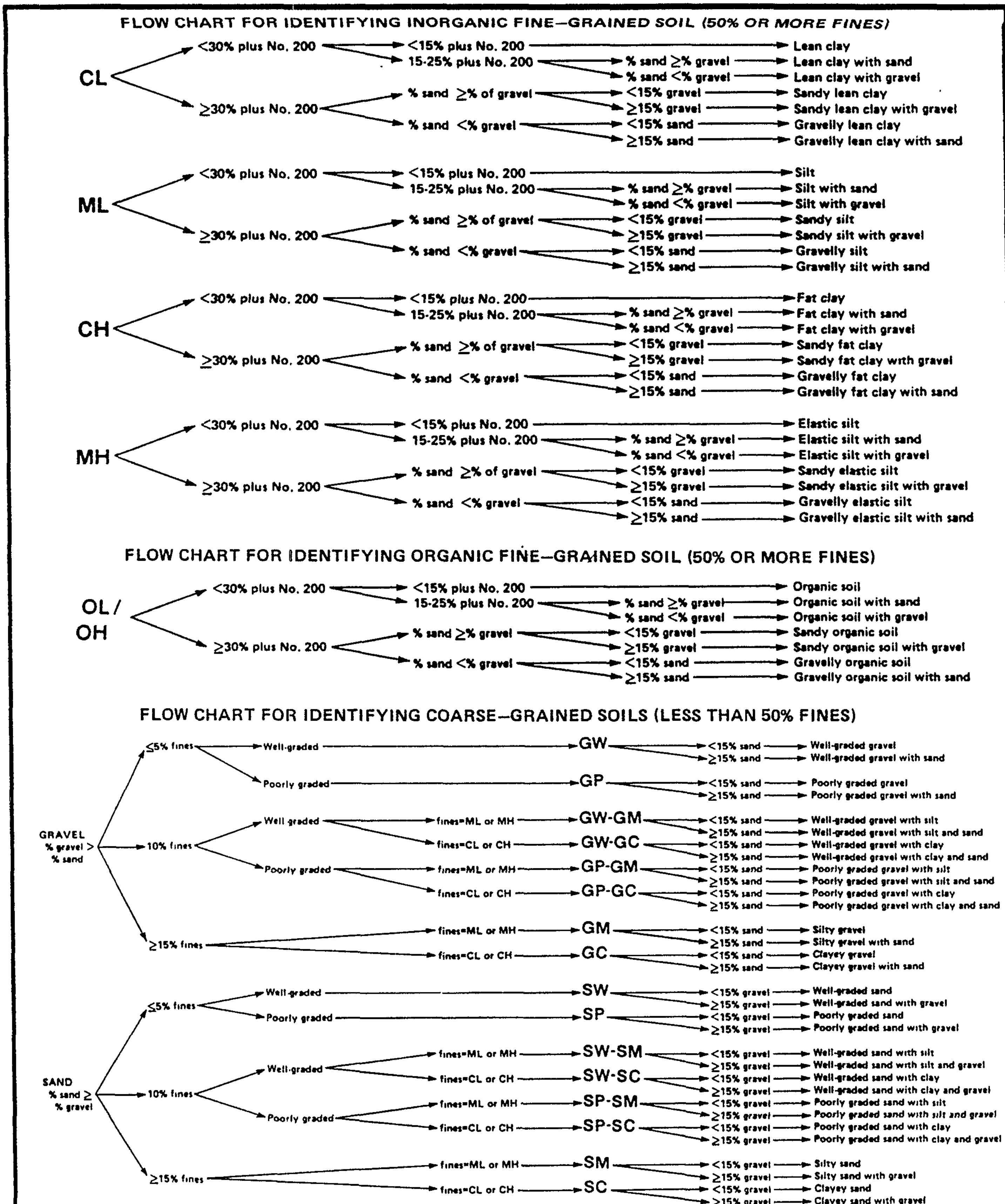
X4. SUGGESTED PROCEDURES FOR ESTIMATING THE PERCENTAGES OF GRAVEL, SAND, AND FINES IN A SOIL SAMPLE

X4.1 *Jar Method*—The relative percentage of coarse- and fine-grained material may be estimated by thoroughly shaking a mixture of soil and water in a test tube or jar, and then allowing the mixture to settle. The coarse particles will fall to the bottom and successively finer particles will be deposited with increasing time; the sand sizes will fall out of suspension in 20 to 30 s. The relative proportions can be estimated from the relative volume of each size separate. This method should be correlated to particle-size laboratory determinations.

X4.2 *Visual Method*—Mentally visualize the gravel size particles placed in a sack (or other container) or sacks. Then, do the same with the sand size particles and the fines. Then, mentally compare the number of sacks to estimate the percentage of plus No. 4 sieve size and minus No. 4 sieve size present. The percentages of sand and fines in the minus sieve size No. 4 material can then be estimated from the wash test (X4.3).

