Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

FINAL

DATA GAP SAMPLING WORK PLAN FOR OPERABLE UNIT-2A and 2B

October 11, 2007

ALAMEDA POINT
ALAMEDA, CALIFORNIA

Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, California 92108-4310

CONTRACT NO. N62473-06-D-2201
CTO NO. 0012

FINAL

DATA GAP SAMPLING WORK PLAN FOR OPERABLE UNITS 2A AND 2B

October 11, 2007

ALAMEDA POINT
ALAMEDA, CALIFORNIA

DCN: ECSD-2201-0012-0002.R1

TETRA TECH EC, INC.
1230 Columbia Street, Suite 750
San Diego, CA 92101-8536

Pete Everds
Project Manager

Marianne Binkin, P.G. 7853
Technical Lead

TETRA TECH EC, INC.

TRANSMITTAL/DELIVERABLE RECEIPT

Contract No. N62473-06-D-2201 (RAC IV)

Document Control No. ECSD-2201-0012-0002.R1

File Code: 5.0

TO: Contracting Officer
Naval Facilities Engineering Command SW
Ms. Beatrice Appling, AQE.BA
Building 127, Room 108
1220 Pacific Highway
San Diego, CA 92132-5190

DATE: 10/26/07
CTO: 0012
LOCATION: Alameda Point, CA

FROM:

A. N. Bolt, Program Manager

DESCRIPTION: Final Data GAP Sampling Work Plan for Operable Units 2A and 2B
October 11, 2007
Draft accepted as Final without changes

TYPE: ☐ Contract/Deliverable ☒ CTO Deliverable ☐ Notification ☐ Other

VERSION: Final (e.g. Draft, Draft Final, Final, etc.) REVISION #: 1

ADMIN RECORD: Yes ☒ No ☐ Category ☐ Confidential ☐
(PM to Identify)

SCHEDULED DELIVERY DATE: 10/11/07 ACTUAL DELIVERY DATE: 10/26/07

NUMBER OF COPIES SUBMITTED: O/11C/9E Copy of SAP to N. Ancog ☒

COPIES TO: (Include Name, Navy Mail Code, and Number of Copies)

NAVY:	TtEC:	OTHER: (Distributed by TtEC)
D. Evans (06DE) O /1C	M. Binkin	*See Attached Cover Letter for
S. Peck (BRAC) 5C/5E	P. Everds	Additonal Distribution.
D. Silva (EVR.DS) 4C/4E	B. Graham	
N. Ancog (EVR.NA) 1 CD	J. Dessort	
Basic Contract (AQE) 1C	R. Margotto	Date/Time Received
	L. Bienkowski	
	Library Copy Alameda	

1230 Columbia Street, Suite 750, San Diego, CA 92101

TETRA TECH

TRANSMITTAL/DELIVERABLE RECEIPT

Contract No. N62473-06-D-2201 (RAC IV)

Document Control No. ECSD-2201-0012-0002
File Code: 5.0

TO: Contracting Officer
Naval Facilities Engineering Command SW
Ms. Beatrice Appling, AQE.BA
Building 127, Room 108
1220 Pacific Highway
San Diego, CA 92132-5190

DATE: 09/07/07
CTO: 0012
LOCATION: Alameda Point, CA

FROM: A. N. Bolt

A. N. Bolt, Program Manager

DESCRIPTION: Draft Final Data GAP Sampling Work Plan for Operable Units 2A and 2B
September 7, 2007

TYPE: ☐ Contract/Deliverable ☒ CTO Deliverable ☐ Notification
☐ Other

VERSION: Draft Final (e.g. Draft, Draft Final, Final, etc.)
REVISION #: N/A

ADMIN RECORD: Yes ☒ No ☐ Category ☐ Confidential ☐
(PM to Identify)

SCHEDULED DELIVERY DATE: 09/07/07 ACTUAL DELIVERY DATE: 09/07/07

NUMBER OF COPIES SUBMITTED: O/10C/8E Copy of SAP to N. Ancog ☒

COPIES TO: (Include Name, Navy Mail Code, and Number of Copies)

NAVY:	TtEC:	OTHER: (Distributed by TtEC)
D. Evans (06DE) O /1C	M. Binkin	*See Attached Cover Letter for
S. Peck (BRAC) 5C/5E	P. Everds	Additonal Distribution.
D. Silva (EVR.DS) 3C/3E	B. Graham	
N. Ancog (EVR.NA) 1 CD	B. Ogle	
Basic Contract (AQE) 1C	R. Margotto	
	L. Bienkowski	Date/Time Received
	Library Copy Alameda	

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

PAGE

TABLE OF CONTENTS
(Continued)

LIST OF TABLES

This page intentionally left blank.

LIST OF FIGURES

LIST OF FIGURES
(Continued)

APPENDICES

This page intentionally left blank.

ABBREVIATIONS AND ACRONYMS

ACPWA	Alameda County Public Works Agency
AOC	area of concern
ARRA	Alameda Reuse and Redevelopment Authority
AST	aboveground storage tank
BaP	benzo(a)pyrene
BERC	Berkeley Environmental Restoration Center
bgs	below ground surface
BMP	Best Management Practice
BRAC	Base Realignment and Closure
BSU	Bay Sediment Unit
BTEX	benzene, toluene, ethylbenzene, xylenes
CAA	Corrective Action Area
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
COC	contaminant of concern
CPT	cone penetrometer testing
CQCP	Contractor Quality Control Plan
CSM	Conceptual Site Model
CSO	Caretaker Site Office
DCA	dichloroethane
DCE	dichloroethene
DERP	Defense Environmental Restoration Program
DNAPL	dense non-aqueous phase liquid
DoN	Department of Navy

ABBREVIATIONS AND ACRONYMS
(Continued)

DOT	Department of Transportation
DPT	direct push technology
DQO	Data Quality Objective
DTSC	Department of Toxic Substances Control
EBS	Environmental Baseline Survey
EHS	Environmental Health and Safety
EPA	United States Environmental Protection Agency
FGCS	Federal Geodetic Control Subcommittee
FWBZ	First Water-Bearing Zone
FS	Feasibility Study
ft	foot/feet
GAP	Generator Accumulation Point
GIS	Geographic Information System
GPR	ground penetrating radar
GPS	Global Positioning System
HDPE	high density polyethylene
HM	hazardous material
ID	inner diameter
IDW	investigation-derived waste
IR	Installation Restoration
ITSI	Innovative Technical Solutions, Inc.
IWTP	Industrial Wastewater Treatment Plant
JMM	James M. Montgomery, Consulting Engineers, Inc.
LDR	Land Disposal Restriction
MCL	maximum contaminant level
MEK	methyl ethyl ketone

ABBREVIATIONS AND ACRONYMS
(Continued)

MLLW	mean lower low water
MP	methylphenol
msl	mean sea level
MW	Montgomery Watson
NAD	North American Datum
NADEP	Naval Aviation Depot
NAS	Naval Air Station
NAVD	North American Vertical Datum
NGVD	National Geodetic Vertical Datum
NTU	nephelometric turbidity unit
ORP	oxidation reduction potential
OU	Operable Unit
OWS	oil water separator
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PCP	pentachlorophenol
P.E.	Professional Engineer
PESM	Project Environmental Safety Manager
P.G.	California-registered Professional Geologist
PID	photoionization detector
PPE	personal protective equipment
PQCM	Project Quality Control Manager
PRC	PRC Environmental Management, Inc.
PRG	preliminary remediation goal
PVC	polyvinyl chloride

ABBREVIATIONS AND ACRONYMS
(Continued)

PWC	Public Works Center
QA	quality assurance
QC	quality control
RA	remedial rction
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI	Remedial Investigation
ROICC	Resident Officer In Charge of Construction
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SARA	Superfund Amendment and Reauthorization Act
SCAPS	Site Characterization and Analysis Penetrometer System
SHSP	Site Health and Safety Plan
SPH	Six-Phase Heating
STLC	soluble threshold limit concentration
SVE	soil vapor extraction
SVOC	semivolatile organic compound
SWBZ	Second Water-Bearing Zone
SWMU	Solid Waste Management Unit
TCA	trichloroethane
TCE	trichloroethene
TCP	trichloropropane
TPH	total petroleum hydrocarbons
TSDF	treatment, storage, and disposal facility

ABBREVIATIONS AND ACRONYMS
(Continued)

TtEC	Tetra Tech EC, Inc.
TTLC	total threshold limit concentration
U&A	Uribe and Associates, Inc.
USCS	Unified Soil Classification System
UST	underground storage tank
VC	vinyl chloride
VOC	volatile organic compound
Water Board	Regional Water Quality Control Board
WMP	Waste Management Plan
Work Plan	Data Gap Sampling Work Plan

This page intentionally left blank.

1.0 INTRODUCTION

This Data Gap Sampling Work Plan (Work Plan) has been developed to acquire the data necessary to support the selected remedies for soil and groundwater at Operable Unit (OU) -2A and OU-2B located on Alameda Point, Alameda, California. Soil and groundwater samples will be collected to provide supplemental information on the nature and extent of contamination, aquifer properties, and natural attenuation parameters prior to preparing the remedial design.

Data gaps and Solid Waste Management Units (SWMUs) identified as a result of the remedial investigations (RIs) conducted for OU-2A and OU-2B (SulTech, 2005a, b) served as the basis for the locations that require further characterization, as described in this Work Plan.

A key objective of this Work Plan is to work collectively with the regulatory agencies during the planning phase. In addition, the Work Plan has been developed to facilitate real-time decisions in the field. To reduce the number of potential delays, this Work Plan provides for a dynamic strategy that is flexible and adaptable in reaching project objectives. This Work Plan includes decision trees to assist the field team in making real-time decisions for additional investigation.

The general location of Alameda Point is shown on Figure 1-1. Site boundaries for OU-2A and OU-2B are shown on Figure 1-2. OU-2A is composed of Alameda Point Sites 9, 13, 19, 22, and 23. OU-2B is composed of Alameda Point Sites 3, 4, 11, and 21.

This Work Plan has been prepared on behalf of the Department of Navy (DoN) Base Realignment and Closure (BRAC) Program Management Office West under Contract Task Order Number 0012, issued under Remedial Action Contract Number N62473-06-D-2201.

1.1 REGULATORY FRAMEWORK AND REQUIREMENTS

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendment and Reauthorization Act (SARA) established a series of federal programs to identify, characterize, and clean up or control contamination from hazardous waste disposal and spill sites. One of these programs, the Defense Environmental Restoration Program (DERP), is codified in SARA Section 21 (Title 10 United States Code Section 2701). The DERP specifies DoN and Marine Corps personnel responsibilities, describes Installation Restoration (IR) Program procedures, and ensures consistency with regulatory guidelines for evaluation of hazardous waste site conditions.

The IR Program was established by the DoN to comply with federal requirements regarding cleanup of hazardous waste sites. The task of the program is to reduce the risk to human health and to the environment from past waste disposal operations and hazardous material spills at DoN and Marine Corps facilities in a cost-effective manner. These federal requirements are outlined in

CERCLA, as amended by SARA and its implementing regulation, the National Oil and Hazardous Substances Pollution Contingency Plan.

In September 1993, the United States Congress and BRAC Commission designated Naval Air Station (NAS) Alameda for closure. NAS Alameda Comprehensive Environmental Response, Compensation, Liability Information System (Identification Number - CA2170023236), now known as Alameda Point, was added to the United States Environmental Protection Agency (EPA) National Priorities List in July 1999.

The DoN's Total Petroleum Hydrocarbons (TPH) Corrective Action program and Resource Conservation and Recovery Act (RCRA) program are conducted separately from CERCLA activities at Alameda Point. These programs address petroleum fuel sites and RCRA sites, respectively.

1.2 WORK PLAN OBJECTIVES

The objective of this Work Plan is to facilitate preparation of the Remedial Design/Remedial Action (RD/RA) Work Plan by collecting supplemental information that will fill the data gaps identified in the RIs for each OU (SulTech, 2005a, b), as well as collecting the necessary parameters to support remedial design activities. The information collected during this program will facilitate the following:

- Investigate soil and groundwater adjacent to individual SWMUs located at OU-2A and OU-2B identified for further action under CERCLA.
- Refine the nature and extent of soil contamination at OU-2A and OU-2B that was identified as a result of previous investigations.
- Refine the lateral and vertical extent of contaminant plumes in groundwater at each OU and determine aquifer parameters at these sites, including groundwater flow direction within the first and second water-bearing zones (FWBZ and SWBZ, respectively).

1.3 SCOPE OF WORK

Elements of the scope of work described in this Work Plan that will be implemented to meet the project objectives consist of the following:

- Utility clearance prior to intrusive activities
- Hand auger and direct push technology (DPT) borings for soil sampling
- Cone penetrometer testing (CPT) borings for characterization of lithology
- Soil and discrete groundwater sampling (HydroPunch®)
- Groundwater monitoring well installation and development
- Groundwater monitoring well sampling

- Laboratory analysis of soil and groundwater
- Location and elevation survey of sampling locations

A Data Summary Report will be prepared, following completion of the field program, to document and present the findings, and delineate, as appropriate, the horizontal and vertical extent of contamination.

1.4 PROJECT POINTS OF CONTACT

Key contacts for the project are provided in Table 1-1.

1.5 PROJECT SCHEDULE

Implementation of field activities will begin following approval of the Work Plan by the regulatory agencies. The proposed project schedule is presented in Figure 1-3. The schedule may be amended based on the start date and will be updated during project execution, as necessary.

1.6 WORK PLAN ORGANIZATION

This Work Plan details the proposed site activities and is organized in the following format:

- **Section 1.0: Introduction**—Describes the regulatory framework, Work Plan objectives, scope of work, points of contact, project schedule, and Work Plan organization.
- **Section 2.0: Background and Site Conditions**—Describes the facility's history and current operations, OU-2A and OU-2B site descriptions, topography, geology, hydrogeology, IR site features, and site-specific hydrology.
- **Section 3.0: Soil and Groundwater Investigation**—Describes the data quality objectives and proposed data gap investigations.
- **Section 4.0: Pre-Field Activities**—Describes pre-field activities, including permitting and notifications, kick-off meeting, mobilization, utility clearance, and traffic control specifications.
- **Section 5.0: Field Activities**—Describes the design and scope of the proposed field activities, including locating previous sampling points; oil water separator (OWS) liquids sampling and removal; hand auger/DPT sampling; logging of soil borings; soil sampling step-down and step-out criteria; CPT logging; HydroPunch® groundwater sampling; groundwater step-down and step-out criteria; FWBZ and SWBZ groundwater monitoring well installation and development; quarterly groundwater monitoring well sampling; slug tests; land survey; demobilization activities; investigation-derived waste (IDW) characterization; and equipment decontamination.
- **Section 6.0: Waste Management Plan**—Provides practices and procedures to be followed for the types and quantities of waste expected to be generated including regulatory requirements, waste minimization, project waste descriptions, waste

management activities, reporting of spills and releases, training and certification requirements, and documentation and records retention.

- **Section 7.0: Traffic Control Plan**—Addresses vehicular traffic and pedestrian control during fieldwork and includes an analysis of potential impacts, traffic safety measures, and traffic control.
- **Section 8.0: Reporting**—Describes the Data Summary Report that will summarize the Work Plan implementation.
- **Section 9.0: References**—Contains literature and report references.
- **Tables and Figures**—Tables and Figures follow the references section.
- **Appendix A**—The Sampling and Analysis Plan (SAP) provides field methods, sampling strategies and procedures, sample analysis, quality assurance (QA)/quality control (QC), and data quality management.
- **Appendix B**—The Site-Specific Contractor Quality Control Plan (CQCP) establishes the procedures and methods to be implemented for the field activities, including criteria for the implementation of QC measures.
- **Appendix C**—The Site Health and Safety Plan (SHSP) identifies potential hazards, activity hazard analyses, personal protective equipment (PPE), required health and safety monitoring, and reporting.
- **Appendix D**—The Field Communication Plan establishes procedures to facilitate real-time field decisions with input from the Technical Team.
- **Appendix E**—Provides revised responses to agency comments to the *Draft OU-1, OU-2A, and OU-2B Data Gap Sampling Work Plan* dated November 3, 2006.

2.0 BACKGROUND AND SITE CONDITIONS

Numerous investigations have been conducted at OU-2A and OU-2B. A summary of these investigations is provided in Tables 2-1 and 2-2 for OU-2A and OU-2B, respectively. Additional details regarding these investigations are provided in the RIs for OU-2A and OU-2B (SulTech, 2005a, b). The following sections provide general descriptions of the facility history and current operations, descriptions of OU-2A and OU-2B, site backgrounds, topography, geology, hydrogeology, and site-specific hydrogeology and data gaps.

2.1 FACILITY HISTORY AND CURRENT OPERATIONS

Alameda Point is located on Alameda Island. Originally a peninsula, Alameda Island was separated from the mainland in 1902 when a channel was cut linking San Leandro Bay to San Francisco Bay.

A summary of the historical use of Alameda Point and the former Alameda NAS is presented below:

- Prior to 1930—NAS Alameda, the western tip of Alameda Island, was farmland and later became an industrial and transit center. Railroad yards and rights-of-way for the Southern Pacific, Central Pacific, South Pacific Coast, and small local railways were built to the north of the present-day NAS facility. For a short period in 1869, the western terminus of the transcontinental railroad was located at the southeastern corner of Alameda Point. A borax plant operated in the eastern end of Alameda Point from the late 1800s to 1903. Pacific Coast Oil Works operated an oil refinery on the western tip of Alameda that was active from 1864 to 1899.
- 1930 to 1931—The U.S. Department of the Army acquired the western tip of Alameda Point from the City of Alameda and began construction activities.
- 1936—In response to the military buildup in Europe prior to World War II, the DoN acquired title to the land from the Army and began building NAS Alameda. Construction involved filling in the tidelands, marshes, and sloughs between the Oakland Inner Harbor and the western tip of Alameda Island. According to historical photographs and records, the NAS Alameda area was filled during two separate events:
  - 1887 to 1915—First fill event included most of NAS Alameda.
  - 1930 to 1939—Second fill event added the material within the southeast portion of the facility. The fill material used to create Alameda Point for both events consisted largely of dredge spoils from the surrounding San Francisco Bay and Oakland Inner Harbor.
- 1941—After the U.S. entered World War II, the DoN acquired more land to the west.

- 1945 to 1997—Following the end of the war, Alameda Point continued to provide facilities and support for fleet aviation activities. During the period that it was an active naval base, the installation provided berthing for Pacific Fleet ships and support for Naval aviation.
- 1993—NAS Alameda was identified for closure during the 1993 round of BRAC.
- 1994—The city and county of Alameda established the Alameda Reuse and Redevelopment Authority (ARRA). The ARRA is responsible for submitting and completing the community reuse plan for NAS Alameda, as recognized by the Department of Defense.
- 1997—NAS Alameda closed, and the DoN began the process of property transfer to the city of Alameda.
- 1999—NAS Alameda was placed on the National Priorities List.

CERCLA sites and petroleum corrective action areas (CAAs) were designated to assess contamination within specific areas of Alameda Point. In addition, an area known as the Marsh Crust was identified. The Marsh Crust layer consists of entrapped organic matter with medium- to heavy-weight petroleum hydrocarbons, situated approximately 10 feet (ft) below ground surface (bgs) in the northern portion of the facility and 20 ft bgs in the southern portion of the facility. The Marsh Crust was formed as petroleum products were discharged into the surrounding marshlands and intertidal areas that were subsequently filled in from 1887 to 1939 to form what would become Alameda Annex and Alameda Point (SulTech, 2005a, b).

2.2 OU-2A AND OU-2B SITE DESCRIPTIONS

Sites 9, 13, 19, 22, and 23 are designated as OU-2A under CERCLA and have been the subject of environmental investigations due to historical activities in the area, including aircraft repair and maintenance, operation of two fuel/service stations, storage of hazardous waste and chemicals, and storage and supply of fuels. These sites have been characterized with relatively low levels of contamination. Previous investigations have been conducted under the IR Program and consist of data collection of soil, groundwater, and soil gas samples at and adjacent to Sites 9, 13, 19, 22, and 23.

Sites 3, 4, 11, and 21 are designated as OU-2B under CERCLA and have been the subject of environmental investigations due to historical documentation of petroleum, oil, and lubricant usage related to bulk fuel service, as well as ship and aircraft maintenance and repair. Previous investigations have been conducted under the IR Program, and include collection of soil, groundwater, and soil gas samples at and adjacent to Sites 3, 4, 11, and 21.

2.3 SITE TOPOGRAPHY

Alameda Point is located on the western portion of Alameda Island. Alameda Island lies at the base of a gently westward-sloping plain that extends from the Oakland-Berkeley Hills in the east to the shore of San Francisco Bay in the west. Alameda Island is characterized by a low topographic profile, with surface elevations varying from mean sea level (msl) to approximately 30 ft above msl. The topography of OU-2A and OU-2B is primarily flat, with ground surface elevations ranging from approximately 6 to 10 ft above msl.

2.4 GEOLOGY

Alameda is located along the eastern San Francisco Bay (East Bay Margin). San Francisco Bay occupies a depression between two uplifted areas: the Berkeley Hills to the east and the Montara and other mountains to the west. The depression and the uplifted areas were formed by two sub-parallel, active faults: the San Andreas Fault west of San Francisco Bay and the Hayward Fault east of San Francisco Bay. The San Andreas and Hayward Faults are located approximately 12 miles west and 5 miles east of the site, respectively.

The thickness of geologic units varies throughout Alameda Point. Alameda Point geologic interpretation was described in the OU-2A (SulTech, 2005a) and OU-2B (SulTech, 2005b) RI reports, and is summarized below. Table 2-3 presents a summary of the geologic units and their approximate depths bgs at each site.

2.4.1 Artificial Fill

Artificial fill is encountered at ground surface at all locations except the northeastern portion of OU-2A Sites 22 and 23. The artificial fill thickness ranges from less than 1 to 18 ft bgs and was emplaced during the historical filling of the San Francisco Bay west of, and tidal marshlands north of, the former Alameda Island. Approximate fill depths by site are presented on Table 2-3.

Much of the artificial fill is believed to be sediments dredged from the surrounding San Francisco Bay and Oakland Inner Harbor. The artificial fill material is a heterogeneous, laterally discontinuous mixture of brown, poorly graded fine to medium silty sand, with minor lenses of clay or gravel similar to the Merritt Sand. Shell fragments have also been observed in the artificial fill. Industrial waste is also believed to be a potential source of the fill material and extensive debris has been encountered in the subsurface in the fill portions of OU-2A Site 19. The thickness of the fill is probably influenced by the pre-fill topography, such as the presence of historical tidal channels that once transected the tidal flats.

2.4.2 The Marsh Crust

An organic-rich peat and grass layer called the Marsh Crust typically marks the top of the Bay Sediment Unit (BSU). The Marsh Crust includes a layer of contaminated sediment formed by the discharge of petroleum waste from two gas plants and an oil refinery from the late 1800s to 1903. This waste migrated over much of the surface of the surrounding marshlands and tidal flats and was deposited through tidal actions under most of what would later become the central and eastern portion of Alameda Point.

The Marsh Crust restriction area (an area, where the Marsh Crust is known to exist, that is subject to excavation restriction by City of Alameda ordinance) extends beneath OU-2A and OU-2B.

2.4.3 The Bay Sediment Unit

The BSU (Young Bay Mud) underlies the artificial fill material, where present, and interfingers with the Merritt Sand along the extent of former Alameda Island. Figure 2-1 is a map of the BSU showing the extent of the original Alameda Island circa 1859 that was developed using an historic Coast Guard bathymetry map rectified to current Geographic Information System (GIS) coverage. In addition, Figure 2-1 shows the extent and general thickness of the BSU, based on a review of boring logs. The approximate BSU depths by site are presented on Table 2-3.

The BSU consists of recent sediment deposited at or near sea level in the San Francisco Bay estuary that is presently, or was historically, tidal marsh, mud flat, or bay bottom, and generally consists of gray to black loose silt and soft clay with laterally discontinuous, poorly graded silty and clayey sand layers with occasional shells. Isolated sand lenses have also been noted within the BSU and are likely associated with historical tidal marsh channels or stream discharge points.

2.4.4 Merritt Sand

The Merritt Sand underlies artificial fill material at sites located between the surface exposure at OU-2A Site 22 and the former Alameda Island shoreline (Figure 2-1). The Merritt Sand underlies the BSU west of the former shoreline. Approximate Merritt Sand depths are shown in Table 2-3.

The Merritt Sand is a fine-grained, well-sorted aeolian sand deposit that outcrops on Alameda Island and is considered a facies of the San Antonio Formation (Rogers and Figuers, 1991). The Merritt Sand described at the OU-2A and -2B sites is composed of brown, fine- to medium-grained, poorly graded sand and silty sand. At greater depths, the Merritt Sand grades into silty sand, then very dense yellowish-brown sand with continuous clayey or silty sand layers.

The Merritt Sand comprises the near surface sediments at OU-2A Site 22, portions of OU-2A Sites 13, 19, and 23, and portions of OU-2B Site 4.

