

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY (CLEAN II)
Northern and Central California, Nevada, and Utah
Contract No. N62474-94-D-7609
Contract Task Order No. 122

Prepared For
U.S. DEPARTMENT OF THE NAVY
Patricia McFadden, Remedial Project Manager
Engineering Field Activity West
Naval Facilities Engineering Command
San Bruno, California

FINAL
FIELD SAMPLING PLAN
DATA GAP INVESTIGATION
AT
OPERABLE UNIT 3
ALAMEDA POINT
ALAMEDA, CALIFORNIA

February 17, 2000

Prepared By

TETRA TECH EM INC.
10670 White Rock Road, Suite 100
Rancho Cordova, California 95670
(916) 852-8300



Nadia Burleson, P.E.
Task Manager

**FIELD SAMPLING PLAN
DATA GAP INVESTIGATION
AT
OPERABLE UNIT 3**

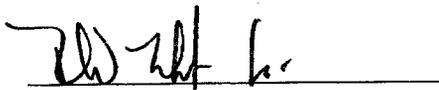
**ALAMEDA POINT
ALAMEDA, CALIFORNIA**

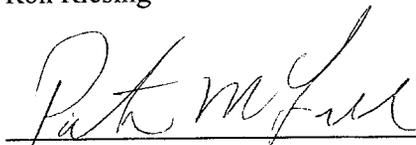
Prepared for:

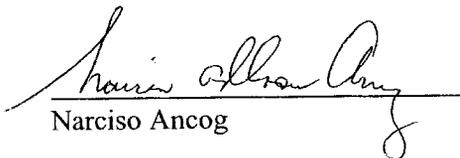
DEPARTMENT OF THE NAVY

REVIEW AND APPROVALS

TtEMI Task Manager:  Date: 2/17/00
Nadia Burleson, P.E.

TtEMI QA Program Manager:  Date: 2-18-00
Ron Riesing

Navy Remedial Project Manager:  Date: 2/24/00
Patricia McFadden

Navy QA Officer:  Date: 3/2/00
Narciso Ancog

TtEMI Sacramento
10670 White Rock Road
Suite 100
Rancho Cordova, CA 95670
(916) 852-8300

TtEMI Chicago
200 East Randolph Drive
Suite 4700
Chicago, IL 60601
(312) 856-8722

CONTENTS

<u>Section</u>	<u>Page</u>
FIGURES	iii
TABLES.....	iii
ACRONYMS AND ABBREVIATIONS.....	iv
1.0 INTRODUCTION.....	1-1
2.0 PURPOSE AND OBJECTIVE	2-1
2.1 PURPOSE	2-1
2.2 OBJECTIVE	2-1
3.0 SITE BACKGROUND	3-1
3.1 SITE LOCATION AND HISTORY	3-1
3.2 GEOLOGY	3-1
3.3 HYDROGEOLOGY	3-3
3.4 CHEMICALS OF CONCERN IN GROUNDWATER	3-4
4.0 FIELD INVESTIGATIVE APPROACH.....	4-1
4.1 GROUNDWATER INVESTIGATION.....	4-1
4.1.1 Direct Push Groundwater Investigation	4-1
4.1.2 Monitoring Well Investigation.....	4-3
4.2 LANDFILL GAS AND SOIL COVER INVESTIGATION.....	4-4
5.0 FIELD AND LABORATORY IDENTIFICATION.....	5-1
5.1 FIELD IDENTIFICATION SYSTEM.....	5-1
5.2 LABORATORY IDENTIFICATION SYSTEM.....	5-1
6.0 FIELD PROCEDURES.....	6-1
6.1 UTILITY CLEARANCES AND PERMITTING	6-1
6.1.1 Utility Clearances.....	6-1
6.2 GROUNDWATER SAMPLING PROCEDURES	6-1
6.3 LANDFILL GAS AND SOIL COVER SAMPLING PROCEDURES	6-2
6.3.1 Landfill Gas Sampling	6-2
6.3.2 Landfill Soil Cover Sampling	6-3
6.3.3 Landfill Gas Flux Rate Measurement	6-3
6.4 BOREHOLE DESTRUCTION.....	6-3
6.5 SAMPLING LOCATION SURVEY	6-4

CONTENTS (Continued)

<u>Section</u>		<u>Page</u>
6.6	DECONTAMINATION PROCEDURES.....	6-5
6.7	WASTE CONTAINMENT, CHARACTERIZATION, AND DISPOSAL.....	6-5
	6.7.1 Waste Containment.....	6-6
	6.7.2 Waste Characterization.....	6-6
	6.7.3 Waste Disposal.....	6-6
7.0	SAMPLE HANDLING AND DOCUMENTATION.....	7-1
	7.1 SAMPLE CONTAINERS.....	7-1
	7.2 COLLECTION OF GROUNDWATER SAMPLES.....	7-1
	7.3 QUALITY CONTROL PROCEDURES.....	7-1
	7.3.1 Equipment Rinsates.....	7-2
	7.3.2 Source Water Blank.....	7-2
	7.3.3 Trip Blanks.....	7-2
	7.3.4 Field Blanks.....	7-2
	7.3.5 Field Duplicates.....	7-3
	7.3.6 Field Laboratory Confirmation Samples.....	7-3
	7.3.7 FLUX CHAMBER BACKGROUND SAMPLE.....	7-3
	7.4 SAMPLE PRESERVATION AND HOLDING TIMES.....	7-3
	7.5 SAMPLE LABELS AND FORMS.....	7-4
	7.5.1 Sample Labels.....	7-4
	7.5.2 Chain of Custody.....	7-5
	7.5.3 Packaging and Shipping.....	7-6
	7.6 FIELD DOCUMENTATION.....	7-7
	7.6.1 Field Activities Logbook.....	7-7
	7.6.2 Field Change Request Document.....	7-8
	7.6.3 Daily Field Progress Reports.....	7-8
8.0	REFERENCES.....	8-1
Appendix A	Standard Operation Procedures	
Appendix B	Field Screening Method Procedures	

FIGURES

Figure

- 1 INSTALLATION RESTORATION SITE LOCATION MAP
- 2 INSTALLATION RESTORATION SITE 1 PHYSICAL FEATURES
- 3 INSTALLATION RESTORATION SITE 1 GROUNDWATER PROPOSED DATA GAP HOT SPOT SAMPLING LOCATIONS
- 4 INSTALLATION RESTORATION SITE 1 PROPOSED DATA GAP GROUNDWATER SAMPLING LOCATIONS
- 5 INSTALLATION RESTORATION SITE 1 PROPOSED LANDFILL GAS DATA GAP SAMPLING LOCATIONS
- 6 SCREEN-POINT GROUNDWATER SAMPLING PROBE

TABLES

Table

- 4-1a FIELD AND LABORATORY IDENTIFICATION NUMBERS FOR GROUNDWATER, LANDFILL GAS, AND QUALITY CONTROL SAMPLES
- 4-1b FIELD AND LABORATORY IDENTIFICATION NUMBER FOR MONITORING WELLS AND QUALITY CONTROL SAMPLES
- 4-1c FIELD AND LABORATORY IDENTIFICATION NUMBER FOR SOIL AND QUALITY CONTROL SAMPLES
- 4-2 ANALYTICAL SUMMARY
- 7-1 SAMPLE CONTAINER, HOLDING TIME, AND PRESERVATIVE REQUIREMENTS FOR INSTALLATION RESTORATION 1 DATA GAP SAMPLING

ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
bgs	Below ground surface
BSU	Bay sediment unit
CLEAN	Comprehensive Long-term Environmental Action Navy
CLP	Contract Laboratory Program
COC	Chemical of concern
CTO	Contract Task Order
DCE	Dichloroethene
DOT	Department of Transportation
DQO	Data quality objective
EPA	U.S. Environmental Protection Agency
ERA	Ecological risk assessment
FWBZ	First water-bearing zone
FWBZU	First water-bearing zone, upper
FSP	Field sampling plan
ft/ft	Foot per foot
HHRA	Human health risk assessment
HI	Hazard index
IDW	Investigation-derived waste
IR	Installation Restoration
LFG	Landfill gas
mg/L	Milligram per liter
MW	Monitoring well
NAS	Naval Air Station
Navy	U.S. Department of the Navy
NFESC	Naval Facilities Engineering Services Center
OU	Operable unit
PPE	Personal protective equipment
PRC	PRC Environmental Management, Inc.
QA	Quality assurance
QC	Quality control

ACRONYMS AND ABBREVIATIONS (Continued)

QAPP	Quality assurance project plan
RI/FS	Remedial investigation and feasibility study
SOP	Standard operating procedure
SOW	Statement of work
SVOC	Semivolatile organic compound
SWBZ	Second water-bearing zone
TSS	Total suspended solids
TtEMI	Tetra Tech EM Inc.
VOC	Volatile organic compound

1.0 INTRODUCTION

This field sampling plan (FSP) has been developed in support of the data gaps pertaining to groundwater, landfill gas, and landfill soil cover identified at Installation Restoration (IR) Site 1 Alameda Point, formerly Naval Air Station (NAS) Alameda, in Alameda, California. In support of the remedial investigation and feasibility study (RI/FS) process at Alameda Point, the U.S. Department of the Navy (Navy) will further assess: (1) the presence of methane and volatile organic compounds (VOC) in landfill gas (LFG) and in surface vapor at IR Site 1; (2) the nature and extent of a known chlorinated solvent and petroleum hydrocarbon plume at IR Site 1; (3) whether chemicals of concern (COC) are adversely impacting aquatic receptors at other groundwater locations; (4) whether cyanide is present in Monitoring Well (MW) M025A that could adversely impact aquatic receptors; and (5) the thickness and geotechnical characteristics of soil overlying landfill refuse. This FSP presents the approach for investigating the five data gaps at IR Site 1. A separate site-specific quality assurance project plan (QAPP), describing specific procedures for the collection, handling, and analysis of groundwater, landfill gas, and soil samples has been prepared to accompany this FSP.

Based on findings from previous RI/FS activities performed by the Navy in 1991 through 1998, the Navy has determined that data gaps exist at IR Site 1 for the (1) landfill gas survey, (2) groundwater hot spot, (3) inadequate shoreline groundwater samples, (4) cyanide analysis for MW M025A at the site, and (5) thickness and geotechnical characteristics of soil overlying landfill refuse. Data gaps were evaluated using the data quality objectives (DQO) process.

2.0 PURPOSE AND OBJECTIVE

This section discusses the purpose and objective of data gap sampling at IR Site 1.

2.1 PURPOSE

The purpose of the field investigation is to obtain the information necessary to address the following four data gaps at IR Site 1:

1. A known groundwater hot spot is present at the site; however, the eastern boundary of the hot spot has not been delineated. Remedial technologies evaluated for IR Site 1 in the FS could be adversely affected by parameters that were not analyzed in the RI process.
2. Shoreline wells are not spaced at adequate intervals to determine that groundwater plumes are not adversely impacting aquatic receptors.
3. Cyanide was detected at levels that could pose an unacceptable risk to aquatic receptors in MW M025A in 1991; this well has not been resampled for cyanide analysis since that time.
4. An LFG survey has not been conducted at IR Site 1.
5. The depth of soil covering refuse at the landfill has not been assessed. Existing soil cover as well as geotechnical parameters will aid in designing the landfill cap.

Data will be obtained through a field investigation consisting of groundwater, LFG, and soil sampling and laboratory analysis to provide information that can be used to determine the extent of contamination.

Results of the data gap investigation will provide information to determine whether the site can be closed in conjunction with remedial actions proposed in the Draft OU-3 FS report or whether further investigation or additional remedial actions are necessary. This determination will be included in the Draft Final OU-3 FS report for IR Site 1.

2.2 OBJECTIVE

The main objective of this investigation is to provide information that can be used to complete the Operable Unit (OU) 3 FS report for IR Site 1. To achieve this objective, the DQO process was used to evaluate data gaps. The purpose of DQOs is to define the quantity and quality of the data to be collected to support the objectives of the proposed sampling event.

U.S. Environmental Protection Agency (EPA) guidance (EPA 1994a) presents DQOs as a seven-step process:

- **Step 1: State the Problem.** Summarize the issues that require environmental data and identify resources available to resolve the problem.
- **Step 2: Identify the Decision.** Identify the decision that requires additional environmental data to address the contamination problem.
- **Step 3: Identify Inputs to the Decision.** Identify the information needed to support the decision and specify which inputs require new environmental measurements.
- **Step 4: Define Study Boundaries.** Specify spatial and temporal aspects of the environmental media that the data must represent to support the decision.
- **Step 5: Develop a Decision Rule.** Develop a logical “if...then” statement that defines the conditions that would cause the decision-maker to choose among alternative actions.
- **Step 6: Specify Limits on Decision Errors.** Specify the decision-maker’s acceptable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data.
- **Step 7: Optimize the Design for Obtaining Data.** Identify a resource-effective design for obtaining environmental data.

The DQO process is discussed in detail in the accompanying OU-3 Data Gap Sampling QAPP.

3.0 SITE BACKGROUND

This section briefly describes the site location and history, geology, and hydrogeology. A more detailed discussion of site background information is provided in the accompanying OU-3 Data Gap Sampling QAPP.

3.1 SITE LOCATION AND HISTORY

IR Site 1 is located in the northwestern corner of Alameda Point (see Figure 1) and was operated between 1943 and 1956 as NAS Alameda's main site for waste disposal. The landfill reportedly received all waste generated at NAS Alameda, except liquid waste, which was discharged directly to the Seaplane Lagoon (Ecology and Environment [E&E] 1983). Figure 2 represents the current configuration of IR Site 1, with boundaries as follows: (1) the northern edge of the burn area and landfill disposal cells is the northern boundary; (2) the eastern edge of landfill disposal cells is the eastern boundary; (3) the southern edge of the landfill cells is the southern boundary; and (4) the San Francisco Bay, adjacent to the burn area and the disposal cell furthest south, is the western boundary.

Limited information is available regarding construction of the IR Site 1 landfill. A geodetic survey chart for NAS Alameda from 1942 shows water as deep as 20 feet at what is now the western shoreline (U.S. Coast Guard and Geodetic Survey 1942). A rock seawall, originally a jetty protecting the harbor entrance, lies at the northern perimeter of the landfill and was in place before 1915. Construction history obtained from Alameda Point, archived drawings, and aerial photographs show that sunken barges and pontoons were placed along the western side of the site adjacent to the bay (Pacific Aerial Surveys 1949, 1957). Natural sedimentation of clayey and silty material likely built up along the barges, which provided a structure for placing hydraulic fill. The disposal area was originally filled with dredge spoils during the early 1940s, beginning with the northern part of the landfill next to the jetty. According to a screening questionnaire completed by the Navy on June 21, 1988, the landfill has no liner, the depth of waste is unknown, and exact boundaries are unknown.

3.2 GEOLOGY

Five geologic units have been identified at IR Site 1: artificial fill, the Bay Sediment Unit (BSU), the Merritt Sand Formation, the Upper San Antonio Formation, and the Lower San Antonio Formation, also called the Yerba Buena Mud. Artificial fill is the uppermost geologic unit at IR Site 1 and overlies a

continuous layer of Bay Sediments. The Merritt Sand and Upper San Antonio Formations are present in the northern portion of IR Site 1, but pinch out at the southern portion of the site, where a paleochannel has removed the two units. In the southern portion of IR Site 1, Bay Sediments are in direct contact with the underlying Yerba Buena Mud. The following geological information was summarized from the OU-3 RI report (Tetra Tech EM Inc. [TtEMI] 1999a).

Artificial Fill. The artificial fill is a continuous layer throughout IR Site 1 and is present between ground surface and 7 and 20 feet below ground surface (bgs). Fill is thickest in the western and northwestern portions of the site and thinnest at the eastern site boundary. The contact of the fill and underlying Bay Sediments at IR Site 1 is distinguished by sand overlying clay and silt and a change in color of the soil. The dominant fill soil type at IR Site 1 is poorly to well-graded sand (SP to SW) that is yellowish brown, grayish brown, brown, black, and gray, fine- to medium-grained and loose to dense.

Bay Sediment Unit. The BSU is a continuous layer throughout IR Site 1. The BSU is interpreted to be a semiconfining layer at the site because of its high clay content and the fact that wells within the second water-bearing zone (SWBZ) were not influenced by aquifer tests performed at the first water-bearing zone (FWBZ) (PRC 1996); water-bearing units are further discussed in Section 3.1.4. The thickness of the BSU at IR Site 1 ranges from 7 to 67 feet, with the thickest part in the southwestern portion of the site. The BSU is in direct contact with the underlying Merritt Sand in the northern portion of IR Site 1 and in direct contact with the underlying Yerba Buena Mud in the southern portion of IR Site 1. The contact of the BSU and Merritt Sand at IR Site 1 is distinguished by a change in color of the soil and by seashells within the BSU. The contact of the BSU and the Yerba Buena Mud at IR Site 1 is distinguished by sand overlying clay and by a change in color of the soil.

Merritt Sand Formation. The Merritt Sand Formation is a discontinuous layer at IR Site 1, present in the northern portion of the site, but absent in the southern portion of the site. The depth of the Merritt Sand Formation at IR Site 1 ranges from about 25 to 70 feet bgs. The Merritt Sand is thickest along the northern boundary of IR Site 1 and thins toward the center of the site, where it pinches out along a northeast to west-trending paleochannel. The Merritt Sand Formation is in direct contact with the underlying Upper San Antonio Formation at the northern portion of IR Site 1. The contact of the Merritt Sand and Upper San Antonio Formations at IR Site 1 is distinguished by a change in color of the soil.

The dominant Merritt Sand soil types at IR Site 1 are poorly graded sand (SP) and silty sand (SM) that are yellowish brown, olive brown, olive yellow, grayish brown, orange brown, and brown and very fine- to medium-grained and loose to dense.

Upper San Antonio Formation and Lower San Antonio Formation (Yerba Buena Mud). The Upper San Antonio Formation is a discontinuous layer at IR Site 1, present in the northern portion of the site, but absent in the southern portion of the site. The depth of the Upper San Antonio Formation at IR Site 1 is about 70 to 80 feet bgs. The upper San Antonio Formation is thickest along the northern boundary of IR Site 1 and thins toward the center of the site, where it pinches out along a northeast to west-trending paleochannel. The Yerba Buena Mud is a continuous stratigraphic unit at a depth between 80 to 90 feet bgs at IR Site 1. The Yerba Buena Mud is the regional aquitard at Alameda Point, separating saline groundwater from fresh groundwater in the underlying Alameda Aquifer.

3.3 HYDROGEOLOGY

The following hydrogeologic information is summarized from the OU-3 RI report (TtEMI 1999a). Four hydrogeologic units were identified beneath IR Site 1: the FWBZ, the BSU, the SWBZ, and the Yerba Buena Mud Aquitard. The FWBZ is unconfined and composed of artificial fill material. The SWBZ is confined and consists of the lower portion of the BSU, the Merritt Sand Formation, and the upper unit of the San Antonio Formation. The BSU acts as a semiconfining layer separating the two water-bearing zones. Each of the two water-bearing zones is divided into two intervals: the FWBZ upper (FWBZU) and FWBZ lower and the SWBZ upper and SWBZ lower. The SWBZ is underlain by the Yerba Buena Mud Aquitard, which is thick and continuous throughout the entire installation. The Yerba Buena Mud Aquitard is about 70 to 90 feet thick and is believed to be an effective hydraulic barrier between the SWBZ and the underlying Alameda Formation.

Sunken barges along the shoreline impede groundwater discharge to the bay and may act as semiconfining barriers to groundwater flow. This is supported by the fact that shoreline wells immediately east of the barges are minimally tidally influenced. Groundwater generally discharges west and north towards San Francisco Bay and the Oakland Inner Harbor in each of the hydrogeologic units. Hydraulic gradients and flow velocities are generally highest in the FWBZU but are variable because of local groundwater recharge (infiltration) effects. Depth to groundwater varies seasonally, but is generally between 4 and 6 feet bgs. Historical groundwater elevations are presented in Appendix H of the RI report.

The groundwater flow characteristics at IR Site 1 (based on April 1998) data are summarized below.