X4.3 *Wash Test (for relative percentages of sand and fines)*—Select and moisten enough minus No. 4 sieve size material to form a 1-in (25-mm) cube of soil. Cut the cube in half, set one-half to the side, and place the other half in a small dish. Wash and decant the fines out of the material in the dish until the wash water is clear and then compare the two samples and estimate the percentage of sand and fines. Remember that the percentage is based on weight, not volume. However, the volume comparison will provide a reasonable indication of grain size percentages.

X4.3.1 While washing, it may be necessary to break down lumps of fines with the finger to get the correct percentages.



NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

Figure 3
FLOW CHARTS FOR CLASSIFICATION OF FINE–GRAINED AND COARSE–GRAINED SOILS

CH2M HILL

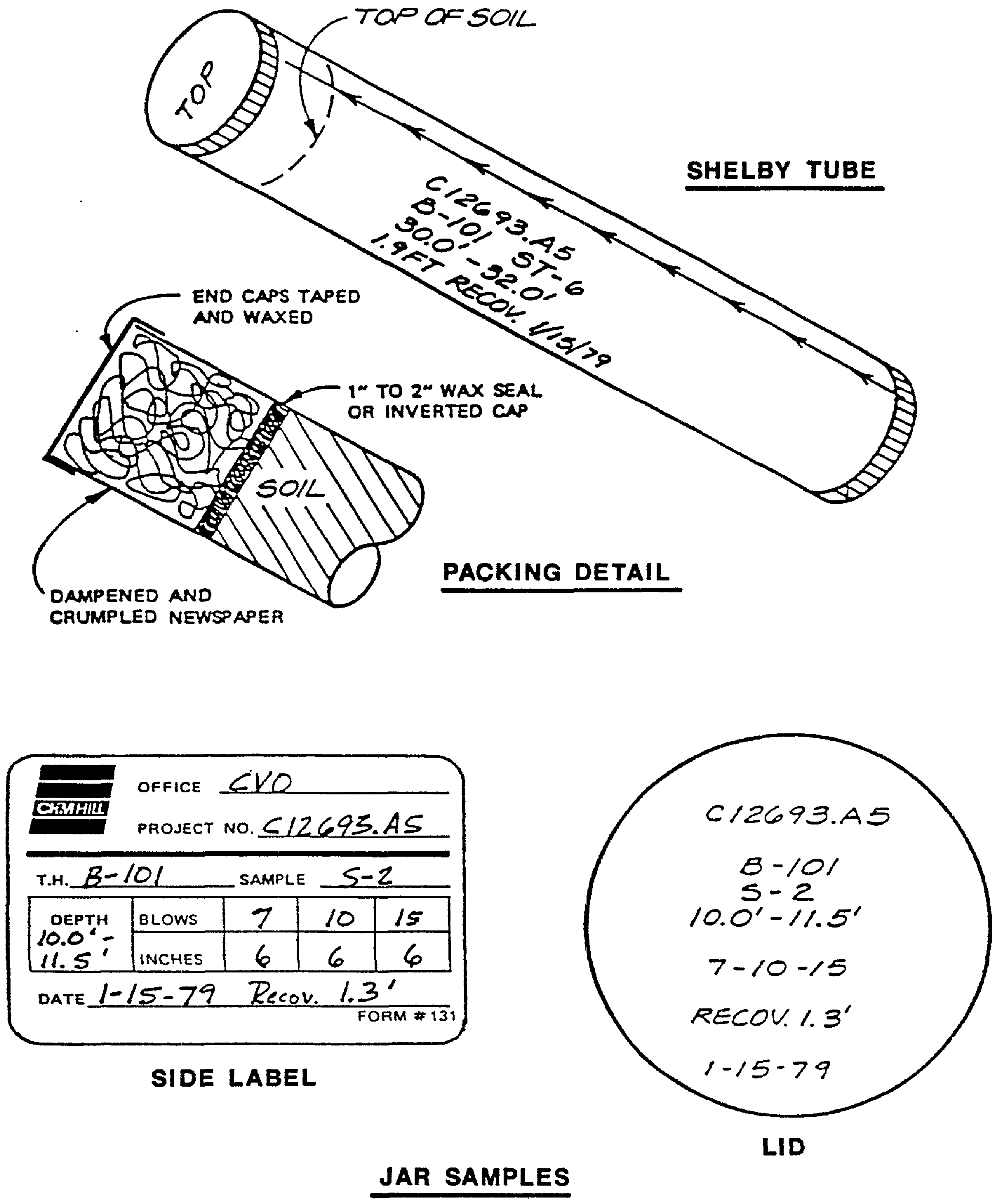


Figure 4
SAMPLE LABELING DETAILS

APPENDIX

Appendix E

U.S. EPA Region IX

Instructions for Sample Shipping and Documentation

INSTRUCTIONS FOR

SAMPLE SHIPPING

AND DOCUMENTATION

November 1997

Quality Assurance Management Section
U. S. EPA Region 9
San Francisco, CA

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FIGURES

1.0 GENERAL

1.1 When all paperwork has been completed by the sampler and samples are ready to be shipped, place the laboratories' copies in a plastic bag and tape it to the inside of the lid of the cooler(s). For CLP Analytical Services, Contract Laboratory Analytical Services Support's (CLASS) copies must be submitted within 5 days of sampling. The Region's copies may be submitted at that time or at the end of the sampling event. If the sampling event covers an extended length of time, the Region's copies must be submitted weekly. (Note: The RSCC coordinator will not forward CLASS's copies. They will be returned to the sampler.)