2.4.5 San Antonio Formation

The San Antonio Formation underlies the Merritt Sand. Approximate San Antonio Formation depths are shown on Table 2-3.

The San Antonio Formation is a sequence of alluvial fan deposits and contains a wide variety of lithologies. At Alameda Point, it has been described as composed of loose greenish-gray to gray clay and silty clay with trace amounts of organic material. An organic-rich layer with plant debris and peat is occasionally encountered at the top of the formation. Bedding planes were observed in several Site 13 and Site 19 borings.

2.4.6 Yerba Buena Mud

The Yerba Buena Mud is a widespread, homogeneous estuarine mud that averages 25 to 50 ft thick and has been encountered in borings at depths ranging from 90 to 100 ft bgs (Table 2-3). The Yerba Buena Mud dips regionally approximately 2 degrees to the southwest (Rogers and Figuers, 1991) and is composed of dark greenish-gray to bluish-gray, plastic, stiff, fat clay.

2.4.7 Alameda Formation

The Alameda Formation underlies the Yerba Buena Mud and ranges in thickness from 250 ft at the western edge of Alameda Point to 850 ft on the eastern side of Alameda Point. In the center of Alameda Point, the Alameda Formation consists of estuarine clays and silts (Rogers and Figuers, 1991). The Alameda Formation was not encountered during previous site investigation activities.

2.5 HYDROGEOLOGY

Five hydrostratigraphic zones have been identified at Alameda Point. The hydrostratigraphic zones have been described in the 2005 Alameda Basewide Annual Groundwater Report (Innovative Technical Solutions, Inc. [ITSI], 2006) and are summarized below. The hydrostratigraphic zones of interest for this study are the FWBZ and SWBZ (separated by the confining layer of the BSU). When the BSU is absent, the upper 15 ft of the formation is considered the FWBZ.

2.5.1 First Water-bearing Zone

The FWBZ has been described as the unconfined uppermost permeable unit at Alameda Point which, in most locations, is within the artificial fill. At Site 22 where the Merritt Sand is encountered at ground surface, the upper 15 ft of the Merritt Sand is considered the FWBZ. Groundwater flow direction in the FWBZ is generally toward the San Francisco Bay (all OU-2A Sites) or the Seaplane Lagoon (all OU-2B Sites). FWBZ groundwater flow direction varies and may be influenced by underground utility corridors, daily tidal variations, and seasonal precipitation rates. The Seaplane Lagoon sheet pile wall may restrict FWBZ groundwater flow to the lagoon, resulting in a local groundwater mounding effect to the east of the Seaplane Lagoon.

2.5.2 BSU Aquitard

The BSU acts as a confining to semi-confining layer between the FWBZ and SWBZ, where BSU silts and clays are of sufficient thickness (OU-2A Site 9 and portions of Sites 13, 19, and 23 and OU-2B Sites 3, 11, and 21 and portions of Site 4). The BSU pinches out to the east along the former Alameda Island shoreline (Figure 2-1).

2.5.3 Second Water-bearing Zone

Where encountered below the BSU Aquitard in the western and central portions of Alameda Point, the SWBZ is a semi-confined to confined permeable unit within the Merritt Sand and the Upper San Antonio Formation. The SWBZ is subdivided into the SWBZ-upper (Merritt Sand) and the SWBZ-lower (Upper San Antonio Formation) and is underlain by the less permeable Yerba Buena Mud (Lower San Antonio Formation). Where the BSU is not present, the SWBZ is unconfined and defined as the Merritt Sand and Upper San Antonio Formation greater than 15 ft bgs.

Groundwater flow direction in the SWBZ is generally toward the San Francisco Bay (all OU-2A Sites) or the Seaplane Lagoon (all OU-2B Sites). The SWBZ is believed to discharge through lateral groundwater flow to the Oakland Inner Harbor, the Seaplane Lagoon, and the San Francisco Bay. Gradients tend to be steeper at low tide, and reverse at high tide in some areas.

2.5.4 Yerba Buena Mud Aquitard

The Yerba Buena Mud is the lower unit of the San Antonio Formation and is a regionally continuous aquitard between the relatively saline groundwater of the SWBZ and the underlying freshwater Alameda FWBZ. The Yerba Buena Mud Aquitard was encountered between approximately 76 to 100 ft bgs at OU-2A Sites 9, 13, 19, 23, and OU-2B Site 4. Borings were not advanced through the Yerba Buena Mud Aquitard at these sites. No borings have been advanced deep enough at Sites 3, 11, 21 or 22 to encounter the Yerba Buena Mud Aquitard.

2.5.5 Alameda Formation Water-bearing Zone

The Alameda FWBZ is the confined regional drinking water aquifer that occurs below the Yerba Buena Mud Aquitard in the Alameda Formation and was not encountered during previous site investigation activities.

2.6 SITE-SPECIFIC HYDROGEOLOGY

The following sections describe the hydrogeology for the individual sites at OU-2A and OU-2B.

2.6.1 OU-2A Sites 9, 13, 19, 22, and 23

Site hydrogeologic conditions were investigated during the OU-2A RI. Because the five sites are adjacent, the conditions for OU-2A, rather than individual sites, were presented in the RI. Hydraulic conditions described in the OU-2A RI are summarized below (SulTech, 2005a).

OU-2A groundwater elevations ranged from 6 to 9 ft above mean lower low water (MLLW). Groundwater elevations are highest at Site 22 and lowest in the western portion of Site 23. Depth to groundwater measurements in ft bgs were not included in the RI. FWBZ groundwater flow direction, as determined in April 2003, was generally to the southwest (toward San Francisco Bay). Localized FWBZ groundwater flow in the western portion of Site 23 was to the northwest (toward Seaplane Lagoon). FWBZ hydraulic gradients ranged from 0.0038 ft/ft at Sites 13, 19, and 22, to 0.01 ft/ft in the southern portion of Site 23 in December 2002. The FWBZ hydraulic gradient ranged from 0.002 at Sites 13, 19, and 22, to 0.004 ft/ft in the southern portion of Site 23 in April 2003. FWBZ hydraulic conductivity values were calculated for Site 9 using slug test data, and for Site 13 using pump test data. A hydraulic conductivity value of 1.7 ft/day was calculated for Site 9. Hydraulic conductivity values ranging from 3.4 to 5.3 ft/day were calculated for Site 13. Results of tidal studies indicate groundwater is influenced by tidal fluctuations at the western and southwestern edges of Sites 9, 13, 19, and 23. Daily tidal-induced groundwater fluctuations ranged from 0.1 to 4 ft (PRC, 1997).

Groundwater flow in the SWBZ, as determined from the 2002 and 2003 groundwater elevation contours, was to the west. SWBZ hydraulic gradients ranged from 0.0035 ft/ft in the northern part of OU-2A to 0.0048 ft/ft in the southern part of OU-2A in June 2002. In April 2003, the SWBZ hydraulic gradient was 0.0015 ft/ft throughout OU-2A. Hydraulic conductivity, transmissivity, and storativity of the SWBZ at Site 9 were calculated using pump test data. The estimated hydraulic conductivity, transmissivity, and storativity for the SWBZ were 2.3 ft/day, 52 square feet (ft^2)/day, and 0.0023, respectively.

Vertical hydraulic gradients between the FWBZ and SWBZ at OU-2A were estimated during the RI using groundwater elevation data from six OU-2B well pairs. Well pairs were located in areas where the BSU Aquitard was absent and in areas where the BSU Aquitard was present. The calculated vertical gradient at each well pair location showed a general downward groundwater movement potential.

2.6.2 OU-2B Sites 3, 4, 11, and 21

Site hydrogeologic conditions were investigated during the OU-2B RI. Because the four sites are adjacent, the conditions for OU-2B, rather than individual sites, were presented in the RI. Hydraulic conditions described in the OU-2B RI are summarized below (SulTech, 2005b).

OU-2B groundwater elevations in the FWBZ ranged from 4.5 to 9.9 ft above MLLW. Groundwater elevations were highest at Site 4 and lowest at Site 21. The FWBZ groundwater flow direction, as determined in September 2002 and April 2003, was generally to the west (toward Seaplane Lagoon). In April 2003, the FWBZ hydraulic gradient ranged from 0.006 ft/ft at Site 4 to 0.006 ft/ft at Site 11. FWBZ hydraulic conductivity at Site 11, calculated using slug test data, was 2.1 ft/day. Hydraulic conductivity values for Site 4, calculated from geotechnical samples, ranged from 0.0022 ft/day to 5.6 ft/day. Results of tidal studies indicate groundwater is influenced by tidal fluctuations at the western and southwestern edges of Sites 3, 4, 11, and 21.

OU-2B groundwater elevations in the SWBZ ranged from 5.2 to 6.8 ft above MLLW. Groundwater flow in the SWBZ, as determined from the 2002 and 2003 groundwater elevation data, was to the west. The hydraulic gradient in the SWBZ at Site 4 was calculated as 0.002 ft/ft in April 2003. Hydraulic conductivity, transmissivity, and storativity of the SWBZ at Site 11 were calculated using pump test data and were 4.4 ft/day, 98 ft^2 per day, and 0.0014, respectively.

Vertical hydraulic gradients between the FWBZ and SWBZ at OU-2B were estimated during the RI using groundwater elevation data from three OU-2B well pairs. One well pair was located in eastern OU-2B where the BSU Aquitard is absent. Two well pairs were located where the BSU Aquitard is present (one in the western portion and one in the northern portion of OU-2B). The calculated vertical gradient at each well pair location showed downward groundwater movement potential.

2.7 SITE BACKGROUNDS AND DATA GAPS

In preparation of this Work Plan, the DoN held a site visit with the regulatory agencies on June 19, 2006 to review SWMUs identified for further action. For OU-2A and OU-2B, 20 SWMUs have been specifically identified for further sampling and 29 SWMUs are being addressed under the Navy's TPH program based on site history (non-CERCLA), previous recommendations, or results of the site visit. Additionally, 36 SWMUs in OU-2A and OU-2B are proposed for no further action, based on either previous regulatory concurrence or results of the site visit. Table 2-4 summarizes the investigation status for each SWMU at OU-2A and OU-2B. Tables 2-5 and 2-6 provide additional details for each SWMU at OU-2A and OU-2B, respectively.

The following sections summarize the relevant background for the SWMUs and data gaps in each area that were recommended for investigation in the RIs for OU-2A and OU-2B (SulTech, 2005a, b).

2.7.1 OU-2A SITE BACKGROUND AND DATA GAPS

Sites 9, 13, 19, 22, and 23 are designated as OU-2A under CERCLA and have been the subject of environmental investigations due to historical activities in the area, including aircraft repair and maintenance, operation of two fuel/service stations, storage of hazardous waste and chemicals, and storage and supply of fuels. These sites have been characterized as having relatively low levels of contamination. Previous investigations have been conducted under the IR Program and consist of data collection of soil, groundwater, and soil gas samples at and adjacent to Sites 9, 13, 19, 22, and 23. The following sections summarize the background and present the SWMU and data gap investigations that are proposed in this Work Plan.

2.7.1.1 Site 9

Site 9 comprises 3 acres and consists of Environmental Baseline Survey (EBS) parcel 152 and open space surrounding Building 410 (Figure 2-2). The site was developed with dredge material from the floor of the San Francisco Bay between 1942 and 1946. The site is mostly paved and is currently occupied by a commercial tenant that provides boat and recreational vehicle storage. The site was previously used for aircraft storage, and includes Buildings 351 and 410 and former Industrial Wastewater Treatment Plant (IWTP) 410.

IWTP 410 underwent closure with approval from the California Department of Toxic Substances Control (DTSC) in 1998. Industrial waste from building activities was discharged into drain laterals between 1958 and 1972 (TtEMI, 1999a, b). Previous investigations have identified tetrachloroethene (PCE) and 1,2-dicholorethene (1,2-DCE) in soil near the storm sewer and former IWTP. Previous investigations at 20 boring locations also yielded no detectable metals concentrations in excess of the respective screening criteria, with the exception of arsenic (TtEMI, 1999a, b).

Building 410 is an existing structure and was the site of aircraft stripping activities. Physical features include the 35,000-ft^2 structure with floor drains that discharged to an outfall in Seaplane Lagoon. Industrial wastes from building activities were discharged into these drains between 1958 and 1972. Paint stripping and aircraft cleaning operations were discontinued by the DoN in 1990.

Investigations by the Navy in 1992, 1995, 1998, 2002, and 2003 indicate groundwater beneath Site 9 has been impacted by activities associated with Building 410 (the Paint Stripping Facility).

Contaminants identified in the OU-2A RI for groundwater included PCE, TCE, vinyl chloride, benzene, 1,2-DCP, 1,2,3-trichloropropane [TCP], semivolatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs) (including naphthalene, 2-methylnapthalene, pentachlorophenol [PCP], 4-methylphenol [MP] and 1,2,3-TCP) and manganese. Recent basewide groundwater sampling data collected between 2002 and 2006 at wells located in Site 9 indicate the following:

- Volatile Organic Compounds (VOCs) continue to be detected in groundwater at concentrations above maximum contaminant levels (MCLs).
- SVOCs have been detected infrequently at concentrations above MCLs.

- With the exception of naphthalene, PAHs have not been detected above MCLs. The extent of naphthalene in groundwater is well-defined and limited to the area east of Building 410.
- Manganese and other metals, with the exception of arsenic, have not been detected above MCLs. Arsenic has been consistently detected in one FWBZ well (MW410-02) at concentrations above background levels. Wells sidegradient and upgradient have low concentrations of arsenic. The area of elevated arsenic concentration in groundwater is isolated.

Site 9 Data Gaps

Two SWMUs in Site 9 require investigation under CERCLA:

- OWS 410A is southwest of Building 410, west of the wash rack area adjacent to the southern edge of the building. The OWS was previously connected to a drain within the wash rack area and is no longer in use. The DoN conducted inspections of OWS 410A and documented that the unit appeared to have been cleaned and contained clear water.
- OWS 410B remains in place southeast of Building 410 and was previously used to collect storm water runoff from an open concrete space adjacent to the east side of Building 410.

The following areas or physical features were identified in the RI as potential sources of soil and groundwater contamination that require further investigation under CERCLA (SulTech, 2005a):

- The wash rack east of OWS 410A will be investigated to determine whether the feature is a potential source of contamination to soil and groundwater.
- Additional investigation is necessary to delineate the horizontal and vertical extent of contamination in groundwater.

The storm drains, sewers and waste drains identified for further investigation in the OU-2A RI will be incorporated into Site 9 groundwater investigation activities.

An expanded pilot test was performed in Site 9 for in-situ chemical oxidation of soil and groundwater using Fenton's reagent-based oxidation chemistry (Shaw, 2006a,b). In conjunction with the Data Gap sampling, the final round of rebound monitoring will be performed for chemical oxidation pilot test wells in Site 9.

2.7.1.2 Site 13

Site 13 comprises approximately 17.5 acres and includes EBS parcels 146, 147, 210, and 214 (Figure 2-3). Site 13 is currently 90 percent open space; approximately half of the ground surface is exposed soil and the other half is paved asphalt or concrete with some vegetated areas. Current uses of the area include vehicle parking, storage, and recreational vehicle storage. A bicycle path also traverses the site. Site 13 includes area of concern (AOC) 009, consisting of aboveground storage tanks (ASTs) 324 through 328, and Building 397.

Building 397 operated as an aircraft overhaul facility until 1997. Materials stored during building operations included petroleum products, halogenated and non-halogenated solvents, and aircraft fuel. The building is currently leased to the City of Alameda for storage of equipment from various municipal entities. Building 397 contains Naval Aviation Depot (NADEP) Generator Accumulation Point (GAP) 62, which was a former temporary storage area for hazardous waste, and former jet engine test cells.

Prior to the DoN's occupation of the area, the site was also the previous location of the former Pacific Coast Oil Works, which operated from 1879 through 1903. Refinery structures included 19 ASTs, six USTs, and a drum storage area. There is no documentation regarding the decommissioning of refinery equipment after operations ceased in 1903.

A former incinerator is reported to have been located in the eastern portion of OU-2A, Site 13. No data have been provided in the RI (SulTech, 2005a) relative to the former incinerator. Information will be gathered, including historic aerial photographs, to investigate the location of the former incinerator.

Previous investigations have identified chemical contaminants in soil and groundwater related to former refinery operations, previous chemical storage, and bulk fueling activities. Additionally, a site evaluation determined further action was recommended for petroleum hydrocarbon-associated chemicals under the TPH Program for soil and groundwater. Additional investigative activities are being performed at Site 13 under the TPH program including a tarry waste investigation using Site Characterization and Analysis Penetrometer System (SCAPS) and laser-induced fluorescence. Site 13 is additionally known as CAA-13.

Investigations by the Navy in 1989, 1993, 1995, 1996, 2001, and 2002 included the collection and analysis of more than 100 soil samples. Laboratory analysis of more than 25 soil samples collected from the western and northwestern portions of Site 13 indicated no metals concentrations above the screening criterion. However, lead concentrations above the screening criterion were found in the south central and southeastern portions of Site 13.

Investigations by the Navy in 1989, 1993, 1995, 1998, 2001, 2002, and 2003 indicate there appears to be contamination of groundwater beneath Site 13 related to activities associated with the Former Oil Refinery (the Storage Area and RV Park).

Contaminants identified for soil in the OU-2A RI include PAHs (calculated as benzo(a)pyrene [BaP] equivalents) and lead.

Contaminants identified for groundwater in the OU-2A RI include TCE, benzene, manganese, and arsenic. Recent basewide groundwater sampling data collected between 2002 and 2006 at wells located in Site 13 indicate the following:

- TCE and benzene continue to be detected in groundwater at concentrations above MCLs.
- PCP was detected in only one sample from monitoring well MWOR-3 above the MCL.
- Arsenic, manganese, and iron have been detected above MCLs and background. Arsenic has been detected consistently in two FWBZ monitoring wells (M07C-06 and M13-07) at concentrations above background. Wells upgradient and down gradient have low arsenic concentrations. The area of elevated arsenic levels in groundwater is isolated. Manganese and iron are above background concentrations in a number of wells. In general, the elevated concentrations are associated with the same wells with elevated arsenic levels. The area of elevated manganese and iron levels in groundwater is isolated.

Site 13 Data Gaps

One SWMU in Site 13 requires additional investigation under CERCLA:

- AOC 009, consisting of ASTs 324 through 328, which were installed in the eastern portion of Site 13 in 1947 for bulk fuel storage. Contents of these tanks are unknown and the ASTs were demolished in May 1990.

The following areas or physical features were identified in the RI as potential sources of soil and groundwater contamination that require further investigation under CERCLA (SulTech, 2005a):

- Further characterization is required in the area of borings B-IMF-06, B13-30, B13-31, B13-32, and B13-41 to delineate the horizontal and vertical extent of lead in soil above the PRG around these previous investigation borings.
- Soil sampling is required to determine whether the former incinerator contributed to soil and/or groundwater contamination.
- Additional investigation is required to delineate the vertical and horizontal extent of groundwater contamination beneath Site 13.

The TPH plume is currently being evaluated under the TPH program as CAA-13 and will not be investigated as part of this Work Plan.

2.7.1.3 Site 19

Site 19 comprises approximately 2.3 acres and consists of EBS parcel 134A (Figure 2-4). The majority of the site is paved in concrete, with existing structures remaining from the former gas station. Approximately 50 percent of the site is open space. The northwestern portion of Site 19 is included in CAA-4B. Site 19 was previously the site of a hazardous waste storage yard, designated as Building 616, and the associated Yard D-13. The RCRA permitted storage area was used for containerized storage of hazardous waste generated by NAS facility activities. There are several documented releases of hazardous waste in the storage area; however, no spills were reported as breaching the secondary containment system. The facility ceased accepting hazardous waste as a permitted storage facility in 1996, and was formally closed by DTSC in 1999.

Two USTs, 616-1 and 616-2, were installed adjacent to Building 616 and Yard D-13 in 1982 for spill control and as emergency overflow tanks for fire control. The tanks were never put into service and both tanks were closed in place in 1987.

Hazardous waste and chemicals used and/or stored within the site included corrosives, halogenated and non-halogenated organic compounds, paints, asbestos, polychlorinated biphenyls (PCBs), petroleum products, and various fuels. Documented releases of waste and/or material include nitric acid, PD-680, poly-paint, Zyglow penetrant, and mixed oil and fuels.

Investigations by the Navy in 1992, 1995, 1996, 1998, 2001, 2002, and 2003 indicate groundwater beneath Site 19 has been contaminated from historical activities associated with Yard D-13 (the Hazardous Waste Storage Yard).

Contaminants for soil identified in the OU-2A RI for Site 19 included PAHs (expressed as BaP equivalents) and metals (copper and lead).

Contaminants identified for groundwater OU-2A RI at Site 19 include PCE, TCE, and manganese. Recent basewide groundwater sampling data collected between 2002 and 2006 at wells located in Site 19 indicate the following:

- TCE and benzene continues to be detected in groundwater at concentrations above MCLs.
- Manganese and iron have been detected only sporadically at concentrations above background in SWBZ monitoring well D19-01.

Site 19 Data Gaps

No SWMUs require investigation at Site 19 under CERCLA.

The following areas or physical features were identified in the RI as potential sources of soil and groundwater contamination that require further investigation under CERCLA (SulTech, 2005a):

- No soil samples have been collected from the solvent storage area of Yard D-13 during previous investigations. Investigation is required to determine whether previous site uses contributed contaminants to soil and/or groundwater.

- Additional investigation is required to delineate the vertical and horizontal extent of groundwater contamination beneath Site 19.

2.7.1.4 Site 22

Site 22 comprises approximately 2.1 acres and coincides with EBS parcel 145 (Figure 2-5). A gasoline service station occupied Site 22 between 1971 and 1980. The majority of the site is paved with concrete, and the foundations of former structures remain from the former service station (Building 547). Site 22 is additionally known as CAA-4C.

Three former USTs and associated fuel lines were located at the site for bulk storage of fuel products. In 1994, the gasoline service station was demolished and all tanks removed from service. Numerous releases of petroleum fuels from leaking USTs or fuel lines were reported during gas station operations as documented in the OU-2A RI report (SulTech, 2005a). Chemicals used during gas station activities included petroleum products and related additives such as 1,2-DCA.

Investigations by the Navy in 1989, 1995, 2002, and 2003 found lead and arsenic concentrations in the soil in excess of the screening criteria near the former gasoline station fuel lines at borings 547-6 and 547-11 (SulTech, 2005a).

Investigations by the Navy in 1989, 1995, 1998, 2000, 2002, and 2003 found groundwater contamination beneath Site 22 that appears to be related to activities associated with Building 547 (the former Service Station). Groundwater in the FWBZ was characterized using DPT grab samples and groundwater monitoring wells.

Contaminants for soil identified in the OU-2A RI for Site 22 include PAHs (calculated as BaP equivalents), benzene, ethylbenzene, xylenes, and lead.

Contaminants identified for groundwater in the OU-2A RI at Site 22 include 1,2-DCA, chloroform, PCE, TCE, benzene, ethylbenzene, xylenes, naphthalene, manganese, arsenic and thallium. Recent basewide groundwater sampling data collected between 2002 and 2006 at wells located in Site 22 indicate the following:

- Chlorinated VOCs (1,2-DCA, chloroform, PCE, and TCE) continue to be detected at concentrations above MCLs.
- Other VOCs (benzene, ethylbenzene, and xylenes) continue to be detected at concentrations above MCLs.
- Arsenic, manganese, and iron have been consistently detected at concentrations above MCLs or background in one FWBZ well (MW547-3). Wells upgradient and downgradient have low arsenic concentrations. The area of elevated arsenic levels in groundwater is isolated. Manganese and iron are above background concentrations in a number of wells. In general, the elevated concentrations are associated with the same

wells with elevated arsenic levels. The area of elevated manganese and iron levels in groundwater is isolated.

- Naphthalene continues to be detected at concentrations above MCLs but is being addressed as part of CAA-4C.

Site 22 Data Gaps

One SWMU at Site 22 requires investigation under CERCLA:

- OWS 547 was located adjacent to the former gas station car wash (Building 547-1) for the collection of wash water.

The following areas or physical features were identified in the RI as potential sources of soil and groundwater contamination and require further investigation under CERCLA (SulTech, 2005a):

- Additional investigation is required to delineate the horizontal and vertical extent of lead contamination above the PRG in soil around previous borings 547-5, 547-6, and 547-11.
- Additional investigation is required to delineate the vertical and horizontal extent of groundwater contamination beneath Site 22.

The Site 22 TPH plume is being investigated and remediated under CAA-4C; therefore, TPH in groundwater will not be assessed as part of this proposed work.

2.7.1.5 Site 23

Site 23 comprises approximately 14 acres and consists of EBS parcels 148 and 211 (Figure 2-6). Site 23 is approximately 80 percent open space with a majority of the surface area paved with asphalt or concrete. Current uses include vehicle parking and storage.

Building 530 was constructed in 1973 and remains the main building present at Site 23. The building was used for missile rework operations until NAS Alameda closed in 1997. Historical activities included missile rework, refurbishment of aviation components, electrical maintenance, cleaning, grinding, welding, painting, paint stripping, drum storage, and parts fabrication.