Hydraulic Parameter	FWBZU	FWBZL
Flow Direction	West toward the bay	West toward the bay
Horizontal Hydraulic Gradient (ft/ft)	0.003 to 0.013	0.002 to 0.007
Estimated Horizontal Flow Velocity (ft/yr)	24 to 127	4.2 to 21.3
Average Vertical Hydraulic Gradient (ft/ft)	0.015 to 0.054 (down between FWBZU and FWBZL) 0.018 to 0.060 (down between FWBZU and SWBZL)	

The horizontal flow velocity was estimated based on an effective porosity of 0.30 for medium and poorly graded sands in the FWBZU and 0.35 for silty sands in the FWBZL. Groundwater generally moves to the west and north toward San Francisco Bay and the Oakland Inner Harbor in each of the hydrogeologic units. Hydraulic gradients and flow velocities are generally highest in the FWBZU but are variable because of local groundwater recharge (infiltration) effects. Velocities are highest in the FWBZU because of the high recharge during the winter and spring seasons. Vertical gradients were calculated for several well clusters using the April 1998 data. Vertical gradients between wells screened in the FWBZU and FWBZL were generally downward and ranged from 0.015 to 0.054 foot per foot (ft/ft). Vertical gradients between the FWBZU and SWBZL were downward and ranged from 0.018 to 0.060 ft/ft.

Hydraulic communication between the FWBZ and SWBZ is minimal because of the presence of the BSU. The thickness of the BSU at the site varies from about 30 to 60 feet. Directly beneath IR Site 1, the BSU acts as a flow barrier between the FWBZ and SWBZ by limiting vertical groundwater flux. The lack of significant hydraulic communication between the FWBZ and SWBZ is also indicated by the low vertical permeability values in the BSU (6.2E-09 to 9.0E-08 feet per minute [ft/min]). The aquifer test conducted at IR Site 1 showed minimal or no response in the SWBZ while the FWBZ was being pumped. The maximum drawdown observed in an SWBZ monitoring well (M031-C) was 0.42 foot. Localized communication may occur between the two water-bearing zones in areas northeast of IR Site 1, where the clayey portion of the BSU is not found. Continuous (preferential) flow paths in relatively high-conductivity clayey sands interbedded within the clays of the Bay Sediments may allow transport of chemicals to the deeper units (SWBZ).

3.4 CHEMICALS OF CONCERN IN GROUNDWATER

The Navy determined that groundwater in the area of IR Site 1 is not potable. The technical basis for this determination is summarized in the Determination of the Beneficial Uses of Groundwater technical memorandum (TtEMI 1998). A human health risk assessment (HHRA) was conducted on IR Site 1

groundwater that focused on the groundwater exposure pathway of inhalation of vapors through (1) direct migration from the FWBZ through the vadose zone to ambient air and (2) release to ambient air during irrigation (TtEMI 1999a). The total risk and hazard index (HI) posed to occupational or recreational receptors by potential exposure through inhalation of VOCs migrating from the FWBZ to ambient air, were less than $1.0E-06$ and 1, respectively. For the second HHRA exposure pathway, a groundwater model was run to determine concentrations of four VOCs at a hypothetical pumped well upgradient from the landfill. Carcinogenic risks for an occupational receptor irrigation scenario were determined to be less than $1.0E-06$, and the HI was less than 1. Therefore, the only risk from IR Site 1 groundwater would be to aquatic receptors in the San Francisco Bay.

An ecological risk assessment (ERA) was conducted for IR Site 1 groundwater to determine the risk to aquatic organisms in the bay (TtEMI 1999a). Results indicated that there is a groundwater hot spot, present in the FWBZ near wells M028A, M028E, and M034A, with levels of 2,4-dimethylphenol; 2-methylphenol; 1,2-dichloroethene (DCE); toluene; and xylene that could adversely impact aquatic receptors. An ERA conducted for IR Site 1 groundwater wells located outside of the hot spot, indicated that an ecological risk would not exist from these areas.

4.0 FIELD INVESTIGATIVE APPROACH

This section describes the sampling approach for the groundwater, LFG, and soil investigations for IR Site 1. Table 4-1 presents the field and laboratory identification numbers for IR Site 1. Table 4-2 presents the analytical summary.

4.1 GROUNDWATER INVESTIGATION

The field investigation entails collection of groundwater samples for laboratory analysis to delineate the eastern boundary of the known groundwater hot spot at IR Site 1 and to determine if conditions exist at the groundwater hot spot that could adversely effect remedial action performance. Downgradient samples at shoreline locations will also be collected to assess the impact to aquatic receptors from groundwater outside of the known hot spot. Groundwater samples will be collected and selectively analyzed for VOCs, semivolatile organic compounds (SVOCs), metals, cyanide, and several water quality and general chemistry parameters.

VOC and SVOC samples will be shipped to a California state certified and Naval Facilities Engineering Services Center (NFESC)-approved off-site laboratory and analyzed in accordance with the Contract Laboratory Program (CLP) Statement of Work (SOW) for Organic Analyses, EPA Document No. OLM03.1 (EPA 1994a). Chromium and cyanide samples will be shipped to a state-certified and NFESC-approved off-site laboratory and analyzed in accordance with the CLP SOW for Inorganic Analyses, EPA Document No. ILM04.0 (EPA 1995). The samples for general chemistry parameters will be shipped to a DHS certified and NFESC approved off-site laboratory for analysis using EPA "Methods for Chemical Analysis in Water and Waste" (EPA 1983), and APHA "Standard Methods for the Examination of Water and Wastewater" (APHA 1992)

Detailed descriptions of off-site laboratory procedures and analytical methodologies for IR Site 1 are provided in the accompanying OU-3 Data Gap Sampling QAPP.

4.1.1 Direct-Push Groundwater Investigation

Groundwater samples will be collected from at least 12 and as many as 17 direct-push locations. Hot-spot groundwater sampling locations are shown in Figure 3, and shoreline groundwater sampling locations are

shown in Figure 4. Groundwater samples will be collected at about 5 and 15 feet bgs, to assess shallow and deeper concentrations. Refuse depth will be recorded for each direct-push location, if observed.

To determine the eastern boundary of the groundwater hot spot, three sampling locations were chosen for this investigation. Samples will be collected from HP-S01-B10, HP-S01-B11, and HP-S01-B12 located in a straight line 75 feet east of and parallel to the former eastern hot spot boundary (see Figure 3). Sampling locations were spaced at 75-foot intervals, because the hot spot is estimated to be about 100 feet wide. Groundwater samples will be collected at depths of about 5 and 15 feet bgs at each sampling location. These six samples will be screened for high levels of organohalides using a field screening kit specific for organohalides and having a detection limit of 10 parts per billion or less. At the same time, samples will be sent to a fixed laboratory for additional analysis.

COC levels at the groundwater hot spot are highest at MW M028-A and decrease towards the east and MW M034-A. Because concentrations of all COCs decrease in the eastern direction, 1,2-DCE will be used as the screening parameter to collect step-out samples. If the action level of 5,900 micrograms per liter (defined as 10 times the ecological screening criteria for 1,2-DCE) measured in the field using the organohalide screening kit is exceeded at any of the three locations, step-out samples will be collected as shown in Figure 3.

The decision to collect additional step-out samples will be based on field screening results from groundwater samples collected at initial sampling locations. Step-out samples will be collected as follows:

- If the organohalide field screening concentration exceeds 5 milligrams per liter (mg/L) in any sample from HP-S010-B10, then step-out samples will be collected at HP-S01-B54 and HP-S01-B16 (see Figure 3).
- If the organohalide field screening concentration exceeds 5 mg/L in any sample from HP-S010-B11, then step-out samples will be collected at HP-S01-B14 (see Figure 3).
- If the organohalide field screening concentration exceeds 5 mg/L in any sample from HP-S010-B12, then step-out samples will be collected at HP-S01-B13 and HP-S01-B17 (see Figure 3).
- Field screening will not be conducted on step-out samples, because the study boundary for the hot spot area is defined at only one step out. All step-out samples will be sent to an off-site laboratory for analyses.
- Step-out samples will be collected from the same depths as the original groundwater samples (5 and 15 feet bgs).

To assess ecological impacts to the bay, nine shoreline locations will be sampled as shown in Figure 4. Samples will be collected at about 5 and 15 feet bgs. These samples will be sent to an off-site laboratory for analysis. The study boundary for the shoreline data gap is defined as the locations shown in Figure 4 for this investigation.

4.1.2 Monitoring Well Investigation

Multiple remedial alternatives for the groundwater hot spot were analyzed in the FS. However, remedial technologies evaluated for IR Site 1 in the FS could be adversely affected by parameters that were not analyzed in the RI process. MW M028-A, located in the groundwater hot spot, will be sampled to determine if alkalinity (carbonate, bicarbonates, and hydroxide), sulfides, nitrates, trivalent chromium, ferrous iron, and oil and grease are present. Groundwater samples collected from MW M028-A will also be analyzed for turbidity and TSS. All the analyses except ferrous iron will be performed by a state-certified and NFESC-approved laboratory. The ferrous iron will be analyzed by the field sample team using a Hach field test kit.

MW M025-A, located south of the landfill cells, was previously sampled in 1991. Cyanide was detected at levels that could pose a risk to aquatic receptors. MW M025-A has not been resampled for cyanide analysis since that time. In support of the data gap investigation, a groundwater sample and a duplicate sample will be collected and analyzed for cyanide. The following section describes the monitoring well sample collection process.

Prior to collecting samples, wells will be purged by removing up to 5 well volumes of water to ensure that groundwater samples collected are representative of aquifer conditions. Monitoring wells will be purged until physical parameters (temperature, pH, and conductivity) measured during the purging process stabilize. Unless the well goes dry during purging, a minimum of 3 and a maximum of 5 well casing volumes will be removed during purging. If the physical parameters do not stabilize, the well will be considered adequately purged after 5 well casing volumes are removed. Physical parameters will be measured in the field during purging, in accordance with PRC Standard Operating Procedure (SOP) Nos. 011, 012, and 013 (see Appendix A).

After purging, groundwater samples will be collected from monitoring wells using a disposable bailer and poured into laboratory-prepared sample bottles, as described in SOP No. 010 (see Appendix A).

If a well is purged dry before 3 well casing volumes are removed or before well purging is complete, groundwater will be collected after the well has recovered to 80 percent of the initial water level, but no later than 24 hours after purging.

After sample collection, sample bottles will be packed in refrigerated coolers (cooled to 4 °C or less using ice) and shipped to the laboratory under chain-of-custody control, as discussed in Section 7.5.2.

4.2 LANDFILL GAS AND SOIL COVER INVESTIGATION

An LFG survey will be conducted to evaluate the presence of LFG and the flux rate of the gas in the landfill cells and burn area. It is anticipated that about four shallow LFG samples and about two flux chamber samples (maximum and median flux) will be collected at each of seven landfill cells, plus the burn area. Shallow LFG samples will be collected from 31 locations at a depth of about 3 feet bgs using a direct-push method. Locations of proposed LFG samples are shown on Figure 5. Continuous soil samples will be collected in clear acetate liners adjacent to each LFG probe location between ground surface and about four feet bgs. Selected soil sections will be cut from thirteen continuous samples and sent to an off-site laboratory for geotechnical analyses of the landfill cover soil. Continuous samples will be used to assess landfill soil cover thickness. Soil geotechnical parameters will be used in LFG modeling (as required) and landfill cover design.

All soil gas samples will be analyzed by an on-site laboratory for VOCs by EPA SW-846 Method 8021B and for methane by American Society for Testing and Materials (ASTM) D-1945. Flux chamber gas samples will be analyzed by an off-site laboratory using EPA Method TO-14 for VOCs and by ASTM Method D-1945 for methane. Each analytical sample batch shall be no more than 20 samples and shall include a laboratory blank, a matrix spike, and a sample duplicate or matrix spike duplicate, when applicable. Analyses shall be performed in accordance with the EPA and ASTM methods described above. Required containers and holding times are listed in Table 7-1. Summa™ canisters will be used for EPA Method TO-14, and ASTM Method D-1945, and gastight syringes or Tedlar® bags will be used for EPA SW-846 Method 8021B.

5.0 FIELD AND LABORATORY IDENTIFICATION

A field identification system and a laboratory identification system were developed for this investigation to provide tracking for each sample through the collection, analysis, validation, and data reduction processes. These two systems were developed to efficiently identify sampling locations and analytical results, as well as to provide a means of submitting blind samples to the laboratory.

Samples submitted to the laboratory will have a unique identifier based on a consecutive alpha-numeric code. Each sample station will have a unique field identification number. This number will be used to facilitate the reporting of information about a particular site or sample. The two identification systems are described in detail below.

5.1 FIELD IDENTIFICATION SYSTEM

A field identification system will be used to name and identify the physical sampling locations in the field. The field identification system will indicate the sample type, site number, boring number, and sample depth. For example:

Sample Type	Site	Boring Number	Sample Depth
HP	S01	B1	5

The above example would be HP-S01-B1-5. The sample type identifier "HP" designates that a HydroPunch® sample was taken. The site identifier "S01" refers to IR Site 1. The boring number represents a discrete identification for each soil sample collected from the site. The sample depth indicates the top depth in feet at which the sample is collected. For samples that will be taken in duplicate the field identification will include the letter D after the depth number, for example HP-S01-B1-5D.

5.2 LABORATORY IDENTIFICATION SYSTEM

The laboratory identification system to be used during sampling at IR Site 1 will assign a blind identification number to each sample submitted to the laboratory. Each laboratory identification code will consist of three parts as in the example below:

CTO Number	Site	Sample Number
122	S01	001

“122” represents CLEAN II Contract Task Order No. 122, under which the field work and sample analyses will be performed. “S01” references the site from which the samples are collected. The last set of numbers represents an arbitrary sample number, sequentially assigned to each sample. This number will be used to cross-reference the field identification number.

Samples submitted for laboratory analysis will be accompanied by an original COC form that includes sample identifications that can be cross-referenced with identification information presented on the extended chain-of-custody forms not submitted to the laboratory. The identification information will be written on the extended chain-of-custody forms for future reference. Identification information will include, for example, soil gas sample depths, duplicate identification, and blank sample types.

6.0 FIELD PROCEDURES

This section discusses the equipment to be used and the procedures to be followed during sampling at IR Site 1.

6.1 UTILITY CLEARANCES AND PERMITTING

The investigation will involve invasive tasks, therefore, care must be exercised to ensure personnel safety and to protect underground and overhead utilities from potential damage. Permitting requirements for Alameda Point will be followed during the site investigation. The following section addresses utility clearances.

6.1.1 Utility Clearances

In accordance with California Code 4216, all proposed sampling locations at the site will be delineated with white markings. Underground Service Alert will be notified 48 hours in advance of any drilling activities.

A local commercial service for locating underground utilities will be subcontracted to identify underground obstacles. Existing engineering plans, drawings, diagrams, and other information showing underground utilities will be given to the utility locator for use during utility locating.

After the new boring locations have been marked, the Navy Transition Office at Alameda Point will issue a digging permit.

6.2 GROUNDWATER SAMPLING PROCEDURES

Groundwater samples for IR Site 1 will be collected at discrete depths (as described in Section 4.1) using a direct-push probe with a screen-point (slotted) sampling tip (see Figure 6). The direct-push probe consists of 3-foot sections of 2-inch-diameter hollow tubular steel rods connected by threads. The tip section contains a smaller diameter section of rod that is slotted to allow water to enter. During advancement, the slotted sampling tip is held up into the tip section of the rod using a pointed metal drive tip. The probe is advanced through the soil using hydraulic, vibratory, or hammer force. As the probe is advanced, additional sections of rod are screwed into place so that the desired sampling depth can be

reached. Once the desired depth is reached, the probe is extracted about 18 inches, allowing exposure of the slotted sampling tip.

Groundwater samples may also be collected using a low-flow sampling pump. This method is preferred for VOC sampling and will reduce volatilization during collection of the petroleum-related chemicals (compounds that have relative densities less than 1.0). If the recharge rate of the groundwater at a chosen sampling location is not adequate to support the low-flow sampling method, the water sample will be collected using a small-diameter well bailer.

After the sample is collected, the rods are extracted from the soil, decontaminated, and refitted with a clean, slotted sampling tip. The sampling probe is then readvanced through the soil to collect the next sample. If hydrogeologic conditions are such that the permeability of the aquifer is insufficient to produce the required amount of groundwater to collect a sample, a temporary piezometer will be installed. The groundwater sample will then be collected at a later time, after sufficient groundwater has percolated into the well screen.

6.3 LANDFILL GAS AND SOIL COVER SAMPLING PROCEDURES

Soil gas sampling will measure the potential for VOC emissions from the landfill. Soil flux sampling will measure the potential flux of VOCs at the land surface. The surface flux data will then be used to assess annual air emissions from the landfill. Procedures for LFG and soil cover sampling and flux measurement are provided below.

6.3.1 Landfill Gas Sampling

To collect LFG samples for analysis, LFG probes will be installed to a depth of up to 3 feet bgs. This is to ensure that the soil cover is fully penetrated and that the probe base is in contact with the landfill cell. A direct-push rig will be used to install the LFG probes.

Landfill gas samples will be collected using gastight syringes, Tedlar® bags, or evacuated stainless-steel canisters. Prior to sampling, at least 2 volumes of air will be purged from the probe. The samples will be submitted to the on-site laboratory and analyzed for methane and VOCs by ASTM Method D-1995 and EPA SW-846 Method 8021B. At the conclusion of sampling, probes will be removed, and each boring will be tremmie-grouted with cement from the bottom to the top of the borehole. A wooden stake should

be placed in the center of the cement during grouting. Each stake should be at least 5 feet long, with 3 feet visible above ground surface. Probe sampling locations will be surveyed as described in the surveying procedures.

6.3.2 Landfill Soil Cover Sampling

Continuous soil samples will be collected in clear acetate liners adjacent to each LFG probe location between ground surface and about four feet bgs. A boring log will be used to record visual soil characteristics and refuse interface depth. Soil samples from locations specified in Table 4-1c will be sent to a laboratory for geotechnical analyses using ASTM methods D-422 and D-3080. At the conclusion of sampling each boring will be tremmie-grouted with cement from the bottom to the top of the borehole.

6.3.3 Landfill Gas Flux Rate Measurement

The LFG flux rate measurements are used to design a ventilation system for the landfill cell or disposal trench. Flux chamber testing is performed to represent the maximum flux, high level flux, average flux, and the range of flux emanating from the landfill. Testing for surface flux is conducted using the EPA-recommended Surface Isolation Flux Chamber as the emission assessment tool to collect emissions data. Flux measurements are performed following EPA flux chamber protocol (EPA 1986). The flux chamber is placed about ¼ inch into the land surface and the chamber is sealed; the chamber can be collocated with soil gas probe sampling locations.

Surface flux gas samples are collected in canisters and analyzed off site using EPA Method TO-14 for VOCs and ASTM Method D-1945 for methane. The chamber is operated at 5.0 liters per minute. The canister sample is collected by interfacing the canister to the sample line of the chamber, pulling a vacuum on the line to collect a 6-liter sample volume.

6.4 BOREHOLE DESTRUCTION

After sampling, boreholes will be backfilled with neat cement grout consisting of a mixture of Portland cement and water, in a proportion of not more than 7 gallons of clean water per bag of cement (1 cubic foot or 94 pounds). Three to 5 percent, by weight, of bentonite powder will be added to reduce shrinkage and make the mixture more plastic. The grout will be mechanically blended to produce a uniform mixture.

6.5 SAMPLING LOCATION SURVEY

The exact sampling locations will be surveyed horizontally into the California Zone III State Plane Coordinates, North American Datum of 1928. Elevations will be surveyed based on mean lower low water level, National Geodetic Vertical Datum of 1929. The approximate data gap coordinates are listed below.