QAMS address:

U.S. EPA Region 9
Quality Assurance Program (PMD-3)
75 Hawthorne Street
San Francisco, CA 94105
Attn.: RSCC Coordinator

CLASS address:

Contract Laboratory Analytical Services Support
DynCorp
2000 Edmund Halley Dr.
Reston, VA 20191-3436
Attn.: Region 9 Coordinator

1.2 For analyses performed by the Regional Laboratory, DO NOT send any copies of the paperwork to the Contract Laboratory Analytical Services Support (CLASS).

1.3 DISTRIBUTION OF COPIES

1.3.1 CLP ANALYTICAL SERVICES

1.3.1.1 ORGANIC TRAFFIC REPORT/CHAIN-OF-CUSTODY FORM

a. Blue (original) copy to QAMS, Region 9
b. Pink (second) copy to CLASS
c. White (third) and Yellow (fourth) copies accompany samples to laboratory
d. Photocopy for sampler's files

1.3.1.2 INORGANIC TRAFFIC REPORT/CHAIN-OF-CUSTODY FORM

a. Green (original) copy to QAMS, Region 9
b. Pink (second) copy to CLASS
c. White (third) and Yellow (fourth) copies accompany samples to laboratory
d. Photocopy for sampler's files

1.3.2 REGIONAL ANALYTICAL PROGRAM (RAP):

1.3.2.1 RAP CHAIN-OF-CUSTODY FORM

a. White (original) copy to laboratory with samples
b. Pink copy to QAMS, Region 9
c. Photocopy for sampler's file

1.3.3 FIELD QA/QC SUMMARY FORM

a. Original to QAMS, Region 9
b. Photocopy for sampler's files

2.0 SAMPLE SHIPMENTS

2.1 Calling in shipments to the RSCC coordinator

2.1.1 Call the EPA Regional Sample Control Center (RSCC) coordinator on a daily basis, even if no shipments were made. The RSCC coordinator may be reached at (415) 744-1498.

2.1.2 Try to stick to the sampling schedule. If this is not possible, let the RSCC coordinator know immediately so other arrangements can be made.

2.1.3 Notify the RSCC coordinator within 12 hours of sample shipments. Calling in sample shipments to the RSCC coordinator is MANDATORY. Provide the following information to the RSCC coordinator:

1. Case number
2. Name of Laboratory
3. Date of shipment
4. Carrier and airbill number
5. Number of samples shipped by matrix and analysis type
6. Number of coolers shipped
7. Information on completions, changes, delays, etc.

2.2 Special shipments (i.e., Saturday delivery/pickup)

2.2.1 General - Friday shipments for Saturday delivery/pickup must be called in by noon (12:00 pm) Friday. This is to enable the RSCC coordinator to pass the information on to CLASS or to the laboratories. Samplers may not contact the laboratories directly. (Laboratories do not have to accept notification of delivery of samples from sources other than CLASS or RSCC.)

2.2.2 Regional Laboratory - The Regional Laboratory is located within a gated compound that is closed on weekends and holidays. Designated laboratory personnel will pickup the samples at the Federal Express office, take them to the laboratory and place them inside the refrigerators. If the following shipping instructions are not followed, an unsuccessful delivery attempt will be made to the Regional Laboratory. In addition, the staff member on call will not be able to pickup the samples, since they will not be at the Federal Express office.

To ensure that samples are held at the Federal Express office, please be sure to complete the following items:

1. On the lower left side of the Federal Express airbill, "For HOLD at FedEx Location check here," mark the box for "Hold Saturday."

2. In Section 3 of the airbill, print the following Federal Express office address:

1600 63rd Street
Emeryville, CA 94608

Federal Express may affix stickers to the coolers. Be sure they read "SATURDAY FEDERAL EXPRESS CENTER HOLD" or something similar. Under no circumstances should a "SATURDAY DELIVERY" sticker be placed on the cooler.

If a carrier other than Federal Express is used, please call the RSCC coordinator (415-744-1498) to make special arrangements.

2.2.3 Most CLP laboratories and other commercial laboratories contracted by QAP are staffed on Saturdays. Therefore, coolers can be delivered directly to these laboratories. In this case, the "SATURDAY DELIVERY" sticker should be placed on the cooler.

2.2.4 Laboratories may request advance notification of the arrival of certain types of samples, such as samples with very short holding times (e.g., Cr +6) that will be hand delivered to the laboratory. Required deadlines for notification of sample shipments in these special cases will be determined on a case by case basis. The RSCC coordinator will inform the samplers as to when notification of sample delivery is required (e.g., by noon on the day samples will be delivered). This is to facilitate the laboratory(ies) having personnel available to analyze the samples as soon as they arrive.