Hazardous materials and chemicals commonly used during rework activities included lead-based paint, hydraulic fluid, silver solder, ethylene glycol, lead, zinc, silver, tin, chromium, nickel, mercury, TCE, and petroleum products. Previous investigations identified chemical contaminants in soil and groundwater related to previous refinery activities and bulk defueling activities that include petroleum hydrocarbons; benzene, toluene, ethylbenzene, xylene (BTEX); PAHs; and lead.

Investigations by the Navy in 1989, 1990, 1994, 1998, 2002, and 2003 have shown groundwater contamination beneath Site 23 that appears to be related to activities associated with Building

530 (the Missile Rework Facility). TPH and TPH-associated chemicals are being addressed under the TPH Program for soil and groundwater. Major corrective actions have been performed at the site as part of CAA-13.

Contaminants for soil identified in the OU-2A RI for Site 23 include PAHs (BaP equivalents and dibenzo(a,h)anthracene).

Contaminants identified for groundwater in the OU-2A RI at Site 23 include 1,2,4-trimethylbenzene, Ethylbenzene, sec-butylbenzene, PAHs (BaP-equivalents, benzo(b)fluoranthene, naphthalene), and arsenic. Recent basewide groundwater sampling data collected between 2002 and 2006 at wells located in Site 23 indicate the following:

- VOCs (1,2,4-trimethylbenzene, ethylbenzene, and sec-butylbenzene) continue to be detected at concentrations above MCLs.
- Naphthalene continues to be detected at concentrations above MCLs and is being addressed as part of CAA-13.
- Arsenic has been detected sporadically at concentrations above MCLs but below background in two FWBZ monitoring wells (MW530-2 and MW530-3). Wells upgradient and downgradient have low arsenic concentrations. The area of elevated arsenic levels in groundwater is isolated.

Site 23 Data Gaps

No SWMUs at Site 23 require investigation under CERCLA.

No areas or physical features were identified in the RI as potential sources of soil and groundwater contamination that require further investigation under CERCLA (SulTech, 2005a). The presence of petroleum in soil and groundwater at Site 23 is being addressed under CAA-13 of the TPH Program.

2.7.2 OU-2B SITE BACKGROUNDS AND DATA GAPS

Sites 3, 4, 11, and 21 are designated as OU-2B under CERCLA and have been the subject of environmental investigations due to historical documentation of petroleum, oil, and lubricant usage related to bulk fuel service and ship and aircraft maintenance and repair. Previous investigations have been conducted under the IR Program, and include the collection of soil, groundwater, and soil gas samples at and adjacent to Sites 3, 4, 11, and 21. The following sections summarize the background and present the SWMU and data gap investigations that are proposed in this Work Plan. Groundwater for OU-2B will be investigated on a site-wide basis and is discussed in Section 2.7.2.5.

2.7.2.1 Site 3

Site 3 comprises approximately 50 acres and consists of EBS parcels 116A, 116B, 116C, 117, 118A, 118B, 120, 122, 128, 129, 131, and 209 (Figure 2-7). Site 3 is bordered by intensively developed areas and the airfield. Infrastructure includes parking lots, buildings, and roads, with a majority of the surface area paved with asphalt or concrete. Current uses of the site include vehicle parking, storage, and tenant leases.

Site 3 was previously the location of four concrete aviation gas underground storage tanks (USTs) (97A, 97B, 97C, and 97D), and a fifth UST constructed of steel (97E). The site is known as the Abandoned Fuel Storage Area with a portion designated as CAA-3A, CAA-3B, and CAA-3C. USTs 97A, 97C, and 97D were cleaned and closed in place, while USTs 97B and 97E were closed in place but not cleaned. Multiple releases of aviation gas from associated tanks and fuel line breaches were documented by former personnel employed by the NAS Alameda Supply Fuels Branch.

Former Building 109 at Site 3 was used as a gasoline truck loading stand. Historical site documents indicate surface staining was present in this area.

Building 112 was constructed in 1944 (IT, 2001). The 33,657-ft^2 building was formerly used for aircraft and ship repair and painting. Former activity areas at Building 112 included a supply storeroom, weight test area, zinc smelter, carpentry shop, upholstery shop, tool shop, and non-destructive testing laboratory. Chemical storage associated with building activities included hydraulic oil, cutting fluids, lubricants, paints, stains, varnishes, solvents, adhesives, cleaners, and corrosive materials. An asphalt-covered storage area around Building 112 was reported to be visibly degraded and paint stained (ERM-West, 1994). Two soil samples have been collected inside Building 112, both in the north-central portion of the building near the former carpentry shop. Analytical results for SVOCs, petroleum hydrocarbons, and arsenic were above the respective screening criteria (SulTech, 2005b).

A zinc smelter was formerly located within Building 112; however, no information has been located as to its location, size, and current status.

Contaminants for soil identified in the OU-2B RI for Site 3 include PCBs (Aroclor-1260), benzene, PAHs (as BaP-equivalents), and iron.

Groundwater contamination at this site is discussed in further detail in Section 2.7.2.5.

Site 3 Data Gaps

No SWMUs at Site 3 require additional investigation under CERCLA.

The following areas or physical features were identified in the RI as potential sources of soil and groundwater contamination and require further investigation under CERCLA (SulTech, 2005b):

- Additional investigation is required at Building 112 to delineate the horizontal and vertical extent of soil contamination in this area.
- Investigation is required in the zinc smelting area, if it can be located, to determine whether this historical feature contributed to soil and/or groundwater contamination.
- Additional investigation is required to delineate the horizontal and vertical extent of lead above MCLs in groundwater north of Buildings 517 and 222.

The site-wide groundwater data gap is discussed in further detail in Section 2.7.2.5.

2.7.2.2 Site 4

Site 4 comprises approximately 14 acres and consists of EBS parcels 133, 143, 144, and Subparcels 134A and 164A (Figure 2-8). Site 4 is approximately 65 percent open space, with infrastructure that includes paved parking lots, storage areas, and a sports field.

Building 360 at Site 4 was a former Aircraft Engine Facility that contained multiple process shops, including a blast shop, cleaning shop, paint shop, welding shop, plating shop, various aircraft component repair rooms, and non-destructive testing facilities (SulTech, 2005b). Building 360 was used for aircraft engine and airframe overhaul. The Phase I and Phase 2A investigations in 1991 identified VOCs, SVOCs (particularly PAHs), TPH, and metals in soil samples. Geochemical profiling conducted in 1997 indicated chlorinated hydrocarbons and aromatic hydrocarbons were identified to the depth investigated. A portion of the site is designated as CAA-3C, CAA-4A, CAA-4B, CAA-4C, and CAA-13.

A Six-Phase Heating (SPH) treatment system has been installed within Building 360 to address VOC contamination of soil and groundwater beneath and adjacent to the building. During SPH pre-construction activities, liquid was discovered in concrete vats located inside the Building 360 plating shop. Analysis of the liquid in the vats showed in hazardous levels of total chromium, hexavalent chromium, cadmium, and cyanide. Additional soil sampling was performed during the installation of the SPH grid, indicating chromium and cyanide contamination of shallow unsaturated soil in the southern portion of the middle vat. The potential extent of metals contamination is unknown, and the treatment of metals is not part of the full-scale SPH treatment system design.

Building 372 was a turbo propeller test cell. The exterior of the building was routinely sprayed with a PCB-containing fluid used for weed control.

Building 163 was constructed in 1939, and was the first building on the base. Building 163 has been used for equipment maintenance, plant services, aircraft overhaul and maintenance, a garage, a calibration shop, a machine shop, parts storage, and offices. The concrete floor of the building is reportedly in poor condition, with considerable staining in the machine shop. The building is currently leased by the Alameda Redevelopment and Reuse Authority. Soil samples have been collected in the southern portion of the building (borings 134-003-011, 134-003-012, 134-006-036, and CA04-04), and in the northwestern portion of the building (borings 134-003-013 and CA04-03). Three soil gas samples have been collected beneath the building slab to evaluate the potential risk of vapor intrusion to building occupants (SulTech, 2006). Subslab probes were installed within the subslab fill directly below the building flooring. The following contaminants were detected in all three of the soil gas probes: trichloroethene (TCE); 1,1,1-TCA; 1,1-DCA; 2-butanone; 4-methyl-2-pentanone; acetone; cis-1,2-DCE; toluene; and tetrahydrofuran. Other VOCs were detected in two of the three soil gas probes.

Contaminants for soil identified in the OU-2B RI for Site 4 include TCE, PCBs (Aroclor 1254), SVOCs (n-nitro-di-n-propylamine; dinitrotoluene; and 3,3'-dichlorobenzidine), PAHs (as BaP-equivalents) and metals (cadmium, copper, and silver).

Groundwater contamination at this site is discussed in further detail in Section 2.7.2.5.

Site 4 Data Gaps

Six SWMUs at Site 4 require investigation under CERCLA:

- AOC 372/SWMU 372 includes a former petroleum spill site associated with an engine testing facility in Building 372. The release was the result of an overflow of JP-5 from UST 372-2.
- AST 360E is a 3,000-gallon tank that contained paint and paint seal wastes. Although not currently in use, the tank is still present within its secondary containment unit.
- NADEP GAP 59 is an area associated with a non-permitted RCRA unit for drum storage of petroleum, oil, and lubricants. NADEP GAP 59 was associated with Building 163, Shop 65132. Currently, the area is contained within a tenant-occupied space and segregated by fencing.
- OWS 163 was associated with Building 163, which provided equipment maintenance. Building 163 previously housed a welding shop, machine shop, and storage of hazardous materials. The OWS is located outside of the southwest portion of Building 163.
- OWS 360 was associated with Building 360 that housed multiple process shops and generated hazardous waste, including halogenated and non-halogenated organics, scrap metals, paints, petroleum products, corrosives, and spent fuel. The OWS has been removed, but was previously located on the northeastern side of Building 360.
- OWS 372A was associated with Building 372 that operated as a jet engine test facility. Former building activities included engine testing and solvent cleaning. Building 372

stored petroleum oil and lubricants. OWS 372A had a capacity of 3,750 gallons, but its contents during operation are unknown. It is located west of Building 372.

The following areas or physical features were identified in the RI as potential sources of soil and groundwater contamination and require further investigation under CERCLA (SulTech, 2005b):

- Investigation is necessary to delineate the horizontal and/or vertical extent of PCBs in soil around Building 372.
- Investigation is necessary to delineate the horizontal and/or vertical extent of soil contamination at Building 163.
- Further investigation is necessary around storm sewer catch basin 5J-3B to determine the horizontal and vertical extent of 1,1-DCE in this area.
- Further investigation is necessary at Building 360 to determine whether historical activities at this building contributed contaminants to soil and/or groundwater. Since SPH treatment was recently conducted at Building 360, the investigation activities will focus on metals contamination in soil beneath and adjacent to Building 360.

The site-wide groundwater data gap is discussed in further detail in Section 2.7.2.5.

2.7.2.3 Site 11

Site 11 comprises approximately 5.3 acres and consists of EBS parcel 137 and subparcels 138A and 140A (Figure 2-9). Site 11 is approximately 95 percent intensively developed with infrastructure that includes paved parking lots, buildings, and roads.

Site 11 includes Building 14, which operated as an aircraft testing and repair facility until operations ceased in 1997. Soil vapor analyses revealed a VOC result in excess of the screening criteria at one location. Soil sampling to confirm the soil vapor result is necessary at Building 14. A 1996 photograph showed a large area of stained soil at the southwest of Building 14. Subsequent soil sampling in the area contained elevated concentrations of lead.

Former Building 118 housed a flower and shoe shop. Previous investigations identified the presence of methylene chloride and solvents in soil beneath this area.

Former Building 265 was used for plant services and aircraft overhaul. During the EBS, stains were noted in the east room of the building.

Contaminants for soil identified in the OU-2B RI for Site 11 include PCBs (Aroclor-1260), PAHs (as BaP-equivalents), and copper.

Groundwater contamination at this site is discussed in further detail in Section 2.7.2.5.

Site 11 Data Gaps

Six SWMUs at Site 11 require investigation under CERCLA:

- OWS 014A is located on the south side of Building 14. The 1,100-gallon OWS collected and separated oil-water mixtures from washing operations.
- OWS 014B is located on the south side of Building 14. The 1,100-gallon OWS collected and separated oil-water mixtures from washing operations.
- OWS 014C was an aboveground OWS that was formerly located on the north side of Building 14. The 1,300-gallon OWS collected and separated oil-water mixtures from washing operations.
- OWS 014D is located on the west side of Building 14. The 135-gallon OWS collected and separated oil-water mixtures from washing operations.
- OWS 014E was formerly located inside the northwest portion of Building 14. The current remnant of this feature are two concrete patches in the floor of the building. The capacity and contents of the OWS are unknown.
- UST(R) 06, UST 14-4 was a 1,000-gallon tank that contained waste oil.

The following areas or physical features were identified in the RI as potential sources of soil and groundwater contamination and require further investigation under CERCLA (SulTech, 2005b):

- Additional investigation is required at Former Building 118 to delineate the horizontal and vertical extent of methylene chloride and solvents in soil above preliminary remediation goals (PRGs).
- Investigation is necessary to delineate the horizontal and/or vertical extent of soil contamination at Building 14.
- The soil southwest of Building 14 has been identified for further characterization to delineate the horizontal and vertical extent of lead above the PRG.
- Soil and groundwater at former Building 265 have been identified for investigation to determine whether historical uses caused contamination of soil and/or groundwater.

The site-wide groundwater data gap is discussed in further detail in Section 2.7.2.5.

2.7.2.4 Site 21

Site 21 comprises approximately 7 acres and consists of EBS parcels 127, 135, 136, and 200 and subparcel 155A (Figure 2-10). Fifty percent of Site 21 is intensively developed with infrastructure that includes paved parking lots, buildings, and roads. Site 21 is included as part of CAA-3A.

Site 21 includes Building 162, which operated as a ship and aircraft maintenance shop from 1945 until operations ceased in 1997. Activities within Building 162 included engine testing, solvent cleaning and degreasing, use of miscellaneous chemicals, paint spray booth, storage of bulk fuels, and abrasive blasting. Soil vapor analyses revealed VOC results in excess of the screening criteria at 12 locations (SulTech, 2006).

Building 113 was used to overhaul air conditioning parts, welding, abrasive blasting, container repair, and as a paint shop. Soil vapor analyses revealed VOC results in excess of the screening criteria at one location (SulTech, 2006).

Building 398, a turbine accessories shop, was built at the former location of an aluminum recovery smelting operation. Previous investigation documents note that mercury spills occurred in the northeast corner of the building. Soil vapor analyses revealed no VOC results in excess of the screening criteria (SulTech, 2006).

Contaminants for soil identified in the OU-2B RI for Site 21 include PAHs (as BaP-equivalents), carbazole, and metals (copper, iron, and lead).

Groundwater contamination at this site is discussed in further detail in Section 2.7.2.5.

Site 21 Data Gaps

Three SWMUs at Site 21 require investigation under CERCLA:

- NADEP GAP 44 is associated with Building 398 and Shop 96327. Shop 96327 operated as a former aircraft engine testing facility. GAP 44 includes a non-permitted RCRA area used for the storage of petroleum, oil, lubricants, JP-5, and solvent. Containers included three 500-gallon square containers located outside Building 398.
- NADEP GAP 76 was located inside the southwest portion of Building 113, Shop 96212. Aerosol paint and rust remover, dope and lacquer thinner, some oil, enamel paint, and 1,1,1-TCA in aerosol cans and 55-gallon drums were managed at this location.
- NAS GAP 11 is a sump inside the first floor of Building 162 that was formerly used to collect waste oils generated during equipment maintenance activities.

The following areas or physical features were identified in the RI as potential sources of soil and groundwater contamination and require further investigation under CERCLA (SulTech, 2005b):

- Additional sampling will be performed to delineate the horizontal and vertical extent of lead above the PRG identified at former soil sample 126-002-003.
- Soil and groundwater at Building 113 have been identified for further characterization to determine whether historical activities impacted the soil and/or groundwater.

- Building 398 has been identified for further characterization to determine whether possible historical mercury spills impacted soil and/or groundwater.
- Investigation is necessary to delineate the horizontal and/or vertical extent of soil contamination at Building 162.

The site-wide groundwater data gap is discussed in further detail in Section 2.7.2.5.

2.7.2.5 OU-2B Site-Wide Groundwater

Site-wide groundwater was identified as a data gap for OU-2B (Figures 2-11 and 2-12). A series of commingled plumes has been identified, in the FWBZ and SWBZ, extending from Site 4 west through Sites 11 and 21 to Seaplane Lagoon. Two isolated plumes have been identified in Site 3 in the FWBZ.

In the vicinity of Building 360 at Site 4, three SWBZ plumes were identified during the RI (SulTech, 2005b). One plume originates from the northwest corner of Building 360, extending to the northwest; one plume originates from the west side of Building 360, extending to the west; and one plume originates on the eastern side of Building 360, extending to the west. The following organic and inorganic compounds were detected exceeding their MCLs at Site 4:

- VOCs (1,1-DCA; 1,1-DCE; cis-1,2-DCE; trans-1,2-DCE; 1,4-DCB; benzene; TCE; and VC)
- SVOCs (particularly PAHs)
- TPH
- Metals (aluminum, arsenic, chromium, lead, nickel, selenium, and thallium).

At Site 11, TPH-impacted groundwater has been identified for further action based on the TPH Strategy for Alameda Point and may be commingled with the plumes originating from Site 4. Solvents and metals were detected in groundwater at Site 21 during the RI (SulTech, 2005b).

Contaminants identified in the RI for site-wide groundwater at OU-2B include TCE, 1,1-DCA; 1,2-DCA; 1,1-DCE; 1,2-DCE [total]; 1,4-dichlorobenzene; 1,1,2-TCA; PCE; naphthalene; benzo(a)anthracene; BaP-equivalents; benzene; iron; manganese; hexalavent chromium; arsenic; and nickel. Recent basewide groundwater sampling data collected between 2002 and 2006 at wells located across OU-2B indicate the following:

- Chlorinated VOCs continue to be detected at concentrations above MCLs in FWBZ and SWBZ wells.
- Benzene continues to be detected at concentrations above MCLs in FWBZ well M03-04.
- Benzo(a)anthracene and BaP-equivalents have not been detected at concentrations above MCLs.

- Arsenic has been detected at concentrations above MCLs and background in five FWBZ and one SWBZ monitoring well(s) (M03-04, M03-05, M03-06, M03-10, MBG-3 and 37-MJ-MW1). Wells upgradient and downgradient have low arsenic concentrations. The area of elevated arsenic levels in groundwater is isolated.
- Chromium has been detected at concentrations above MCLs in three FWBZ monitoring wells (M03-13, M03-07, and M04-05) and one SWBZ monitoring well (D03-03).
- Hexavalent chromium was detected above MCLs beneath Building 360 and is associated with the chromium and other metals soil contamination in that area.
- Nickel has been detected at concentrations above background in one FWBZ monitoring well (MW360-1) and one SWBZ monitoring well (D03-03). Wells upgradient and downgradient have low nickel concentrations. The area of elevated nickel levels in groundwater is isolated.
- Manganese and iron are above background concentrations in a number of wells. In general, the elevated concentrations are associated with the same wells with other elevated metals levels. Concentrations of iron and manganese are also elevated in the three deep monitoring wells (86 ft to 96 ft) completed in the San Antonio formation (D04-01, D04-02 and D04-03).

OU-2B Site-wide Groundwater Data Gap

- Additional investigation is required to delineate the vertical and horizontal extent of groundwater contamination beneath OU-2B. This investigation will be centered around the VOC plumes identified at Sites 4, 11, and 21 and at the benzene and lead plumes identified at Site 3.
- The storm sewers south of Buildings 162 and 349 will be investigated to determine whether these features are secondary sources of groundwater contamination.

3.0 SOIL AND GROUNDWATER INVESTIGATION

As introduced in Sections 1.0 and 2.7, the RIs conducted for OU-2A and OU-2B served as the basis for developing the list of SWMUs that require assessment and the list of data gaps that require further characterization. The sampling approaches for the SWMU and data gap investigations are discussed by Site in this section. Table 3-1 and the SAP (Appendix A) provide the number of initial sampling locations, sampling depths, and analyses for each of the SWMU and soil and groundwater investigations. Table 3-2 lists the existing monitoring wells at OU-2A and OU-2B that will be sampled as part of this investigation. Pre-field activities are described in detail in Section 4.0 and field sampling methods are described in detail in Section 5.0 and the SAP (Appendix A).

To reduce the number of potential delays, decision trees (included in Section 5.0) and a Field Communication Plan (Appendix D) have been developed to assist the field team in making real-time decisions for additional investigation.

Conceptual Site Models (CSMs) are provided for each groundwater investigation site. These preliminary CSMs are intended to be updated during the course of the investigation by project personnel based on the data gap sampling results. Updated CSMs will be included in the Pre-design Data Summary Report.

3.1 DATA QUALITY OBJECTIVES

Sample collection methodology and analysis are described in the SAP (Appendix A). The SAP also presents Data Quality Objectives (DQOs) for the SWMU sampling and the soil and groundwater plume delineation sampling described in this section. The screening criteria for soil and groundwater are discussed in detail in the SAP (Appendix A). In general, residential PRGs and site-specific background concentrations, where appropriate, will be used as screening criteria for soil. MCLs will be used as screening criteria for groundwater.

3.2 OU-2A SITE 9 INVESTIGATION

The SWMUs and soil and groundwater investigation locations for Site 9 are discussed in the following sections. A CSM for the site is provided as Figure 3-1. Figures 3-2 and 3-3 show the proposed sampling locations.

3.2.1 OWS 410A and OWS 410B

The locations of the OWSs in Site 9 are shown on Figure 3-2. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to commencing soil sampling at these OWSs, the field geologist will visually inspect each OWS to determine whether there are visible liquids within the feature. If sufficient liquids are present, a sample of the liquid will be collected and the remaining liquid will be removed from each OWS.
- Once liquids have been removed from the OWS, the field geologist will determine the depth of the feature using a measuring tape.
- The field geologist will visually inspect the sides and base of each OWS for cracks.
- The field geologist will identify the influent and effluent piping locations for each OWS.
- If accessible, a boring will be placed through the base of the OWS. Soil samples will be retrieved from immediately below the bedding of the OWS, but no deeper than 1 ft below the bottom of the OWS. An additional soil sample will be retrieved from the vadose zone to ensure a total of two unsaturated soil samples are collected.
- A boring will be placed adjacent to each end of the OWS where influent and effluent piping is connected to the OWS. The initial sample from each piping area will be collected from approximately 0.5 ft below the piping connection to the OWS.
- If a crack in a sidewall of the OWS is observed, a soil sample will be collected adjacent to the base of the crack.
- To obtain parameters necessary to support the remedial design, the field geologist will select one boring from each OWS that will be completed to the saturated soil in the FWBZ. The field geologist will select the location based on accessibility, condition of the OWS, and field conditions. A saturated soil sample will be retrieved from this boring.
- The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.
- Holes in the base of the OWS will be sealed with concrete after samples are collected.

Collected samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out and step-down procedures described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.2.2 Site 9 Wash Rack Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine whether the wash rack contributed contaminants to soil. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to commencing soil sampling, the field geologist will inspect the wash rack for cracks and open joints that could be a preferred pathway to soil and groundwater.
- If there are cracks and/or open joints within the wash rack, soil borings will be placed at the locations of two of the most obvious cracks or open joints that could be a pathway to underlying soil. If there are no cracks and/or open joints, two soil borings will be placed within the former wash rack area, as shown on Figure 3-2.
- A soil sample will be collected from each boring from immediately below the base of the bedding material used for construction of the wash rack flooring or a maximum of 1 ft below the bottom of the current wash rack flooring. A second soil sample will be collected from the vadose zone in each boring.

Soil samples will be collected using a hand auger, as described in Section 5.0. Collected soil samples will be submitted for analyses, as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.2.3 Site 9 Groundwater Investigation

As described in the RI for OU-2A, additional groundwater sampling and monitoring is necessary to delineate the lateral and vertical extent of contamination in groundwater (see Section 2.0). Initial groundwater sampling, including the installation of groundwater monitoring wells, will be performed at locations shown in Figure 3-3. The current understanding of the extent of the groundwater plume was developed from information in the RI (SulTech, 2005a) and recent sampling results from site-wide groundwater sampling (ITSI, 2006). There have been two areas identified with elevated VOCs in the FWBZ. One area is under and west of Building 410. The second is near the southeast corner of Building 410, as identified by an elevated DPT sample in 1994. It should be noted that monitoring well MW410-3, which is directly downgradient of this area, is sampled in the quarterly basewide groundwater sampling and no exceedances above MCLs have been detected in the samples from this monitoring well. Monitoring wells MW410-1, MW410-2, and D09-01 are also sampled on a quarterly basis and no exceedances above MCLs have been detected in the samples from these monitoring wells.