<u>Sample Name</u>	<u>East Coordinate</u>	<u>North Coordinate</u>
HP-S01-B1	1471918.22900	477261.71300
HP-S01-B2	1471813.56500	477305.54200
HP-S01-B3	1471384.94500	477397.21200
HP-S01-B4	1471194.59600	477251.06300
HP-S01-B5	1471067.46500	476940.56200
HP-S01-B6	1471200.52300	476619.84200
HP-S01-B7	1471305.87633	476201.03832
HP-S01-B8	1471331.61800	475971.49000
HP-S01-B9	1472274.32900	477083.23100
HP-S01-B10	1471572.15967	476416.83419
HP-S01-B11	1471559.85663	476341.75004
HP-S01-B12	1471572.20263	476265.63464
HP-S01-B13	1471650.66500	476262.33600
HP-S01-B14	1471648.44210	476341.69786
HP-S01-B15	1471647.48547	476416.40589
HP-S01-B16	1471572.46408	476488.96026
HP-S01-B17	1471572.89259	476190.73519
SG-S01-B1	1472168.27943	476880.75162
SG-S01-B2	1472076.54343	476876.38317
SG-S01-B3	1472205.83700	476812.55200
SG-S01-B4	1472133.33248	476775.91051
SG-S01-B5	1471734.67702	476345.86834
SG-S01-B6	1471558.00097	476579.97925
SG-S01-B7	1471639.70519	476181.81058
SG-S01-B8	1471600.38979	476072.60106
SG-S01-B9	1471521.75898	476129.39002
SG-S01-B10	1471572.01212	476416.88043
SG-S01-B11	1471571.54131	476341.73456
SG-S01-B12	1471572.19732	476265.63186
SG-S01-B13	1471456.23336	476443.91347
SG-S01-B14	1471648.41785	476341.71114
SG-S01-B15	1471647.50135	476416.39467
SG-S01-B16	1471440.05476	476558.13741
SG-S01-B17	1471504.32000	475834.77100
SG-S01-B18	1471517.39069	475915.33932
SG-S01-B19	1471403.81277	475836.70847
SG-S01-B20	1471412.54933	475928.44447
SG-S01-B21	1471534.86417	476697.27954
SG-S01-B22	1471399.44431	476679.80615
SG-S01-B23	1471425.65453	476889.48836
SG-S01-B24	1471360.12891	476837.06785
SG-S01-B25	1471198.49867	476972.48779
SG-S01-B26	1471080.55246	476959.38260
SG-S01-B27	1471264.02446	477090.43400
SG-S01-B28	1471102.39439	477147.22288
SG-S01-B29	1471931.35807	476877.32002
SG-S01-B30	1471658.96533	476651.23399
SG-S01-B31	1471674.40090	476568.60816

Data collected from this survey will be compatible with data collected from previous surveying activities. Locations (horizontal coordinates) will be measured with the accuracy of 1 foot. The elevations (vertical) of the ground surface at each boring will be measured to the nearest 0.01 foot.

6.6 DECONTAMINATION PROCEDURES

Decontamination and cleaning procedures will be followed carefully during sampling tasks to prevent foreign substance contamination or cross-contamination between sampling locations. Before use, sampling equipment will be decontaminated by steam cleaning or by washing with a nonphosphate detergent, such as Liquinox, or its equivalent. A tap water rinse and a deionized water rinse will follow the detergent washing. The following item-specific decontamination procedures will be observed.

<u>Item</u>	<u>Decontamination Method</u>	<u>Occasion</u>
Direct-push probe	Steam clean	Before and after borehole advancement activities
Sampling pumps, tubing, and testing equipment	Steam clean or detergent wash and replace tubing	Between samples
Sampler	Steam clean or detergent wash and replace tubing	Between samples

Decontamination rinsates will be containerized. Section 6.7 further addresses the containment and disposal of decontamination rinsates.

6.7 WASTE CONTAINMENT, CHARACTERIZATION, AND DISPOSAL

Waste groundwater, decontamination water, and personal protective equipment (PPE) will be generated during the field investigation. The direct-push probe sampling technique does not typically generate drill cuttings or other waste soil. Therefore, it is anticipated that no waste soil will be generated during field activities. The following subsections detail the required containment, storage, documentation, characterization, and disposal of the generated wastes.

6.7.1 Waste Containment

The direct-push probe does not bring significant quantities of soil to the surface, as do conventional drilling methods. However, investigation-derived waste (IDW), consisting of decontamination water, will be generated during cleaning of the direct-push probe assembly.

Equipment decontamination will be conducted at the designated decontamination area on site. Solid wastes, decontamination fluids, and disposable PPE used during field activities will be placed in Department of Transportation (DOT)-approved drums for temporary storage and eventual disposal.

All IDW will be stored on site in appropriately labeled drums until the conclusion of the project. The drum lids will be kept closed and secured at times when not in use. Filled drums will be transported to the designated IDW storage area behind Building 360 for temporary storage.

The drums will be labeled to indicate the date and time of collection, sampling location(s), sampling personnel, and waste media.

6.7.2 Waste Characterization

Environmental samples will provide data that can be used to characterize waste collected in drums during the data gap investigation at IR Site 1. The IDW subcontractor may choose to collect representative samples from the drums before disposal, as needed, to be analyzed for VOCs and SVOCs. Results of the laboratory analyses will be used to characterize contained waste for determination of the most cost-effective disposal methods.

6.7.3 Waste Disposal

The disposal or remediation of IDW will be determined based on waste profiling using environmental sample results and waste profile samples. IDW will be transported off site for disposal at a licensed facility, in accordance with appropriate federal and state regulations and analytical results.

7.0 SAMPLE HANDLING AND DOCUMENTATION

Standard sample custody procedures will be used to document sample integrity during the collection, transportation, storage, and analysis processes. The field team leader is responsible for implementing procedures that will allow samples to be traced from the time of collection to the time of receipt by the laboratory. The laboratory quality assurance (QA) coordinator is responsible for establishing a sample control system that will allow for tracing sample custody from laboratory receipt to the final sample disposition.

The following sections describe sample handling and documentation procedures to be followed in the field, during transport to the laboratory, and when the sample arrives at the laboratory.

7.1 SAMPLE CONTAINERS

At the time of collection, samples will be properly documented, as described in Section 5.0. Containers that have been previously preserved by the laboratory will be labeled to indicate this. Section 7.2 describes the procedures for collecting groundwater samples. Table 7-1 present the holding times for the respective analyses, in addition to the methods of preservation.

7.2 COLLECTION OF GROUNDWATER SAMPLES

Each direct-push groundwater sample will be collected, through the direct-push probe sampler, by using a low flow sampling pump (EPA 1996). It will then be decanted to an appropriate container that is provided by the laboratory. Monitoring well samples will be collected in accordance with SOP No. 010 in Appendix A.

Immediately after collection, groundwater samples will be labeled and placed in a cooler chilled to a temperature not exceeding 4 °C. Reusable “blue ice” packets will be used to maintain this temperature. If ice is used in the coolers, it will be sealed in a leakproof plastic bag.

7.3 QUALITY CONTROL PROCEDURES

The purpose of quality control (QC) is to follow routine procedures to control the reliability and defensibility of data. QC samples collected in the field will be used to assess the overall quality of the

sampling and analysis process. Field QC samples will include equipment rinsates, a source water blank, trip blanks, field blanks, field duplicates and field laboratory confirmation samples.

7.3.1 Equipment Rinsates

An equipment rinsate consists of the deionized, analyte-free water used in the final step of equipment decontamination poured through the decontaminated sampling equipment into appropriate containers. Equipment rinsates will be collected at least once per day during the duration of sampling activities and will be laboratory-tested for representative analytes. Equipment rinsates are intended to identify possible impacts to analytical results caused by the decontamination process and the sampling equipment.

7.3.2 Source Water Blank

One source water blank will be collected to represent the source water used during this investigation. Source water is the water used during equipment decontamination, typically the on-base water supply, or a supply provided by the sampling team. The intent of sampling the source water is to identify any analytes that may impact the analytical results.

7.3.3 Trip Blanks

Trip blanks are samples of analyte-free water that (1) originate from the laboratory, (2) are brought to the sample site in the cooler, and (3) are returned to the laboratory with water samples collected for VOC analysis. The trip blank container is filled at the laboratory and must not be opened until it is returned to the laboratory. One trip blank will accompany each cooler containing groundwater samples to be analyzed for VOCs. The laboratory will treat the trip blanks in the same manner as the field-derived samples. Trip blanks will be analyzed only for VOCs. When several coolers are shipped simultaneously, samples for VOC analysis may be placed in one cooler with a single trip blank.

7.3.4 Field Blanks

Field blanks are samples collected during landfill gas sampling. They represent ambient air samples collected either at the exact site in the case of flux chamber samples, or above the site in the case of soil gas samples. They are used to evaluate the potential contamination caused by ambient air intrusion during field sampling or possible contamination from sampling equipment.

7.3.5 Field Duplicates

A field duplicate sample is one of two samples collected at the same time and from the same source but submitted to the laboratory blindly as unrelated samples. The objective of the duplicate sample is to assess the consistency of the overall sampling and analytical system.

Water samples and their duplicates will be collected at the same time and from the same sampling device, when possible. Field duplicates will be identified by the addition of the letter D at the end of the field identification number, for example, HP-SO1-B10-5D. Field duplicate samples will be collected and analyzed on a 10 percent basis or one per sampling day, whichever is greater, and analyzed for the same parameters as the original sample. Field duplicate samples will be collected, numbered, packaged, and sealed in the same manner as other samples and submitted blind to the laboratory

7.3.6 Field Laboratory Confirmation Samples

A field laboratory confirmation sample is a field duplicate sample where the original sample is analyzed by the field laboratory and its duplicate is analyzed by an off-site laboratory. The objective of the field laboratory confirmation sample is to assess the overall consistency of the field laboratory analytical system. Field laboratory confirmation will be analyzed on a 10 percent basis and will be analyzed for the same parameters as the original sample.

7.3.7 Flux Chamber Background Sample

A flux chamber background sample will be taken at a location on Alameda Point, other than the landfill area to obtain data that represents the background volatile components of the ambient air. These data will be used to assess low level detects in flux chamber samples taken at the landfill site. Only one sample will be taken during this sampling event.

7.4 SAMPLE PRESERVATION AND HOLDING TIMES

Some of the parameters to be measured in the QC water samples are not chemically stable under certain conditions and therefore require sample preservation. Methods of sample preservation are generally intended to retard biological activity and hydrolysis and to reduce sorption effects. Preservation methods include adjusting pH, adding chemicals, and refrigerating the samples. Preservation methods for the

analytes of concern at IR Site 1 are presented in Table 7-1, and in Attachment 2, Table 2-1 of the accompanying OU-3 Data Gap Sampling QAPP.

Methods of preservation for water samples will follow EPA protocol. The laboratory will add preservatives to the water sample bottles, as necessary, before shipment to the project site. This will help ensure that proper volumes of preservative are used, and that the potential for sample contamination through the use of contaminated preservatives is minimized.

All samples will be analyzed by the laboratory within the EPA-specified holding times for each analyte. The holding times for the respective analyses are presented, along with the methods of preservation, in Table 7-1, and Attachment 2, Table 2-1 of the accompanying OU-3 Data Gap Sampling QAPP.

7.5 SAMPLE LABELS AND FORMS

As samples are collected, they will be placed in appropriate containers, properly labeled, and prepared for transport to the laboratory. Specific methods for labeling, handling, packaging, and transporting samples to the laboratory are discussed below.

7.5.1 Sample Labels

Sample labels will be completed and attached to the container of every sample collected. Labels will be made of a waterproof material backed with a water-resistant adhesive backing. Labels will be marked using waterproof ink and will include the following information:

- Project location
- Sample (laboratory) identification number
- Date and time of sample collection
- Preservative (if applicable)
- Initials of sampler
- Analyses to be conducted

After each sample is labeled, it will be refrigerated or placed in a cooler chilled to 4 °C or less.

7.5.2 Chain of Custody

Chain-of-custody procedures provide for an accurate written record that traces the possession of individual samples from the time of field collection through laboratory analysis. A sample is considered to be “in custody” if one of the following conditions applies:

- The sample is in a person’s possession.
- The sample is in view after being in physical possession.
- The sample is in a secure area after having been in physical possession.
- The sample is in a designated secure area, restricted to authorized personnel.

The chain-of-custody record will be used to document the samples taken and the analyses requested. A chain-of-custody record will be prepared for groups of samples collected at a given location on a given day. Each chain-of-custody record will be prepared in triplicate.

One of the three copies (white) will accompany each shipment of samples to the laboratory. The pink copy is kept by the sampler, and the yellow copy is kept in the TtEMI QA/QC file. The chain-of-custody record documents the identity of personnel involved in sample handling and transfer. Information that field personnel will record on the chain-of-custody record includes the following:

- Project name and number
- Sampling location
- Sample identification number
- Sample station identification (pink and yellow copies only)
- Sampler’s/recorder’s name and signature
- Date and time of collection
- Sample matrix
- Destination of samples (laboratory name)
- Number and types of containers filled
- Analyses requested
- Signatures of individuals involved in custody transfer (including date and time of transfer)
- Airbill number (if applicable)

Chain-of-custody records initiated in the field will be signed, placed in a plastic bag, and taped to the inside of the shipping container used for sampling transport. The method of shipment may be hand delivery by field personnel, laboratory courier, or commercial shipping services (for example, United Parcel Service or Federal Express). The method of sample shipment shall be noted on the chain-of-custody record. Signed airbills shall serve as evidence of custody transfer between the field sampler and commercial shipping service courier, and between the commercial shipping service courier and the laboratory. Copies of the chain-of-custody record and the airbill shall be retained in the project files. Occasionally, several coolers will be sent in one shipment to the laboratory. Each cooler shall have a separate chain-of-custody record listing the samples contained in that shipment. In addition, the outside of the shipping container shall be marked to indicate how many total coolers are in the shipment (for example, in a shipment of three coolers, the coolers would be marked "1 of 3," "2 of 3," and "3 of 3.").

7.5.3 Packaging and Shipping

Procedures for transporting samples to the laboratory will be based on the estimated contaminant concentrations in the samples to be shipped. Samples collected during data gap investigation sampling will be identified as environmental samples. Environmental samples are defined as soil or water that is not saturated or mixed with product material. Packaging and shipment of samples will adhere to DOT regulations. Each water sample will be packaged and transported according to the procedures outlined below, which meet DOT requirements and are in accordance with the EPA guidance on field operation methods (EPA 1988).

- A cooler will be lined with a large plastic bag. Once in place, the cooler will be filled with "bubble wrap," sample bottles, and packing material. Sufficient packing material will be used to prevent sample containers from making contact during shipment. Ice will be added to maintain the temperature at 4 °C. The large inner (plastic bag) liner will be taped shut.
- The chain-of-custody records shipped with the samples to the laboratory will be placed inside of a plastic bag. The bag will be sealed and taped to the inside of the cooler lid. The airbill (if applicable) will be filled out before the samples are handed over to the courier. The laboratory will be notified if the shipper suspects that the samples contain any substances for which the laboratory personnel should take safety precautions.
- The cooler will be closed and taped shut with strapping tape (filament-type) around both ends. If there is a drain in the cooler, it will be taped shut both inside and outside of the cooler.

- Two signed custody seals, consisting of security tape with the date and initials of the sampler(s), will be placed on the cooler, one on the front and one on the back. Additional seals may be used if the sampler or shipper determines that more seals are necessary. Wide, clear tape will be placed over the seals to help protect them against accidental breakage.
- The cooler will be handed over to the overnight carrier (if applicable), along with a completed airbill for shipping environmental samples.

Samples will not be held on site for more than 24 hours, except during weekend field activities. Water samples collected on the weekend will be refrigerated, LFG samples will be stored at ambient temperature and shipped the following Monday. Sampling for analytes with extremely short holding times (such as 24 hours) will not be scheduled for a weekend.

7.6 FIELD DOCUMENTATION

Sampling activities during the field effort require several forms of documentation in addition to the chain-of-custody forms discussed in Section 7.5.2. Such documents are prepared to maintain sample identification and chain of custody and to provide records of significant events or observations. Additional documentation prepared during field sampling activities will include the following:

- Field activities logbook
- Field log for borehole lithology
- Field change request document
- Daily field progress reports

7.6.1 Field Activities Logbook

The field activities logbook is a hardbound notebook in which full descriptions of daily activities associated with the field investigation are recorded. The logbook is intended to provide sufficient data to reconstruct events that occur during the field project. Both drilling and sampling activities will be recorded. The logbook will be signed and dated by appropriate project personnel. Each logbook entry will include information about field activities, instrument calibration, personnel, and sampling. Logbook documentation procedures are presented in Section 4.4 of the accompanying QAPP.

The pages in the logbook will be consecutively numbered, and all entries will be made in indelible ink. Erasures are not allowed. Incorrect entries will be addressed by drawing a single line in indelible ink through the entry and initializing the correction.

7.6.2 Field Change Request Document

The field change request document provides a written record of proposed changes to project plans. Appropriate project personnel, including the field team leader, on-site safety officer, and project manager, will approve the rationale for proposed changes and anticipated effects of the deviation. Approval by the remedial project manager and the Southwest Division (SWDIV) Quality Assurance Officer is necessary before any change to the field program is implemented.

7.6.3 Daily Field Progress Reports

Daily field progress reports will be submitted to the project manager each week during field activities. Each report will include a discussion of personnel, activities, environmental conditions, any problems encountered, and steps taken to solve the problems.

8.0 REFERENCES

- Ecology and Environment. 1983. "Initial Assessment Study of Naval Air Station Alameda, California, Final Report." Prepared for Navy Assessment and Control of Installation Pollutants (NACIP) and Naval Energy and Environmental Support Activity (NEESA), Port Hueneme, California.
- U.S. Environmental Protection Agency (EPA). 1986. "Measurement of Gaseous Emission Rates from Land Surfaces Using an Emission Isolation Flux Chamber, User's Guide." EPA Environmental Monitoring Systems Laboratory. Las Vegas, Nevada. EPA Contract No. 68-02-3889, Work Assignment No. 18. February.
- EPA. 1988. "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final." Office of Emergency and Remedial Response.
- EPA. 1994a. "Contract Laboratory Program (CLP) SOW for Organic Analysis, Multi-Media, Multi-Concentration." Document No. OLM03.1. August.
- EPA. 1994b. "Guidance for the Data Quality Objective Process." QA/G-4. September.
- EPA. 1995. "CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration." Document No. ILM04.0.
- EPA. 1996. "Low Flow (Minimal Drawdown) Groundwater Sampling Procedure." April
- Pacific Aerial Surveys. 1949. No. AV-28-9-33. September 6.
- Pacific Aerial Surveys. 1957. No. AV-253-6-23. May 5.
- PRC Environmental Management, Inc. and Montgomery Watson (PRC and MW). 1993a. "Solid Waste Water Quality Assessment Test and Data Summary Report for RI/FS Phases 5 and 6." Prepared for Department of Navy, Western Division Naval Facilities Engineering Command, San Bruno, California. Final. April.
- PRC and MW. 1993b. "Naval Air Station, Alameda, California, Remedial Investigation/Feasibility Study Work Plan Addendum Draft. Prepared for Department of Navy, Western Division Naval Facilities Engineering Command, San Bruno, California." September.
- PRC. 1996a. "Draft Technical Memorandum Aquifer Test Data Analysis, NAS Alameda." Alameda, California. August.
- PRC. 1996b. "Technical Memorandum Aquifer Test Data Analysis, Draft." Prepared for Department of the Navy Engineering Field Activity West. Naval Facilities Engineering Command. San Bruno, California. August.
- Tetra Tech EM Inc (TtEMI). 1998. "Technical Memorandum Estimation of Ambient Metal Concentrations in Shallow Groundwater, Alameda Point, California." August.
- TtEMI. 1999a. "OU-3 Remedial Investigation Report, Alameda Point, Alameda, California, Final." August 9.

REFERENCES (Continued)

TEMI. 1999b. "Operable Unit-3 Feasibility Study, Alameda Point, Alameda, California, Draft."
August 27.

U.S. Coast and Geodetic Survey. 1942. S.F. Bay, Candlestick Point to Angel Island.

EPA 1983 "Method for Chemical Analysis of Water and Wastes"

APHA 1992 "Standard Methods for the Examination of Water and Wastewater", 18th Edition

APPENDIX A
STANDARD OPERATING PROCEDURES

SOP APPROVAL FORM

PRC ENVIRONMENTAL MANAGEMENT, INC.

STANDARD OPERATING PROCEDURE

GROUND-WATER SAMPLING

SOP NO. 010

REVISION NO. 2

Approved by:

Signed Copy on File
Quality Assurance Officer

Date

Date of Original Issue: 03/31/91

Title: **Ground-Water Sampling**

1.0 BACKGROUND

Ground-water sampling may be required for a variety of reasons, such as examining potable or industrial water supplies, checking for and/or tracking contaminant plume movement in the vicinity of a land disposal or spill site, RCRA compliance monitoring, or examining a site where historical information is minimal or non-existent, but where it is thought ground water contamination could have occurred.

Ground water is usually sampled through an in place well, either temporarily or permanently installed. However, it can also be sampled anywhere ground water is present, as in a pit or a dug or drilled hole.

Occasionally, a well will not be in the ideal location to obtain the sample needed; for example, to track a contaminant plume. In that case, a well will have to be installed, and it may be either a temporary or permanently installed well. An experienced and knowledgeable person, preferably a hydrogeologist, will need to locate the well and supervise its installation so that the samples ultimately collected will be representative of the ground water.

1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedure for determining the quality of ground water entering, leaving, or affected by site activities through ground-water sampling. The samples are obtained by retrieving water from a well placed into underlying aquifer(s) at a site.

Date of Original Issue: 03/31/91

Title: **Ground-Water Sampling**

1.2 SCOPE

This SOP applies to all ground water sampling activities conducted in the field.