2.3 Cooler Return

Samplers are responsible for providing laboratories with a means to return coolers to their place of origin. The easiest way is to enclose an airbill with return shipping instructions (i.e., the address filled in as to where the coolers are to be returned to) and an account number to charge shipping costs to.

Samplers using EMFAC coolers should refer to Section 7 of the EMFAC Users Guide for cooler return instructions. EPA contractors should contact their EPA Project Officer for details on acceptable modes of cooler return and shipping cost reimbursement.

3.0 CLP ANALYTICAL SERVICES (CLPAS) TRAFFIC REPORT/CHAIN-OF-CUSTODY FORMS FOR ORGANIC AND INORGANIC ANALYSES

3.1 CASE DOCUMENTATION

Complete this form when collecting CLPAS samples. See Attachments 1 through 3 for examples.

Enter the CLPAS case number in the box(es) located in the upper right corner of the form. CLPAS case numbers have the format "xxxxx" (e.g., 18123).

3.2 HEADER INFORMATION

3.2.1 Box 1 - PROJECT CODE/SITE INFORMATION

Enter the Project Code (i.e., $F), Site Name, City, State, Site Spill ID. **(Note: the information entered here does not go through to the laboratory's copies.)**

If sampling is not under the Superfund program, enter the Account code (account to be billed), any Regional Information and the name of the program (e.g., RCRA) in the box titled "Non-Superfund program."

3.2.2 Box 2 - REGIONAL INFORMATION

Enter the Region number, the name of your sampling company, and your name and signature in the designated spaces.

3.2.3 Box 3 - TYPE OF ACTIVITY

Check the appropriate box(es) for the type of activity for this sampling event. See Appendix A for acronym definitions.

3.2.4 Box 4 - SHIPPING INFORMATION

Enter the date shipped, the carrier (e.g., Federal Express, Airbourne, etc.) and the air bill number in the appropriate spaces.

3.2.5 Box 5 - SHIP TO

Enter the laboratory name, full address and laboratory contact (e.g., Sample Custodian).

3.2.6 Box 6 - PRESERVATIVE

This box provides a list of commonly used preservatives. Enter the appropriate preservative in Column D. If you enter "5" on the Organic Traffic Report or "7" on the Inorganic Traffic Report indicating "Other", specify the preservative used at the bottom of the "Sample Documentation" area.

If you are using more than one type of preservative, you may either note the preservatives in the box specifically under the requested analyses (e.g., in the Cyanide box enter "2") or list them, separated by commas, in the same order as the checked sample analyses. (Alternatively, the analyses may be listed on separate lines.)

3.2.7 Box 7 - SAMPLE DESCRIPTION

This box provides a list of the description/matrices of the samples that are collected. Enter the appropriate description in Column A.

3.3 SAMPLE DOCUMENTATION

3.3.1 SAMPLE NUMBERS

Carefully transcribe the CLPAS sample numbers from the printed labels onto the Organic or Inorganic Traffic Report/Chain-of-Custody forms in the column labeled "CLP Sample Numbers".

CLPAS sample numbers have the following formats: YX123 for organic and MYX123 for inorganic samples. See Appendix B for examples.

3.3.2 Column A - SAMPLE DESCRIPTION

Enter the appropriate sample description code from Box 7.

Note: Item #6 "Oil" and Item #7 "Waste" are for RAP projects only. Do not ship oily samples or waste samples without making prior arrangements with the EPA.

3.3.3 Column B - CONCENTRATION

Enter "L" for low and "M" for medium concentration samples. (Prior arrangements must have been made with the ESAT RSCC coordinator, CLASS and the laboratories accepting the samples before shipping medium concentration samples. At this time, high concentration samples must be scheduled through the RAP system.)

NOTE: Medium concentration samples must be shipped in metal cans.

3.3.4 Column C - SAMPLE TYPE COMPOSITE/GRAB
Enter the type of sample you collected. A composite is a sample composed of more than one discrete sample. A grab is a discrete sample.

3.3.5 Column D - PRESERVATIVE USED

Enter the preservative used from Box 6.

3.3.6 Column E - CLPAS ANALYSIS

Check the analytical fractions requested for each sample, for example, VOAs, BNAs and Pesticides/PCBs are for low/medium concentration organics. Total metals and cyanide are for low/medium concentration inorganics.

NOTE: If dissolved metals are requested, a note must be added indicating that the samples have been field filtered and that digestion is required. See Attachment 2 for an example.

3.3.7 Column F - REGIONAL SPECIFIC TRACKING NUMBERS OR TAG NUMBERS

Region 9 does not issue tracking numbers or tag numbers. Samplers may use this column for sampler specific tracking numbers or for "Special Instructions". If you choose to use this as "Special Instructions", be sure to note, at the bottom of the "Sample Documentation" area, what the special handling is. The number and type of containers could be entered here. (e.g., 3-40 mL, 6-1L)

3.3.8 Column G - STATION LOCATION NUMBER

Enter the station location in the space provided.

3.3.9 Column H - MO/DAY/YEAR/TIME OF SAMPLE COLLECTION

Record the month, day, year and time (use military time, e.g., 1600 = 4:00 pm) of sample collection.