Storm and sanitary sewers are to be investigated as secondary sources contributing to the groundwater contamination. They will be investigated only in areas inside the groundwater plume. They are not contributing to groundwater contamination in areas where groundwater contaminants are below the MCLs.

In conjunction with the data gap sampling, the final round of rebound sampling will be performed for chemical oxidation pilot test wells in Site 9.

The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- A tidal study for select monitoring wells to determine if contaminant distribution is tidally influenced (see Section 5.14).
- Collection of groundwater samples using Hydropunch® methods in at least four locations adjacent to sewer lines. Locations were selected along bends or joints in the sewer lines that are located within the groundwater plume.
- Collection of groundwater samples using Hydropunch® methods in at least five locations to delineate the extent of the groundwater plume.
- Installation of two FWBZ groundwater monitoring wells. One monitoring well will be placed immediately downgradient of the plume based on recent groundwater flow direction. An additional monitoring well will be placed in the southeast corner of the plume, which contains elevated concentrations of VOCs.
- Installation of one SWBZ groundwater monitoring well located in the southeast corner of the plume to determine if elevated concentrations of VOCs in the FWBZ have impacted the SWBZ.
- A slug test for newly installed monitoring wells to determine hydraulic conductivity.
- Quarterly sampling of all new groundwater monitoring wells and select existing groundwater monitoring wells (Table 3-2) at the site for one year.
- One-time rebound sampling of chemical oxidation pilot test groundwater monitoring wells (Table 3-2).

Groundwater samples will be retrieved and groundwater monitoring wells will be installed as described in Section 5.0. Collected groundwater samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out and step-down procedures described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s) for the Hydropunch® locations.

3.3 OU-2A SITE 13 INVESTIGATION

The SWMUs and soil and groundwater investigation locations for Site 13 are discussed in the following sections. A CSM for the site is provided as Figure 3-4. Figures 3-5 and 3-6 show the proposed sampling locations.

3.3.1 AOC 009

AOC 009 comprises five former ASTs that stored fuel (Figure 3-5). Concrete foundations are still present at the site. The ASTs were removed in 1990. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to sampling, the area will be cleared of debris and examined for visible signs of the former tank boundaries and any visible signs of leaks or spills (e.g., staining).
- If there are visible signs of staining, a soil boring will be placed at the location of the most obvious stained area for each concrete pad.
- If no staining is apparent, one boring will be placed beyond the edge of the concrete pad in the downgradient direction.
- Initial soil samples will be retrieved from 1 ft bgs. A second soil sample will be collected from the vadose zone in each boring.
- To obtain parameters necessary to support the remedial design, the field geologist will select one boring that will be completed to the saturated soil in the FWBZ. The field geologist will select the location based on accessibility, condition of the AST and field conditions. A saturated soil sample will be retrieved from this boring.
- The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

Collected samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out and step-down procedures described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.3.2 Site 13 Previous Borings B13-28 thru B13-32, B13-41, and B-IMF-06 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to delineate soil contamination above PRGs. Soil samples will be collected at the locations shown in Figure 3-5. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Three soil borings each will be completed in a triangular placement approximately 10 ft from each of the following previous borings: B13-30, B13-31, B13-32, and B13-41. A total of 12 borings will be installed. For each of the proposed borings, initial soil samples will be collected at a depth of 0.5 to 1 ft bgs in unpaved areas, or where paved, the bottom of the bedding material used for construction of the pavement or a maximum of 1 ft below the bottom of the pavement. A second soil sample will be collected from the vadose zone in each boring.
- Previous borings B13-28 and B13-29 are in close proximity to each other. A total of three borings will be completed in a triangular placement approximately 10 ft from the locations of these borings. For each of the proposed borings, initial soil samples will be collected at a depth of 0.5 to 1 ft bgs in unpaved areas, or where paved, the bottom of the bedding material used for construction of the pavement or a maximum of 1 ft below the bottom of the pavement. A second soil sample will be collected from the vadose zone in each boring.

- One boring will be placed immediately adjacent to previous boring B-IMF-06. A sample will be retrieved from approximately 5 ft bgs in this boring, or immediately above the vadose zone, whichever is shallower.

Soil samples will be collected using a hand auger, as described in Section 5.0. Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.3.3 Site 13 Incinerator Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine whether the former incinerator at Site 13 contributed contaminants to soil. Soil samples will be collected at the locations shown in Figure 3-5. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- The investigation area comprises approximately 79,200 ft^2. Soil borings will be placed throughout the former yard on 75-ft centers, resulting in 15 borings.
- The field geologist may bias the placement of borings to areas exhibiting surface discoloration or cracks.
- At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs. A second soil sample will be retrieved from the vadose zone in each boring.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.3.4 Site 13 Groundwater Investigation

Additional groundwater sampling and monitoring is necessary to delineate the lateral and vertical extent of groundwater contamination at Site 13. Site 13 contains two distinct plumes, which are shown on Figure 3-6. Plume 1 is currently being evaluated under the TPH Program as CAA-13 and will not be investigated as part of this Work Plan. However, Plume 2 is being investigated under this work plan for commingled contaminants. The current understanding of the extent of the groundwater Plume 2 was developed from information in the RI (SulTech, 2005a) and recent sampling results from the quarterly site-wide groundwater sampling (ITSI, 2006). The quarterly sampling includes nine monitoring wells at Site 13, seven wells in the fill and two in the Merritt Sands. Plume 2 is well defined to the north and east by quarterly sampling of monitoring wells M07-06, M07-07, and M13-09.

The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Conduct a tidal study for select monitoring wells to determine if contaminant distribution is tidally influenced (see Section 5.14).
- Collect groundwater samples in at least four locations using Hydropunch® methods to further delineate the lateral and vertical extent of contaminants above MCLs.
- Install one FWBZ groundwater monitoring well downgradient of the southern edge of Plume 2, which contains elevated concentrations of benzene.
- Conduct a slug test for the newly installed monitoring well to determine hydraulic conductivity.
- Conduct quarterly sampling of the new groundwater monitoring well and select existing groundwater monitoring wells (Table 3-2) at the site for 1 year.

Section 5.0 discusses collection of groundwater samples and groundwater monitoring wells. Collected groundwater samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out and step-down procedures described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s) for the Hydropunch® locations.

3.4 OU-2A SITE 19 INVESTIGATION

The SWMUs and soil and groundwater investigation locations for Site 19 are discussed in the following sections. A CSM for the site is provided as Figure 3-7. Figures 3-8 and 3-9 show the proposed sampling locations.

3.4.1 Site 19 Yard D-13 Soil Investigation

As described in the RI for this site, to support the selected remedy for soil, additional soil sampling is necessary to determine whether Yard D-13 contributed contaminants to soil. Soil samples will be collected at the locations shown in Figure 3-8. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to sampling, the investigation area will be cleared of debris.
- The investigation area comprises approximately 26,400 ft^2. Soil borings will be placed throughout the former yard on 50-ft centers, resulting in nine borings.
- The field geologist may bias the placement of borings to areas exhibiting surface discoloration or cracks.
- At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in each boring.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.4.2 Site 19 Groundwater Investigation

As described in the RI document for this site, additional groundwater sampling and monitoring is necessary to delineate the lateral and vertical extent of groundwater contamination. The proposed groundwater investigation and approximate plume boundary are shown in Figure 3-9. The current understanding of the extent of the groundwater contamination was developed from information in the RI (SulTech, 2005a) and recent sampling results from the quarterly site wide groundwater sampling (ITSI, 2006). The current quarterly sampling includes three monitoring wells, two monitoring wells in the FWBZ and one in the SWBZ. The only sample exceeding MCLs for VOCs is located in monitoring well MWD13-4 with exceedances of 1,2-DCA and PCE. The plume is well defined to the west and east by former DPTs and quarterly sampled monitoring wells MWD13-3 and M13-P.

The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- A tidal study for select monitoring wells to determine if contaminant distribution is tidally influenced (see Section 5.14).
- Collection of groundwater samples in at least two locations using Hydropunch® methods to further delineate VOCs above the MCLs (upgradient and downgradient).
- Installation of one FWBZ groundwater monitoring well downgradient of VOCs above the MCLs.
- A slug test for the newly installed monitoring well to determine hydraulic conductivity.
- Quarterly sampling of the new groundwater monitoring well and select existing groundwater monitoring wells (Table 3-2) at the site for one year.

Groundwater samples will be retrieved and groundwater monitoring wells will be installed as described in Section 5.0. Collected groundwater samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out and step-down procedures described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s) for the Hydropunch® locations.

3.5 OU-2A SITE 22 DATA GAP INVESTIGATION

The SWMUs and soil and groundwater investigation locations for Site 22 are discussed in the following sections. A CSM for the site is provided as Figure 3-10. Figure 3-11 shows the proposed sampling locations.

3.5.1 OWS 547

Sampling at OWS 547 will be conducted according to the procedure described in Section 3.2.1. The location of OWS 547 is provided on Figure 3-11.

3.5.2 Site 22 Previous Borings 547-5, 547-6, and 547-11 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine the horizontal and vertical extent of lead above the PRG in soil. Soil samples will be collected at the locations shown in Figure 3-11. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Three soil borings will be placed in a triangular pattern approximately 10 ft from the previous boring 547-5. Soil samples will be collected from 0.5 to 1 ft bgs in each boring. Deeper samples are not necessary, as historical results have determined the vertical extent of contamination.
- Three soil borings each will be placed in a triangular pattern approximately 10 ft from each of the previous borings: 547-11 and 547-6. If fill material from previous fuel line excavations is encountered, then locations will be moved outside of the excavated area. Soil samples will be collected from 0.5 to 1 ft bgs in each boring. A second soil sample will be retrieved from the vadose zone in each boring to determine the vertical extent of soil contamination.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.5.3 Site 22 Groundwater Investigation

As described in the RI for this site, the presence of petroleum in soil and groundwater at Site 22 is attributed to gas station and fuel releases and is addressed under CAA-4C of the TPH Program.

Additional investigation will not be conducted as part of this Work Plan. However, select monitoring wells in Site 22 may be utilized to assist in the OU-wide tidal study, which is described in Section 5.14.

3.6 OU-2A SITE 23 INVESTIGATION

No SWMUs or site soil are data gaps for Site 23. As described in the RI for this site, the presence of petroleum in soil and groundwater at Site 23 is addressed under CAA-13 of the TPH Program. Additional investigation will not be conducted as part of this Work Plan. However, select monitoring wells in Site 23 may be utilized to assist in the OU-wide tidal study, which is described in Section 5.14.

3.7 OU-2B SITE 3 INVESTIGATION

No SWMUs require investigation at Site 3.

The soil investigations for Site 3 are discussed in the following sections. A CSM for the site is provided as Figure 3-12. Figure 3-13 shows the proposed sampling locations for Site 3. The OU-2B site-wide groundwater assessment includes groundwater sampling to define the western extent of the lead plume in the northern portion of Site 3. This investigation is detailed in Section 3.11.

3.7.1 Site 3 Building 112 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine the horizontal and vertical extent of contaminants in soil. Soil samples will be collected at the locations shown in Figure 3-13. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Two soil borings will be placed within Building 112 in the vicinity of the former carpentry shop identified as Target Area 1 in the EBS (EMR-West, 1994). Soil samples will be collected from each boring from just below the base of the building foundation. A second soil sample will be retrieved from the vadose zone in each boring to determine the vertical extent of soil contamination.
- Aerial photographs, previous documents, and/or a field inspection will be performed to locate the former storage area outside Building 112. If the area can be identified, a maximum of five initial soil borings will be placed in the area. Soil samples will be collected from each boring from the base of the bedding material that was used for the asphalt pavement, or from a maximum of 1 ft below the bottom of the pavement.
- If further information is obtained to locate the area of the former zinc smelter, soil samples will be retrieved from this area. The number of samples will be determined by the field geologist based on the investigation area. The placement of soil borings will be biased to areas with staining, cracks, joints, and/or piping through the flooring around the zinc smelter, if present. Samples will be collected from below the base of the bedding material that was used for construction of the flooring, or from a maximum of 1 ft below the bottom of the current flooring.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.8 OU-2B SITE 4 INVESTIGATION

The SWMUs and soil investigation locations for Site 4 are discussed in the following sections. A CSM for the site is provided as Figure 3-12. Figure 3-14 shows the proposed sampling locations in Site 4. The OU-2B site-wide groundwater assessment includes groundwater sampling and well installation surrounding Building 360. This investigation is detailed in Section 3.11.

3.8.1 OWS 163, OWS 360, OWS 372A

Sampling at the OWSs for Site 4 will be conducted according to the procedure described in Section 3.2.1. The locations of the OWSs are provided on Figure 3-14.

3.8.2 AST-360E

The location of the AST-360E is provided on Figure 3-14. The AST is still present and located within secondary containment. To determine the nature and extent of possible contamination due to historical waste management activities, the proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to sampling, the area will be cleared of debris and the secondary containment pad will be examined for visible signs of leaks or spills (e.g., staining).
- One boring will be placed outside the edge of the secondary containment, on the downgradient side of the AST. The initial soil sample will be retrieved from 1 ft bgs. A second soil sample will be collected from the vadose zone. Additional borings may be placed at locations where visible signs of leaks or spills are observed.
- To obtain parameters necessary to support the remedial design, one boring will be completed to the saturated soil in the FWBZ. The field geologist will select the location based on accessibility, condition of the AST, and field conditions. A saturated soil sample will be retrieved from this boring.
- The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

Collected samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out and step-down procedures described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.8.3 AOC 372/ SWMU 372

The location of AOC 372/SWMU 372 is shown on Figure 3-14. AOC 372 is the location of two former USTs that were located one above the other. SWMU 372 is the location of a former surface release of JP-5 fuel. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to initiating sampling, the field geologist will confirm the location of both features by reviewing as-built drawings, historic aerial photographs, site inspection, and previous reports. If the location of the former UST remains in question, ground penetrating radar (GPR) will be used to locate the tank excavation.

- Prior to sampling, the area will be cleared of any debris.
- Four borings will be placed at locations outside the former UST excavation, one on each side.
- Two borings will be placed within the area of the surface release if the location can be determined.
- Initial soil samples will be collected from approximately 1 ft bgs. A second soil sample will be retrieved from the vadose zone in each boring to determine the vertical extent of soil contamination.
- To obtain parameters necessary to support the remedial design, the field geologist will select one boring from the investigation area that will be completed to the saturated soil in the FWBZ. The field geologist will select the location based on accessibility, condition of the investigation area, and field conditions. A saturated soil sample will be retrieved from this boring.
- The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

Collected samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out and step-down procedures described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.8.4 NADEP GAP 59

NADEP GAP 59 was located outside of Building 163. The location of the GAP is provided on Figure 3-14. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to initiating sampling, the field geologist will confirm the former GAP location by reviewing as-built drawings, historic aerial photographs, site inspection, and previous reports.
- Prior to sampling, the area will be cleared of any debris.
- The GAP area will be visually inspected for visible staining and cracks in the pavement or concrete floor.
- One sample location will be biased based on the above criteria towards areas of staining or cracks, if present. Otherwise, one boring will be advanced through the center of the GAP area.
- The initial sample will be collected below any bedding material for the concrete or asphalt flooring, but no deeper than 1 ft below the concrete or asphalt flooring. A second soil sample will be retrieved from the vadose zone in each boring.
- To obtain parameters necessary to support the remedial design, the boring will be completed to the saturated soil in the FWBZ. The field geologist will select the

location based on accessibility, condition of the GAP and field conditions. A saturated soil sample will be retrieved from this boring.

- The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.8.5 Site 4 Building 163 Soil Investigation

As described in the RI document for this site, additional soil sampling is necessary to determine whether Building 163 contributed contaminants to soil. Soil samples will be collected at the locations shown in Figure 3-14. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Two soil borings will be placed in Building 163 to determine the horizontal and vertical extent of soil contamination. The locations have been placed adjacent to the previous soil gas borings (163SG-01 and 163SG-02) in which elevated VOCs were indicated.
- At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in each boring.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.8.6 Site 4 Building 372 PCB Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine the horizontal and vertical extent of PCBs in soil. Soil samples will be collected at the locations shown in Figure 3-14. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Nine soil borings will be placed every 60 ft around the perimeter of the building, at a distance of about 5 ft from the outside of the building, as shown on Figure 3-14.
- Initial soil samples will be collected at the bottom of the bedding material that was used for construction of the current pavement or from a maximum of 1 ft below the bottom of the current pavement. A second soil sample will be retrieved from the vadose zone in each boring to determine the vertical extent of soil contamination.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.8.7 Site 4 Building 360 Storm Drain Investigation

As described in the RI for this site, additional soil sampling is necessary to determine the horizontal and vertical extent of contaminants in soil. Soil samples will be collected at the locations shown in Figure 3-14. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Six borings will be installed to define the horizontal extent of VOCs detected in previous samples collected from borings 143-SS-004 and 143-SS-005 located northwest and southwest of Building 360 respectively. As shown in Figure 3-14, three borings will be placed 10 ft from each nearby storm drain to define the horizontal extent of VOC-impacted soil found at 5 ft bgs. Soil samples will be collected at 6 ft. bgs. In addition, two borings will be installed adjacent to each storm drain to define the vertical extent of contamination detected in the previous sample. At these two locations, a soil sample will be collected from immediately above the saturated zone to define the vertical extent of contamination above PRGs.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s)

3.8.8 Site 4 Building 360 Metals Investigation

As described in the RI, additional sampling is necessary in the vicinity of Building 360 to delineate the horizontal and vertical extent of VOC and metals contamination in soil. Since SPH treatment was recently conducted at Building 360, the investigation activities will focus on metals contamination in soil beneath and adjacent to Building 360. Soil samples will be collected at locations shown in Figure 3-14. The proposed sampling activities are as follows:

- Nine borings will be installed at the northern end of Building 360, in the vicinity of monitoring well D03-03 to define the horizontal and vertical extent of metals detected in soil.
- Three borings will be installed at locations north, east and south of the SPH system in order to define the extent of metals contamination in soil in the vicinity of the former plating area.
- At each boring location, soil samples will be collected from the surface soil beneath the building, from approximately 3 ft bgs, and from the vadose zone.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.9 OU-2B SITE 11 INVESTIGATION

The SWMUs and soil investigation locations for Site 11 are discussed in the following sections. A CSM for the OU-2B site is provided as Figure 3-12. Figure 3-15 shows the proposed sampling locations to Site 11. The OU-2B site-wide groundwater assessment includes groundwater sampling and well installation in the vicinity of Building 14. This investigation is detailed in Section 3.11.

3.9.1 OWS 014A, OWS 014B, OWS 014C, OWS 014D, OWS 014E

Sampling at the OWSs for Site 11 will be conducted according to the procedure described in Section 3.2.1. The location of the OWSs is provided on Figure 3-15.

3.9.2 UST 14-4

The location of former UST 14-4 is shown in Figure 3-15. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to initiating sampling, the field geologist will confirm the former UST location by reviewing as-built drawings, historic aerial photographs, site inspection, and previous reports.
- If the location of the former UST remains in question, GPR will be used to locate the tank (if abandoned in place) or tank excavation.
- Prior to sampling, the area will be cleared of debris and examined for visible signs of the former tank boundaries and any visible signs of leaks or spills (e.g., staining).
- One boring will be placed near the center of the former tank location. Sampling will be initiated from the bottom of the tank excavation backfill if apparent, but no deeper than 5 ft bgs or the water table, whichever is shallower.
- To obtain parameters necessary to support the remedial design, the boring above will be completed to the saturated soil in the FWBZ. A saturated soil sample will be retrieved from this boring.
- The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

Collected samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out and step-down procedures described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.9.3 Site 11 Building 118 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine whether Building 118 contributed contaminants to soil. Soil samples will be collected at the locations shown in Figure 3-15. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to sampling, the investigation area will be cleared of debris.
- The investigation area comprises approximately 750 ft^2. Three borings will be placed in the footprint of the previous building, as shown in Figure 3-15.
- The field geologist may bias the placement of borings to areas exhibiting surface discoloration or cracks.
- At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in each boring.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.9.4 Site 11 Previous Boring M11-03 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine the horizontal and vertical extent of lead above the PRG in soil. Soil samples will be collected at the locations shown in Figure 3-15. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Three initial sample locations will be placed in a triangular arrangement approximately 10 ft from previous boring M11-03 to define the horizontal extent of lead-impacted soil found at 0.3 to 0.8 ft bgs. Soil samples from these locations will be retrieved from about 0.5 ft bgs.
- A soil boring will also be placed immediately adjacent to boring M11-03. A soil sample will be collected from 2.5 ft bgs to determine the vertical extent of lead contamination identified in the historical sample.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.9.5 Site 11 Building 265 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine whether Building 265 contributed contaminants to soil. Soil samples will be collected at the locations shown in Figure 3-15. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to sampling, the investigation area will be cleared of debris.

- The investigation area comprises approximately 375 ft^2. Two soil borings will be placed in the footprint of the previous building, as shown in Figure 3-15.
- The field geologist may bias the placement of borings to areas exhibiting surface discoloration or cracks.
- At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in each boring.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.9.6 Site 11 Building 14 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine whether Building 14 contributed contaminants to soil. Soil samples will be collected at the locations shown in Figure 3-15. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to sampling, the investigation area will be cleared of debris.
- One soil boring will be placed adjacent to a previous soil gas boring (14SG08), in which elevated VOCs were indicated.
- At the boring, an initial soil sample will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in the boring.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.10 OU-2B SITE 21 INVESTIGATION

The SWMUs and soil investigation locations for Site 21 are discussed in the following sections. A CSM for OU-2B is provided as Figure 3-12. Figure 3-16 shows the proposed sampling locations for Site 21. The OU-2B site-wide groundwater assessment includes groundwater sampling and well installation surrounding Buildings 113 and 162. This investigation is detailed in Section 3.11.

3.10.1 NAS GAP 11

NAS GAP 11 is a sump located inside Building 162. The location of NAS GAP 11 is provided on Figure 3-16. Per the June 16, 2006 site visit, it was agreed upon with agencies that one sample would be collected from beneath the floor of the sump. The sampling activity is summarized as follows:

- Prior to sampling, the area will be cleared of any debris.
- The sump floor will be visually inspected for visible cracks.
- One boring will be advanced through the bottom of the sump. The final sample location will be biased based on the above criteria towards cracks, if present.
- The initial sample will be collected below any bedding material for the concrete, but no deeper than 1 ft below the concrete floor. A second soil sample will be retrieved from the vadose zone.
- To obtain parameters necessary to support the remedial design, the boring above will be completed to the saturated soil in the FWBZ. A saturated soil sample will be retrieved from this boring.
- The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

Collected samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out and step-down procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.10.2 NADEP GAP 44

NADEP GAP 44 is located outside Building 398 and consisted of three 500-gallon bowser containers. The only remnant visible of the GAP location is a partial square of concrete painted red and white. The remainder of the GAP area has been asphalted over during remediation activities conducted at CAA-3A. The location of NADEP GAP 44 is provided on Figure 3-16. The proposed sampling activities and rationale for the selection of sample locations at the site are summarized as follows:

- Prior to initiating sampling, the field geologist will confirm the former GAP location by reviewing as-built drawings, historic aerial photographs, site inspection, and previous reports.
- Prior to sampling, the area will be cleared of any debris.
- The exposed area will be visually inspected for visible staining and cracks in the pavement or concrete floor.
- One sample location will be biased based on the above criteria towards areas of staining or cracks, if present. Otherwise, one boring will be advanced through the center of the exposed area. A second boring will be advanced at the other end of the GAP from the exposed area.

- The initial samples will be collected below any bedding material for the concrete or asphalt flooring, but no deeper than 1 ft below the concrete or asphalt flooring. A second soil sample will be retrieved from the vadose zone in each boring.
- To obtain parameters necessary to support the remedial design, the field geologist will select one boring from the GAP that will be completed to the saturated soil in the FWBZ. The field geologist will select the location based on accessibility, condition of the GAP, and field conditions. A saturated soil sample will be retrieved from this boring.
- The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out and step-down procedures described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.10.3 NADEP GAP 76

NADEP GAP 76 is located within Building 113. The location of the GAP is provided on Figure 3-16. Per the June 16, 2006 site visit, it was agreed upon with the agencies that one groundwater sample would be collected from a location outside Building 113, adjacent to the location of the GAP. The sampling activity is summarized as follows:

- The field geologist will retrieve a groundwater sample from a soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

Collected samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out and step-down procedures described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.10.4 Site 21 Previous Boring 126-002-003 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine the horizontal and vertical extent of lead above the PRG in soil. Soil samples will be collected at the locations shown in Figure 3-16. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Two initial borings will be placed 10 ft from 126-002-003 to define the horizontal extent of lead-impacted soil found at 0.5 to 1 ft bgs (Figure 3-16). One boring will be placed southwest of 126-002-003 and one boring will be placed southeast of 126-002-003. Initial soil samples will be collected from about 0.5 to 1 ft bgs.