1.3 DEFINITIONS

Bailer -- A tube of stainless steel or teflon with valves on either end used to extract water from a well. The bailer is lowered and raised by means of a cable which may be cleaned and reused or disposable rope.

Electrical Water Level Indicator -- An electrical device that has a light or sound alarm connected to an open circuit used to determine the depth to fluid. The circuit is closed when the probe intersects a conducting fluid. The wire used to raise and lower the probe is usually graduated.

Immiscible Phase -- Liquid phases that cannot be uniformly mixed or blended with water. Heavy immiscible phases sink and light immiscible phases float on water.

Interface Probe -- An electrical probe that determines the distance from the surface to air/water, air/immiscible or immiscible/water interfaces.

Purge Volume -- The volume of water that needs to be removed from the well to insure that a sample representative of the ground water is taken.

Riser Pipe -- The length of well casing above the ground surface.

Total Well Depth -- The distance from the ground surface to the bottom of the well.

Date of Original Issue: 03/31/91

Title: **Ground-Water Sampling**

Water Level -- The level of water in a well. Measured as depth to water or as elevation of water, relative to a reference mark or datum.

1.4 REFERENCES

Korte, N. P. Kearl, Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells: Second Edition, GJ/TMC-08, U.S. Department of Energy, Technical Measurements Center, Grand Junction Projects Office, 1985.

U.S. EPA, "Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities," EPA-530/SW-611, August 1977.

U.S. EPA, "Sampling at Hazardous Materials Incidents," EPA Hazardous Response Support Division, Cincinnati, 1984.

U.S.G.S., 1984, National Handbook of Recommended Methods for Water-Data Acquisition, Reston, VA.

1.5 REQUIREMENTS AND RESOURCES

There are various options available to obtain ground water samples. The procedures are outlined in the following section. The equipment needed to accomplish these procedures are given below:

-  OVA or HNu
-  Pipe wrench
-  Electrical water level indicator or interface probe

Date of Original Issue: 03/31/91

Title: Ground-Water Sampling

- ✍ Steel tape with heavy weight
- ✍ Purging device (type needed depends on well depth, casing diameter, type of sample desired)
- ✍ Sampling device (type needed depends upon depth to water and type of sample desired)
 - teflon bailer
 - stainless steel bailer
 - teflon bladder pump
 - stainless steel submersible (non oil bearing) pump
 - existing dedicated equipment
 - peristaltic pump
- ✍ Sample containers
- ✍ Waste water containers of known value
- ✍ Logbook
- ✍ Stopwatch

Note: Additional equipment will be necessary to complete field measurements of the sample. Refer to SOP Nos. 011, 012, and 013. These procedures are done concurrent with ground-water sampling.

2.0 PROCEDURE

Prior to sampling, a site-specific sampling plan will be developed. The plan will take into consideration the site characteristics and will include:

- ✍ The specific repeatable well measurement techniques and reference points for the depth to water and the depth to bottom of the well.
- ✍ The specific method of purging and selection of purging equipment.

Date of Original Issue: 03/31/91

Title: Ground-Water Sampling

- ✍ The specific method for field analytical measurements and the selection of field analytical equipment.
- ✍ The specific method of sample collection and selection of sampling equipment.
- ✍ The order of sample bottle filling.
- ✍ The sample chemical analytical parameters.

2.1 APPROACHING THE WELL

In general, all wells should be assumed to pose a health and safety risk until field measurements determine otherwise. Approach wells from the upwind side. Record well appearance and general condition in the logbook.

Once at the well, the lead person should systematically use the health and safety monitoring instrument to survey the immediate area around the well (from casing to ground and from top of casing to breathing zone) while wearing appropriate respiratory protection equipment. If elevated OVA and HNu meter readings are encountered, retreat to a safe area and instruct the sampling team to put on the appropriate safety gear.

Upon opening the well, the lead person should systematically survey inside the well casing from casing to ground, from above well casing to breathing zone, and the immediate area around the well. If elevated OVA and HNu meter readings at the breathing zone are encountered, (see health and safety plan for action levels) retreat and put on the appropriate safety gear. It is important to remember that action levels are not to be determined by readings within the well casing but at the breathing zone. All health and safety monitoring instrument readings will be recorded in the logbook.

Date of Original Issue: 03/31/91

Title: **Ground-Water Sampling**

2.2 ESTABLISHING A SAMPLE PREPARATION AREA

In general, survey readings at the well will dictate the appropriate location to set up an area for sample preparation. If no elevated readings are encountered, any area upwind or to either side of the well should be selected. If elevated readings are encountered, this area should be taped off and continuously monitored during sample preparation. If persistent elevated readings in this area are encountered, cease sampling and reestablish the sample area upwind where safe ambient readings are found.

2.3 PRELIMINARY WELL MEASUREMENTS

Several preliminary well measurements should be made prior to initiating sampling of the well. These include determining water level and total well depth measurements, determining the presence of immiscible phases, and calculating purge volumes. All preliminary measurements will be recorded in the logbook as they are determined.

2.3.1 Water Level and Total Well Depth Measurements

PRC typically uses an electric water-level indicator for water level measurements. This device sounds an alarm or illuminates a light when the measuring probe touches the water surface thus closing an electrical circuit. The electric cable supporting the probe is usually graduated in feet and can be read at the well site directly. The remaining fraction is measured with a steel tape graduated to 0.01 feet. If the monitoring well is not constructed flush to the ground surface, the distance between the static water level and the top of the riser pipe is measured. The height of the riser pipe above ground surface is then subtracted from the total reading to give the depth to static water. To improve the accuracy of the readings, the probe and cables should be left hanging in the well for a series of three

Date of Original Issue: 03/31/91

Title: **Ground-Water Sampling**

readings, and the values averaged. This helps to eliminate any errors from kinks or bends in the wires which may change the length when the device is pulled up and let down.

The total well depth measurement can be accomplished by using a steel tape with a heavy weight attached to the end. The tape is lowered into the well until resistance is met, indicating that the weight has reached the bottom of the well. The total well depth is then read directly from the steel tape to the 0.01 foot fraction. If the well is not constructed flush to the ground surface, the distance between the bottom of the well and the riser pipe is measured. The height of the riser pipe above the ground surface is then subtracted from the total reading to give the depth to the bottom of the well. To improve the accuracy of the readings, the weighted steel tape should be left hanging in the well for a series of three readings, and the readings averaged.

2.3.2 Determining If Immiscible Phases Are Present

If immiscible phases (organic floaters or sinkers) are present, the following measurement activities should be undertaken. Measurements of organic liquids are made by lowering an interface probe slowly to the surface of the liquid in the well. When the audible alarm sounds, record the depth. If the alarm is continuous, an organic layer has been detected. To determine the thickness of this layer, continue lowering the probe until the alarm changes to an oscillating signal. The oscillating signal indicates that the probe has detected an aqueous layer. Record this depth as the depth to water and determine the thickness and the volume of the immiscible layer.

Continue lowering the probe into the well to determine if immiscible dense phases (sinkers) are present. If the alarm signal changes from oscillating to a continuous sound, a heavier immiscible layer has been detected; record this depth.

Date of Original Issue: 03/31/91

Title: **Ground-Water Sampling**

Continue lowering the probe to the bottom of the well and record the total depth. Separate total depth measurements with a steel tape are not necessary when using an interface probe. Calculate and record the sinker phase volume and total water volume in the well. A chart is provided in Table 1 to assist in these calculations. If immiscible phases are present, immediately refer to Sections 2.5.1 or 2.5.2 of this SOP.

2.3.3 Determination of Purging Volume

If the presence of floaters or sinkers does not need to be determined, determine the depth to water and the total depth of the well as described in Section 2.3.1. Once these measurements have been made and recorded, use Table 1 to calculate the total volume of water in the well. Multiply this volume by the purging factor to determine purging volume. The project-specific standard purging factor is three casing volumes but may be superseded by site-specific program requirements and by individual well yield characteristics.

In Table 1, the volume of water in a 1-foot section of a 2-inch diameter well is 0.16 gallons. This chart can easily be used for any water depth by multiplying all the values in Table 1 by the L value (depth in feet of water in the well).

2.4 PURGING THE WELL

Currently, PRC standards allow for six options for purging wells:

- 1) Teflon bailers
- 2) Stainless-steel bailers
- 3) Teflon bladder pumps

Date of Original Issue: 03/31/91

Title: Ground-Water Sampling

- 4) Stainless-steel submersible (non-oil bearing) pumps
- 5) Existing dedicated equipment - Use of these devices must be approved by on-site client representatives
- 6) Peristaltic pumps - Use of these devices are for shallow wells only and must be approved by the on-site client representative.

TABLE 1
LIQUID VOLUME IN A 1-FOOT SECTION OF WELL CASING

Casing Inside Diameter (inches)	(Fluid oz.) [V=5.22(I.D.) ²]	Volume of Liquid (Gallons) [V=0.408(I.D.) ²]	(Milliliters) [V=154.4(I.D.) ²]
1	5.22	0.04	154.4
1 1/2	11.74	0.09	347.3
2	20.88	0.16	617.5
3	46.98	0.37	1389.4
4	83.52	0.65	2470.0

The volume of water in the well is based on the formula:

$$V = \frac{\pi \times D^2}{4} \times L$$

where

- D = the inside diameter of the well in feet
L = the depth in feet of the water in the well
V = the volume of water in the well in cubic feet

Date of Original Issue: 03/31/91

Title: **Ground-Water Sampling**

As previously stated, the established standard purging volume is three casing volumes. The exception to this standard (other than program requirements) is in the case of low yield wells. When purging low yield wells, purge the well once to dryness. Samples should be collected as soon as the well recovers. When full recovery exceeds 3 hours, samples should be collected as soon as sufficient volume is available.

At no time should the purging rate be high enough to cause the ground water to cascade back into the well, resulting in excessive aeration and potential stripping of volatile constituents.

The actual volume of purged water can be measured using several acceptable methods:

- ✍ When bailers are used, the actual volume of each bailer's contents can be measured using a calibrated bucket.
- ✍ If a pump is used for purging, the pump rate can be determined by using a bucket, stopwatch, and the duration of pumping timed until the necessary volume is purged.

2.5 SAMPLE COLLECTION

The technique used to withdraw a ground water sample from a well should be selected based on the parameters for which analysis will be performed. To ensure that the ground-water samples are representative, it is important to avoid physically altering or chemically contaminating the sample during collection, withdrawal, or containerization.

The preferred sampling devices for all parameters are double check valve stainless steel or Teflon bailers. A Teflon bladder pump may be used. Additional field measurements should be

Date of Original Issue: 03/31/91

Title: **Ground-Water Sampling**

performed at the time of sampling. Refer to SOP Nos. 011, 012, and 013.

In some cases, it may become necessary to use dedicated equipment already in the well to collect samples. This is particularly true of high volume, deep wells (> 150 feet) where bladder pumps are ineffective, and bailing is impractical. If existing equipment must be used, however, determine the make and model of the pump, and check with the manufacturer concerning component construction materials. If an existing pump is to be used for sampling, make sure the flow volume can be reduced so that a reliable volatile organics analysis (VOA) sample can be taken. Record which specific port, tap, or valve sample is collected from.

General sampling procedures include the following:

- ✍ Clean sampling equipment should not be placed directly on the ground. Use a plastic drop cloth or feed line from clean reels. Never place contaminated lines back on reels.
- ✍ Check the operation of the bailer check valve assemblies to confirm free operation.
- ✍ If the bailer cable is to be decontaminated and reused, it must be made of Teflon coated stainless steel. Braided stainless steel is acceptable if used once and disposed.
- ✍ Lower sampling equipment slowly into the well to avoid degassing the water and damaging the equipment.
- ✍ Bladder pump flow rates should be adjusted to eliminate intermittent or pulsed flow. The settings should be determined during the purging operations.
- ✍ A separate sample volume should be collected to measure necessary field data. Samples should be collected and containerized in the order of the parameters' volatilization sensitivity. Table 2 lists the preferred collection order for some common ground water parameters.

Date of Original Issue: 03/31/91

Title: **Ground-Water Sampling**

There are two schools of thought on using an intermediate container to prepare VOA samples specifically, and all parameters, in general. Until more quantitative data is generated, the project-specific standard is not to use such intermediate containers. PRC will, instead, obtain all replicate VOA samples at a single sampling point or from a single bailer load.

2.5.1 Collection of Light Immiscible Floaters

The approach used when collecting floaters is dependent on the depth to the floating layer and the thickness of that layer. If the thickness of the floater is two feet or greater, a bottom valve bailer is the equipment of choice. Slowly lower the bailer until contact is made with the floater surface and lower the bailer to a depth less than that of the floater/water interface depth as determined by preliminary measurements with the interface probe.

When the thickness of the floating layer is less than 2 feet, and the depth to the surface of the floating layer is less than 15 feet, a peristaltic pump can be used to extract a sample.

TABLE 2

ORDER OF PREFERRED SAMPLE COLLECTION

1. Volatile organics (VOA)
2. Purgeable organic carbon (POC)
3. Purgeable organic halogens (POX)
4. Extractable organics
5. Total metals
6. Dissolved metals
7. Total organic carbon (TOC)
8. Total organic halogens (TOX)
9. Phenols

Date of Original Issue: 03/31/91

Title: **Ground-Water Sampling**

10. Cyanide
11. Sulfate and chloride
12. Nitrate and ammonia
13. Radionuclides

However, when the thickness of the floating layer is less than two feet and the depth to the surface of the floating layer is beyond the effective "lift" of a peristaltic pump (greater than 25 feet), a bailer can be modified to allow filling from the top only (an acceptable alternative is to use a top loading Teflon or stainless-steel bailer). Disassemble the bailer's bottom check valve and insert a piece of two-inch diameter teflon sheet between the ball and ball seat. This will seal off the bottom valve. Remove the ball from the top check valve, thus allowing the sample to enter from the top. To overcome buoyancy when the bailer is lowered into the floater, place a length of one-inch stainless steel pipe on the retrieval line above the bailer (this pipe may have to be notched to allow sample entry if the pipe remains within the top of the bailer). Or, as an alternative, use a top-loading stainless-steel bailer. Lower the device, carefully measuring the depth to the surface of the floating layer, until the top of the bailer is level with the top of the floating layer. Lower the bailer an additional one-half thickness of the floating layer and collect sample. This technique is the most effective method of collection if the floater consists of only a few inches of material.

2.5.2 Collection of Heavy Immiscible Sinkers

The best method for collection of sinkers is use of a double check valve bailer. The key to collection is slow, controlled, slow lowering and raising of the bailer to and from the bottom of the well. Collection methods are equivalent to those described in Section 2.5.1 above. Note that both floaters and sinkers must be collected prior to any purging activities.

2.5.3 Collection of Volatile Organics Samples (VOAs)

Date of Original Issue: 03/31/91

Title: Ground-Water Sampling

This section discusses the collection of VOAs using either a bailer or bladder pump.

Date of Original Issue: 03/31/91

Title: **Ground-Water Sampling**

2.5.3.1 Collection with Bailers

VOAs should be collected from the first bailer removed from the well after purging. The most effective means employs two people. One person should retrieve the bailer from the well and pour its contents into the appropriate number of 40 ml VOA vials held by the second person. Cap the vial and invert. If a bubble exists, discard and repeat. Do not reopen the vial and add additional sample. The transfer of the sample from the bailer to the container is performed in a manner that will limit the amount of agitation in order to reduce the loss of volatile organics from the sample.

Always prepare VOA splits from a single bailer full. If the bailer is refilled, samples are not splits.

2.5.3.2 Collection with a Bladder Pump (Well Wizard)

To successfully perform VOA sampling with a Well Wizard bladder pump, the following steps must be completed:

- 1) Following manufacturer's directions, activate the Well Wizard pump. Full water flow from the discharge tubing will begin after five to fifteen pumping cycles. These initial pumping cycles are required to purge air from the pump and discharge tubing. The discharge and recharge settings must be manually set and adjusted to pump at optimum flow rates. To activate the bladder, it is best to set the initial cycle at long discharge and recharge rates.
- 2) Reduce water flow rate for VOA sample collection. To reduce the water flow rate, turn the throttle control valve (located on the left side of the Well Wizard pump control

Date of Original Issue: 03/31/91

Title: Ground-Water Sampling

panel) counterclockwise.

- 3) Collect VOA sample from discharge tubing. VOA vials must be placed beneath the discharge tubing while avoiding direct contact between the vials and the tubing. Never place tubing past the mouth of the VOA vial. The pump throttle control must be turned as necessary to maintain a trickle of water in order to obtain a meniscus in the vial.

- 4) Continue with non-VOA sampling. Increase pump flow rate by turning the throttle control knob clockwise.

SOP APPROVAL FORM

PRC ENVIRONMENTAL MANAGEMENT, INC.

STANDARD OPERATING PROCEDURE

FIELD MEASUREMENT OF WATER TEMPERATURE

SOP NO. 011

REVISION NO. 1

Approved by:

Signed Copy on File
Quality Assurance Officer

Date

Date of Original Issue: 03/31/91

Revision Date: 03/23/92

Title: **Field Measurement of Water Temperature**

1.0 BACKGROUND

Temperature readings are used in the calculation of various forms of alkalinity, in studies of saturation and stability with respect to calcium carbonate, in the calculation of salinity, and in general laboratory operations.

1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for measuring water temperature in the field.

1.2 SCOPE

This SOP applies to measuring the temperature of surface and ground water while in the field.

1.3 DEFINITIONS

National Institute of Standards and Technology Certified Thermometer--a thermometer that carries certification of its temperature reading precision.

1.4 REFERENCES

U.S. Environmental Protection Agency. RCRA Ground-Water Monitoring Technical Enforcement Guidance Document, September 1986.

1.5 REQUIREMENTS AND RESOURCES

The following equipment may be required for field measurement of water temperature:

 Mercury-filled thermometer with metal case

Date of Original Issue: 03/31/91

Title: Field Measurement of Water Temperature

- ✍ Electronic thermistor with accuracy to 0.1 °C
- ✍ National Institute of Standards Technology Certified Thermometer (for periodic calibration)
- ✍ Container
- ✍ Decontamination materials
- ✍ Field logbook

2.0 PROCEDURES

Under normal conditions, temperature measurements may be made with any reliable, glass, mercury-filled celsius thermometer. At a minimum, the thermometer should have a scale marked for every 0.1 ° or 0.2 °C, with markings etched on the capillary glass. The thermometer should have a minimal thermal capacity to permit rapid equilibration. The thermometer should be calibrated periodically against a precision thermometer certified by the National Institute of Standards and Technology. A certified thermometer is located in PRC Environmental Management, Inc.'s (PRC's) Chicago office. For field operations, use a thermometer that has metal case to prevent breakage.

Alternatively, temperature measurements may be made with a digital electronic thermistor, reading to 0.1 °C. Maintain the thermistor as described in its operation and maintenance manual. In particular, always check the battery before each use. If an extremely long probe is required, follow the manufacturer's directions to insure that unbalanced resistance does not distort readings.

Temperature measurements should be taken at the source. If it is not possible to measure the temperature at the source, use an intermediate container. When an intermediate container is used, fill the container with sample and allow the container temperature to equilibrate with that of the sample source. Dispose of the sample and draw a new sample. Transfer the sample to the equilibrated container and measure its temperature.

Make readings with the thermometer or probe immersed in water long enough to permit

Date of Original Issue: 03/31/91

Title: Field Measurement of Water Temperature

complete equilibration. Depending on the type of thermometer, immerse to mark or immerse totally. Report results to the nearest 0.1°C or 1.0°C, depending on the testing specifications.

Record measurements in the field logbook or on a specially designated form surface field sheet or as specified in the work plan.

SOP APPROVAL FORM

PRC ENVIRONMENTAL MANAGEMENT, INC.

STANDARD OPERATING PROCEDURE

FIELD MEASUREMENT OF pH

SOP NO. 012

REVISION NO. 2

Approved by:

Signed Copy on File
Quality Assurance Officer

_____ Date

Date of Original Issue: 03/31/91

Title: Field Measurement of pH

1.0 BACKGROUND

Determining pH is critical for predicting and interpreting the reactions and migration of dissolved chemical constituents in ground or surface water. The pH of ground or surface water must be determined when a sample is collected in the field.

1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for measuring the pH of water samples in the field.

1.2 SCOPE

This SOP applies to the use of pH meters in the field.

1.3 DEFINITIONS

pH Electrode -- An electrode that measures the hydrogen ion potential of a solution by comparing it to a standard solution with a known hydrogen ion potential. A thin glass membrane functions as a cation exchange surface. When the electric potential of the interior of the glass membrane is compared to the electric potential of a standard solution kept isolated from the environment, a quantitative determination of the change in the internal solution's electric potential, induced by the external solution, can be made.