3.3.10 Column I - SAMPLER INITIALS

Enter your initials.

3.3.11 Column J - CORRESPONDING CLP ORGANIC/INORGANIC SAMPLE NUMBER

Enter the corresponding CLP sample number for organic or inorganic CLPAS analysis.

3.3.12 Column K - DESIGNATED FIELD QC

NOTE: This column is NOT to be used for the designated laboratory QC samples. **Information entered here is not reproduced onto the laboratories' copies.**

Enter the appropriate qualifier as listed below for "Blind" Field QC samples in this column. (NOTE: All samples must have a qualifier.)

Blind Field QC	Qualifier
Blind Blanks (field, etc.)	B
Blind Field Duplicates	D
Blind Field Spikes	S
Blind PE Samples	PE
All other field samples	--

"B" = These are blanks and include trip blanks (T), field blanks (F) and equipment blanks (E). Blanks may be further identified by the letter in parenthesis. For example, B(T) indicates that the sample is a trip blank.

"D" = These are field duplicates. Do not include samples designated as laboratory duplicates. The primary sample is identified with "--" and the duplicate is given "D" in column K. In addition, the station locations should also identify the primary and duplicate samples. For example, MW-1 is the primary sample and MW-1B is the duplicate sample.

"S" = These are spiked field samples and are generated by field personnel

"PE" = These are performance evaluation samples. They are spiked samples but are not field samples. They are usually prepared by other than field personnel.

"--" = All other samples not designated as blind field QC samples are given this qualifier.

3.4 "SHIPMENT FOR CASE COMPLETE (Y/N)"

This should reflect the status of the samples scheduled to be shipped to a laboratory for a specific case. Only when ALL samples scheduled for shipment to a laboratory for a specific case have been shipped is the case complete.

3.5 "PAGE 1 OF __"

Enter the number of Traffic Report/Chain-of-Custody Record form(s) enclosed in each cooler. The form(s) accompanying each cooler must list only those samples contained in that cooler.

3.6 "SAMPLE USED FOR SPIKE AND/OR DUPLICATE"

Enter the sample number of the sample designated for laboratory spike and/or duplicate analysis. This is also known as the Laboratory QC sample. This sample should be included in the first shipment to the laboratory and in the first shipment for each subsequent sample delivery group (SDG).

DO NOT enter samples designated as blind field duplicates in this block.

3.7 "ADDITIONAL SAMPLER SIGNATURES"

Record additional sampler signatures that are different from that in Box 2.

3.8 "CHAIN OF CUSTODY SEAL NUMBER"

Enter the Chain of Custody Seal Number used to seal the cooler, if applicable.

3.9 Instructions summarizing CLP sample volumes, packaging and shipment reporting requirements are printed on the back of the Traffic Reports.

4.0 REGIONAL ANALYTICAL PROGRAM (RAP) CHAIN-OF-CUSTODY FORMS

4.1 CASE DOCUMENTATION

Complete this form when collecting RAP samples. See Attachment 4 for an example.

4.1.1 PROJECT NUMBER

Enter the RAP case number in this box.

4.1.2 PROJECT NAME

Leave this space blank.

4.1.3 SAMPLERS (Signature)

Record all sampler signatures in this box.

4.2 SAMPLE DOCUMENTATION

4.2.1 SAMPLE NUMBERS

No sample numbers are provided. Samplers should designate their own numbers and enter them in the space labeled STA.NO.

4.2.2 DATE

Enter the month, day and year the sample was collected in the "DATE" column.

4.2.3 TIME

Enter the time (using military time) in the "TIME" column.

4.2.4 COMP/GRAB

Check the kind of sample collected in the composite or grab column.

4.2.5 STATION LOCATION

Enter the sample site location in the space provided.

4.2.6 SAMPLE MATRIX

For each sample, enter the appropriate sample matrix description in the right third portion of the "STATION LOCATION" column.

4.2.7 NO. OF CONTAINERS

Enter the total number of sample containers collected for each matrix at each station location.

4.2.8 SAMPLE ANALYSES

There are six slanted columns to be used to specify the kind of analysis to be performed by the laboratory. Enter the appropriate analysis in each column. Mark the box of the appropriate analysis for each sample collected.

4.2.9 REMARKS

The items listed below are to be included in this area on the appropriate sample line.

4.2.9.1 CONCENTRATION

Enter "L" for low concentration, "M" for medium concentration and "H" for high concentration.

NOTE: Medium and high concentration samples must be shipped in metal cans.

4.2.9.2 PRESERVATIVE USED

Enter the preservative used.

If more than one type of preservative is used for a sample, separate the preservative references with commas. The sequence of the reference numbers must follow the sequence of the requested "RAP Analysis" parameters that are recorded in the analysis columns.

4.2.9.3 SAMPLE USED FOR SPIKE AND/OR DUPLICATE

Enter the sample number designated for spike and/or duplicate analysis.

This is also known as the Laboratory QC sample. This sample should be included in the first shipment to the laboratory and in the first shipment for each subsequent sample delivery group (SDG).