- To define the vertical extent of lead-impacted soil, a third boring will be installed adjacent to previous boring 126-002-003. A soil sample will be retrieved from about 3 ft bgs in this boring.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.10.5 Site 21 Building 113 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine whether Building 113 contributed contaminants to soil. Soil samples will be collected at the locations shown in Figure 3-16. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to sampling, the investigation area will be cleared of debris.
- One soil boring will be placed within Building 113 adjacent to the previous soil gas sample (113SG-03), which indicated the presence of elevated VOCs.
- An initial soil sample will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in the soil boring.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.10.6 Site 21 Buildings 162 and 398 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine whether these buildings contributed contaminants to soil. Soil samples will be collected at the locations shown in Figure 3-16. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to sampling, the investigation area will be cleared of debris.
- Soil sampling will be performed in Building 162 adjacent to 12 previous soil gas collection borings with elevated VOCs, as shown in Figure 3-16.
- The mercury investigation area within Building 398 comprises approximately 28,900 ft^2. Borings will be placed on 75-ft centers, resulting in seven borings.
- The investigation area between Building 398 and 399 comprises approximately 500 ft^2. Borings will be placed on 50-ft centers resulting in three borings.
- The field geologist may bias the placement of borings to areas exhibiting surface discoloration or cracks.

- At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in each boring.

Collected soil samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out procedure described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s).

3.11 OU-2B SITE-WIDE GROUNDWATER INVESTIGATION

As described in the RI for this site, additional groundwater sampling and monitoring is necessary to delineate the lateral and vertical extent of groundwater contamination. The proposed groundwater investigations and approximate plume boundaries are shown in Figures 3-17 and 3-18. The site-wide investigation will focus on delineating the extent of benzene, VOC, and lead contamination in the FWBZ and the extent of VOC and metals (chromium and nickel) contamination in the SWBZ.

The extent of the VOC groundwater contamination in the FWBZ has been well-defined in most areas of OU-2B from former studies and the basewide groundwater sampling program. Two FWBZ groundwater monitoring wells will be installed at the locations depicted on Figure 3-17. The monitoring well in the northeast portion of OU-2B will be installed to complete the delineation in the southern direction of a small benzene plume. The remainder of the plume is defined with other existing monitoring wells and DPTs. The monitoring well north of Building 360 near Atlantic Avenue will be installed to complete delineation of the VOC plume in this area.

Storm sewers south of Buildings 162 and 349 could be acting as secondary sources for groundwater contamination of the FWBZ in OU-2B in the Site 21 area. Previous investigations identified that most of the storm sewer lines south of Buildings 162 and 349 are below the water table. Hydropunch® locations will be installed in the FWBZ along the storm sewer lines at the six locations depicted in Figure 3-17. The locations selected are biased to line connections, manholes, catch basins, and bends in the lines, where releases are most likely to originate. The remainder of the storm sewer lines in the area are located outside of the groundwater plume in the FWBZ. These storm sewer lines are not contributing to groundwater contamination in areas where groundwater contaminants are below the MCLs and, therefore, will not be sampled.

Four Hydropunch® locations will be installed in the FWBZ as depicted in Figure 3-17 in the northern portion of Site 3, to delineate a lead plume identified during previous investigations in 2001 and 2002 (SulTech, 2005b). Groundwater samples will be collected from three locations to delineate the western boundary and the vertical extent of the plume. Groundwater samples will be collected from one location adjacent to previous sample location (S03-DGS-DP14) with the highest concentration of lead in order to assess current concentrations and define the vertical extent of the plume.

The extent of the VOC groundwater contamination in the SWBZ (below the fill and BSU) has not been well-defined in OU-2B. Figure 3-18 depicts the current understanding of the horizontal extent of groundwater contamination at OU-2B from previous investigations and the basewide groundwater sampling program. There appear to be four source areas of VOC contamination in the groundwater. One location is northwest of Building 360, the second is at the northeast corner of Building 360, the third is on the west side of Building 360, and the fourth is located between Buildings 14 and 162.

Multi-level monitoring wells will be installed at 12 locations, as depicted in Figure 3-18, and screened at the five discrete depths of 15 to 20 ft, 25 to 30 ft, 35 to 40 ft, 45 to 50 ft, and 55 to 60 ft bgs. The four multi-level monitoring wells located along the Seaplane Lagoon will be installed to determine the chemistry of the groundwater prior to discharging into the lagoon. Seven of the multi-level monitoring wells will be placed along the center line of the groundwater contamination and in source areas to obtain a vertical profile of the contamination and determine the depth intervals where the bulk of the contaminant mass is migrating. The multi-level monitoring well located south of Building 14 will be used to determine if the contaminant plume emanating from the west side of Building 360 is limited to the current understanding or migrating further to the west towards Seaplane Lagoon.

Twenty-five CPT/Hydropunchs® will be installed, as depicted in Figure 3-18, with groundwater sampling at 15 to 20 ft, 25 to 30 ft, 35 to 40 ft, 45 to 50 ft, and 55 to 60 ft bgs. The CPT/Hydropunch® locations will assist in developing a 3-dimensional understanding of the contaminant distribution at OU-2B along with the 12 multi-level monitoring wells and existing wells. The three CPT/Hydropunch® locations in the area of the contaminant plume on the east side of Building 360 will be advanced an additional 10 ft and samples will be collected from 65 to 70 ft bgs, because previous sampling suggests that contamination may extend to this depth. The three CPT/Hydropunch® locations in the area of monitoring well D03-03 will be used to define the vertical and horizontal extent of chromium and nickel contamination.

The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Conduct a tidal study for select monitoring wells to determine if the plumes at OU-2B are tidally influenced (see Section 5.14).
- Install two FWBZ groundwater monitoring wells to delineate the benzene plume and the northern extent of a VOC plume (Figure 3-17).
- Collect Hydropunch® samples from the FWBZ at six locations adjacent to sewers near Buildings 162 and 349 (Figure 3-17) to determine whether the sewers are a contributing source to groundwater contamination.

- Collect Hydropunch® samples from the FWBZ at four locations north of Buildings 222 and 517 to define the horizontal and vertical profile of lead contamination (Figure 3-17).
- Install 12 multi-level groundwater monitoring wells in the SWBZ with completions at each of the 10 locations at 15 to 20 ft, 25 to 30 ft, 35 to 40 ft, 45 to 50 ft, and 55 to 60 ft bgs to define the vertical profile of the groundwater contamination (Figure 3-18).
- Collect saturated soil samples at the 25-to 30-ft interval at each multi-level monitoring well location and analyze for remediation design parameters.
- Install 25 CPT/Hydropunchs® from the SWBZ with groundwater sampling at each of the 20 locations at 15 to 20 ft, 25 to 30 ft, 35 to 40 ft, 45 to 50 ft, and 55 to 60 ft bgs to define the horizontal and vertical profile of the groundwater contamination (Figure 3-18).
- Conduct a slug test for newly installed monitoring wells to determine hydraulic conductivity.
- Conduct quarterly sampling of all new groundwater monitoring wells (Figures 3-17 and 3-18) and select existing groundwater monitoring wells (Table 3-2) at the site for 1 year.

Saturated soil and groundwater samples will be retrieved and groundwater monitoring wells will be installed as described in Section 5.0. Collected soil and groundwater samples will be submitted for analyses as indicated on Table 3-1 and in the SAP (Appendix A). Consistent with the step-out and step-down procedures described in Section 5.0, subsequent samples may be necessary to delineate the impacted area(s) for the Hydropunch® locations.

This page intentionally left blank.

4.0 PRE-FIELD ACTIVITIES

This section describes specific activities involved with preparing for and implementing the field work. Activities include permitting and notifications, kick-off meeting, mobilization, utility clearance, and traffic control.

4.1 PERMITTING AND NOTIFICATIONS

Staff will complete the required notifications for this work prior to start of the fieldwork. Pursuant to CERCLA Section 121(e), monitoring well or soil boring permits are not required for on-site response actions. Permit application forms for monitoring wells and borings will be filed with the Alameda County Public Works Agency – Water Resources Division as a courtesy, even though exempt under CERCLA. Staff will notify Underground Service Alert to obtain utility clearance at least 48 hours prior to intrusive activities. Notifications will be made in advance to the DoN, the Caretaker Site Office (CSO), and the Resident Officer In Charge of Construction (ROICC). In addition, a Fact Sheet will be distributed to residents and tenants in the investigation area prior to the commencement of fieldwork.

4.2 KICK-OFF MEETING

A kick-off meeting will be held prior to commencement of the fieldwork. The meeting will include the DoN Remedial Project Manager (RPM), Tetra Tech EC, Inc. (TtEC) Project Manager, TtEC Technical Lead, TtEC Project Quality Control Manager (PQCM), TtEC Project Field Lead, the CSO, and the ROICC. The purpose of this meeting is to develop a mutual understanding of the work to be performed, CQCP details (including forms to be used), administration of on-site work, and coordination of fieldwork. TtEC will prepare minutes of the meeting for submittal to the DoN.

4.3 MOBILIZATION

Mobilization activities include marking drilling locations, utility clearance (described in Section 4.4), and movement of equipment and materials to the site, as well as health and safety awareness, training, and site orientation of field personnel. Mobilization will also involve identifying an equipment storage area, general support area, and decontamination area to support project activities within the existing contractor's staging, storage, and office areas. Use of the staging area will be coordinated with the RPM, the CSO, and the ROICC.

4.4 UTILITY CLEARANCE

Prior to intrusive activities, staff will notify Underground Service Alert to obtain utility clearance.

Additionally, a subcontractor will conduct a geophysical survey within a 10-ft radius of each proposed sampling location using GPR and/or an electromagnetic induction instrument. These instruments produce an image of the subsurface conditions and identify discontinuities in the soil column that may indicate the presence of buried utility lines or other obstructions. Subsurface utility maps will be reviewed to evaluate if any utilities or other features exist in the proposed sampling areas. The existing ground surface at locations of suspected underground utilities will be marked with paint and/or stakes.

4.5 TRAFFIC CONTROL

Traffic control will be implemented at the site to enable efficient completion of the work activities in a safe working environment, while minimizing the impact on the normal traffic flow. Additional information is provided in Section 7.0, Traffic Control Plan, of this Work Plan.

5.0 FIELD ACTIVITIES

The following sections describe the types of field activities that will be conducted and the methods that will be used during each activity. Site-specific details, such as number and location of samples and sample analytical method procedures, are described in Section 3.0. Additional field sampling procedures, description of sampling containers, and laboratory analysis procedures can be found in the SAP (Appendix A). Data collected will be of sufficient quality to achieve the data quality objectives discussed in Section 3.0 and the SAP (Appendix A). IDW generated during field activities will be handled and disposed in accordance with the Waste Management Plan (WMP) provided in Section 6.0.

5.1 LOCATING PREVIOUS SAMPLING POINTS

At select sites, samples are proposed to be retrieved adjacent to previous sampling locations. Where surface evidence of previous sampling points may no longer be present, previous sample location coordinates will be obtained from original survey data (if available) or will be generated using GIS software and site figures. Previous sample location coordinates will be verified by the field geologist using a hand-held differential Global Positioning System (GPS) instrument. For example, if a hand-held differential GPS instrument cannot be used within a building, previous locations will be identified by existing scaled drawings and use of a tape measure. The GPS/taped locations will be field-checked by the field geologist for signs of previous sampling activities such as disturbed ground or patches in the pavement. If a relevant feature is identified within 10 ft of the GPS/taped location, the feature will be identified as the previous sample point at the discretion of the field geologist. If no such relevant features are identified, the GPS/taped location will be used as the previous sample location. Prior to marking the sampling locations, the area will be cleared of debris. Sample locations will be marked with cones, flags, or paint.

5.2 OWS LIQUID SAMPLING AND LIQUID REMOVAL

Each OWS will be visually inspected for the presence of liquid. If liquid is present, a field determination will be made whether or not there is sufficient liquid volume to collect a sample. Remaining liquid will be removed using a vacuum truck and will be disposed in accordance with the WMP (Section 6.0).

5.3 HAND AUGER AND DPT SAMPLING

Soil samples will be collected using a hand auger or DPT rig. Locations in paved areas, such as parking lots, GAPs, OWSs, roads, or floors, will be cored prior to sampling.

Hand auger borings will be completed using two different-sized auger buckets. The larger size auger bucket, approximately 4 inches in diameter, will be used to clear the boring to the top of the desired sample interval. Once that interval is reached, a clean piece of polyvinyl chloride

(PVC) pipe will be lowered into the boring to keep the side walls open and prevent sloughing of material from the upper intervals into the desired sample interval. A smaller auger bucket, approximately 2 inches in diameter, will be used to collect the sample. After the initial sample is collected, the PVC pipe will be removed from the boring and the 4-inch diameter auger will be used to bore the hole to the top of the next sample interval. The PVC pipe will be lowered into the boring and the smaller auger will be used to collect the sample. The auger buckets and PVC pipe will be cleaned between each sample interval.

A DPT rig will be used to collect soil samples at depths greater than 5 ft bgs. The DPT rig will push the Geoprobe® DT325 dual tube sampling system (or equivalent) into the ground by percussive hammering, hydraulic pushing, or static pushing. An outer tube and inner soil-coring liner will be simultaneously advanced. The outer tube serves to hold back formation material while the inner liner is retrieved and soil samples are extracted. The outer tube typically consists of nominal 3¼-inch-diameter steel, flush-threaded rods typically 3 to 5 ft in length. An inner clear PVC liner or equivalent is fitted inside the outer tube. The liner is typically as long as the outer tube and contains an integrated core catcher. The dual tube sampling system is advanced into the formation, filling the PVC liner or equivalent. The liner is retrieved with an inner rod string. A new liner and additional length of inner rod is added and the liner is lowered to the bottom of the outer tube. An additional length of outer tube is added and the dual tube sampling system is advanced until the desired sample depth is reached.

The hand auger and DPT equipment will be decontaminated between sample locations (see Section 5.18). Following sample collection, the boring will be backfilled with a bentonite-cement grout. The grout will be poured from the ground surface. The surface will be restored to pre-sampling conditions.

5.4 LOGGING OF SOIL BORINGS

Soil from borings will be logged in accordance with the Unified Soil Classification System (USCS) visual-manual procedure (Howard, 1986) and Munsell® (GretagMacbeth, 1994) soil chart. Soil core samples will be collected and field-screened for organic vapors using photoionization detector (PID) headspace analysis in accordance with the following procedures:

- The PVC liners or equivalent will be retrieved and sliced open to expose the soil core. One half of the soil core will be immediately placed in a clean plastic bag, sealed, labeled, and placed on ice in a cooler. The other half of the core (exposed) will be initially screened by passing a PID approximately 1 inch from the surface of the core. PID readings will be recorded in the field logbook and on the boring log.
- Headspace field-screening increments will be based on initial PID readings, lithology, color change, odor, or staining.
- A portion of the exposed core sample will be placed in a clean, plastic, resealable bag to measure the headspace reading. The bag will be filled approximately one-half with

soil, leaving one-half empty. After a minimum of 5 minutes, the probe will be inserted into the bag to sample the headspace.

- Field screening readings and ambient background readings will be recorded in the field logbook and on the boring log at the appropriate interval.
- Soil samples will be collected for chemical and/or physical testing as described in the SAP (Appendix A) and as determined from the headspace reading from the equivalent interval of the core.

5.5 SOIL SAMPLING STEP-OUT CRITERIA

Soil samples will be collected by various methods at numerous sites. If the screening criteria for site-specific contaminants of concern (COCs) are exceeded in the initial sample, additional samples will be required to characterize the horizontal extent of contamination above the screening criteria. The initial soil samples will be analyzed for the suite of analytes specified for the specific area. Step-out samples will be analyzed for the suite of analytes related to the exceedance of the initial soil samples (i.e., if TCE exceeds the screening criteria in the initial samples, then step-down and step-out samples will be analyzed for VOCs). The step-out sampling procedure for soil is described below:

- The first step-out boring will be placed 10 ft from the initial sample location. The soil sample will be retrieved from this boring at a depth corresponding to the depth of the sample from the initial boring that contained the elevated COC concentration(s).
- If the first step-out boring yields concentrations of COCs in excess of the screening criteria, a second step-out boring will be placed no greater than 50 ft from the first step-out boring. Soil samples will be retrieved from this boring at a depth corresponding to the depth of the samples from the first step-out boring that contained the elevated COC concentration(s).
- If the second step-out boring yields concentrations of COCs in excess of the screening criteria, a third step-out boring will be placed no greater than 50 ft from the second step-out boring. Soil samples will be retrieved from this boring at a depth corresponding to the depth of the samples from the second step-out boring that contained the elevated COC concentration(s).
- If the second step-out boring yields no detectable concentrations of the COCs, a third boring will be placed at the mid-point between the first and second step-out borings. Soil samples will be retrieved from this boring at a depth corresponding to the depth of the sample(s) from the first step-out boring that contained the elevated COC concentration(s). At the completion of this boring, the lateral extent of contamination will be considered to be well-defined.
- If the third step-out sample reveals a COC concentration greater than the screening criteria, the project team will confer with agency representatives to determine whether further sampling is warranted.

The step-out criteria for soil sampling is also provided in Figure 5-1. The field geologist may adjust, amend, or terminate step-out boring locations based on obstructions or other site conditions. Additionally, the field geologist may terminate or otherwise amend a portion of the step-out procedure if a step-out boring would overlap with another soil boring.

5.6 CPT LOGGING

Continuous lithologic logs will be collected at select sites using a CPT rig. In addition, CPT lithologic logs will be used to determine groundwater monitoring well screen locations, where appropriate.

Access through concrete-paved areas will be gained by coring through the pavement. Access through asphalt-paved areas will be gained using the CPT rig. A hand auger or post-hole digger, the same diameter as the sampling equipment, will be used to clear each boring to 5 ft bgs to avoid underground utilities and/or obstructions.

CPT technology consists of hydraulically pushing (using up to 80,000 pounds of force) a drive casing (typically 2 inches in diameter) terminated with a conical tip into the ground. As the CPT drive casing is advanced, the soil is laterally displaced. Therefore, soil cuttings are not generated. Electronic sensors located in the tip record tip resistance, local sleeve friction, and pore water pressure as it is advanced through the soil. A computer on the CPT rig analyzes the data and generates continuous, approximately real-time, lithologic logs of subsurface materials.

The CPT lithologic boring will be backfilled pending collection of the Hydropunch® sample. Boring decommissioning will occur in this order to eliminate the possibility of cement-bentonite grout migrating from the CPT lithologic boring and impacting groundwater sample quality. The CPT lithologic boring will be tremie-backfilled using cement-bentonite grout. The cement-bentonite grout will be allowed to set for approximately 24 hours. The boring will be topped off with additional grout, as needed. Then the surface will be restored to pre-investigation conditions.

Continuous soil cores will be collected at four select locations using a DPT rig to calibrate the CPT logs across the sites.

5.7 HYDROPUNCH® GROUNDWATER SAMPLING

Groundwater samples will be collected using a Hydropunch® sampler. If the groundwater sample depth interval is not predetermined, the groundwater sample will be collected from a second DPT or CPT boring located no more than 5 ft from the first boring (based on site-specific conditions). A CPT lithologic log, if available, will be used to aid in selecting the depth intervals for Hydropunch® groundwater sampling. The following steps summarize the sampling procedures:

- The DPT or CPT rig will be used to drive the Hydropunch® sampling equipment to the desired sampling depth. The Hydropunch® sampling system will consist of a ¾-inch-inside-diameter PVC or stainless steel slotted screen, 3 to 5 ft in length, attached to a metal, conical drive tip. The screen will be housed inside a 2-inch-outside-diameter drive casing.
- When the Hydropunch® sampler reaches the sampling depth (straddling the depth of the corresponding soil sample interval), the drive casing will be retracted, exposing the 3- to 5-ft Hydropunch® screen interval to the saturated formation.
- The Hydropunch® screen interval will be developed using a bladder pump until the following conditions have been met or a maximum of 1 hour of pumping time has elapsed:
  - Turbidity has stabilized to less than 50 nephelometric turbidity units (NTUs)
  - Consecutive readings are within +/- 5 percent for conductivity, +/- 0.2 units for pH, and +/- 1 degree Celsius
- Development parameters and approximate water volumes will be reported on the development forms. Field instruments for measurement of water parameters, including temperature, oxidation reduction potential (ORP), salinity, pH, and specific conductance, will be calibrated prior to use as described in the SAP (Appendix A).
- The groundwater samples will be collected using a bladder pump.

The sampling equipment will be recovered and decontaminated as detailed in Section 5.18. A new length of PVC screen or decontaminated stainless steel screen will be used for each Hydropunch® sample. If additional groundwater samples are required, the Hydropunch® sample will be reinserted into the hole, pushed to the next interval, and the sampling process will be repeated.

After completing groundwater sampling at each location, the Hydropunch® boring will be tremie-backfilled with cement-bentonite grout. The cement-bentonite grout will be allowed to set for approximately 24 hours. The boring will be topped off with additional grout, as needed, and the surface will be restored to pre-investigation conditions.

5.8 GROUNDWATER STEP-DOWN AND STEP-OUT CRITERIA

Groundwater samples will be collected by Hydropunch® methods at various locations at the sites. If the screening criteria (MCLs) for site-specific COCs are exceeded in the initial sampling, additional samples will be required to characterize the vertical and horizontal extent of groundwater contamination above the screening criteria. The following sections describe the step-down and step-out procedures for groundwater sampling.

5.8.1 Groundwater Step-Down Criteria

If initial groundwater samples in the FWBZ yield concentrations of COCs in excess of the screening criteria, step-down groundwater sampling will be performed into the underlying water-bearing zone. The collected samples will be analyzed for the suite of chemicals that contain the COCs from the upper groundwater zone. If the step-down sample yields no detectable concentrations of the COCs, the vertical extent of contamination will be considered to be well-defined. If the step-down sample yields concentrations of COCs in excess of the screening criteria, further step-down sampling will be performed.

The groundwater step-down procedure is also provided in Figure 5-2. The field geologist may adjust sampling locations based on obstructions or other site conditions. Additionally, the field geologist may terminate or otherwise amend a portion of the step-down procedure if sufficient groundwater data are available from previous investigations.

5.8.2 Groundwater Step-Out Criteria

If groundwater samples contain COC concentrations in excess of the screening criteria (MCLs), step-out sampling will be performed within the groundwater zone. The collected samples will be analyzed for the suite of chemicals that contain the COCs from the previous groundwater sample. The step-out sampling procedure for groundwater is described below:

- The first step-out boring will be placed no greater than 100 ft from the initial groundwater sample location. If the first step-out boring yields no detectable concentrations of the COCs, the lateral extent of contamination in the groundwater zone will be considered to be well-defined.
- If the first step-out boring yields concentrations of COCs in groundwater in excess of the screening criteria, a second step-out boring will be placed no greater than 100 ft from the first step-out boring. If the second step-out boring yields no detectable concentrations of the COCs, the lateral extent of contamination in the groundwater zone will be considered to be well-defined.
- If the second step-out boring yields concentrations of COCs in excess of the screening criteria, a third step-out boring will be placed no greater than 100 ft from the second step-out boring. If the third step-out boring yields no detectable concentrations of the COCs, the lateral extent of contamination in the groundwater zone will be considered to be well-defined.
- If the third step-out sample reveals a COC concentration in groundwater greater than the screening criteria, the project team will confer with agency representatives to determine whether further step-out sampling is warranted.

The step-out criteria for groundwater sampling are also provided in Figure 5-3. The field geologist may adjust step-out boring locations based on obstructions or other site conditions. Additionally, the field geologist may terminate or otherwise amend a portion of the step-out procedure if a step-out boring would overlap with another soil boring and/or Hydropunch® location.

5.9 FWBZ GROUNDWATER MONITORING WELL INSTALLATION

New monitoring wells will be installed in the FWBZ (the artificial fill) at select sites using hollow-stem auger drilling methods. Prior to field activities, the base of the artificial fill or top of the BSU will be mapped using available geologic data.

At each well location, prior to drilling, a hand auger or post-hole digger will be used to advance the boring to a depth of 5 ft bgs. Once a depth of 5 ft bgs is reached, a hollow-stem auger drill rig will be used to advance the boring. After the bottom of the artificial fill is reached, the well will be constructed inside the nominal 8-inch inner diameter (ID) augers. FWBZ monitoring well completion schematics are shown in Figures 5-4 and 5-5. Each monitoring well will be constructed of nominal 4-inch diameter, flush-threaded, PVC casing, and a 0.010-inch slotted PVC screen. Each monitoring well screen will be 5 to 10 ft in length. Screen length and placement will be based on site-specific criteria. A centralizer will be attached to the top and bottom of each well screen and every 10 ft along the riser casing. The well screen and casing will be assembled and lowered into the augers. The filter pack of each monitoring well will consist of clean silica sand (Lonestar 2-16 or equivalent) and will be placed from the bottom to 1 ft above the top of the screened interval. The filter pack will be placed in the annular space between the inside of the augers and well screen, while the augers are removed to the top of the filter pack. The well will be surged as the filter pack is installed to ensure settlement of the packing material. A 2-ft-thick bentonite transitional seal will be placed on top of the filter pack while the augers are removed to the top of the transitional seal. The bentonite transitional seal will be composed of uncoated, 1/8-inch bentonite pellets or bentonite chips. Potable water will be added to hydrate the bentonite seal, if above the water table. The transitional seal will be allowed to hydrate for a minimum of 1 hour before any annular seal material is placed. Actual time to hydrate will depend on site-specific conditions and will be determined by the field geologist in consultation with the California-registered Professional Geologist for this project. The annular seal will consist of a bentonite-cement grout (3 to 5 percent bentonite by dry weight) installed from the top of the bentonite transitional seal to about 1 ft bgs. The bentonite-cement grout will be installed using a tremie pipe pumped from just above the bentonite transitional seal while the remaining augers are removed. If the depth to the artificial fill bottom does not allow using the sand pack, bentonite seal, and grout thickness dimensions stated, the dimensions will be scaled back proportionately.