Nernst Potential -- Nernst Potential is observed when the glass membrane separates the external solution from the internal solution. This is expressed in the following equation:

$$E = \frac{RT}{F} \ln \left[\frac{[H^+]_{int}}{[H^+]_{ext}} \right]$$

Date of Original Issue: 03/31/91

Title: **Field Measurement of pH**

where E = Voltage

R = Gas constant

T = Absolute temperature

F = Faraday constant

$[H^+_{in}]$ = Concentration of hydrogen ion (internal)

$[H^+_{ex}]$ = Concentration of hydrogen ion (external)

Because $[H^+_{in}]$ is constant, the changes in Nernst Potential are due to the changes in the external solution.

Buffer Solution -- A buffer solution is capable of maintaining the relative concentrations of acids and bases by neutralizing, within limits, added acids or bases. It has a known pH for a specific temperature range.

1.4 REFERENCES

None.

1.5 REQUIREMENTS AND RESOURCES

The pH meters used in remedial action programs should have temperature and slope adjustments and a repeatability of ≤ 0.01 standard pH unit. Meters used for pH field measurement should be of rugged construction. A foam-lined carrying case is convenient both for transport and for use as a work table. Battery-operated meters with easily replaceable or rechargeable batteries are required. Also, a spare pH electrode should be available in the field. Both the spare and working electrodes should be immersed in a pH 4 or pH 7 buffer solution when not in use.

PRC Environmental Management, Inc.
Standard Operating Procedure

SOP No. 012

Page 3 of 78

Revision No.: 2

Revision Date: 03/24/92

Date of Original Issue: 03/31/91

Title: **Field Measurement of pH**

Date of Original Issue: 03/31/91

Title: **Field Measurement of pH**

The following are recommended for field measurement of pH:

- ✍ pH meter with repeatability of ≤ 0.01 standard pH unit
- ✍ Buffer solutions of pH 4, 7, and 10
- ✍ Combination pH electrode
- ✍ Reference electrode filling solution
- ✍ Electrode holder
- ✍ Thermometer
- ✍ Deionized water and wash bottle
- ✍ Disposable beakers

2.0 PROCEDURES

Meter calibration and field measurement procedures are outlined in the following subsections.

2.1 CALIBRATION

Commercially prepared buffer solutions should be used for calibration. Solutions traceable to the National Bureau of Standards can be purchased inexpensively from any major laboratory supply house. These solutions are certified with an accuracy of ≤ 0.01 pH unit at a specific temperature, usually 25°C. Theoretically, buffer solutions are stable indefinitely. However, they are susceptible to contamination, and old, partially full bottles should be replaced.

Because various terms are used to describe the pH meter calibration process, providing a detailed set of instructions for each type of instrument is not practical. Always refer to those instructions when using the instrument. The user must be familiar with the manufacturer's instructions for a particular instrument. The following general procedure should be used to calibrate any pH meter:

- 1) Calibrate the meter with two buffer solutions to determine if the electrodes are in working order. The slope cannot be adjusted with a one-point calibration.

Date of Original Issue: 03/31/91

Title: **Field Measurement of pH**

- 2) To calibrate the meter, use one buffer solution with a pH greater and one buffer solution with a pH less than the anticipated pH of the sample. For example, for an anticipated pH of 6, calibrate with pH 4 and pH 7 buffers; for an anticipated pH of 8, calibrate with pH 7 and pH 10 buffers.
- 3) Ensure that the buffers are at the same temperature as the sample. Pour aliquots into small containers; never put the electrode into the buffer storage bottles.
- 4) Adjust the instrument to read the pH 7 buffer accurately. Adjust the temperature compensator according to the manufacturer's instructions. Be sure to rinse the probe with deionized water after taking the calibration measurement.
- 5) Adjust the instrument to read the second buffer. Adjust the slope to obtain the correct reading. If the slope deviates greatly from its theoretical value, check for a defective electrode or contaminated buffer solution.
- 6) The meter must be calibrated before the start of work each day. Check calibration periodically and recalibrate if necessary.

2.2 FIELD MEASUREMENT

Do not filter field samples prior to analysis. To minimize the release of gas from a sample, use a submersible pump or bladder pump to obtain ground-water samples.

Procedure

The following procedure should be used for field measurement of pH:

- 1) Calibrate the instrument according to the manufacturer's instructions. Set the temperature compensation according to procedures provided in Section 2.1.
- 2) Collect sample in a pre-rinsed jar or beaker or a flow-through cell.
- 3) Measure the temperature of the sample to the nearest 1.0°C.
- 4) Set the temperature compensation to the temperature of the sample.

Date of Original Issue: 03/31/91

Title: **Field Measurement of pH**

- 5) Rinse the electrode with deionized water.
- 6) Immerse the electrode in the solution. Record the value. If the sample is being pumped through a closed container, wait for the temperature and pH to stabilize. Stop sample flow to prevent the streaming potential. Record the pH.
- 7) Record measurements in log book or forms as specified in the work plan.

3.0 POTENTIAL PROBLEMS

Temperature, atmospheric contamination, and ionic strength are factors that may affect pH measurements. Color, turbidity, and colloids will not affect pH measurements.

Temperature: The temperature compensation on a pH meter only permits adjustments of the electrode slope. It does not compensate for changes in the potential of the reference electrode, the asymmetry potential of the glass electrode, or the liquid junction potential. Nor does it compensate for changes in pH because of temperature. Table 1 demonstrates the effect of temperature on pH. The temperatures of the buffer and the unknown liquid must be recorded at the time of measurement. Ideally, their temperatures will be within 2°C of each other.

Date of Original Issue: 03/31/91

Title: **Field Measurement of pH**

TABLE 1

pH OF BUFFER SOLUTIONS AS A FUNCTION OF TEMPERATURE

<u>Temperature (°C)</u>	<u>Buffer Values</u>			
	<u>Standard</u>	<u>4.0</u>	<u>7.0</u>	<u>10.0</u>
0		4.01	7.13	10.34
5		3.99	7.10	10.26
10		4.00	7.07	10.19
15		3.99	7.05	10.12
20		4.00	7.02	10.06
25		4.00	7.00	10.00
30		4.01	6.99	9.94

Atmospheric Contamination: Atmospheric contamination can be a significant problem in ground-water sampling. Dissolved oxygen and carbon dioxide can be evolved or dissolved when the sample is exposed to air, and a considerable change in pH may result. For best results, a ground-water sample is pumped through a closed container in which pH and temperature probes are immersed. The measurements are not recorded until both temperature and pH have stabilized. The sampling pump should be stopped before recording the data because a streaming potential results with flowing sample.

Ionic Strength: Because of errors due to ionic strength, which are not worth correcting in the field, pH measurement should be accompanied by measurement of specific conductance. pH is a measure of hydrogen ion activity. Normally, the ground-water sample is assumed to be an ideal solution in which other ions do not affect hydrogen ion activity. However, if the ionic strength is too high, this assumption does not hold true. Some remedial action investigations include sampling of waste ponds or other highly contaminated water. Because buffer solutions used in the field are not made with a similar concentration of dissolved ions, pH measurement of highly contaminated water will be inaccurate. Similarly, pH measurement of a sample with very low ionic strength will be inaccurate because the resistance of the sample approaches that of the glass electrode. For best results, samples

Date of Original Issue: 03/31/91

Title: Field Measurement of pH

with very low ionic strength should be stirred for a few seconds before taking a reading. Even then, several minutes may be required for the reading to stabilize. High sodium concentration and alkalinity may also produce errors in pH measurement. For a pH greater than 9 and a sodium concentration greater than 10 moles per liter, a special electrode is needed. It can be purchased from any of the principal electrode manufacturers. Similarly, pH values less than 1 or greater than 9 will have greater uncertainty associated with them because the electrode response is non-Nernstian at these levels.

SOP APPROVAL FORM

PRC ENVIRONMENTAL MANAGEMENT, INC.

STANDARD OPERATING PROCEDURE

FIELD MEASUREMENT OF SPECIFIC CONDUCTANCE

SOP NO. 013

REVISION NO. 2

Approved by:

Signed Copy on File
Quality Assurance Officer

Date

Date of Original Issue: 03/31/91

Title: **Field Measurement of Specific Conductance**

1.0 BACKGROUND

Specific conductance is a widely used non-specific parameter for ground-water and surface water quality. It is a simple indicator of change within a system and provides useful information to laboratory personnel performing other measurements on a water sample.

1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for measuring ground- or surface water specific conductance in the field. Specific conductance should be determined when the sample is collected in the field.

1.2 SCOPE

This SOP applies to the use of specific conductance meters in the field.

1.3 DEFINITIONS

Specific Conductance -- The reciprocal of electrical resistivity. The values of electrical resistivity and specific conductance depends on the number of ions in a solution. Pure water has 100-percent resistivity and no specific conductance. As ions are added to a solution, resistivity drops and specific conductance increases.

1.4 REFERENCES

U.S. Environmental Protection Agency, November 1986. Test Methods for Evaluating Solid Waste, Volume 1C: Laboratory Manual Physical/Chemical Methods, SW-846.

Date of Original Issue: 03/31/91

Title: Field Measurement of Specific Conductance

American Society for Testing and Materials Annual Book of Standards. Standard Test Methods for Electrical Conductivity and Resistivity of Water, Method D-1125.

National Handbook of Recommended Methods for Water Data Acquisition, 1977

1.5 REQUIREMENTS AND RESOURCES

Specific conductance meters used in remedial action programs should measure temperature, should have a temperature compensator, and should read directly in $\mu\text{mhos/cm}$ corrected to 25°C. For field measurements, the more rugged probe-type unit is preferred over the pipet type. Specific conductance meters should have a foam-lined carrying case and should be battery-operated with easily rechargeable or replaceable batteries. A relative accuracy of ± 3 percent is adequate.

The following are required for field measurement of specific conductance:

- ✎ Probe-type specific conductance meter meeting the requirements given above
- ✎ Deionized water and wash bottle
- ✎ Disposable beakers
- ✎ Reagent-grade potassium chloride (KCl)
- ✎ Sampling containers
- ✎ Sampling equipment
- ✎ One-liter mixing container
- ✎ Standard 0.01M KCl Solution
- ✎ Thermometer (Calibrated per SOP 011, Field Measurement of Ground Water)

Date of Original Issue: 03/31/91

Title: **Field Measurement of Specific Conductance**

Temperature)

2.0 PROCEDURES FOR FIELD MEASUREMENT OF SPECIFIC CONDUCTANCE

Meter calibration and field measurement procedures are outlined in the following subsections.

2.1 METER CALIBRATION

Reagent-grade KCl is the universal standard for calibrating specific conductance equipment. The electrodes are calibrated by reading the specific conductance of standard KCl solutions. A concentration of 0.01 mole per liter (M). KCL should be used because its specific conductance is closest to that of most natural samples.

The measuring circuit of the specific conductance meter is calibrated either by the manufacturer or with a calibrating resistor. The manufacturer's instructions for the particular instrument should be followed for this step.

Individual manufacturers may use slightly different terminology, but the following general procedure will always apply:

- 1) Prepare a 0.01M KCl solution by dissolving 0.745 gram of pure, dry KCl in 1 liter of deionized water. The base conductivity for the prepared solution is 1408.1 μ mhos/cm at 25°C; if the deionized water has any conductance, it must be corrected to 25°C and added to the value of the solution. Alternatively, commercially prepared solutions can be used.
- 2) Measure the temperatures of the 0.01 M KCl solution and the deionized water used for the dilution. They should be at the same temperature.
- 3) Using Table 1, determine the expected specific conductance (C_3) of the 0.01M KCl

Date of Original Issue: 03/31/91

Title: Field Measurement of Specific Conductance

solution at the temperature measured.

- 4) Measure the specific conductance of the 0.01M KCl solution (C_1) and of the deionized water (C_2).

TABLE 1
RELATIONSHIP OF TEMPERATURE AND SPECIFIC CONDUCTANCE
FOR 0.01M POTASSIUM CHLORIDE

Temperature (°C)	Specific Conductance (μ mhos/cm)
15	1141.5
16	1167.5
17	1193.6
18	1219.9
19	1246.4
20	1273.0
21	1299.7
22	1326.6
23	1353.6
24	1380.8
25	1408.1
26	1436.5
27	1463.2
28	1490.9
29	1518.7
30	1546.7

Date of Original Issue: 03/31/91

Title: Field Measurement of Specific Conductance

- 5) Use the following equation to check the cell constant (K) specified by the manufacturer:

$$K = \frac{C + C_2}{10^6 \times C}$$

- 6) Large changes in the cell constant generally indicate that the electrodes are dirty. Clean and replatinize electrodes according to instructions found in the manufacturer's manual or in the American Society for Testing and Materials Method D-1125, Section 8.3
- 7) After checking the cell constant, measure the specific conductance of samples according to the procedure given in Section 2.2.

2.2 FIELD MEASUREMENT

Do not filter samples before analysis. To minimize release of gas from the sample, use a submersible pump or bladder pump to obtain ground-water samples.

The following procedure should be used for field measurement at specific conductance:

- 1) Calibrate the instrument and check the cell constant according to the manufacturer's instructions and the procedure provided in Section 2.1.
- 2) Collect sample in a pre-rinsed jar or beaker or a flow-through cell.
- 3) Measure and record the temperature of the sample in degrees Celsius.
- 4) Rinse the specific conductance meter probe with deionized water.
- 5) Immerse the specific conductance meter probe in the sample. Record the reading in $\mu\text{mhos/cm}$.

Date of Original Issue: 03/31/91

Title: Field Measurement of Specific Conductance

- 6) Record measurements in the logbook or form specified in the work plan.

3.0 POTENTIAL PROBLEMS

Principal problem areas for specific conductance measurement are the temperature effect, determination of the cell constant, and allowance for very high ionic strengths. A change in temperature of 10°C can cause a 20-percent change in the measured specific conductance. Generally, the reported data does not note whether temperature correction has been applied. Some instruments perform temperature compensation automatically, but this, too, is seldom noted in reported data. To ensure uniformity of readings, data should be corrected to 25°C.

Field personnel are frequently unaware of the cell constant used in specific conductance measurement. A significant change in the cell constant indicates that the electrodes require cleaning or replatinizing. The constant should be checked at each calibration.

Specific conductance varies directly with ion concentrations up to a specific conductance of about 5,000 μ mhos/cm (National Handbook of Recommended Methods for Water Data Acquisition, 1977). Relative measurements are useful up to about 50,000 μ mhos/cm. Samples collected at remedial action sites seldom have a specific conductance greater than 10,000 μ mhos/cm. Most readings are less than 5,000 μ mhos/cm.

APPENDIX B
FIELD SCREENING METHOD PROCEDURES

Quick Test[®] for Volatile Organic Halides

Including: Trichloroethylene (TCE), Perchloroethylene (PCE), Trihalomethanes (THMs), and Carbon Tetrachloride (CCl₄)

Abstract: Halogenated volatile organic compounds such as trichloroethylene (TCE), perchloroethylene (PCE), trihalomethanes (THMs), carbon tetrachloride (CCl₄) and others can be found as pollutants in a variety of environmental samples. Since these compounds present serious health risks, the Environmental Protection Agency (EPA) has mandated the clean-up of waters containing such compounds. Currently, laboratory methods exist for the detection and quantitation of these compounds, but on-site field methods have been desired. Envirol, Inc. has developed a quick, reliable and sensitive analytical field test procedure for the analysis of these compounds in water. This procedure is called the Quick Test[®] Volatile Organic Halides Water Test.

The Quick Test Volatile Organic Halides Water Test Kit for on-site and laboratory analysis is designed to give the user quick, reliable screening results for environmental decision making. The Quick Test Volatile Organic Halides Water Test Kit can be used for site characterization and mapping, ground water monitoring, selecting samples for laboratory analysis, and monitoring remediation processes.

The Quick Test Volatile Organic Halides Water Test system is based on a photochemical reaction that produces coloration proportional to the concentration of the contaminate in water. A water sample is taken and mixed with a solvent to extract the analyte from the sample. Teflon[®] Tape is used in the extraction process to separate the extraction solvent from the water sample and minimize analyte volatilization. The Teflon Tape is removed and the extraction solvent containing the analyte is forced from the Teflon Tape and mixed with a reagent. The reagent-analyte complex is then exposed to ultra-violet (UV) light.

An instrument (Envirometer[™]) is used to expose the sample to UV light and measure the absorbance produced by the reagent-analyte complex. The absorbance is compared to an internal standard curve that is stored electronically within the instrument. The concentration of the analyte in water is then displayed in $\mu\text{g/l}$ or parts per billion (ppb). The user should note that if multiple organic halides are present in the water sample the result will be a total of all organic halides. Optimal agreement with standard methods is obtained by establishing a correlation between the Quick Test Volatile Organic Halides test and standard methods.

Standard solutions and calibration checks are provided with each Quick Test Volatile Organic Halides Water Test Kit to ensure that quality control standards are met. The standard curve for the instrument should be set at the beginning of each testing period. The Quick Test Volatile Organic Halides Water Test Kit standard curve can be set and checked with one of four standard compounds: perchloroethylene (PCE), trichloroethylene (TCE), trihalomethanes (THMs), and carbon tetrachloride (CCl₄).

Quick Test[®] Demonstration

Step 1: Extraction

- A. Fill the Extraction Container (1) with the Water Sample to the blue mark on the neck of the Extraction Container (1).
- B. Pour all of the clear solution from the Extraction Solvent Vial (2) into the Extraction Container (1). Leave the red crystals in the Extraction Solvent Vial (2).
- C. Shake for 3 minutes.

Step 2: Extraction Solvent Transfer

- A. Remove the cap of the Extraction Solvent Vial (2). Remove the plunger from the barrel of the Extraction Solvent Transfer Syringe (3).
- B. Remove the Teflon[®] Tape, using the plastic fork device, from the Extraction Container (1) and place it in the Extraction Solvent Transfer Syringe (3).
- C. Place the tip of the Extraction Solvent Transfer Syringe (3) in the Extraction Solvent Vial (2). Replace the plunger in the barrel of the Extraction Solvent Transfer Syringe (3). Force the plunger of the Extraction Solvent Transfer Syringe (3) to the blue line on the barrel of the Extraction Solvent Transfer Syringe (3). This will allow for adequate removal of the extraction solvent from the Teflon Tape.
- D. Invert the Extraction Solvent Vial (2) three or four times. Allow separation of the two layers.

Step 3: Drying

- A. Remove the cap from the Drying Vial (4). Place a new disposable tip on the pipette. Adjust the pipette volume to 0.6 ml (600 μ l). Use the pipette to transfer all of the clear top solution (which contains the TCE and/or PCE) from the Extraction Solvent Vial (2) to the Drying Vial (4).

Note: Be careful to remove only the clear top solution from the Extraction Solvent Vial (2). Removal of the red colored layer can negatively effect the result of the test.

Step 4: Liquid/Liquid Transfer

- A. Place a new disposable tip on the pipette. Adjust the pipette volume to 0.6 ml (600 μ l). Using the pipette, transfer all of the solution from the Drying Vial (4) to the Liquid/Liquid Transfer Vial (5).
- B. Cap the Liquid/Liquid Transfer Vial (5). Shake vigorously for approximately 1 minute.
- C. Allow the contents to separate into two layers.
- D. Place a new disposable tip on the pipette. Adjust the pipette volume to 0.6 ml (600 μ l). Using the pipette, transfer all of the upper layer from the Liquid/Liquid Transfer Vial (5), into the Drying Vial (4) and cap for discard.
- E. Place a new disposable tip on the pipette. Adjust the pipette volume to 0.6 ml (600 μ l). Transfer 0.6 ml (600 μ l) of the remaining layer from the Liquid/Liquid Transfer Vial (5) to the Reaction Vial (6). Do this by placing the pipette tip on the bottom of the Liquid/Liquid Transfer Vial (5) and then drawing up the solution.

Note: Be careful to remove only the upper layer from the Liquid/Liquid Transfer Vial (5). When approaching the meniscus between the two layers, the user may pipette up some of the bottom layer into the pipette tip. Separation of the two solvents will be visible in the pipette tip. Carefully force the bottom layer back into the Liquid/Liquid Transfer Vial (5). This technique may be used to ensure that all of the top layer is removed from the Liquid/Liquid transfer Vial (5).

If the user removes too much of the lower layer, or leaves too much of the upper layer in the Liquid/Liquid Transfer Vial (5), the final concentration reading may be effected and result in a low or diluted reading.