4.3 AIRBILL NUMBER

The airbill number should be entered on the first signature line, in the box marked "Received by: (Signature)".

4.4 "REMARKS" BOX

Located in the lower right hand corner of the Chain of Custody is a box labeled "Remarks". The following items should be entered there.

4.4.1 CHAIN OF CUSTODY SEAL NUMBER

Enter the Chain of Custody Seal Number used to seal the coolers, if applicable, in the box labeled "Remarks", in the lower right-hand corner.

4.4.2 LABORATORY NAME

Enter the Laboratory name in the box labeled "Remarks", in the lower right-hand corner.

4.4.3 SHIPPING COMPLETE?

Enter "yes, shipping is complete" or "No, shipping is not complete" in the box labeled "Remarks", in the lower right-hand corner.

4.4.4 CARRIER

Enter the carrier (e.g., "Fed Ex") in the box labeled "Remarks", in the lower right-hand corner.

5.0 SAMPLE BOTTLES

5.1 Sample bottles be labeled with the following information:

a. Case number
b. Date/Time of collection
c. Matrix/Concentration
d. Station Location
e. Sample number (CLP or sampler designated)
f. Analysis
g. Preservative

5.2 Pre-printed, self-adhesive labels are provided for CLPAS Organic, CLPAS Inorganic and RAP samples.

5.2.1 Transcribe the appropriate sample number onto the corresponding bottle label and/or affix the sample number label onto the bottle.

5.2.2 Destroy all unused labels or return them to the ESAT RSCC coordinator. DO NOT use them for future samplings. New sample numbers will be assigned.

6.0 FIELD QA/QC SUMMARY FORM

6.1 Complete one form per laboratory per matrix for each sampling event. For long term projects, complete a form(s) after each week of sampling. Complete the header portion even if no QA/QC samples were provided.

6.2 Complete all applicable entries. Please use the appropriate sample numbers for each laboratory. (e.g., for the laboratory performing CLPAS organics, use the CLP organic sample numbers, YX123, etc. For the laboratory performing RAP analyses, use the RAP sample numbers, SY0123, etc.) Please do not use station locations. If a laboratory is performing more than one type of analysis, list all applicable sample numbers.

6.3 This form is very important for validation purposes. The validators will compare the results of duplicates and assess the quality of blanks, if they know which samples they are. Failure to provide this information will delay the completion of validation.

Appendix A

TYPE OF ACTIVITY

Check the box which describes the funding lead for this sampling event:

Funding Lead

SF = Superfund
PRP = Potentially Responsible Party
ST = State
FED = Federal

Check one or more boxes, as appropriate, which describe the task of this sampling event:

Pre-Remedial

PA = Preliminary Assessment
SSI = Screening Site Investigation
LSI = Listing Site Investigation

Remedial

RIFS = Remedial Investigation Feasibility Study
RD = Remedial Design
O&M = Operations and Maintenance
NPLD = National Priorities List

Removal

CLEM = Classic Emergency
REMA = Removal Assessment
REM = Removal
OIL = Oil Response
UST = Underground Storage Tank Response

Appendix B

CLP SAMPLE NUMBERS

Each sample is assigned a unique sample number. A "sample" is defined as follows:

- one matrix, e.g., water, soil/sediment, fish, etc.
- one station location
- one analytical program, e.g., CLPAS organics, CLPAS inorganics or a RAP analysis
- one laboratory

Sample numbers for CLPAS analyses:

- CLPAS Organic sample numbers consist of five alpha-numerics, always beginning with "Y"

  Example - YJ386

- CLPAS Inorganic sample numbers consist of six alpha-numerics, always beginning with "MY"

  Example - MYG528

Examples for assigning sample numbers:

- CLPAS Volatiles & CLPAS Pesticides/PCBs receive the **SAME SAMPLE NUMBER**, if the samples are:

  - the same matrix
  - part of the same analytical program, e.g., CLPAS organics
  - from the same station location
  - going to the same laboratory

  - CLPAS Volatiles & CLPAS Pesticides/PCBs receive **DIFFERENT SAMPLE NUMBERS**, if the samples are:

    - the same matrix
    - part of the same analytical program, e.g., CLPAS organics
    - from the same station location
    - going to different laboratories

- CLPAS Volatiles & CLPAS Metals receive **DIFFERENT SAMPLE NUMBERS**, if the samples are:

  - the same matrix
  - part of different analytical programs, e.g., CLPAS organics & CLPAS inorganics
  - from the same station location
  - going to the same laboratory

United States Environmental Protection Agency
Contract Laboratory Program Sample Management Office
PO Box 818 Alexandria, VA 22313
703-557-2490 FTS 557-2490

Organic Traffic Report & Chain of Custody Record

(For Organic CLP Analysis)

SAS No. (if applicable)

Case No. 17235

1. Project Code: SF
Account Code:
2. Region No.: 9
Sampling Co.: Ace
4. Date Shipped: 1-7-94
Carrier: Fed. Express
Regional Information:
Sampler (Name): Gail Jones
Airbill Number: 0912345678
Non-Superfund Program:
Sampler Signature: Gail Jones
5. Ship To: Alpha Lab, 123 Pine Ave, NY, NY 10001
ATTN: John Doe
Site Name: Toxic Dump
City, State: Smallville CA
Site Spill ID: 99