Monitoring wells will have an aboveground surface completion (Figure 5-4) or a flush-mount surface completion (Figure 5-5). Aboveground completion will consist of a 12-inch-diameter steel surface protective casing installed 3 ft above the ground surface in a 4-ft by 4-ft concrete pad at least 4 inches thick unless otherwise approved by the Alameda County Public Works Agency (ACPWA). Four concrete-filled bollards will be installed around the concrete pad.

Flush-mount completion will consist of a high-traffic manhole set in a concrete base. The concrete base will be at least 4 inches thick and will slope to drain away from the protective manhole. The base will extend 2 ft laterally in all directions from the outside of the well, unless otherwise approved by ACPWA.

Decontamination of all down-hole equipment will be performed as described in Section 5.18.

5.10 SWBZ GROUNDWATER MONITORING WELL INSTALLATION

New monitoring wells will be installed in the SWBZ (the Merritt Sand and the Upper San Antonio Formation) at select sites. Monitoring well borings will be drilled into the SWBZ using hollow-stem auger or mud rotary drilling methods. Prior to field activities, the base of the BSU and top of the SWBZ will be mapped using all available geologic data.

To avoid dragging contamination from the FWBZ to the SWBZ during well construction, a conductor casing will be installed through the artificial fill, across the FWBZ, to the top of the BSU at all SWBZ monitoring well locations. The boring will be advanced through the artificial fill into the BSU, where present. A conductor casing will be fitted with a grout float (or shoe) so that borehole material cannot enter the casing while the casing is being installed. The conductor casing will be installed into the BSU or to the bottom of the artificial fill, depending on location. The conductor casing will be grouted into place by pumping grout under pressure through the grout float and up the annulus. The grout will be allowed to cure for 24 hours before the boring will be advanced. The auger drilling method will be used to drill out the bottom of the casing and advance.

After the desired depth is reached, a well will be constructed inside the nominal 8-inch-diameter ID augers, as described in Section 5.9. SWBZ monitoring well completion schematics are shown on Figures 5-6 and 5-7. Single monitoring wells will be constructed of nominal 4-inch-diameter, flush-threaded, PVC casing, and a 0.010-inch slotted, pre-packed PVC screen. The slot size of the well screen and the grain size of the filter pack may vary based on field conditions. Each monitoring well screen will be 10 ft in length. Screen placement will be based on site-specific criteria.

Nested wells proposed for the OU-2B site-wide investigation will be completed in groups of five, with the deep well (top of the screen approximately 60 ft bgs) being a single well completion. The nested pairs will have the approximate top of the well screens at 20 ft bgs and 40 ft bgs for one completion, and 30 ft bgs and 50 ft bgs for the other completion. The nested wells will consist of 2-inch diameter PVC casing and completed with pre-packed screens (Johnson Screens with 20/40 carbolite packing material, or equivalent). Other well completion features will be similar to the FWBZ wells and determined in the field based on actual conditions. The nested well completion schematics are shown on Figure 5-8.

All equipment will be decontaminated prior to use, as described in Section 5.18.

5.11 MONITORING WELL DEVELOPMENT

Monitoring well development will not begin until the bentonite-cement grout has cured a minimum of 24 hours. The newly constructed monitoring wells will be developed using a combination of bailing, surging, and pumping.

Sediments that may have accumulated during well construction will initially be removed using a bottom-suction bailer. The entire screen interval will then be surged with a decontaminated surge block. Accumulated sediments will again be removed by bailing. Finally, the well will be pumped using a submersible pump. This surging, bailing, and pumping cycle will be repeated as necessary, depending on the amount of fines produced from the well.

Development will be complete when a minimum of three times the casing volume of water in the well has been removed, plus the volume of any water added during drilling. In addition to removing water from the well, field parameters must be stabilized, as defined below:

- Turbidity has stabilized to less than 10 NTUs
- Consecutive readings are within +/- 5 percent micro-ohms per centimeter for conductivity, +/- 0.2 units for pH, and +/- 1 degree Celsius

Well development time for each well will not exceed 4 hours. All water parameter data and approximate volumes of water produced will be reported on the well development forms. Field instruments for measurement of water parameters, including temperature, pH, and specific conductance, will be calibrated prior to use as described in the SAP (Appendix A). All equipment will be decontaminated prior to use, as described in Section 5.18.

5.12 QUARTERLY GROUNDWATER MONITORING WELL SAMPLING

Groundwater monitoring will be conducted quarterly for 1 year. Existing and newly installed monitoring wells will be sampled each quarter and analyzed for COCs (Table 3-2). Prior to sampling, each well will be gauged, and water level depth relative to a reference mark on the north side of the top of the monitoring well casing will be recorded. Purging and sampling will be performed using a low-flow bladder pump with new, disposable high density polyethylene (HDPE) and pharmaceutical-grade tubing. The purge water will be monitored for dissolved oxygen, ORP, pH, temperature, specific conductance, salinity, and turbidity stability. Well purging measurements and observations will be documented on a well sampling form. All non-disposable sampling equipment will be decontaminated as described in Section 5.18.

5.13 SLUG TESTS

Slug tests will be performed on each newly installed monitoring well to determine aquifer characteristics. Slug tests are an in situ measurement of hydraulic conductivity in the area surrounding the well screen and filter pack. Hydraulic conductivity is a measurement of a porous medium's ability to transmit water.

The slug tests will be performed using a "rising head" test, which is performed by removing a volume of water or a slug (sealed PVC cylinder of known dimensions) from a monitoring well and recording the recovery of the water level within the well. Following a manual static water level measurement, a pressure transducer and data logger will be placed within the well. Next, a slug will be lowered into the well below the static water level. The slug will remain at this depth until the water level approaches the original static level. The data logger will be programmed to record data on a logarithmic mode. To start the test, the data logger is started, and the slug is quickly removed to simulate instantaneous change in volume in the well. Time and pressure head measurements are then collected until the water level has recovered to within 90 percent of static conditions.

5.14 TIDAL STUDY

A tidal influence study was conducted by Shaw in the Fall of 2004 and documented in a report entitled *Fall 2004 Tidal Study For Installation Restoration Sites 1 and 2* (Shaw, 2005). An additional informal tidal study was conducted by ITSI in the Spring of 2006 on 23 wells located throughout Alameda Point. In both studies, only FWBZ wells were monitored. In all cases, tidally influenced wells were within 100 ft of the shoreline. Tidal influence is usually limited in an unconfined aquifer like the FWBZ. In an unconfined aquifer, the surface water from the bay has to physically move into the formation to fill the pores to raise the water table. This physical movement is usually limited to a narrow band near the water body, such as observed in the two studies.

In a confined aquifer, the tidal influence can move inland much further than in an unconfined aquifer, because the surface water does not have to physically move into the pores in the aquifer. The rising tide increases the pressure head in a confined aquifer instantaneously and can impact the pressure head in the aquifer hundreds of ft inland. Therefore, a tidal study will be conducted in the OU-2A and -2B areas to measure the tidal influence in the SWBZ. The average groundwater flow direction is not well-defined; therefore, it is necessary to perform a tidal study to refine the current understanding of the average groundwater flow direction in the SWBZ. Data-loggers will be placed in 13 existing monitoring wells. Monitoring well locations are shown on Figure 5-9. Data loggers will be used to collect water level data in each well for a 72-hour period. The resulting data will be analyzed using the Serfes method (Serfes, 1991) and used to develop potentiometric surface maps representative of the average groundwater flow.

5.15 LAND SURVEY

A land survey will be performed to locate horizontal and vertical coordinates for the top of well casings and adjacent ground surface elevation for the newly-installed groundwater monitoring wells. A survey report will be generated by the land surveyor and will be signed by a State of California-registered professional surveyor. Horizontal coordinates for all surface soil grab and groundwater Hydropunch® sampling points will be recorded in the field using a hand-held differential GPS instrument and measuring tape inside buildings.

The monitoring well top of casing elevation will be measured by placing the surveying rod directly on the top of the north side of the well casing. The top of casing elevation measuring reference point shall be marked with a minimum 1/8-inch-deep saw-cut.

The survey will be conducted using a third-order, Class I accuracy established by current Federal Geodetic Control Subcommittee (FGCS) standards for both vertical and horizontal measurements (at least within +/-0.1-ft accuracy for horizontal measurements and +/-0.01-ft accuracy for vertical measurements). Horizontal control will be tied to the California State Plane Coordinate System Zone, based on the North American Datum (NAD) of 1983 (NAD83) grid coordinates as ft northing and easting. Vertical control will be tied to the North American Vertical Datum (NAVD) of 1988 (NAVD88) and given in ft of elevation above msl. The surveyor will also report all horizontal data in California State Plane NAD 1927 (ft), and elevations as National Geodetic Vertical Datum (NGVD) 1929 (ft msl).

All other sampling points, such as hand auger, DPT, and CPT, will be surveyed for location and elevation using a hand-held differential GPS instrument and measuring tape inside buildings. Location coordinates will be recorded in the field notebook. For example, if a hand-held GPS unit device cannot be used within a building, the sampling locations will be measured from existing site features.

5.16 DEMOBILIZATION AND SITE CLEANUP

Demobilization activities will consist of decontamination of all equipment, cleaning the project site, and final inspection/certification of completion. The activities will include decontamination and removal of all equipment and materials, as well as collection and disposal of all disposable equipment for which decontamination is inappropriate.

Prior to removal from the site, all decontaminated equipment and materials will be inspected and accepted by the Site Health and Safety Specialist. This individual will verify decontamination was performed for all equipment and materials. The original certificate will be maintained in the project file.

5.17 IDW CHARACTERIZATION

Following completion of the field activities, the drums of soil and water IDW will be sampled and analyzed to determine if the contents are hazardous, and to satisfy the pre-admittance requirements of the disposal facility. IDW disposal requirements are described in the WMP (see Section 6.0).

5.18 EQUIPMENT DECONTAMINATION

Equipment will be decontaminated after use and between each sampling location. Equipment, such as auger flights and cores, Geoprobe® DT325 dual tube sampling system components, and Hydropunch® sample equipment, will be decontaminated with high-pressure, hot-water washing with non-phosphate detergents followed by a high-pressure, hot-water rinse.

The following steps will be followed for decontamination of non-disposable sample equipment (except for the equipment mentioned in the paragraph above):

1. **Wash with non-phosphate detergent and water solution**—This step will remove all visible contamination from the equipment. Use of a 5-gallon bucket approximately 75 percent full of solution and a long-handled brush is suggested for this step. Dilute non-phosphate detergent as directed by the manufacturer.
2. **Rinse with potable water**—This step will rinse all the detergent solution away from equipment. Use of a 5-gallon bucket approximately 75 percent full of water and a long-handled brush is suggested for this step. Periodic changing of this water is required.
3. **Rinse with deionized water**—This step will rinse any detergent solution and potable water residues. Rinsing is most effective when water is applied using a stainless steel Hudson-type sprayer or Nalgene® squeeze bottle while holding equipment over a 5-gallon bucket.
4. **Rinse with deionized water**—This step will be a final rinse to remove any contaminants. Rinsing is most effective when water is applied using a stainless steel Hudson-type sprayer or Nalgene® squeeze bottle while holding equipment over a 5-gallon bucket.

A temporary equipment decontamination pad, consisting of a bermed polyethylene liner, may be constructed to facilitate collection of the wastewater during decontamination of drilling equipment. Equipment may also be decontaminated in subcontractor-provided decontamination trailers with self-contained wastewater reservoirs.

6.0 WASTE MANAGEMENT PLAN

The purpose of the WMP is to provide guidelines for the containment, handling, and disposal of waste generated during site field activities. The WMP details waste management practices, documentation, and training requirements necessary to ensure proper waste handling, transportation, and disposal. In addition, the WMP provides guidance regarding waste minimization practices to be followed during project execution to reduce the volume of waste generated, stored, and removed from the site for disposal. The WMP will be revised if the scope of this project or any applicable regulation changes.

The WMP addresses the following anticipated regulated activities:

- Characterization, containerization, storage, and disposal of RCRA-hazardous, non-RCRA hazardous, and non-hazardous wastes generated from soil borings and groundwater monitoring well installation, development, and sampling; these wastes may include drill cuttings, PPE, purge and development water, and decontamination water.
- Sampling and analysis of waste materials for subsequent characterization, management, and disposal purposes.
- Identification of appropriate transportation companies and disposal facilities for hazardous and non-hazardous waste resulting from the project activities.
- Preparation of profile and manifest documentation and labeling and marking waste containers for transport to an appropriate off-site disposal facility.

6.1 REGULATORY REQUIREMENTS

Project activities may potentially generate non-hazardous waste, non-RCRA hazardous wastes, and RCRA-hazardous wastes. As such, the following federal and state regulations are applicable and must be complied with during implementation of planned project activities:

- California and EPA Regulations for Identification and Management of Hazardous Waste, 22 California Code of Regulations (CCR), Sections 66260 through 66299;
- U.S. Department of Transportation (DOT) Rules for Hazardous Materials Transport, 49 Code of Federal Regulations (CFR), Parts 171 through 178;
- Bay Area Air Quality Management District Regulations; and
- Applicable DoN and Department of Defense Environmental Permits, Policies, and Procedures.

Appropriate Best Management Practices (BMPs) will be followed to control run-on/runoff and to minimize fugitive dust emissions during project activities.

6.2 WASTE MINIMIZATION

To minimize the volume of waste, the following general rules will be applied:

- Contaminated materials will not be unnecessarily commingled with uncontaminated materials.
- When practicable, material and equipment will be decontaminated and reused.
- Volume reduction techniques will be utilized, as appropriate.

6.3 PROJECT WASTE DESCRIPTIONS

The anticipated waste streams associated with the project can be categorized as follows:

- Contaminated soil cuttings
- Uncontaminated soil cuttings
- Decontamination fluids
- Purge and development water
- Used PPE and disposable sample equipment

Table 6-1 presents a summary of the applicable waste management, transportation, and disposal requirements for each of the above waste streams.

6.4 WASTE MANAGEMENT ACTIVITIES

This section describes in more detail how waste generated during site characterization activities will be characterized and classified.

6.4.1 Waste Characterization/Classification

Unless investigation-derived materials are predetermined to be hazardous waste (22 CCR, Section 66261, and 40 CFR, Part 261), all waste streams require a determination of whether or not the materials are a hazardous waste. Listed wastes are specifically identified in 22 CCR, Section 66261, Article 4. When a clear hazardous waste determination cannot be made, the materials will be sampled and analyzed in accordance with federal and California Hazardous Waste Management Regulations and Solid Waste Management Regulations. A determination will then be made as to whether the material is a characteristic hazardous waste based on the criteria for ignitability, reactivity, corrosivity, or toxicity as defined in 22 CCR, Section 66261, Article 3. Listed wastes are not expected to be encountered during project activities.

State of California requirements for determining whether a waste is hazardous under the toxicity characteristic requires a Soluble Threshold Limit Concentration leaching procedure and a total analysis for certain inorganics and organics, and is generally more conservative than the federal Toxicity Characteristic Leaching Procedure. California also has additional hazardous waste classification criteria (including 96-hour fish bioassays) that may need to be considered on a case-by-case basis. Therefore, some wastes may be considered hazardous wastes under California regulations and not under federal regulations. These wastes are referred to as non-RCRA hazardous wastes.

In addition to the investigation-derived soil materials from the groundwater monitoring well installation, development, and sampling, the hazardous waste classification requirements also apply to decontamination water generated from daily decontamination activities and PPE utilized during project activities.

Appropriately trained TtEC personnel will accurately prepare and make all final waste stream characterizations. TtEC personnel will also accurately prepare all waste documentation, including waste profiles and manifests for DoN signature. The ROICC will sign all profiles and waste manifests. The ROICC will receive a copy of the waste stream characterizations.

All non-hazardous waste transported from the site will be accompanied by a Non-hazardous Waste Manifest. DoN personnel will also be responsible for reviewing and signing all non-hazardous waste documentation, including waste profiles and manifests.

6.4.2 Hazardous Waste Management

RCRA Subtitle C and the California Hazardous Waste Management Regulations govern hazardous waste from the point of generation through storage and treatment (if necessary), to its ultimate disposal site. The DTSC is authorized by the EPA to oversee management of the hazardous waste program in California.

Hazardous waste must comply with the following requirements:

- Any waste generated during project activities must be characterized to determine whether it is a hazardous waste. Analytical testing requirements are detailed in the SAP (Appendix A).
- Hazardous waste must be managed in accordance with 22 CCR, Section 66262, Standards Applicable to Generators of Hazardous Waste.
- Hazardous waste transported off-site must be manifested in accordance with 22 CCR, Section 66262, Article 2, Manifests, and accompanied by Land Disposal Restriction (LDR) certification notices in accordance with 22 CCR, Section 66268.7, Waste Analysis and Recordkeeping.
- Hazardous waste must be stored in accordance with 22 CCR, Section 66265, Article 9, Use and Management of Containers, and/or 22 CCR, Section 66265, Article 10, Tank Systems.
- All containers and tanks of hazardous waste to be stored or disposed will be clearly marked with completed hazardous waste labels that indicate the accumulation start date. Labels will also indicate the EPA identification number, EPA waste code, and

DOT shipping description, which will be entered prior to off-site transport of containers. Appropriate DOT markings and labels will be affixed prior to off-site transport of containers.

- Hazardous waste may be stored on site for a maximum of 90 days. The 90 days begin on the date that the waste is first generated and containerized (the day the first drop of waste is placed in a container).
- Hazardous waste must be disposed only at a hazardous waste disposal facility permitted for the disposal of the particular type of hazardous waste generated. This facility must be prequalified by TtEC.

6.4.3 Waste Containerization and Storage

Container selection will be performed by DOT-trained personnel based on the type and quantity of waste to be generated. Containers may include either DOT-specification drums or sift-proof roll-offs for DOT hazardous materials. DOT-specification containers are not required for material that does not meet a DOT hazard class.

Prior to commencing project activities, the TtEC Project Manager, in conjunction with the ROICC, will select areas for the temporary staging and storage of investigation-derived materials, decontamination fluids, and PPE. Secondary containment will be established for all liquid hazardous wastes.

Waste material must be classified according to State of California and DOT criteria before the labels are applied. Upon classification, each container will be marked and labeled as required. Trained personnel, as required by 49 CFR, Part 172, Subpart H, will conduct all DOT functions.

At the time of generation, all waste containers will be labeled, using indelible ink, with the following information:

- Source and location
- Contents and quantity of material in the container
- Accumulation start date (the date the first drop of material was placed in the container)

Containers determined to contain hazardous waste will immediately be labeled with a completed "HAZARDOUS WASTE" label, which will include the accumulation start date and other requested information.

Containers of waste material that may be hazardous will be presumed to be hazardous and managed as such. In addition, these containers will be marked or labeled as "POTENTIALLY HAZARDOUS – PENDING ANALYSIS" until a proper waste determination can be made when the results of waste analysis are received.

As practicable, hazardous waste stored in containers (55-gallon drums) will also be stored on wooden pallets, if possible, and within a pre-designated waste storage area with secondary containment. If multiple rows are needed, a 4-ft aisle will be maintained between rows. Pallets will be limited to three drums. An inventory of waste containers and their associated accumulation start dates will be maintained.

Containers of hazardous waste will be inspected and logged weekly in accordance with Environmental Health and Safety (EHS) 3-3 while the fieldwork is in progress. Tanks containing hazardous waste will be inspected on a daily basis. Inspections will encompass an evaluation for proper labeling, secure closure, the condition of each container or tank, number of containers or tanks, and condition of the storage and secondary containment area. Any signs of deterioration, leaks, or significant dents will be noted, and containers will immediately be overpacked or replaced, if necessary.

6.4.4 Wastewater and Decontamination Fluids

Applicable requirements for facilities that manage hazardous wastes in tanks or containers are contained in 22 CCR, Section 66265, and 40 CFR, Part 265. Tanks will be installed, managed, and inspected in accordance with the substantive requirements of 22 CCR, Article 10. These regulations require specific engineering and design specifications, daily inspections of the tanks, adequate secondary containment (i.e., 100 percent of the tank volume, plus the maximum rainfall from a 25-year, 24-hour storm event), and closure standards. The contents of the tank will be characterized per the requirements of 22 CCR, Section 66261 to determine appropriate disposal options. Tanks used for hazardous waste storage are not anticipated to be required during project activities.

Decontamination, purge, and development water from the groundwater monitoring wells will be contained within 55-gallon drums, appropriately labeled, and situated within a pre-designated and properly designed waste container storage area. For non-hazardous wastewaters, the containers will be closed when not in use and will be inspected on a weekly basis. As a BMP, containers will be stored within secondary containment to prevent accidental release into the environment. For containers containing hazardous wastes, the substantive requirements of 22 CCR, Article 9 are applicable. These regulations require that containers of hazardous wastes containing free liquids have stringent secondary containment requirements, which include the following:

- A base will be free of cracks or gaps and sufficiently impervious to contain leaks, spills, and accumulated precipitation until the collected material is detected and removed.
- The base will be sloped or the containment system will be otherwise designed and operated to drain and remove liquids resulting from leaks, spills, or precipitation. Alternatively, the containers may be elevated on pallets to prevent contact with accumulated liquids.

- The containment system must have sufficient capacity to contain 110 percent of the volume of containers or the volume of the largest container, whichever is greater.
- Spilled or leaked waste and accumulated precipitation will be removed from the sump or collection area in a timely manner to prevent overflow of the collection system.

All wastewater will be disposed at a CERCLA off-site, rule-approved facility.

6.4.5 Used PPE and Disposable Sample Equipment

Used PPE and disposable sample equipment will be bagged and disposed as non-hazardous waste with general trash. Heavily contaminated PPE may be stored within drums containing soil cuttings. Bagged, uncontaminated PPE may be disposed at a Class III disposal facility.

6.4.6 Soil Cuttings

As borings are being developed, soil cuttings will be generated. Soil is expected to contain low levels of chemical contaminants. Soil cuttings will be placed into open-top, 55-gallon drums in preparation for off-site disposal. The soil cuttings will be stored, labeled, manifested, and shipped in accordance with applicable DOT regulations.

Soil cuttings classified as non-hazardous will be transported to an appropriate, prequalified, CERCLA off-site, rule-approved disposal (Class II) facility. Soil cuttings classified as hazardous (either RCRA or non-RCRA) will be transported to an appropriate, prequalified, CERCLA off-site, rule-approved facility (Class I).

6.4.7 Waste Accumulation Areas

Although soil cuttings, liquids, and PPE generated from the project activities are not anticipated to be hazardous, the following requirements apply to hazardous waste storage areas:

- A sign or signs with the legend, "DANGER! HAZARDOUS WASTE AREA – UNAUTHORIZED PERSONNEL KEEP OUT" (written in English and Spanish) will be posted at each 90-day accumulation area in sufficient numbers to be seen from any approach. The signs will be legible from a distance of at least 25 ft.
- Aisle space will be maintained to allow the unobstructed movements of personnel, fire-protection equipment, spill-control equipment, and decontamination equipment to any area of facility operation in an emergency, unless aisle space is not needed for any of these purposes.
- The following emergency equipment will be available to personnel during active waste management activities at each accumulation area:
  - A device, such as a telephone or a hand-held, two-way radio, capable of summoning emergency assistance.
  - Portable fire extinguishers, fire-control equipment, spill-control equipment, and decontamination equipment.

  - Water at adequate volume and pressure to supply water hose streams, foam-producing equipment, automatic sprinklers, or water spray systems.
  - A spill kit containing adequate absorbent.
- Bulk quantities of fuel, oil, or other hazardous materials will not be stored on site.

6.4.8 Waste Disposal

All wastes disposed off site (including non-hazardous wastes) will be sent to RCRA Subtitle C or RCRA Subtitle D facilities that meet the requirements of 40 CFR, Part 300.440 (CERCLA Off-site Rule), accepting uncontaminated PPE/sample equipment that may be disposed at a permitted Class III facility. Water (generated by decontamination, groundwater monitoring, well development, and purging procedures), soil cuttings, and PPE will be disposed off-site. All waste will be disposed only at a waste-disposal facility prequalified under TtEC Compliance Procedures (in accordance with TtEC Procedure EHS 1-4) and covered by the applicable permit for the disposal of the particular type of waste generated.