Step 5: Reaction/Reading Concentration

- A. Cap the Reaction Vial (6).
- B. Invert the Reaction Vial (6) three or four times.
- C. Place the Reaction Vial (6) in the Envirometer™.
- D. After exposure is complete, read the sample concentration from the Envirometer display.
- E. If "OL" (over limit) appears on the Envirometer display, the sample concentration is greater than 200 ppb.
- F. After exposure is complete and the user has recorded the displayed concentration, remove the Reaction Vial (5) from the Envirometer.

Quick Test For Volatile Organic Halides in Water

Including: Trichloroethylene (TCE), Perchloroethylene (PCE), Trihalomethanes (THMs), and Carbon Tetrachloride (CCl₄)

Quick Test for Volatile Organic Halides Water Test Method Performance:

Performance Parameters:

Dynamic Range 5-2,000 ppb
 Number of False Positives¹ 0
 Number of False Negatives¹ 0

Method Detection Limit (MDL) :

Trichloroethylene (TCE) 4 ppb
 Perchloroethylene (PCE) 4 ppb
 Carbon Tetrachloride (CCl₄) 3 ppb
 Chloroform (CHCl₃) 5 ppb

Method Quantitation Limit (MQL):

Trichloroethylene (TCE) 9 ppb
 Perchloroethylene (PCE) 8 ppb
 Carbon Tetrachloride (CCl₄) 7 ppb
 Chloroform (CHCl₃) 10 ppb

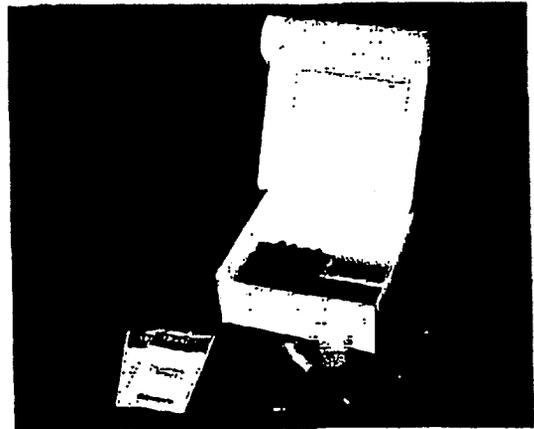
Other Volatile Organic Halides:	Relative Sensitivity Compared to:			
	TCE	PCE	CCl ₄	CHCl ₃
Trichloroethylene (TCE)	100%	122%	88%	122%
Perchloroethylene (PCE)	82%	100%	72%	100%
Carbon Tetrachloride (CCl ₄)	114%	139%	100%	139%
Chloroform (CHCl ₃)	82%	100%	72%	100%
1,1-Dichloroethene	69%	84%	61%	84%
Vinyl Chloride	0.8%	1.0%	0.7%	1.0%
trans-1,2-Dichloroethene	61%	74%	54%	74%
cis-1,2-Dichloroethene	43%	52%	38%	52%
Dichloromethane	20%	24%	18%	24%
1,1,1-Trichloroethane	112%	137%	98%	137%
1,1,2-Trichloroethane	80%	98%	70%	98%
1,2-Dichloroethane	15%	18%	13%	18%
Bromoform	77%	94%	68%	94%
Bromodichloromethane	75%	91%	65%	91%
Chlorodibromomethane	71%	87%	63%	87%

¹ False positive and false negative study conducted on TCE only.

Interferences¹

	Concentration Required for a Detectable Interference (ppm)
Benzene	>2,000
Methanol	>2,000
Toluene	>2,000
Oxalic Acid	>2,000
Glyoxylic Acid	>2,000
Sodium Trichloroacetate	>2,000
Sodium Dichloroacetate	>2,000
2,2,2-trichloroethanol	>200
Vinyl Chloride	>200
Pentachlorophenol	>20

¹ Initial Trichloroethylene concentration was 20 ppb.



Complete Volatile Organic Halides in Water Test Kit

Kia O. Wyatt
Account Manager



STRATEGIC DIAGNOSTICS INC.
 111 Pencader Drive
 Newark, DE 19702
 (800) 544-8881 vm140
 (302) 458-6789
 FAX: (302) 458-6782
 email: kwyatt@sdix.com
 www.sdix.com

To place an order or have technical questions answered, please call 1-800-748-3548

• Trousse d'analyse fer ferreux

Méthode réactif fer 1, 10 Phéanthroline

• Eisen, 2wertig Test Kit

1,10 Phenanthrolin-Eisenreagenz Methode

• Kit de análisis para hierro ferroso

Método reactivo de fenatrolina de hierro 1,10

0.0 – 10.0 mg/L

• Mod. IR-18C

• # 26672-00

Ferrous

- To ensure accurate results, read carefully before proceeding.
- Pour obtenir des résultats exacts, lire attentivement le mode d'emploi avant d'utiliser la trousse.
- Um genaue Ergebnisse zu gewährleisten, lesen Sie das Folgende bitte aufmerksam durch, bevor Sie fortfahren.
- Para obtener resultados precisos, lea detenidamente las instrucciones antes de proceder al análisis.

Introduction

The 1,10 phenanthroline indicator in the Ferrous Iron Reagent reacts with ferrous iron in the sample to form an orange color in proportion to the ferrous iron concentration. Ferric iron does not react. The ferric iron (Fe^{3+}) concentration can be determined by subtracting the ferrous iron concentration from the results of a total iron test.

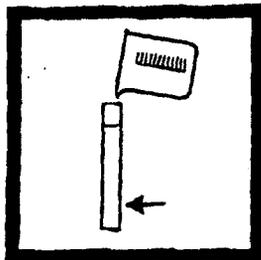
Measuring Hints and General Test Information

- Wash all labware between tests. Contamination may alter test results. Clean with a non-abrasive detergent or a solvent such as isopropyl alcohol. Use a soft cloth for wiping or drying. Do not use paper towels or tissue on plastic tubes as this may scratch them. Rinse with clean water (preferably deionized water).
- Rinse all viewing tubes thoroughly with the sample water before testing.
- Use clippers to open plastic powder pillows.
- For critical testing, reagent accuracy should be checked with each new lot of reagents. Prepare a ferrous iron stock solution (100 mg/L Fe) by dissolving 0.702 grams of ferrous ammonium sulfate, hexahydrate, in one liter deionized water. Dilute 5.00 mL of this solution to 100 mL with deionized water to make a 5.0 mg/L standard solution. Prepare this immediately before use. Follow the ferrous iron test instructions using this solution instead of a water sample.

Conseils pour les mesures et informations générales sur l'analyse

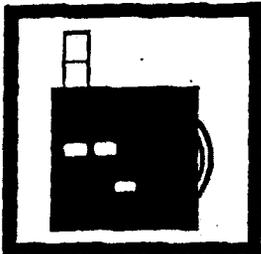
- Laver toute la verrerie entre les analyses. La contamination peut fausser les résultats d'analyses. Laver avec un détergent non abrasif ou un solvant tel que l'isopropanol. Utiliser un tissu doux pour essuyer ou sécher. Ne pas utiliser de tissu ou papier d'essuyage sur les tubes en plastique pour ne pas les rayer. Rincer à l'eau propre (de préférence de l'eau désionisée).
- Rincer soigneusement tous les tubes colorimétriques avec l'échantillon d'eau avant l'analyse.
- Utiliser la pince coupante pour ouvrir les gélules en plastique.
- Pour des analyses critiques, l'exactitude du réactif doit être vérifiée pour chaque nouveau lot de réactifs. Préparer une solution-mère de fer ferreux (100 mg/L Fe) en dissolvant 0,702 grammes d'ammonium-fer (II) sulfate, hexahydrate, dans un litre d'eau désionisée. Diluer 3,00 mL de cette solution à 100 mL avec de l'eau désionisée pour obtenir une solution étalon à 3,0 mg/L. Préparer cette solution immédiatement avant emploi. Suivre les instructions d'analyse du fer ferreux en remplaçant l'échantillon par cette solution étalon.

• procedure • technique • Verfahren • Procedimiento



1. Fill a viewing tube to the first (5-mL) line with sample water. This is the blank.

- ◆ Remplir un tube colorimétrique jusqu'au premier trait (5 mL) avec l'échantillon d'eau. Ceci est le blanc.
- ◆ Füllen Sie ein Prüfröhrchen bis zur ersten (5 mL) Linie mit Probenwasser. Dieses ist die Blindprobe.
- ◆ Llène un tubo para colorimetría hasta la primera marca (5 mL) con la muestra de agua. Esto constituye el blanco.



2. Place this tube in the top left opening of the color comparator.

- ◆ Placer ce tube dans l'ouverture supérieure gauche du comparateur.
- ◆ Stellen Sie dieses Röhrchen in die obere linke Öffnung des Farbkomparators.
- ◆ Coloque este tubo en la abertura superior izquierda del comparador.



3. Fill the measuring vial to the 25-mL mark with sample water.

- ◆ Remplir le tube de mesure jusqu'au trait 25 mL avec l'échantillon d'eau.
- ◆ Füllen Sie das Messröhrchen bis zur 25 mL Markierung mit dem Probenwasser.
- ◆ Llène el frasco medidor hasta la marca de 25 mL con el agua de la muestra.



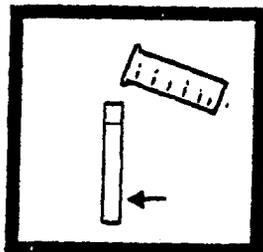
4. Add the contents of one Ferrous Iron Reagent Powder Pillow to the measuring vial.

- ◆ Ajouter le contenu d'une gélule de réactif du fer ferreux au tube de mesure.
- ◆ Geben Sie den Inhalt eines Eisen(II)-Reagenz-Pulverkissens in das Messröhrchen.
- ◆ Agregue el contenido de una cápsula del Reactivo para Hierro Ferroso al frasco medidor.



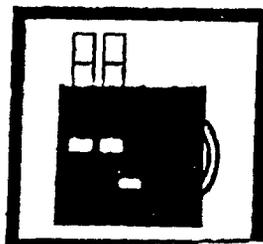
5. Swirl to mix. An orange color will develop if ferrous iron is present. Allow three minutes for full color development.

- ◆ Agiter pour mélanger. En présence de fer ferreux, une coloration orange se développe. Attendre le développement complet de la coloration.
- ◆ Schwenken Sie zum Vermischen. Ist Eisen(II) vorhanden, entwickelt sich eine orange Färbung. Warten Sie drei Minuten, bis sich die Farbe vollständig ausgebildet hat.
- ◆ Agite para mezclar. Se formará un color anaranjado en presencia de hierro ferroso. Deje pasar tres minutos para que el color se desarrolle completamente.



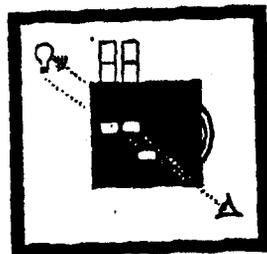
6. Fill another viewing tube to the first (5-mL) mark with the prepared sample.

- ◆ Remplir un autre tube jusqu'au premier trait (5 mL) avec l'échantillon préparé.
- ◆ Füllen Sie ein weiteres Prüfröhrchen bis zur ersten (5 mL-) Linie mit der vorbereiteten Probe.
- ◆ Llene otro tubo para colorimetría hasta la marca de 5mL con la muestra preparada en los puntos 4 y 5.



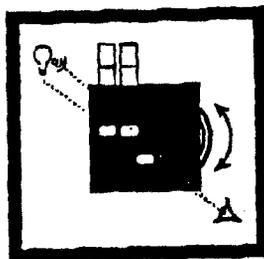
7. Place the second tube in the top right opening of the color comparator.

- ◆ Placer le second tube dans l'ouverture supérieure droite du comparateur.
- ◆ Setzen Sie das zweite Röhrchen in die obere rechte Öffnung des Farbkomparators.
- ◆ Coloque el segundo tubo en la abertura superior derecha del comparador.



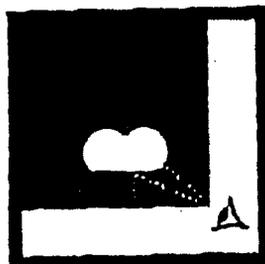
8. Hold comparator up to a light source such as the sky, a window or a lamp. Look through the openings in front.

- ◆ Tenir le comparateur face à une surface uniformément éclairée (ciel, lampe, fenêtre) et regarder par les ouvertures de la face antérieure du comparateur.
- ◆ Halten Sie den Komparator gegen eine Lichtquelle wie zum Beispiel den Himmel, ein Fenster oder eine Lampe. Sehen Sie durch die Öffnungen vorn.
- ◆ Lleve el comparador hasta una fuente de luz, tal como el cielo, una ventana o una lámpara. Mire a través de las aberturas frontales del comparador.



9. Rotate the color disc until the color matches in the two openings.

- ◆ Tourner le disque jusqu'à égalité des teintes dans les deux ouvertures.
- ◆ Drehen Sie die Farbscheibe, bis die Farbe in den beiden Öffnungen übereinstimmt.
- ◆ Haga girar el disco de color hasta que el color coincida en ambas aberturas.



10. Read the mg/L ferrous iron in the scale window.

- ◆ Lire la concentration du fer ferreux en mg/L dans la fenêtre de l'échelle.
- ◆ Lesen Sie die mg/L Eisen(II) im Skalenfenster ab.
- ◆ Lea la concentración de hierro ferroso en mg/L en la ventanilla graduada.

Description	Unit	Cat. No.
Clippers	each	968-00
Color Comparator	each	1732-00
Color Disc, Iron Phenanthroline	each	1874-00
Ferrous Iron Reagent Powder Pillows, 25 mL	100/pkg	1037-69
Instruction Card, IR-18C Test Kit	each	26672-88
Vial, measuring, with 2, 5, 10, 15, 20 and 25-mL marks	each	2193-00
Viewing Tube, plastic	4/pkg	46600-04
	4 L	272-56

OPTIONAL REAGENTS AND EQUIPMENT

Description	Unit	Cat. No.
Caps, for plastic Color Viewing Tubes 46600-04	4/pkg	46600-14
Ferrous Ammonium Sulfate, Hexahydrate	113 g	11256-14
Flask, volumetric, Class A, 100-mL	each	26366-42
Flask, volumetric, Class A, 1000-mL	each	26366-53
Pipet, volumetric, Class A, 5-mL	each	14515-37
Pipet Filler, safety bulb	each	14651-00

REACTIFS ET EQUIPEMENTS OPTIONNELS

Désignation	Unité	Ref. N°
Bouchons pour tubes en plastique 46600-04	4/paq	46600-14
Ammonium, fer (II) sulfate, 6 H ₂ O ACS	113 g	11256-14
Fiole jaugée, classe A, 100ml	1	26366-42
Fiole jaugée, classe A, 1000 ml	1	26366-53
Pipette jaugée, classe A, 5,00ml	1	14515-37
Poire à pipetter	1	14651-00

ZUSÄTZLICHE REAGENZIEN UND ZUBEHÖR

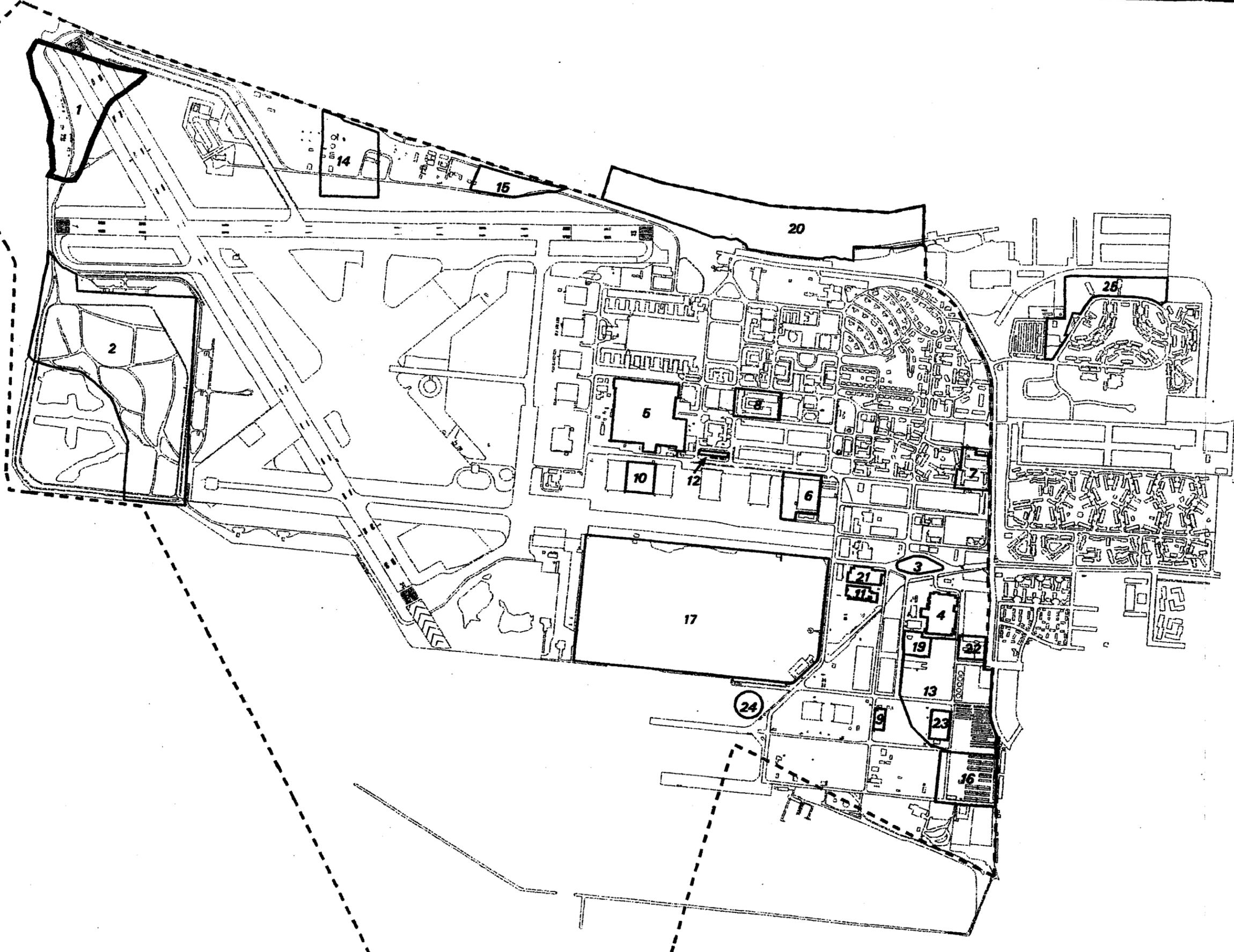
Beschreibung	Einheit	Kat. Nr.
Kappen, für Plastik-Farbprüfröhrchen 46600-04	4/Stück	46600-14
Eisen(II)-Ammoniumsulfat, hexahydrat	113 g	11256-14
Messkolben, Klasse A, 100 mL	1	26366-42
Messkolben, Klasse A, 1000 mL	1	26366-53
Messpipette, Klasse A, 5mL	1	14515-37
Pipettenfüller, Sicherheitsball	1	14651-00

REACTIVOS Y EQUIPAMIENTO OPCIONALES

Descripción	Unidad	N° Ref.
Tapas protectoras para tubos de plástico 46600-04	4/lote	46600-14
Sulfato de Amonio Ferroso, Hexahidratado	113 g	11256-14
Frasco volumétrico, clase A, 100-mL	1	26366-42
Frasco volumétrico, clase A, 1000-mL	1	26366-53
Pipeta volumétrica, clase A, 5-0 mL	1	14515-37
Bulbo de seguridad para llenador de pipeta	1	14651-00