3. Type of Activity: Lead: SF [X] PRP [ ] ST [ ] FED [ ]; Pre-Remedial: PA [ ] SSI [ ] LSI [ ]; Remedial: RIFS [X] RD [ ] RA [ ] O&M [ ] NPLD [ ]; Removal: CLEM [ ] REMA [ ] REM [ ] OIL [ ] UST [ ]

6. Preservative (Enter in Column D)
1. HCl
2. HNO3
3. $NaHSO_4$
4. H_2SO_4
5. Other (Specify)
6. Ice only
N. Not preserved

7. Sample Description (Enter in Column A)
1. Surface Water
2. Ground Water
3. Leachate
4. Rinsate
5. Soil/Sediment
6. Oil (High only)
7. Waste (High only)
8. Other (Specify)

CLP Sample Numbers (from labels)	A Enter # from Box 7	B Conc. Low Med High	C Sample Type: Comp./Grab	D Preservative from Box 6	E RAS Analysis VOA	BNA	Pest/PCB	High only ARO/TOX	F Regional Specific Tracking Number or Tag Numbers	G Station Location Number	H Mo/Day/Year/Time Sample Collection	I Sampler Initials	J Corresp. CLP Inorg. Samp. No.	K Enter Appropriate Qualifier for Designated Field QC (B = Blank S = Spike D = Duplicate PE = Perform. Eval. — = Not a QC Sample)
YJ126	2	L	G			X				MW-1	1-6-94 0900	GJ	MYG001	—
YJ127	2	L	G			X				MW-2	1-6-94 1000	GJ	MYG003	—
YJ128	2	L	G			X				MW-3	1-6-94 1100	GJ	MYG005	—

Shipment for Case complete? (Y/N): N
Page 1 of 1
Sample used for a spike and/or duplicate: YJ127
Additional Sampler Signatures:
Chain of Custody Seal Number:

CHAIN OF CUSTODY RECORD

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Gail Jones	1-7-94 1600	0912345678			
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks Is custody seal intact? Y/N/none

Split Samples [ ] Accepted [ ] Declined (Signature)

EPA Form 9110-2 (Rev. 5-91) Replaces EPA Form (2075-7), previous edition which may be used

04/13/99 TUE 13:13 FAX 1 415 744 1476 EPA REG 8 002

ATTACHMENT 1

EPA United States Environmental Protection Agency
Contract Laboratory Program Sample Management Office
PO Box 818 Alexandria, VA 22313
703-557-2490 FTS 557-2490

Inorganic Traffic Report & Chain of Custody Record
(For Inorganic CLP Analysis)

SAS No. (if applicable):

Case No. 17235

1. Project Code	Account Code	2. Region No.	Sampling Co.	4. Date Shipped	Carrier
SF		9	Ace	1-7-94	Fed. Express

Regional Information:

Sampler (Name): Gail Jones

Airbill Number: 0912345699

Non-Superfund Program:

Sampler Signature: Gail Jones

5. Ship To: Beta Labs, Inc. 465 Maple Ave. Atlanta, GA 04507
ATTN: Mary Smith

Site Name: Toxic Dump

City, State: Smallville CA

Site Spill ID: 99

3. Type of Activity — Lead: SF [X] PRP [ ] ST [ ] FED [ ]; Fin. Remedial: PA [ ] SSI [ ] LSI [ ]; Remedial: RIFS [X] RD [ ] RA [ ] O&M [ ] NPLD [ ]; Removal: CLEM [ ] REMA [ ] REM [ ] OIL [ ] UST [ ]

6. Preservative (Enter in Column D)
1. HCl
2. HNO_3
3. NaOH
4. H_2SO_4
5. $K_2Cr_2O_7$
6. Ice only
7. Other (Specify)
N. Not preserved

7. Sample Description (Enter in Column A)
1. Surface Water
2. Ground Water
3. Leachate
4. Rinsate
5. Soil/Sediment
6. Oil (High only)
7. Waste (High only)
8. Other (Specify)

CLP Sample Numbers (from labels)	A Enter # from Box 7	B Conc. Low Med High	C Sample Type: Comp./Grab	D Preservative from Box 6	E - RAS Analysis: Metals Total	Metals Dissolved	Cyanide	Low Conc only: Nitrate/Nitrite	Low Conc only: Fluoride	High only: pH	High only: Conductivity	F Regional Specific Tracking Number or Tag Numbers	G Station Location Number	H Mo/Day/Year/Time Sample Collection	I Sampler Initials	J Corresp. CLP Org. Samp. No.	K Enter Appropriate Qualifier for Designated Field QC (B = Blank S = Spike D = Duplicate PE = Perform. Eval — = Not a QC Sample)
MYG001	2	L	G	23	X		X						MW-1	1-6-94 0900	JB	YJ126	—
MYG002	2	L	G	2		X						A	MW-1	1-6-94 0915	JB	YJ126	—
MYG003	2	L	G	23	X		X						MW-2	1-6-94 1000	JB	YJ127	—
MYG004	2	L	G	2		X						A	MW-2	1-6-94 1015	JB	YJ127	—