6.5 REPORTING SPILLS AND RELEASES

Precautions will be taken to prevent hazardous material spills. Site personnel will conduct informal daily inspections of equipment, structure(s), and containers. In addition, personnel using hazardous materials will inspect containers before and after use. In the event of a spill/release, the Project Manager will immediately notify the Project Environmental Safety Manager (PESM), who will determine what, if any, notifications need to be made by the DoN to regulatory agencies. The Project Manager will subsequently notify the DoN, as necessary. Spill response will be conducted in accordance with the Site Health and Safety Plan and federal, state, and local regulations and with NAS Alameda policies and procedures.

6.6 TRAINING/CERTIFICATION REQUIREMENTS

This section presents the DOT and waste-management training and certification requirements for personnel involved in the project. Employees involved in waste management operations will be trained in TtEC Waste Management and Environmental Compliance policies and procedures to ensure they are familiar with the program. These policies and procedures satisfy the hazardous waste management training requirements under 22 CCR, Section 66265.16. Waste management training is required annually.

In addition, personnel who perform or oversee DOT-related activities will be DOT-trained. DOT and waste management training records will be maintained in TtEC Corporate Environmental Safety and Quality Department files and will be available, as necessary, to on-site personnel. DOT training is required every 2 years.

6.7 DOCUMENTATION AND RECORDS RETENTION

This section presents project requirements relating to waste management documentation, records, and their retention.

6.7.1 Documentation

The information contained in this section applies to all waste managed during project activities. Field records will be kept in a bound, numbered field notebook. Information to be recorded includes, but is not limited to, the following:

- Description of waste-generating activities
- Location of waste generation (including depth, if applicable)
- Type of waste
- Date and time of generation
- Name of person recording information
- Name of field manager at time of generation and at time of disposal
- Test results
- Inspection logs
- Waste documentation, including the following:
  - Waste profile sheets
  - LDR certification
  - Hazardous waste manifest
  - Non-hazardous waste manifest
  - Trip tickets or bills of lading
  - Copies of any state or local permits or approvals

6.7.2 Transportation

Transportation documentation will comply with DOT regulations 49 CFR, Parts 100 through 178, and will be prepared by appropriately trained TtEC personnel.

Containers will be marked, labeled, and/or placarded prior to off-site transport. Treatment, storage, and disposal facility (TSDF) waste profile sheets, LDR notifications, waste manifests, and shipping documents will be prepared by properly trained TtEC personnel for the appropriate DoN officials to review and sign.

Waste transporters used will be registered with the California DTSC and prequalified by TtEC prior to use.

6.7.3 Hazardous Waste Manifests and LDR Certification

All hazardous waste transported from the site will be accompanied by a Hazardous Waste Manifest. DoN personnel will be responsible for reviewing and signing all waste documentation, including waste profiles, manifests, and LDR notifications (manifest packages), as necessary. Prior to signing the manifest, TtEC will ensure that pre-transport requirements of packaging, labeling, marking, and placarding are met, according to 22 CCR, Sections 66262.30 through 66262.33, and 49 CFR, Parts 100 through 177.

The DoN will receive two copies of the manifest; the remaining copies will be given to the transporter. The two manifest copies will be returned to the DoN signatory official who will forward one copy to the California DTSC and retain one copy for record-keeping requirements. Copies of all manifests for waste generated at the site will also be kept in a central project file.

An LDR form will accompany any shipments of RCRA-hazardous waste to the TSDF. The TSDF must be notified prior to sending the waste.

6.7.4 Non-hazardous Waste Manifests

All non-hazardous waste transported from the site will be accompanied by a Non-hazardous Waste Manifest. DoN personnel will be responsible for reviewing and signing all waste documentation, including waste profiles and manifests. Prior to signing the manifest, TtEC will ensure that pre-transport requirements of packaging, labeling, marking, and placarding are met according to 22 CCR, Sections 66262.30 through 66262.33, and 49 CFR, Parts 100 through 177.

The DoN will receive one copy of the manifest; the remaining copies will be given to the transporter. The manifest will be returned to the DoN signatory official to be placed on file. Copies of all manifests for waste generated at the site will also be kept in a central project file.

6.7.5 RCRA Records Retention

The designated DoN-manifest signatory official will be responsible for ensuring all hazardous waste record-keeping requirements are met according to 22 CCR, Sections 66262.20 through 66262.44, including retention of signed copies of manifests from the designated facility that received the waste. The copy must be maintained for at least 3 years from the date the waste was accepted by the initial transporter.

This page intentionally left blank.

7.0 TRAFFIC CONTROL PLAN

This Traffic Control Plan provides project-specific information for vehicular traffic and pedestrian control during data gap investigation activities that include the following:

- Surface soil sampling
- DPT/CPT soil and groundwater sampling
- Groundwater monitoring well installation and development
- Quarterly groundwater monitoring
- Slug testing
- Location and elevation survey of sampling locations

Site access and the equipment laydown areas are shown on Figure 7-1. Access to individual sites within OU-2A and OU-2B will be via Main Street on former military base roads or aircraft runways no longer in use. Equipment laydown areas will be located within a fenced area at Building 112 (Figure 7-1).

Prior to commencing field activities, a site survey will be conducted to verify locations in roads, parking lots, or sidewalks. Controls that will be in place for vehicle traffic and pedestrian traffic in or around sidewalks and parking areas during all field activities are described in this plan.

Traffic controls and signs will be used in accordance with the *Manual of Traffic Control for Construction and Maintenance Work Zones* (California State Department of Transportation [CalTrans], 1996) to provide for the effective completion of work activities in a safe manner, while minimizing the impact on the normal traffic flow. Signage, including that announcing construction ahead, will be installed along roadways entering construction areas; and flagmen, if required, will be posted. Any affected sidewalk or parking areas will have proper signage, construction areas barricaded for pedestrian safety, and a safe detour. In addition, field crews will wear appropriate highly visible clothing when working in traffic areas.

7.1 ANALYSIS OF POTENTIAL IMPACTS

The following sections detail the potential impacts to traffic and pedestrian areas during each anticipated phase of field activities.

7.1.1 Surface Soil Sampling

Surface soil samples will be collected at select sites using a hand auger. Locations in paved areas, such as parking lots, roads, or floors, will be cored prior to sampling. Soil sampling may require closure of a portion of a street or sidewalk at each sampling location for a period of up to 1 hour per location.

7.1.2 DPT/CPT Soil and Groundwater Sampling

During subsurface borings and soil sampling, sidewalk or partial lane closure may be necessary. Sampling locations will depend on passive soil gas screening results. Final sample locations will be adjusted in the field to minimize impacts to vehicle or pedestrian traffic. Depending on the final location and selected sampling technology, sampling may require closure of a portion of traffic lanes or sidewalks for a period of up to 2 hours per location.

7.1.3 Groundwater Monitoring Well Installation and Development

New groundwater monitoring wells will be installed as part of the data gap sampling. Well locations will depend on the results of soil and water sampling. Final well locations will be adjusted in the field to minimize impacts to vehicle or pedestrian traffic. Well installation and development is not anticipated to require blockage of any roads or sidewalks, except during equipment-staging activities. Equipment staging should not exceed 10 minutes.

7.1.4 Quarterly Groundwater Monitoring Well Sampling

New and existing monitoring wells will be sampled quarterly for 1 year. Well sampling is not anticipated to require blockage of any roads or sidewalks.

7.1.5 Slug Testing

Slug tests will be performed on each newly installed monitoring well as part of this project. Slug testing is not anticipated to require blockage of any roads or sidewalks, except during equipment-staging activities. Equipment staging should not exceed 10 minutes.

7.1.6 Survey of Sampling Locations

Location and elevation surveying of sample locations is not anticipated to require blockage of any roads or sidewalks.

7.2 TRAFFIC SAFETY MEASURES

To expedite the passage of traffic through the work areas, temporary signs, barricades with flashing lights, and cones at key locations to warn base traffic of site activities will be installed and maintained throughout the project.

All equipment and obstructions will be removed at the end of each work day and at other times when construction operations are suspended for any reason.

7.3 TRAFFIC CONTROL

Traffic controls will be utilized to provide for the efficient completion of work activities in a safe working environment while minimizing the impact on traffic flow. Traffic controls will be required during surface soil sampling and may be required during subsurface sampling activities that take place adjacent to or on a roadway, or that block or intrude a sidewalk or parking area. Traffic-control measures will include the following:

- Traffic cones will be set up around the surface soil location or DPT/CPT equipment using appropriate cone taper distances.
- Warning signs will be placed to alert traffic of construction area.
- A flagman, when required, will be used to control traffic flow.
- On-street parking will be limited to vehicles associated with sampling activities throughout the project to maintain normal access and clear lanes. When possible, vehicles associated with the project will be parked off the roadway.

All traffic-control activities will conform to the applicable specifications of the *Manual of Traffic Control for Construction and Maintenance Work Zones* (CalTrans, 1996) and will be approved by the ROICC.

Other project-specific measures will be used to minimize the impacts of the proposed construction activities, such as:

- Ensure that proper traffic control design geometries are applied at access driveways and all street crossings to accommodate trucks and fire apparatus.
- Maintain close coordination with the ROICC and all other contractors to ensure safety and minimize impact to other activities within the facility.

This page intentionally left blank.

8.0 REPORTING

Upon completion of the activities proposed in this Work Plan, a Pre-design Data Summary Report will be prepared to document the findings and will include an evaluation of the decision rule for each DQO, based on the sampling results, and delineate as appropriate the horizontal and vertical extent of contamination. The report will be organized as follows:

Section 1.0 – Introduction including summary of data gaps and sampling

Section 2.0 – Sampling results by DQO

Section 3.0 – Deviations from sampling plan

Section 4.0 – Plume delineation/site characterization/interpretation of results

Section 5.0 – IDW summary

The report will also include the following tables and figures:

- Boring logs
- CPT logs
- Monitoring well logs
- Monitoring well construction diagrams
- Analytical data summary tables and figures
- Slug test data summary tables
- Potentiometric surface maps showing average groundwater flow
- Maps showing refined plume boundaries and identified source areas
- Revised CSMs
- Tidal study summary tables

Additionally, the report will contain the following attachments:

- Laboratory Data Sheets and other Analytical Reports
- Field Forms
- Boring/CPT/Groundwater Monitoring Well Logs
- Boring/Well Location Survey Report

This page intentionally left blank.

9.0 REFERENCES

California State Department of Transportation (CalTrans). 1996. *Manual of Traffic Control for Construction and Maintenance Work Zones.*

ERM-West. 1994. *Final Environmental Baseline Survey/Community Environmental Response Facilitation Act Report for NAS/NADEP Alameda.* October 31.

GretagMacbeth. 1994. *Munsell® Soil Color Charts, rev. ed.* New Windsor, N.Y.: GretagMacbeth

Howard, A. K. 1986. *Visual Classification of Soils, Unified Soil Classification System.* Bureau of Reclamation. January.

IT Corporation (IT). 2001. *Final Comprehensive Guide to the Environmental Baseline Survey, Alameda Point, Alameda, California.* June 2001.

Innovative Technical Solutions, Inc. (ITSI). 2006. *Draft Spring 2006 Alameda Basewide Annual Groundwater Monitoring Report, Alameda Point, Alameda, California.* October.

PRC Environmental Management, Inc. (PRC). 1997. *Tidal Influence Study Letter Report.* NAS Alameda, California.

Rogers, J. D. and S. H. Figuers. 1991. *Engineering Geologic Site Characterization of the Greater Oakland-Alameda Area, Alameda and San Francisco Counties, California.* December 30.

Serfes, M.E., 1991. *Determining the Mean Hydraulic Gradient of Ground Water Affected by Tidal Fluctuations: Ground Water,* v. 29, no.4, p. 549-555.

Shaw. 2006. Final Field Sampling and Analysis Plan Addendum #2. Contract Number N62474-98-d-2076, Document Control Number 9983, Task Order 0133. August 15.

SulTech. 2005a. *Final Remedial Investigation Study Report Operable Unit 2A (OU-2A) Sites 9, 13, 19, 22, and 23, Alameda Point, Alameda, CA. Volumes I–III.* April 1, 2005.

——, 2005b. *Final OU-2B Remedial Investigation Study Report Sites 3, 4, 11, and 21, Alameda Point, Alameda, CA. Volumes I–IV.* August 5, 2005.

——, 2006. *Draft Final Technical Memorandum Subslab Soil Gas Investigation of Buildings 14, 113, 162, 163, and 398, Alameda Point, Alameda, CA.* November 20, 2006.

Tetra Tech EM, Inc. (TtEMI). 1999a. *OU-2 Remedial Investigation Report.* June.

——, 1999b. OU-2 Remedial Investigation Report. November.

This page intentionally left blank.

TABLES

This page intentionally left blank.

TABLE 1-1

CONTACT LIST

Agency	Contact	Project Title
BRAC Program Management Office West 1455 Frazee Road, Suite 900 San Diego, CA 92108-4310	Mr. Steve Peck, P.E. (619) 532-0786	Remedial Project Manager
BRAC Program Management Office West 1455 Frazee Road, Suite 900 San Diego, CA 92108-4310	Mr. Thomas Macchiarella (619) 532-0923	BRAC Environmental Coordinator
Navy BRAC Detachment 410 Palm Avenue, Building 1 Treasure Island, CA 94130	Mr. Doug DeLong (415) 743-4713	Caretaker Site Office
EFA West ROICC 2450 Saratoga Street, Suite 200, Bldg 114 Alameda Point Alameda, CA 94501	Mr. Gregory Grace (510) 749-5940	ROICC
Naval Facilities Engineering Command, Southwest Division 1220 Pacific Highway San Diego, CA 92132-5190	Mr. Narciso Ancog (619) 532-2540	Quality Assurance Officer
EPA Region 9 75 Hawthorne St., SDF-73 San Francisco, CA 94105	Ms. Anna Marie Cook (415) 972-3029	EPA – Remedial Project Manager
Water Board, San Francisco Bay Region 1515 Clay Street, Suite 1400 Oakland, CA 94612	Mr. Erich Simon (510) 622-2355	Water Board – Remedial Project Manager
DTSC 700 Heinz Avenue, Suite 100 Berkley, California 94710	Ms. Michelle Dalrymple, P.G. (510) 540-3926	DTSC – Remedial Project Manager
TtEC 1230 Columbia Street, Suite 750 San Diego, CA 92101-8536	Mr. Pete Everds (619) 471-3504 phone (619) 301-0433 cell	Project Manager
TtEC 1230 Columbia Street, Suite 750 San Diego, CA 92101-8536	Mr. Gordon Jamieson (619) 471-3565	Lead Hydrogeologist
TtEC 1230 Columbia Street, Suite 750 San Diego, CA 92101-8536	Ms. Marianne Binkin, P.G. (619) 471-3564	Technical Lead
TtEC 1230 Columbia Street, Suite 750 San Diego, CA 92101-8536	Mr. Bryan Graham (425) 482-7865	Project Geologist/Site Health and Safety

TABLE 1-1

CONTACT LIST

Agency	Contact	Project Title
TtEC 1230 Columbia Street, Suite 750 San Diego, CA 92101-8536	Mr. Roger Margotto, CIH (619) 471-3503 (619) 981-4148 cell (714) 810-3742 pager	Project Environmental Safety Manager
TtEC Former Naval Air Station Moffett Field Building TE-45 Moffett Field, CA 94035	Mr. Bill Ogle (650) 564-9868 (650) 450-2982 cell	Project Quality Control Manager/Site Supervisor
TtEC 1940 E. Deere Avenue, Suite 200 Santa Ana, CA 92705-5718	Mr. Gregory Joyce (360) 598-8117	Quality Control Program Manager
TtEC 1940 East Deere Avenue, Suite 200 Santa Ana, CA 92705-5718	Ms. Lisa Bienkowski (949) 756-7592	Project Chemist

Abbreviations and Acronyms:

BRAC – Base Realignment and Closure
CIH – Certified Industrial Hygienist
DTSC – Department of Toxic Substances Control
EPA – Environmental Protection Agency
P.E. – Professional Engineer
P.G. – California-registered Professional Geologist
ROICC – Resident Officer in Charge of Construction
Water Board – Regional Water Quality Control Board
TtEC – Tetra Tech EC, Inc.

TABLE 2-1

SUMMARY OF PREVIOUS INVESTIGATIONS AT OU-2A

Site	Report Date	Author	Subject of Investigation
9	1992	PRC Environmental Management Inc. (PRC) and James M. Montgomery, Consulting Engineers, Inc. (JMM)	Phase 1 and 2A Investigation, 1991
9	1995	PRC and Montgomery Watson (MW)	Follow-On Investigation, 1994
9	1998	Tetra Tech and Uribe and Associates, Inc. (U&A)	Follow-On Investigation, 1998
9	2000	Tetra Tech	Storm Sewer Investigation, 2000
9	2002	Tetra Tech	Supplemental Data Gaps Sampling Investigation, 2001
9	2003, 2003	Shaw	Basewide Groundwater Monitoring, 2002 and 2003
9	2002	Navy	Basewide PAH Study, 2003
9	2001	IT	EBS Investigations Phase 2A, Phase 2B
13	1989	Harding Lawson Associates	Soil and Groundwater Investigation, 1989
13	1996	PRC and JMM	Phases I, II, and III Investigations, 1991
13	1993	PRC and MW	Phase 1 and 2A Investigation, 1991
13	1995	PRC and MW	Follow-On Investigation, 1994
13	1998	U&A	Follow-On Investigation, 1998
13	2002	Tetra Tech	Supplemental Data Gaps Sampling, 2001
13	2003	Shaw	Basewide Groundwater Monitoring, 2002 and 2003
13	2001	Navy	Basewide PAH Study, 2003
13	2001	Tetra Tech	TPH Investigations
19	1983	E&E	Initial Assessment Study
19	1992	PRC and JMM	Phase 1 and 2A Investigation
19	1996	PRC and MW	Follow-On Investigation
19	1998	Tetra Tech and U&A	Follow-On Investigation
19	2000	Tetra Tech	Storm Sewer Investigation

TABLE 2-1

SUMMARY OF PREVIOUS INVESTIGATIONS AT OU-2A

Site	Report Date	Author	Subject of Investigation
19	2002	Tetra Tech	Supplemental Data Gaps Investigation
19	2003	Shaw	Basewide Groundwater Monitoring
19	2003	Bechtel	Basewide PAH Study
19	1995	ERM-West	Phase 1 EBS
19	2001	IT	Phase 2A EBS
19	2001	IT	Phase 2B EBS
19	1995	No reference	TPH Program
19	2000	Tetra Tech	Removal Actions
22	1988	ERM-West	UST Testing
22	1989	Canonie	Phase 1 and 2A Investigation, 1991
22	1995	PRC and MW	Follow-On Investigation, 1994
22	1998	Tetra Tech and U&A	Follow-On Investigation, 1998
22	2000	Tetra Tech	Storm Sewer Investigation, 2000
22	2002	Tetra Tech	Supplemental Data Gaps Investigation, 2001
22	2003	Shaw	Basewide Groundwater Monitoring, 2002 and 2003
22	2003	Bechtel	Basewide PAH study, 2003
22	1995	ERM-West	Phase 1 EBS
22	2001	IT	Phase 2A
22	1998	Precision Locating	Metal Detector Survey
22	2000	Tetra Tech	Floating Product Investigation
22	2001	Tetra Tech	Data Gaps Investigation at CAAs
22	2003	Tetra Tech	CAP for CAA 4C
23	1989, 1990	Canonie	Phase 1 and 2A Investigation, 1991

TABLE 2-1

SUMMARY OF PREVIOUS INVESTIGATIONS AT OU-2A

Site	Report Date	Author	Subject of Investigation
23	1994	PRC and JMM	Follow-On Investigation, 1994
23	1998	U&A	Follow-On Investigation, 1998
23	2002	Tetra Tech	Supplemental Data Gaps Sampling, 2001
23	2003	Shaw	Basewide Groundwater Monitoring, 2002 and 2003
23	2003	Bechtel	Basewide PAH Study, 2003

Notes:

Previous investigation information compiled from Remedial Investigation Report, Sites 9, 13, 19, and 22 Operable Unit 2A (SulTech, 2005a).

Abbreviations and Acronyms:

EBS – Environmental Baseline Survey
IT – International Technology Corporation
JMM – James M. Montgomery, Consulting Engineers, Inc.
MW – Montgomery Watson
PAH – polynuclear aromatic hydrocarbon
PRC – PRC Environmental Management Inc.
TPH – total petroleum hydrocarbons
U&A – Uribe and Associates, Inc.
UST – underground storage tank

This page intentionally left blank.

TABLE 2-2

SUMMARY OF PREVIOUS INVESTIGATIONS AT OU-2B

Site	Report Date	Author	Report
3	1993	PRC Environmental Management, Inc. (PRC) and Montgomery Watson (MW)	Phases 1 and 2A Investigation, 1991
3	1995	PRC and MW	Follow-on Investigation, 1994
3	2000	Tetra Tech	Storm Sewer Removal, 1997
3	1997	Tetra Tech	Follow-on Investigation, 1998
3	1998	Tetra Tech	Follow-on Investigation, 1998
3	2002	Tetra Tech	Supplemental Remedial Investigation Data Gaps Sampling, 2001
3	2002	Innovative Technical Solutions Inc. (ITSI)	Basewide Investigation of Transformer Pads, 2001
3	2002	International Technology Corporation (IT)	Dense Nonaqueous-Phase Liquid (DNAPL) Removal Action, 2002
3	2003	Shaw Environmental & Infrastructure, Inc. (Shaw)	Basewide Groundwater Monitoring, 2002
3	2002	Bechtel Corporation (Bechtel)	Basewide PAH Investigation, 2003
3	1994	Environmental Resources Management-West (ERM-West)	Environmental Baseline Survey Investigations: Phase 1
3	2001	IT	Environmental Baseline Survey Investigation: Phases 2A, 2B, and 2C
3	1994	IT	Storm Sewer Investigation
3	1998	Berkeley Environmental Restoration Center (BERC)	Total Petroleum Hydrocarbon Program Investigation
4	1989, 1990	Canonie Environmental (Canonie)	Phase 1 and 2A Investigation, 1991
4	1992	PRC and James M. Montgomery, Consulting Engineers, Inc. (JMM)	Phase 2B and 3 Investigation, 1991
4	1995	PRC and MW	Additional Work at Sites 4 and 5, 1992
4	1996	PRC and MW	Follow-on Investigation, 1994
4	1997	OGISO Environmental	Geochemical Profiling to Define Chlorinated Solvent Plumes, 1997
4	2000	Tetra Tech	Storm Sewer Removal, 1997
4	1997	Tetra Tech	Follow-on Investigation, 1998

TABLE 2-2

SUMMARY OF PREVIOUS INVESTIGATIONS AT OU-2B

Site	Report Date	Author	Report
4	1998	Tetra Tech	Alameda Point, BRAC Cleanup Plan, Revision 5
4	2002	Tetra Tech	Supplemental Remedial Investigation Data Gaps Sampling, 2001
4	2002	IT Corporation	Data Transmittal of Design Investigation (Phase III) for Plume 4-1 at IR Site 4
4	2002	IT Corporation	Data Transmittal of Design Investigation (Phase III) for Plume 4-2 at IR Site 4
4	2002	IT Corporation	Data Transmittal of Design Investigation (Phase III) for Plume 4-3 at IR Site 4
4	2003	Shaw	Basewide Groundwater Monitoring, 2002
4	2006	Shaw	Final Sampling and Analysis Plan Addendum #2
4	2002	Bechtel	Basewide PAH Investigation, 2003
4	2002	IT	Pilot Studies, 2002
4	2004	Shaw	Pilot Studies, 2002
4	1994	ERM-West	Environmental Baseline Survey Investigations: Phase 1
4	2001	IT	Environmental Baseline Survey Investigations: Phase 2A and 2B
4	2001	IT	Storm Sewer Investigation
4	1996	Public Works Center (PWC)	Petroleum Hydrocarbon Program Investigations
4	1999	Tetra Tech	Petroleum Hydrocarbon Program Investigations
4	2001	Tetra Tech	Petroleum Hydrocarbon Program Investigations
4	1997	E & E	Resource Conservation Recovery Act Investigation
11	1995	PRC and MW	Phase 2B and 3 Investigations, 1991
11	2000	Tetra Tech	Follow-on Investigation, 1994
11	1997	Tetra Tech	Follow-on Investigation, 1998
11	2001, 2002	Tetra Tech	Supplemental Remedial Investigation Data Gap Sampling, 2001
11	2002	ITSI	Basewide Investigation of Transformer Pads, 2001

TABLE 2-2

SUMMARY OF PREVIOUS INVESTIGATIONS AT OU-2B

Site	Report Date	Author	Report
11	2003	Shaw	Basewide Groundwater Monitoring, 2002
11	2003	Bechtel	Basewide PAH Investigation, 2003
11	1994	ERM-West	Environmental Baseline Survey Investigations: Phase 1
11	2001	IT	Environmental Baseline Survey Investigations: Phase 2A and 2B
11	2004	Shaw	Total Petroleum Hydrocarbon Program Investigations
21	1993	PRC and MW	Phase 2B and 3 Investigations, 1991
21	1995	PRC and MW	Follow-on Investigation, 1994
21	1997	Tetra Tech	Follow-on Investigation, 1998
21	2002	Tetra Tech	Supplemental Remedial Investigation Data Gap Sampling, 2001
21	2002	ITSI	Basewide Investigation of Transformer Pads, 2001
21	2003	Shaw	Basewide Groundwater Monitoring, 2002
21	2003	Shaw	Installation and Sampling of Wells OU2B MW-01 through MW-05, 2006
21	2003	Bechtel	Basewide PAH Investigation, 2003
21	1994	ERM-West	Environmental Baseline Survey Investigations: Phase 1
21	1996	ERM-West	Total Petroleum Hydrocarbon Program Investigations
21	1997	Navy PWC	Total Petroleum Hydrocarbon Program Investigations
21	1998	Moju	Total Petroleum Hydrocarbon Program Investigations
21	2001	Tetra Tech	Total Petroleum Hydrocarbon Program Investigations
21	1999	DTSC	Resource Conservation Recovery Act Investigations

TABLE 2-2

SUMMARY OF PREVIOUS INVESTIGATIONS AT OU-2B

Notes:

Previous investigation information compiled from Remedial Investigation Report, Sites 3, 4, 11, and 21 Operable Unit 2B (SulTech, 2005b).