FIGURES

1 through 6



- LEGEND**
- INSTALLATION RESTORATION SITE BOUNDARY
 - - - ALAMEDA POINT BOUNDARY
 - ▬ OPERABLE UNIT 3 BOUNDARY

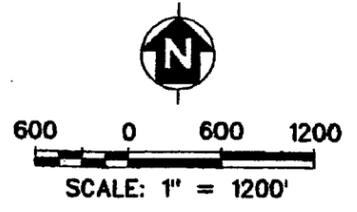
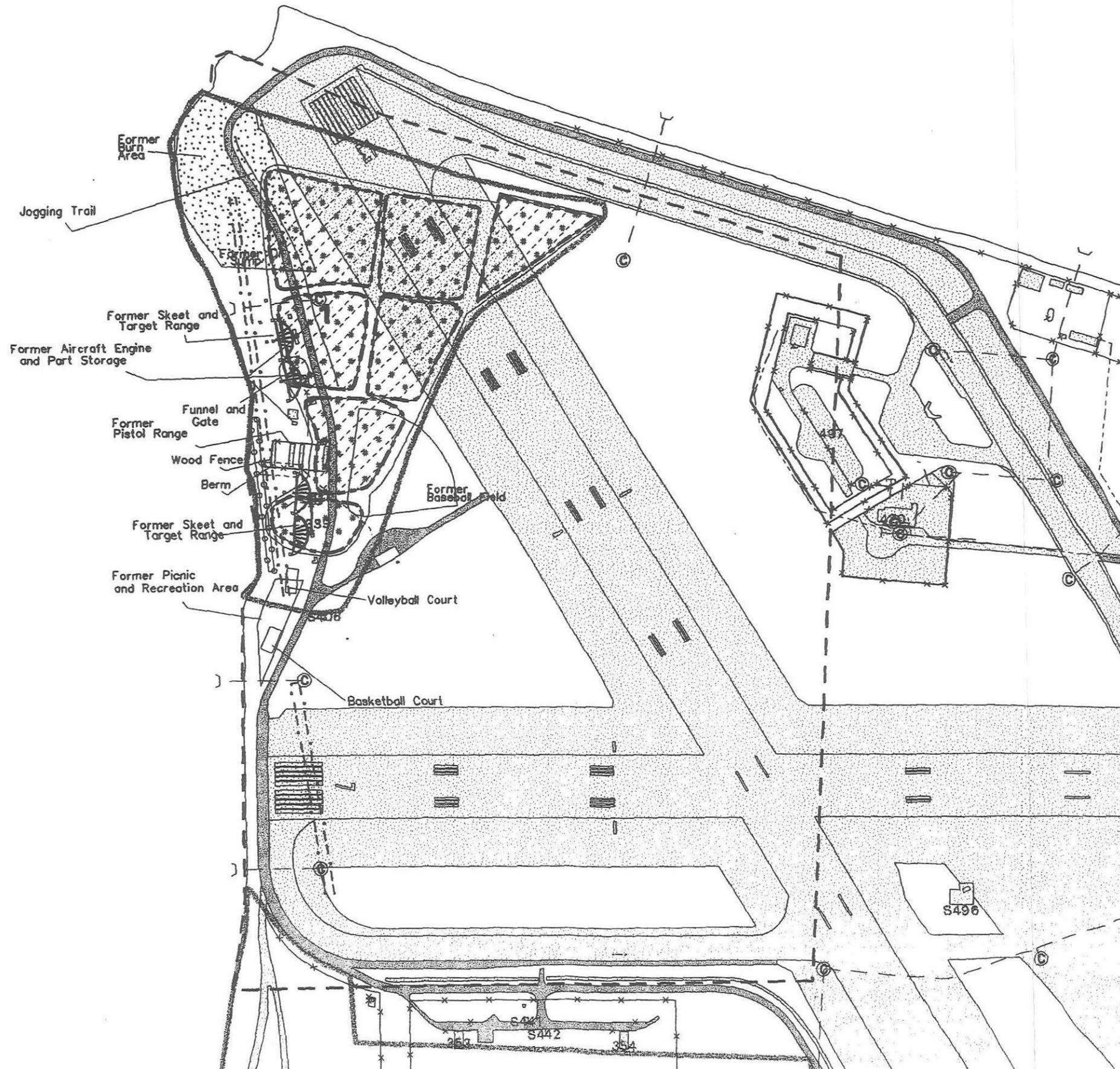


FIGURE 1
INSTALLATION RESTORATION
SITE LOCATION MAP
ALAMEDA POINT
ALAMEDA, CALIFORNIA



LEGEND

- STORM DRAIN CATCH BASIN
- ORIGINAL IR SITE (OUTSIDE BOUNDARY)
- - - FENCE
- ▨ PAVED ROAD OR PARKING LOT
- ▩ BUILDING, CONCRETE, PAVED, OR COVERED AREA
- 1 INSTALLATION RESTORATION SITE (INSIDE BOUNDARY)
- 517 BUILDING AND BUILDING NUMBER
- ▨ 1947 DISPOSAL ACTIVITIES
- ▩ 1949 DISPOSAL ACTIVITIES
- ▩ 1957 DISPOSAL ACTIVITIES
- ▭ WASTE DISPOSAL CELL BOUNDARY
- - - BARGE LINES (1949 AERIAL SURVEY)
- - - BARGE LINES (1957 AERIAL SURVEY)

NOTE: BARGE LINES ARE INFERRED

SAN FRANCISCO BAY

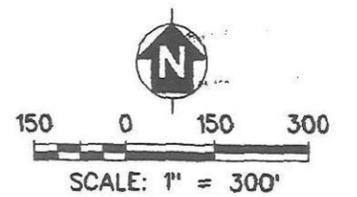


FIGURE 2
IR SITE 1 PHYSICAL FEATURES
ALAMEDA POINT
ALAMEDA, CALIFORNIA

02/09/00 /data3/okameda/ou2r1/site1.am /data3/okameda/ou2r1/r1gw32.map cornek

- LEGEND**
- MONITORING WELL LOCATION
 - △ PROPOSED GROUNDWATER STEP OUT
 - ▲ PROPOSED GROUNDWATER SAMPLE LOCATION
 - ⊙ WATERLOO GROUNDWATER SAMPLE LOCATION
 - ⊙ WATERLOO MONITORING WELL
 - 512 BUILDING AND BUILDING NUMBER
 - ▭ PAVED ROAD OR PARKING LOT
 - ▨ BUILDING, CONCRETE, PAVED, OR COVERED AREA
 - IR SITE BOUNDARY
 - GROUNDWATER FLOW DIRECTION
 - ▭ GROUNDWATER HOT SPOT LOCATION

NOTES:

CONCENTRATIONS SHOW TOTAL CHLORINATED HYDROCARBONS - PEAK CONCENTRATION (MICROGRAMS PER LITER) FROM MULTI-LEVEL SAMPLING POINTS, PROJECTED TO GROUND SURFACE.

IF GROUNDWATER SAMPLES AT HP-S01-B10 HAVE FIELD SCREENING CONCENTRATIONS ABOVE THE ACTION LEVEL, THEN LOCATIONS HPS01-B15 AND HP-S01-B16 WILL BE SAMPLED.

IF GROUNDWATER SAMPLES AT HP-S01-B11 HAVE FIELD SCREENING CONCENTRATIONS ABOVE THE ACTION LEVEL, THEN LOCATION HP-S01-B14 WILL BE SAMPLED.

IF GROUNDWATER SAMPLES AT HP-S01-B12 HAVE FIELD SCREENING CONCENTRATIONS ABOVE THE ACTION LEVEL, THEN LOCATIONS HP-S01-B17 AND HP-S01-B13 WILL BE SAMPLED.

M029-E
M029-A

LANDFILL

HP-S01-B6

M033-A

B-12
60.4

HP-S01-B16

B-10
0.0

HP-S01-B10

HP-S01-B15

M028-E-OLD

B-10
11.5

M028-E

M034-A

B-3
235264.4

HP-S01-B11

HP-S01-B14

M028-C

M028-A

B-2
80081.3

MV-3

002.3

B-6
520.5

VW-2

B-11
2053.9

HP-S01-B12

HP-S01-B13

HP-S01-B7

B-9
209.9

B-7
2533.2

HP-S01-B17

LANDFILL

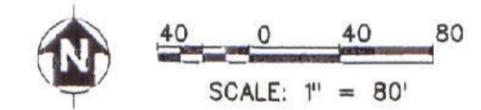
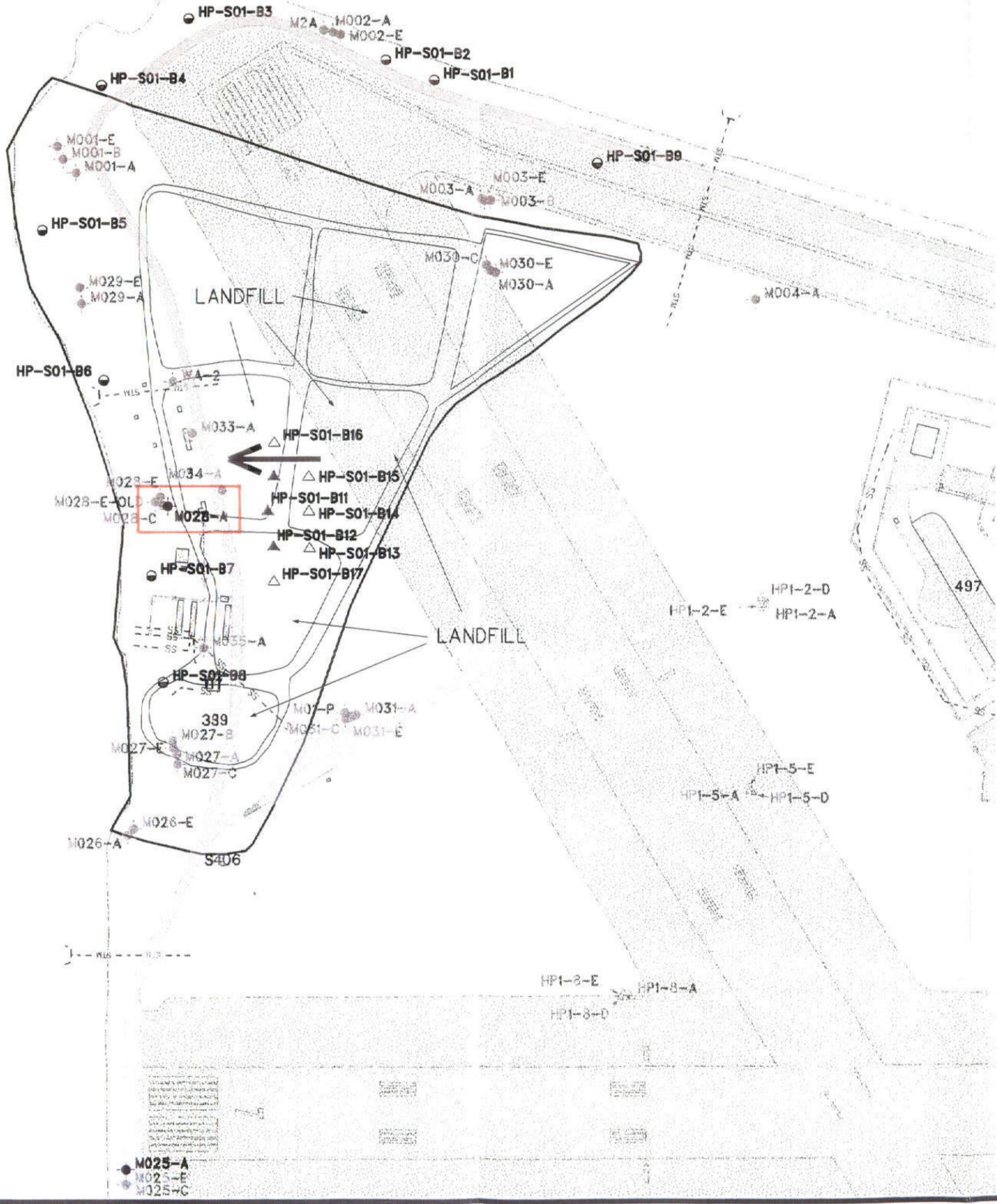


FIGURE 3
IR SITE 1
GROUNDWATER PROPOSED DATA GAP
HOT SPOT
SAMPLING LOCATIONS
ALAMEDA POINT
ALAMEDA, CALIFORNIA

02/09/00 . . . /data3/alameda/ou2r1/site1.aml /data3/alameda/ou2r1/irgw42.mqp cornak



- LEGEND**
- MONITORING WELL LOCATION
 - △ PROPOSED GROUNDWATER STEP OUT
 - ▲ PROPOSED GROUNDWATER SAMPLE LOCATION
 - WATERLOO GROUNDWATER SAMPLE LOCATION
 - ⊗ WATERLOO MONITORING WELL
 - 517 BUILDING AND BUILDING NUMBER
 - ▭ PAVED ROAD OR PARKING LOT
 - ▨ BUILDING, CONCRETE, PAVED, OR COVERED AREA
 - IR SITE BOUNDARY
 - GROUNDWATER FLOW DIRECTION
 - ▭ GROUNDWATER HOT SPOT LOCATION

NOTES:

CONCENTRATIONS SHOW TOTAL CHLORINATED HYDROCARBONS - PEAK CONCENTRATION (MICROGRAMS PER LITER) FROM MULTI-LEVEL SAMPLING POINTS, PROJECTED TO GROUND SURFACE.

IF GROUNDWATER SAMPLES AT HP-S01-B10 HAVE FIELD SCREENING CONCENTRATIONS ABOVE THE ACTION LEVEL, THEN LOCATIONS HPS01-B15 AND HP-S01-B16 WILL BE SAMPLED.

IF GROUNDWATER SAMPLES AT HP-S01-B11 HAVE FIELD SCREENING CONCENTRATIONS ABOVE THE ACTION LEVEL, THEN LOCATION HP-S01-B14 WILL BE SAMPLED.

IF GROUNDWATER SAMPLES AT HP-S01-B12 HAVE FIELD SCREENING CONCENTRATIONS ABOVE THE ACTION LEVEL, THEN LOCATIONS HP-S01-B17 AND HP-S01-B13 WILL BE SAMPLED.

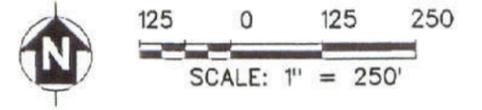


FIGURE 4
IR SITE 1
PROPOSED DATA GAP
GROUNDWATER SAMPLING
LOCATIONS
ALAMEDA POINT
ALAMEDA, CALIFORNIA

02/08/00 /data3/alameda/ou2r1/r/bv52.mop cornekk



LEGEND

- ☒ PROPOSED SOIL VAPOR SAMPLING LOCATIONS
- ▨ PAVED ROAD OR PARKING LOT
- ▩ BUILDING, CONCRETE, PAVED, OR COVERED AREA
- 517 BUILDING AND BUILDING NUMBER
- ▭ IR SITE BOUNDARY
- GROUNDWATER FLOW DIRECTION

NOTE:

SAMPLE LOCATIONS SG-S01-B10
 SG-S01-B11
 SG-S01-B12
 SG-S01-B14
 SG-S01-B15
 ARE IDENTICAL TO HP-S01-B10
 HP-S01-B11
 HP-S01-B12
 HP-S01-B14
 HP-S01-B15

ON FIGURE 3

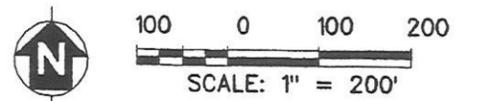


FIGURE 5
 IR SITE 1
 PROPOSED LANDFILL GAS
 DATAGAP SAMPLING LOCATIONS
 ALAMEDA POINT
 ALAMEDA, CALIFORNIA

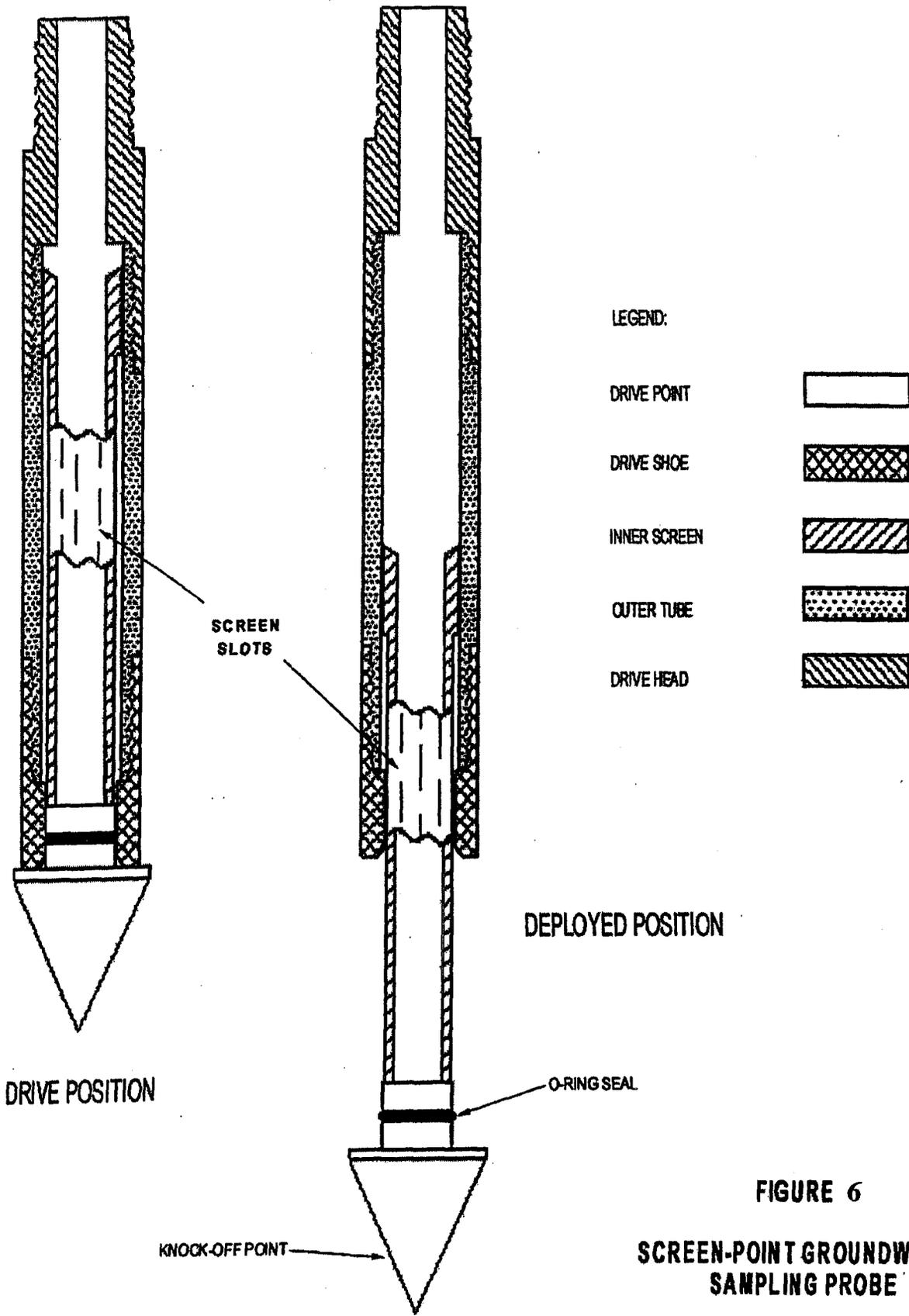


FIGURE 6
SCREEN-POINT GROUNDWATER
SAMPLING PROBE
ALAMEDA POINT
ALAMEDA, CALIFORNIA

TABLES

TABLE 4-1a

**FIELD AND LABORATORY IDENTIFICATION NUMBERS
FOR GROUNDWATER, LANDFILL GAS, AND QUALITY CONTROL SAMPLES
IR SITE 1 DATA GAP SAMPLING
ALAMEDA POINT, ALAMEDA, CALIFORNIA
(page 1 of 7)**

Laboratory Identification	Field Identification	Matrix	Field Interphase probe	Field Screening Organohalides	VOC Fixed-Lab Analysis	SVOC Fixed-Lab Analysis	VOC/Methane		
							Landfill Gas Confirmatory Analysis	Landfill Gas	Flux Chamber Gas
SHORELINE SAMPLES									
122-S01-001	HP-S01-B1-5	Water	--	--	X	--	--	--	--
122-S01-002	HP-S01-B1-15	Water	--	--	X	--	--	--	--
122-S01-003	HP-S01-B2-5	Water	--	--	X	X	--	--	--
122-S01-004	HP-S01-B2-15	Water	--	--	X	X	--	--	--
122-S01-005	HP-S01-B3-5	Water	--	--	X	X	--	--	--
122-S01-006	HP-S01-B3-15	Water	--	--	X	X	--	--	--
122-S01-007	HP-S01-B4-5	Water	--	--	X	X	--	--	--
122-S01-008	HP-S01-B4-15	Water	--	--	X	X	--	--	--
122-S01-009	HP-S01-B5-5	Water	--	--	X	X	--	--	--
122-S01-010	HP-S01-B5-15	Water	--	--	X	X	--	--	--
122-S01-011	HP-S01-B6-5	Water	--	--	X	X	--	--	--
122-S01-012	HP-S01-B6-15	Water	--	--	X	X	--	--	--
122-S01-013	HP-S01-B7-5	Water	--	--	X	X	--	--	--
122-S01-014	HP-S01-B7-15	Water	--	--	X	X	--	--	--
122-S01-015	HP-S01-B8-5	Water	--	--	X	X	--	--	--
122-S01-016	HP-S01-B8-15	Water	--	--	X	X	--	--	--
122-S01-017	HP-S01-B9-5	Water	--	--	X	X	--	--	--
122-S01-018	HP-S01-B9-15	Water	--	--	X	X	--	--	--
122-S01-019	<i>Duplicate</i>	Water	--	--	X	X	--	--	--