A = Field Filtered, 0.45 micron
Digestion required for all dissolved samples

Shipment for Case complete? (Y/N): N

Page 1 of 1

Sample used for a spike and/or duplicate: MYG003 + MYG004

Additional Sampler Signatures: John Brown

Chain of Custody Seal Number:

CHAIN OF CUSTODY RECORD

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Gail Jones	1-7-94 1600	0912345699			
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks Is custody seal intact? Y/N/none

[redacted] (Rev. [redacted]-91) Replaces EPA Form (2075-6), previous edition which may be used

Split Samples [ ] Accepted (Signature) [ ] Declined [redacted]

ATTACHMENT 2

ENVIRONMENTA IOTECTION AGENCY
Office of Enforcement

REGION . .
75 Hawthorne Street
San Francisco, California 94105

CHAIN OF CUSTODY RECORD

PROJ. NO.: R94S12
PROJECT NAME:

SAMPLERS: (Signature) K. Pettit

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	MATRIX	NO. OF CONTAINERS	LOW LEVEL VOA	SULFIDE	NITRATE/NITRITE				REMARKS
SYD000	7/21/94	1000		✓	FRONT – MW	GW	4	X	X	X				VOA'S PRESERVED W/ HCL SULFIDE PRESERVED W/NaOH + Zn ACETATE
SYD001	7/21/94	1030		✓	BACK – MW	GW	4	X	X	X				
SYD002	7/21/94	1300		✓	EAST – MW	GW	4	X	X	X				LABQC
SYD003	7/21/94	1320	✓		EAST – S	SOIL	1			X				LABQC
														ALL SOIL AND GW SAMPLES ARE LOW CONCENTRATION

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
K. Pettit	7/22/94 1600	1234567890			
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks
				LAB: REGION 9 SHIPPING IS COMPLETE 7/22/94 CARRIER: FED EX, CUSTODY SEAL #: 12345

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

ATTACHMENT 4

FIELD QA/QC SUMMARY FORM

Instructions: Complete one form per laboratory and per matrix for each sampling eve

Date: 1-10-94 Site: Toxic Dump

Sampler: Gail Jones Case/SAS #: 17235

Office: ACE Laboratory: Beta Labs, Inc

Phone: (415) 456-7890

Matrix: (check one)

X Groundwater ___ Surface Soil ___ Air

___ Surface Water ___ Subsurface Soil ___ Other ______

I. BLANKS

Sample #	Type (circle one)	Date Collected
MYG 021	(Equip) / Field / Travel	1-9-94
	Equip / Field / Travel	
	Equip / Field / Travel	
	Equip / Field / Travel	
	Equip / Field / Travel	
	Equip / Field / Travel	
	Equip / Field / Travel	
	Equip / Field / Travel	
	Equip / Field / Travel	
	Equip / Field / Travel	
	Equip / Field / Travel	
	Equip / Field / Travel	

II. BACKGROUND SAMPLES

Sample #	Date Collec

III. LAB QC SAMPLES

Sample #	Date Collec
MVG 003	1-6-94
MVG 004	1-6-94

IV. DUPLICATES

Sample #	Matches Sample #	Date Collected	Type (circle one)
MVG 015	MVG 016	1-9-94	a / (b) / c / d
			a / b / c / d
			a / b / c / d
			a / b / c / d
			a / b / c / d
			a / b / c / d

a= composite s
b= consecutive
c= colocated
d= consecutive soil sleeve

V. Checklist of Field Problems Encountered

Sample # / Date(s) of Occurrence / Comments

X None
___ Pumping Equipment Problems
___ Sample Filtering Problems
___ Less Than Required Sample Volume
___ Low Flow/Recharge Rates
___ Preservation Problems
___ Samples Not Shipped in 24 hrs.
___ Federal Express Delay
___ Other

ATTACHMENT 5

SAMPLE SHIPMENT INFORMATION

DATE: ____________ # OF PAGES: ____________

TO: GAIL JONES, RSCC COORDINATOR FROM: ____________

CO.: EPA REGION 9 (P-3-2) CO.: ____________

PHONE #: (415) 744-1498 PHONE #: ____________

FAX #: (415) 744-1476 FAX #: ____________

//

CASE #: ____________ LAB NAME: ____________

COOLERS: ____________ SHIPPING DATE: ____________

CARRIER: ____________ AIRBILL #: ____________

# SAMPLES	CONC/MATRIX	ANALYSES

Is this sampling event complete with this shipment? Y N

COMMENTS: ____________

//

CASE #: ____________ LAB NAME: ____________

COOLERS: ____________ SHIPPING DATE: ____________

CARRIER: ____________ AIRBILL #: ____________

# SAMPLES	CONC/MATRIX	ANALYSES

Is this sampling event complete with this shipment? Y N

COMMENTS: ____________