TABLE 4-1a

**FIELD AND LABORATORY IDENTIFICATION NUMBERS
FOR GROUNDWATER, LANDFILL GAS, AND QUALITY CONTROL SAMPLES
IR SITE 1 DATA GAP SAMPLING
ALAMEDA POINT, ALAMEDA, CALIFORNIA**

(page 2 of 7)

Laboratory Identification	Field Identification	Matrix	Field Interphase probe	Field Screening Organohalides	VOC Fixed-Lab Analysis	SVOC Fixed-Lab Analysis	VOC/Methane		
							Landfill Gas Confirmatory Analysis	Landfill Gas	Flux Chamber Gas ^a
122-S01-020	<i>Duplicate</i>	Water	--	--	X	X	--	--	--
122-S01-147	HP-S01-B1-5A	Water	--	--	X	X	--	--	--
122-S01-148	HP-S01-B1-15A	Water	--	--	X	X	--	--	--
SAMPLES EAST OF MONITORING WELL MO34A (HOT SPOT)									
122-S01-021	HP-S01-10-5	Water	X	X	X	X	--	--	--
122-S01-022	HP-S01-10-15	Water	--	X	X	X	--	--	--
122-S01-023	HP-S01-B11-5	Water	X	X	X	X	--	--	--
122-S01-024	HP-S01-B11-15	Water	--	X	X	X	--	--	--
122-S01-025	HP-S01-B12-5	Water	X	X	X	X	--	--	--
122-S01-026	HP-S01-B12-15	Water	--	X	X	X	--	--	--
122-S01-027	<i>Duplicate</i>	Water	X	X	X	X	--	--	--
STEP-OUT SAMPLES^b									
122-S01-028	HP-S01-B13-5	Water	X	--	X	X	--	--	--
122-S01-029	HP-S01-B13-15	Water	X	--	X	X	--	--	--
122-S01-030	HP-S01-B14-5	Water	X	--	X	X	--	--	--
122-S01-031	HP-S01-B14-15	Water	X	--	X	X	--	--	--
122-S01-032	HP-S01-B15-5	Water	X	--	X	X	--	--	--
122-S01-033	HP-S01-B15-15	Water	X	--	X	X	--	--	--
122-S01-034	HP-S01-B16-5	Water	X	--	X	X	--	--	--
122-S01-035	HP-S01-B16-15	Water	X	--	X	X	--	--	--

TABLE 4-1a

**FIELD AND LABORATORY IDENTIFICATION NUMBERS
FOR GROUNDWATER, LANDFILL GAS, AND QUALITY CONTROL SAMPLES
IR SITE 1 DATA GAP SAMPLING
ALAMEDA POINT, ALAMEDA, CALIFORNIA
(page 3 of 7)**

Laboratory Identification	Field Identification	Matrix	Field Interphase probe	Field Screening Organohalides	VOC Fixed-Lab Analysis	SVOC Fixed-Lab Analysis	VOC/Methane		
							Landfill Gas Confirmatory Analysis	Landfill Gas	Flux Chamber Gas ^a
122-S01-036	HP-S01-B17-5	Water	X	--	X	X	--	--	--
122-S01-037	HP-S01-B17-15	Water	X	--	X	X	--	--	--
122-S01-038	<i>Duplicate^e</i>	Water	X	--	X	X	--	--	--
LANDFILL GAS SAMPLES									
122-S01-039	SG-S01-B1-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-040	SG-S01-B1-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-041	SG-S01-B2-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-042	SG-S01-B2-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-043	SG-S01-B3-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-044	SG-S01-B3-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-045	SG-S01-B4-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-046	SG-S01-B4-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-047	SG-S01-B5-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-048	SG-S01-B5-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-049	SG-S01-B6-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-050	SG-S01-B6-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-051	SG-S01-B7-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-052	SG-S01-B7-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-053	SG-S01-B8-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-054	SG-S01-B8-3	Landfill Gas	--	--	--	--	--	X	--

TABLE 4-1a

**FIELD AND LABORATORY IDENTIFICATION NUMBERS
FOR GROUNDWATER, LANDFILL GAS, AND QUALITY CONTROL SAMPLES
IR SITE 1 DATA GAP SAMPLING
ALAMEDA POINT, ALAMEDA, CALIFORNIA
(page 4 of 7)**

Laboratory Identification	Field Identification	Matrix	Field Interphase probe	Field Screening Organonitrides	VOC Fixed-Lab Analysis	SVOC Fixed-Lab Analysis	VOC/Methane		
							Landfill Gas Confirmatory Analysis	Landfill Gas	Flux Chamber Gas
122-S01-055	SG-S01-B9-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-056	SG-S01-B9-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-056D	SG-S01-B9-3D ^d	Landfill Gas	--	--	--	--	X	--	--
122-S01-057	SG-S01-B10-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-058	SG-S01-B10-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-058D	SG-S01-B10-3D ^d	Landfill Gas	--	--	--	--	X	--	--
122-S01-059	SG-S01-B11-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-060	SG-S01-B11-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-061	SG-S01-B12-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-062	SG-S01-B12-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-063	SG-S01-B13-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-064	SG-S01-B13-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-065	SG-S01-B14-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-066	SG-S01-B14-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-067	SG-S01-B15-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-068	SG-S01-B15-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-068D	SG-S01-B15-3D ^d	Landfill Gas	--	--	--	--	X	--	--
122-S01-069	SG-S01-B16-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-070	SG-S01-B16-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-071	SG-S01-B17-0	Landfill Gas	--	--	--	--	--	--	X

TABLE 4-1a

**FIELD AND LABORATORY IDENTIFICATION NUMBERS
FOR GROUNDWATER, LANDFILL GAS, AND QUALITY CONTROL SAMPLES
IR SITE 1 DATA GAP SAMPLING
ALAMEDA POINT, ALAMEDA, CALIFORNIA**

(page 5 of 7)

Laboratory Identification	Field Identification	Matrix	Field Interphase probe	Field Screening Organohalides	VOC Fixed-Lab Analysis	SVOC Fixed-Lab Analysis	VOC/Methane		
							Landfill Gas Confirmatory Analysis	Landfill Gas	Flux Chamber Gas ¹
122-S01-072	SG-S01-B17-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-073	SG-S01-B18-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-074	SG-S01-B18-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-075	SG-S01-B19-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-076	SG-S01-B19-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-077	SG-S01-B20-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-078	SG-S01-B20-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-079	SG-S01-B21-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-080	SG-S01-B21-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-081	SG-S01-B22-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-082	SG-S01-B22-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-083	SG-S01-B23-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-084	SG-S01-B23-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-085	SG-S01-B24-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-086	SG-S01-B24-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-087	SG-S01-B25-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-088	SG-S01-B25-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-089	SG-S01-B26-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-090	SG-S01-B26-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-091	SG-S01-B27-0	Landfill Gas	--	--	--	--	--	--	X

TABLE 4-1a

**FIELD AND LABORATORY IDENTIFICATION NUMBERS
FOR GROUNDWATER, LANDFILL GAS, AND QUALITY CONTROL SAMPLES
IR SITE 1 DATA GAP SAMPLING
ALAMEDA POINT, ALAMEDA, CALIFORNIA
(page 6 of 7)**

Laboratory Identification	Field Identification	Matrix	Field Interphase probe	Field Screening Organohalides	VOC Fixed-Lab Analysis	SVOC Fixed-Lab Analysis	VOC/Methane		
							Landfill Gas Confirmatory Analysis	Landfill Gas	Flux Chamber Gas
122-S01-092	SG-S01-B27-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-093	SG-S01-B28-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-094	SG-S01-B28-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-095	SG-S01-B29-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-096	SG-S01-B29-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-097	SG-S01-B30-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-098	SG-S01-B30-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-099A	SG-S01-B31-0	Landfill Gas	--	--	--	--	--	--	X
122-S01-099	SG-S01-B31-3	Landfill Gas	--	--	--	--	--	X	--
122-S01-100	<i>Duplicate</i>	Landfill Gas	--	--	--	--	--	X	--
122-S01-101	<i>Duplicate</i>	Landfill Gas	--	--	--	--	--	X	--
122-S01-102	<i>Duplicate</i>	Landfill Gas	--	--	--	--	--	X	--
122-S01-103	<i>Duplicate</i>	Landfill Gas	--	--	--	--	--	--	X
122-S01-104	<i>Duplicate</i>	Landfill Gas	--	--	--	--	--	--	X
122-S01-151	<i>Duplicate</i>	Landfill Gas	--	--	--	--	--	--	X
SOURCE WATER BLANK									
122-S01-105	<i>Source water</i>	Water	--	--	X	X	--	--	--
EQUIPMENT RINSATES									
122-S01-106	<i>Equipment rinsate</i>	Water	--	--	X	X	--	--	--
122-S01-107	<i>Equipment rinsate</i>	Water	--	--	X	X	--	--	--

TABLE 4-1a

**FIELD AND LABORATORY IDENTIFICATION NUMBERS
FOR GROUNDWATER, LANDFILL GAS, AND QUALITY CONTROL SAMPLES
IR SITE 1 DATA GAP SAMPLING
ALAMEDA POINT, ALAMEDA, CALIFORNIA
(page 7 of 7)**

Laboratory Identification	Field Identification	Matrix	Field Interphase probe	Field Screening Organohalides	VOC Fixed-Lab Analysis	SVOC Fixed-Lab Analysis	VOC/Methane		
							Landfill Gas Confirmatory Analysis	Landfill Gas	Flux Chamber Gas
122-S01-108	<i>Equipment rinsate</i>	Water	--	--	X	X	--	--	--
122-S01-109	<i>Equipment rinsate</i>	Water	--	--	X	X	--	--	--
TRIP BLANK									
122-S01-110	<i>Trip Blank</i>	Water	--	--	X	--	--	--	--
122-S01-111	<i>Trip Blank</i>	Water	--	--	X	--	--	--	--
122-S01-149	<i>Trip Blank</i>	Water	--	--	X	--	--	--	--
FIELD BLANK									
122-S01-112	<i>Landfill Gas</i>	Air	--	--	--	--	--	X	--
122-S01-113	<i>Landfill Gas</i>	Air	--	--	--	--	--	X	--
122-S01-114	<i>Landfill Gas</i>	Air	--	--	--	--	--	X	--
122-S01-115	<i>Flux Chamber</i>	Air	--	--	--	--	--	--	X
122-S01-116	<i>Flux Chamber</i>	Air	--	--	--	--	--	--	X
FLUX CHAMBER BACKGROUND SAMPLE									
122-S01-117	<i>Flux Chamber</i>	Air	--	--	--	--	--	--	X

Notes:

- Not applicable
- ^a Flux chamber samples are contingent on landfill gas results only 16 sample will be taken.
- ^b Samples HP-S01-B13-5 through HP-S01-B17-15 will be taken on a contingency basis
- ^c Interphase measured at surface
- ^d Samples 122-S01-056D, 122-S01-058D, and 122-S01-068D are field laboratory confirmation samples.
- ^e Duplicates will be identified by adding the letter D after the field identification number.

- ^f Flux chamber control point sample
- SVOC Semivolatile organic compound
- VOC Volatile organic compound

TABLE 4-1b

**FIELD AND LABORATORY IDENTIFICATION NUMBERS
FOR MONITORING WELL AND QUALITY CONTROL SAMPLES
IR SITE 1 DATA GAP SAMPLING
ALAMEDA POINT, ALAMEDA, CALIFORNIA**

Laboratory Identification	Field Identification	Matrix	VOC	SVOC	CN	Total Fe ²⁺ Hach Method ^a	TSS	Turbidity	Total Sulfide	Total Nitrate	Total Alkalinity	Total Cr ⁺⁶	Total Cr ⁺³	Oil/Grease
Monitoring Wells														
122-S01-118	M-025A-5	Water	--	--	X	--	--	--	--	--	--	--	--	--
122-S01-119	M-028A-5	Water	X	X	--	X	X	X	X	X	X	X	X	X
122-S01-120	M-025A-5D ^b	Water	--	--	X	--	--	--	--	--	--	--	--	--
122-S01-121	M-028A-5D ^b	Water	X	X	--	X	X	X	X	X	X	X	X	X

Notes:

- ^a Ferrous iron by Hach field kit method to be performed by the field sampling team.
- ^b Duplicates will be identified by adding the letter D after the field identification number.
- CN Cyanide
- Cr⁺³ Trivalent chromium
- Cr⁺⁶ Hexavalent chromium
- SVOC Semivolatile organic compound

- TSS Total suspended solids
- VOC Volatile organic compound

Table 4-1b (cont)

Laboratory Identification	Field Identification	Matrix	Dissolved Fe ²⁺ Hach Method ^a	Dissolved Sulfide	Dissolved Nitrate	Dissolved Alkalinity	Dissolved Cr ⁺⁶	Dissolved Cr ⁺³
Monitoring Wells								
122-S01-118	M-025A-5	Water	--	--	--	--	--	--
122-S01-119	M-028A-5	Water	X	X	X	X	X	X
122-S01-120	M-025A-5D ^b	Water	--	--	--	--	--	--
122-S01-121	M-028A-5D ^b	Water	X	X	X	X	X	X

Notes:

- ^a Ferrous iron by Hach field kit method to be performed by the field sampling team.
- ^b Duplicates will be identified by adding the letter D after the field identification number.
- Cr⁺³ Trivalent chromium

- Cr⁺⁶ Hexavalent chromium

TABLE 4-1c

**FIELD AND LABORATORY IDENTIFICATION NUMBERS
FOR SOIL AND QUALITY CONTROL SAMPLES
IR SITE 1 DATA GAP SAMPLING
ALAMEDA POINT, ALAMEDA, CALIFORNIA**

Laboratory Identification	Field Identification	Matrix	Depth Feet (bgs)	Grain Size	Load Bearing Capacity ^b
122-S01-122	GP-S01-B2	Soil	0 to 4	X	X
122-S01-123	GP-S01-B3	Soil	0 to 4	X	X
122-S01-124	GP-S01-B9	Soil	0 to 4	X	X
122-S01-125	GP-S01-B10	Soil	0 to 4	X	X
122-S01-126	GP-S01-B12	Soil	0 to 4	X	X
122-S01-127	GP-S01-B15	Soil	0 to 4	X	X
122-S01-128	GP-S01-B16	Soil	0 to 4	X	X
122-S01-129	GP-S01-B18	Soil	0 to 4	X	X
122-S01-130	GP-S01-B19	Soil	0 to 4	X	X
122-S01-131	GP-S01-B22	Soil	0 to 4	X	X
122-S01-132	GP-S01-B23	Soil	0 to 4	X	X
122-S01-133	GP-S01-B25	Soil	0 to 4	X	X
122-S01-134	GP-S01-B28	Soil	0 to 4	X	X
122-S01-135	<i>Duplicate</i>	Soil	0 to 4	X	X
122-S01-136	<i>Duplicate</i>	Soil	0 to 4	X	X
122-S01-137	GP-S01-B12	Soil	4 to 8 ^c	X	X
122-S01-138	<i>Duplicate</i>	Soil	0 to 4	X	X
122-S01-139	GP-S01-B16	Soil	4 to 8 ^c	X	X
122-S01-140	GP-S01-B18	Soil	4 to 8 ^c	X	X
122-S01-141	GP-S01-B19	Soil	4 to 8 ^c	X	X
122-S01-142	GP-S01-B22	Soil	4 to 8 ^c	X	X
122-S01-143	GP-S01-B23	Soil	4 to 8 ^c	X	X
122-S01-145	GP-S01-B28	Soil	4 to 8 ^c	X	X
122-S01-146	<i>Duplicate</i>	Soil	4 to 8 ^c	X	X

Note:

-- Not analyzed

^a Duplicates will be identified by adding the letter D after the field identification number.^b Load bearing capacity will be determined using ASTM method D-3080.^c Soil sample to be used if 0 to 4 foot soil sample does not penetrate existing landfill cap

bgs Below ground surface

TABLE 4-2

**ANALYTICAL SUMMARY
IR SITE 1 DATA GAP SAMPLING
ALAMEDA POINT, ALAMEDA, CALIFORNIA**

SITE 1	VOC	VOC'S PLUS METHANE		SVOC	INORGANIC ANALYTES ^{d,e}	CYANIDE	GEOTECHNICAL MEASUREMENT
	GW	SOIL GAS	FLUX CHAMBER GAS ^a	GW	GW	GW	SOIL
Samples	36 ^b	31	16	34	1	1	9
Field Duplicates ^c	4	3	3	4	1	1	3
Confirmation samples ^f	--	3	--	--	--	--	--
Equipment Rinsate	4	--	--	4	--	--	--
Source Water Blank	1	--	--	1	--	--	--
Trip Blank	3	--	--	--	--	--	--
Field Blank	--	3	2	--	--	--	--
Flux Chamber Background Sample	--	--	1	--	--	--	--
TOTAL	48	40	22	43	2	2	12

Notes:

- ^a Up to 16 flux chamber samples to be taken, dependent on soil gas results
- ^b Six samples will be tested by the sampling team using field test kits.
- ^c These represent the minimum numbers, sample specific requirements may require more.
- ^d TSS, turbidity, alkalinity, nitrate, sulfide, chromium, oil and grease, ferrous iron,
- ^e alkalinity, nitrate, sulfide, chromium will be run as both total and dissolved
- ^f Confirmation samples will be analyzed by a Fixed Laboratory using methods TO-14 and ASTM D-1945

- Cyanide CLP SOW ILM04.0
- CLP Contract laboratory program
- EPA Environmental Protection Agency
- GW Groundwater
- OLM Organic low medium
- SOW Statement of work
- SVOC Semivolatile organic compounds - EPA Method CLP OLM03.1
- VOC Volatile organic compounds - EPA CLP OLM03.1, TO-14, or SW-846 8021B
- Not applicable

TABLE 7-1

**SAMPLE CONTAINER, HOLDING TIME, AND PRESERVATIVE REQUIREMENTS
IR SITE 1 DATA GAP SAMPLING
ALAMEDA POINT, ALAMEDA, CALIFORNIA**

Parameter	Method Number ^a	Sample Container	Preservative	Holding Time ^b
Organic Analyses				
VOC	CLP OLM03.1	3 40-ml VOA vials with Teflon-lined septum caps	HCl, pH<2, 4 °C	14 days
VOC in Landfill Gas ^d	SW-846 8021B	Gastight syringe or Tedlar® bag	---	30 minutes ^c /72 hours
VOC in Flux Chamber Gas	TO-14	Summa™ cannister	---	14 days
Total Methane ^d	D-1945 Modified	Gastight syringe or Summa™ cannister	---	30 minutes ^c /72 hours
SVOC	CLP OLM03.1	2 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days ^b /40 days ^c
Inorganic Analyses				
Cyanide	CLP ILM04.0 part III	1 1-liter polyethylene bottle	NaOH, pH>12, 4°C	14 days
Total Suspended Solids	SM-2540D	1 1-liter polyethylene bottle	4°C	7 days
Turbidity	SM-2130B	1 1-liter polyethylene bottle	4°C	48 hours
Alkalinity	EPA-310.1	1 1-liter polyethylene bottle	4°C	14 days
Sulfide	EPA-376.2	1 1 liter polyethylene bottle	4°C, Zinc acetate, NaOH, pH >9	7 days
Nitrate	EPA 353.1	1 1 liter polyethylene bottle	4°C	48 hours
Hexavalent Chromium	SW-846 Method 7196A	1 1-liter polyethylene bottle	4°C	24 hours
Total Chromium	CLP ILM04.0 part III	1 1-liter polyethylene bottle	HNO ₃ , pH <2	6 months
Oil and Grease	SW-846 Method 9070	1 1-liter amber glass bottle	4°C, HCl, pH <2	28 days

Notes:

- a Complete method references are presented in Section B5.
- b From sample collection to extraction
- c From extraction to analysis
- d Methods to be used by on-site field laboratory
- e Holding time if sample collected in a gastight syringe
- °C Degrees Celsius
- CLP Contract Laboratory Program
- EPA Environmental Protection Agency
- HCl Hydrochloric acid

- ILM Inorganic low medium
- ml milliliter
- OLM Organic low medium
- SM Standard Method for Examination of Water and Wastewater
- SVOC Semivolatile organic compound
- SW-846 "Test Methods for Evaluating Solid Waste". Third Edition; U.S. Environmental Protection Agency Revision Four
- VOA Volatile organic analysis
- VOC Volatile organic compound