Abbreviations and Acronyms:

BERC –Berkeley Environmental Restoration Center
BRAC – Base Realignment and Closure
DNAPL – dense non-aqueous phase liquid
DTSC – Department of Toxic Substances Control
EBS – Environmental Baseline Survey
ERM-WEST – Environmental Resources Management-West
ft - feet
ITSI – Innovative Technical Solutions, Inc.
IT – International Technology Corporation
JMM – James M. Montgomery, Consulting Engineers, Inc.
MW – Montgomery Watson
PAH – polynuclear aromatic hydrocarbon
PRC – PRC Environmental Management, Inc.
PWC – Public Works Center
TPH – total petroleum hydrocarbons
UST – underground storage tank

TABLE 2-3

SUMMARY OF GEOLOGIC UNITS

Geologic Unit	OU-2A Site 9			OU-2A Site 13		
	Ranges of Approximate Depths (ft bgs)		Comments	Ranges of Approximate Depths (ft bgs)		Comments
	Top	Bottom		Top	Bottom	
Artificial Fill	0	6 to 12		0	2 to 10	
Bay Sediment Unit	9 to 14	14 to 22		4 to 15	6 to 20	Present in southwest corner of Site.
Merritt Sand	14 to 22	66 to 76		7 to 15	68 to 75	
San Antonio Formation	66 to 76	70 to 80		68 to 75	96 to 97	
Yerba Buena Mud	76 to 80	>84		96 to 97	>100	

TABLE 2-3

SUMMARY OF GEOLOGIC UNITS

Geologic Unit	OU-2A Site 19			OU-2A Site 22		
	Ranges of Approximate Depths (ft bgs)		Comments	Ranges of Approximate Depths (ft bgs)		Comments
	Top	Bottom		Top	Bottom	
Artificial Fill	0	7 to 10	Debris encountered to depths of 10 ft bgs.	0	<1 to 18	Not encountered on northeast portion of Site.
Bay Sediment Unit	8 to 10	9 to 11	Present in western half of Site.	Not present.	Not present.	
Merritt Sand	9 to 16	68		0 to 18	>90	
San Antonio Formation	68	97		?	?	No site-specific information.
Yerba Buena Mud	97	>100		?	?	No site-specific information.

TABLE 2-3

SUMMARY OF GEOLOGIC UNITS

Geologic Unit	OU-2A Site 23			OU-2B Site 3		
	Ranges of Approximate Depths (ft bgs)		Comments	Ranges of Approximate Depths (ft bgs)		Comments
	Top	Bottom		Top	Bottom	
Artificial Fill	0	5 to 15		0	3 to 12	
Bay Sediment Unit	10 to 13	13 to 18	Present in western portion of Site.	3 to 10	4 to 13	Transitions to marshland deposits in eastern portion of Site.
Merritt Sand	5 to 18	75 to 85		8.5 to 15	>59	
San Antonio Formation	75 to 85	100		?	?	No site-specific information.
Yerba Buena Mud	100	>100		?	?	No site-specific information.

TABLE 2-3

SUMMARY OF GEOLOGIC UNITS

Geologic Unit	OU-2B Site 4			OU-2B Site 11		
	Ranges of Approximate Depths (ft bgs)		Comments	Ranges of Approximate Depths (ft bgs)		Comments
	Top	Bottom		Top	Bottom	
Artificial Fill	0	6 to 18		0	5 to 13	
Bay Sediment Unit	4 to 6	5 to 7	Present in north and northwestern portions of Site.	7.5 to 13	12 to 15	
Merritt Sand	8 to 18	63 to 79		11 to 15	>60	
San Antonio Formation	63 to 79	89 to 90		?	?	No site-specific information.
Yerba Buena Mud	90	>95		?	?	No site-specific information.

TABLE 2-3

SUMMARY OF GEOLOGIC UNITS

Geologic Unit	OU-2B Site 21		
	Ranges of Approximate Depths (ft bgs)		Comments
	Top	Bottom	
Artificial Fill	0	6 to 9	
Bay Sediment Unit	6 to 15	8 to 20	
Merritt Sand	10 to 20	>40	
San Antonio Formation	?	?	No site-specific information.
Yerba Buena Mud	?	?	No site-specific information.

Notes:
Depths determined from cross-sections and review of boring logs from previous investigations (SulTech, 2005a,b).

Abbreviations and Acronyms:
? – site-specific depths unknown
> – greater than
< – less than
bgs – below ground surface
BSU – Bay Sediment Unit
OU – operable unit

This page intentionally left blank.

TABLE 2-4

OU-2A AND OU-2B SWMU INVENTORY AND STATUS

OU-2A	OU-2B	
SWMUs Requiring No Further Action		
Site 9 AST 410A AST 410B AST 410C OWS 588 Site 13 NADEP GAP 62 Site 19 AOC 616 Site 23 NADEP GAP 63 NADEP GAP 63A NADEP GAP 64	Site 3 NAS GAP 10 Site 4 AST 360D M-06 OWS 372B NADEP GAP 01 NADEP GAP 49A NADEP GAP 50 NADEP GAP 51 NADEP GAP 52 NADEP GAP 55 NADEP GAP 56 NADEP GAP 57A NADEP GAP 58 NADEP GAP 61 NADEP GAP 80	Site 11 AST 014A AST 014B AST 014C AST 014D NADEP GAP 47 NADEP GAP 48 Site 21 M-07 NADEP GAP 45 NADEP GAP 46 NADEP GAP 77 SWMU 162 OWS 162
SWMUs Requiring Further Characterization		
Site 9 OWS 410A OWS 410B Site 13 AOC 009 Site 22 OWS 547	Site 4 AST 360E NADEP GAP 59 OWS 163 OWS 360 OWS 372A AOC 372/SWMU 372 Site 11 OWS 014A OWS 014B OWS 014C OWS 014D OWS 014E UST(R)-06 (UST 14-4)	Site 21 NADEP GAP 44 NADEP GAP 76 NAS GAP 11

TABLE 2-4

OU-2A AND OU-2B SWMU INVENTORY AND STATUS

OU-2A	OU-2B	
SWMUs that Require Further Characterization Deferred to the TPH Program		
Site 13 AOC 397 OWS 397A OWS 397B OWS 397C OWS 397D Site 22 UST(R)-17 Site 23 AST 530A AST 530B AST 530C OWS 529 OWS 530	Site 3 UST 97A UST 97B UST 97C UST 97D UST 97E Site 4 AST 360A AST 360B AST 360C AST 372 UST 163-1	Site 11 AST 37A AST 37B AST 37C AST 37D UST(R)-06 (USTs 14-1, 14-2, 14-3, 14-5, 14-6) Site 21 AOC 398 AST 113 UST(R)-09

Abbreviations and Acronyms:

AOC – area of concern
AST – aboveground storage tank
GAP – Generator Accumulation Point
NAS – Naval Air Station
NADEP – Naval Depot
OU – operable unit
OWS – Oil Water Separator
SWMU – Solid Waste Management Unit
TPH – total petroleum hydrocarbons
UST – underground storage tank

TABLE 2-5

OU-2A SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
I. Further Sampling–Navy and Agencies Concur [3]								
9	OWS 410A	Southwestern corner of Bldg 410; west of wash rack area along southern edge of building	Rinse water from wash rack; 4.5 ft x 7 ft, depth unknown	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	A drain was observed in wash rack, apparently associated with the subject OWS. Sampling of soil or groundwater has not been conducted directly at the OWS or in groundwater immediately downgradient of the OWS.	Further Sampling Required
9	OWS 410B	Southeastern corner of Bldg 410	Stormwater runoff from building; 6 ft x 10 ft, depth unknown	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Stains on concrete leading to OWS suggest undocumented spills. The nearest downgradient groundwater monitoring well is 60 feet away. Soil boring samples were below PRGs. Metal concentrations are elevated. Analytical results for select VOCs and metals have been identified historically. Soil has not been sampled immediately adjacent to the OWS.	Further Sampling Required
13	AOC 009	Eastern side of Site 13	Former ASTs 324, 325, 326, 327, 328 on concrete foundations; sizes and contents unknown	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Tanks with unknown contents have been removed. Historically, elevated concentrations of naphthalene and 2-methylnaphthylene suggesting a possible fuel and crude oil source. Further action is recommended in RI. Not addressed in 2003 Technical Memorandum.	Further Sampling Required
22	OWS 547	Bldg 547; south of former car wash pad	Unknown materials; 5 ft x 9 ft x 5 ft deep	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Petroleum removal action ongoing (SWMU Evaluation Report, 2/2005). No sampling has been conducted near the OWS. The RI describes the area as being a likely source of contaminants in groundwater and soil at the site.	Further Sampling Required

TABLE 2-5

OU-2A SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
II. SWMUs Under TPH Program								
13	AOC 397	Bldg 397	3,500 to 17,000-gallon spill of fuel/oil/water mixture (part of CAA 13)	Further Action (under UST/Petroleum Corrective Action Program)	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	No CERCLA contaminants were detected. Cleanup activities included skimming free product from groundwater, recovering a fuel/water/oil mixture from sewer, soil removal, and installation of a dual phase SVE system. Contamination is being addressed under the base-wide TPH Corrective Action Plan. Analytical results are consistent with a petroleum spill.	Under TPH Program
13	OWS 397A	Eastern end of Bldg 397	Dirty water sump; 6,000-gallon capacity; status unknown	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	No CERCLA contaminants were detected. OWS appears associated with former fuel lines located approximately 60 feet away and floor drains located in the building. An OWS overflow appears to have occurred. TPH compounds have been identified above	Under TPH Program

TABLE 2-5

OU-2A SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
13	OWS-397B	Eastern end of Bldg 397	6,000-gallon dirty water sump	Further Action (under TPH Program)	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	No CERCLA contaminants were detected. OWS appears associated with former fuel lines located approximately 60 feet away and floor drains located in the building. An OWS overflow appears to have occurred. TPH compounds have been identified above	Under TPH Program
13	OWS 397C	Northeastern corner of Bldg 397	Dirty water sump; capacity and status unknown	Further Action (under TPH Program)	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	No CERCLA contaminants were detected. OWS appears associated with former fuel lines located approximately 60 feet away and floor drains located in the building. An OWS overflow appears to have occurred. TPH compounds have been identified above	Under TPH Program
13	OWS 397D	Northern corner of Bldg 397	Dirty water sump; capacity and status unknown	Further Action (under TPH Program)	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	No CERCLA contaminants were detected. OWS appears associated with former fuel lines located approximately 60 feet away and floor drains located in the building. An OWS overflow appears to have occurred. TPH compounds have been identified above	Under TPH Program
22	UST(R) 17	Approximately 70 ft north of northwestern corner of Bldg 547	Leaded gasoline in USTs 547-1, 547-2, and 547-3 (12,000-gallon tanks); tanks removed	Further Action (under UST/Petroleum Corrective Action Program)	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Tanks never contained waste, only gasoline. BTEX soil contamination in excess of PRGs has been confirmed. Groundwater contamination has been confirmed above MCLs. TPH exceeds the groundwater PRG for aquatic receptors. SVE system installed in the area.	Under TPH Program
23	AST 530A	Southeast of Bldg 530	1010 oil (10,000-gallon tank); tank removed; pipes partially removed	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	ASTs have been removed. TPH concentrations in excess of PRGs for soil and groundwater have been identified near the former AST locations. The presence of free-product is suggested by the concentrations. Benzene concentrations in groundwater exceed the MCL. Fuel-related PAHs were identified in soil and groundwater. Non-fuel-related compounds do not appear to be present.	Under TPH Program
23	AST 530B	Southeast of Bldg 530	Fuel or oil (10,000-gallon tank); tank removed and piping partially removed	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	TPH concentrations in excess of PRGs for soil and groundwater have been identified near the former AST locations. The presence of free-product is suggested by the concentrations. Benzene concentrations in groundwater exceed the MCL. Fuel-related PAHs were identified in soil and groundwater. Non-fuel-related compounds do not appear to be present.	Under TPH Program

TABLE 2-5

OU-2A SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
23	AST 530C	Southeast of Bldg 530	Jet fuel (15,000-gallon AST); tank removed; pipes partially removed	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	TPH concentrations in excess of PRGs for soil and groundwater have been identified near the former AST locations. The presence of free-product is suggested by the concentrations. Benzene concentrations in groundwater exceed the MCL. Fuel-related PAHs were identified in soil and groundwater. Non-fuel-related compounds do not appear to be present.	Under TPH Program

TABLE 2-5

OU-2A SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
23	OWS 529	West of former ASTs west of Bldg 529 on eastern end of Avenue M	Unknown materials; 5 ft x 5 ft x 4 ft deep	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	The OWS is associated with three former USTs at a refueling area. The closest soil sampling location (18 feet away) contains TPH-gas and TPH -diesel above residential PRGs. TPH-diesel also exceeded non-residential PRGs. Concentrations suggest the possible presence of free-product. Benzene concentrations in groundwater exceed the MCL. OWS is likely source of petroleum contamination. To be addressed under the TPH Program for CAA 13.	Under TPH Program
23	OWS 530	Northwestern corner of fenced area west of Bldg 530	Unknown materials; 6.5 ft x 13 ft, depth unknown	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	TPH concentrations exceed the aquatic receptor PRG. OWS is likely source of petroleum contamination (SWMU Evaluation Report, 2/2005).Navy conducting groundwater remediation in area (SWMU Evaluation Report, 2/2005). To be addressed under the TPH Program for CAA 13.	Under TPH Program
III. NFA–Navy and Agencies Concur [4]								
9	AST 410A	East of Bldg 410	Methylene chloride (10,000-gallon tank); AST and piping removed	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	AST removed. Open space around building covered in concrete. Surface staining on concrete suggests undocumented spills. Groundwater was sampled in the immediate vicinity with no detections for target analytes. Only one detection reported in a soil sample, likely due to laboratory contamination.	No Further Action
9	AST 410B	East of Bldg 410	Phenol (10,000-gallon tank); AST and piping removed	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	AST removed. Open space around building covered in concrete. Surface staining on concrete suggests undocumented spills. Multiple groundwater samples were obtained in the immediate vicinity with no detections for target analytes. Soil samples not obtained.	No Further Action

TABLE 2-5

OU-2A SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
9	AST 410C	East of Bldg 410	Surfactant (1,500-gallon tank); AST and piping removed	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	AST removed. Open space around building covered in concrete. Surface staining on concrete suggests undocumented spills. The former tank does not meet the definition of a hazardous material, hazardous waste, or petroleum product.	No Further Action
9	OWS 588	South of Bldg 588	Contents unknown; associated with IWTP 410; tank contents unknown	NFA	Closed by DTSC 11/9/1998	No SWMU-specific comments on data gaps	Received DTSC closure in 1998.	No Further Action
13	NADEP GAP 62	Inside Bldg 397, Shop 96231	Drums of Mil-L-23699 lubrication and engine oil	NFA	NFA (11/4/1999)	No SWMU-specific comments on data gaps	Drums were in a secondary containment system, located indoors on a concrete floor. RFI not required. No staining observed. DTSC recommended NFA in 1999. Not considered a likely source of groundwater or soil contamination.	No Further Action
19	AOC 616	Bldg 616	Contains USTs 616-1 (5,000-gal) and 616-2 (10,000-gal) that held water as spill control for Bldg 616	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Tanks are not believed to have ever contained hazardous waste materials. Soil and groundwater samples indicate no impacts above PRGs at or near the tanks. Not addressed in 2003 Technical Memorandum.	No Further Action

TABLE 2-5

OU-2A SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
23	NADEP GAP 64 [5]	Inside Bldg 530, Shop 94224	30- and 55-gallon drums and aerosol cans containing paint, lubrication, solvents, rust remover	NFA	Soil and groundwater near NADEP GAP 64 need further characterization for VOCs. NFA recommended by DTSC 11/4/1999.	Soil and groundwater near NADEP GAP 64 need further characterization for VOCs.	According to RFA, NADEP GAP 64 is a low potential for release into soil and groundwater because the site was located indoors on a flat concrete floor. RFI not required. Phase I EBS concluded NFA because the site was paved and no staining was observed. DTSC recommended NFA in 1999. Not considered a likely source of groundwater and soil contamination.	No Further Action
23	NADEP GAP 63	Inside Bldg 530, Shop 94224	5-gallon containers, 30-gallon drums, 55-gallon drums containing acetone, naphtha with solvents (MEK), poly paint and thinner, 1,1,1-TCA, and MX-4M solvent	NFA	NFA (11/4/1999)	No SWMU-specific comments on data gaps	Drums were in a secondary containment system, located indoors on a concrete floor. RFI not required. No staining observed. Results from soil samples under the building were all below PRGs although mercury reporting limit was elevated (slightly above PRGs). DTSC recommended NFA in 1999. Not considered a likely source of groundwater or soil contamination.	No Further Action

TABLE 2-5

OU-2A SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
23	NADEP GAP 63A	Inside Bldg 530, Shop 94223	55-gallon drums and bowser containing hydraulic oil	NFA	NFA (11/4/1999)	No SWMU-specific comments on data gaps	Site was located indoors on a flat, tile-covered concrete floor. RFI not required. No staining observed in site reconnaissance. DTSC recommended NFA in 1999.	No Further Action

Notes:

[1] Based on the Remedial Investigation Report, Appendix G Solid Waste Management Unit Report for Operable Unit 2A Sites 9, 13, 19, 22, and 23 (SulTech, 2005a) and the Technical Memorandum: Evaluation of Issues Related to the RCRA Facility Permit EPA ID CA 2170023236, Tiered Permits, and the

[2] Based on the Draft Feasibility Study Report (September 2006) comments submitted in correspondence to the Navy by DTSC (April 28,2006), Water Board (April 28, 2006), and EPA (April 27, 2006).

[3] Additional sampling requested for specific SWMU based on the Feasibility Study Report, Responses to Agency comments (see footnote 2 above).

[4] Assumption of Agencies' concurrence of NFA is based on their lack of comments pertaining to specific SWMUs evaluated in the FS.

[5] Agencies agreed that this SWMU required No Further Action during site visit on 06-19-2006.

Abbreviations and Acronyms:

AOC – area of concern
AST – aboveground storage tank
bgs – below ground surface
Bldg – Building (by number)
BTEX – benzene, ethylbenzene, toluene, xylene
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
CPT – cone penetrometer test
DPT – direct push technology
DTSC – Department of Toxic Substances Control
EBS – Environmental Baseline Survey
EPA – Environmental Protection Agency
ft – foot/feet
GAP – generator accumulation point
IWTP – Industrial Wastewater Treatment Plant
MCL – Maximum Contaminant Level
MEK – methyl ethyl ketone
NADEP – Naval Aviation Depot
NAS – Naval Air Station
NFA – No further action
OWS – oil water separator
PAH – polynuclear aromatic hydrocarbons
PCB – polychlorinated biphenyls
PRG – Preliminary Remediation Goal
RFA – RCRA Facility Assessment
RFI – RCRA Facility Investigation
RI – Remedial investigation
SVE – soil vapor extraction
SVOC – semivolatile organic compound
SWMU – solid waste management unit
1,1,1-TCA – 1,1,1-trichloroethane
TPH – total petroleum hydrocarbons
UST – underground storage tank
VOC – volatile organic compound
Water Board – California Regional Water Quality Control Board

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
I. Further Sampling–Navy and Agencies Concur [3]								
4	AOC 372/SWMU 372	West of Bldg 372	SWMU 372 is JP-5 fuel spill due to overflow from UST. AOC 372 is UST 372-1 (6,000 gallon tank) and UST 372-2 (1,000-gallon tank).	Further Action (under UST/Petroleum Corrective Action Program)	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	USTs have been removed. The tanks were originally installed on top of each other. Free product was reported in the tank cavity during removal of the top tank. The top tank was 6,000 gals (JP-5), the other was 1,000 gals (waste oil). Likely source of soil and groundwater contamination. Elevated concentrations of BTEX, TPH-diesel, and TPH-gas detected in two excavation soil samples. No other nearby soil data. Extremely elevated concentrations of BTEX, TPH-diesel, and TPH-gas detected in groundwater samples, and commingled with chlorinated hydrocarbons.	Further Sampling Required
4	AST 360E	West of Bldg 360	Paint and paint seal wastes (3,000-gallon tank)	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Tank present in fair condition with some corrosion apparent. Identified as a likely source of groundwater contamination in RI. Further action recommended for FS.	Further Sampling Required
4	NADEP GAP 59	Bldg 163A, Shop 65132; outside between Bldgs 163A and 414	Petroleum and lubrication oil; 55-gallon and 30-gallon drums	Further Action (under TPH Program)	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	GAP area is identifiable. Likely source of TPH surface soil contamination. Elevated concentrations of TPH-motor oil detected in surface soil samples. No shallow soil samples or groundwater samples collected nearby. Drums were encased in safety packs.	Further Sampling Required
4	OWS 163	Southwestern portion of Bldg 163	OWS with unknown contents and capacity	Further Action	Need further sampling of building interior for VOCs, metals, and TPH. Source evaluation.	No SWMU-specific comments on data gaps	OWS in place. Likely source of soil and groundwater contamination. No previous soil or groundwater samples within 25 feet of OWS. Further action recommended for OWS 163.	Further Sampling Required

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
4	OWS 360	Bldg 360	OWS with unknown contents and capacity	Further Action	Investigate or explain why TCE is not found shallower in this area	No SWMU-specific comments on data gaps	OWS removed. Likely source of soil and groundwater contamination. One soil sample with minor detections below action level. Elevated concentrations of chlorinated compounds in the groundwater. Further action recommended for OWS 360.	Further Sampling Required

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
4	OWS 372A	West of Bldg 372	Oil/water mixture; 3750-gallon capacity	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	OWS in place. Likely source of soil and groundwater contamination. One groundwater sample from a piezometer had minor detections below the action level. However, nearby soil and groundwater samples (possibly related to other nearby SWMUs) have elevated concentrations of TPH and chlorinated hydrocarbons. Further action was recommended for OWS 372A.	Further Sampling Required
11	OWS 014A	Bldg 14 located on southern side in 2nd bay from the western end	Oil/water mixture; 1100-gallon capacity	Further Action	Fill data gaps as indicated in recommendation for OWSs	No SWMU-specific comments on data gaps	Inactive as of 2002 site visit. Likely a source of soil and groundwater contamination. TPH detected at levels suggesting JP-5 free product. Recommended for Further Action in RI.	Further Sampling Required
11	OWS 014B [6]	Bldg 14 located on southern side in 4th bay from the western end	Oil/water mixture; 1100-gallon capacity	NFA	Fill data gaps as recommended for OWSs	No SWMU-specific comments on data gaps	Inactive at the time of the 2002 site visit. Shallow groundwater and soil sampled in vicinity of OWS and analyzed for TPH, metals, and VOCs. Analytes (metals not evaluated) in groundwater were not detected or detected at levels less than MCLs. Not identified as a potential source for soil and groundwater contamination.	Further Sampling Required
11	OWS 014C [6]	Bldg 14, northeastern corner of building	Oil/water mixture; 1,300-gallon capacity; Aboveground OWS.	NFA	Fill data gaps as recommended for OWSs	No SWMU-specific comments on data gaps	Inactive at the time of the 2002 site visit. Shallow groundwater and soil sampled in vicinity of OWS and analyzed for TPH, metals, and VOCs. Analytes (metals not evaluated) in groundwater were not detected. Not identified as a potential source for soil and groundwater contamination.	Further Sampling Required

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
11	OWS 014D [6]	Bldg 14, western side of building	Oil/water mixture; 135-gallon capacity	NFA	Fill data gaps as recommended for OWSs	No SWMU-specific comments on data gaps	Inactive at the time of the 2002 site visit. Shallow groundwater and soil sampled in vicinity of OWS and analyzed for TPH, PAHs, and VOCs. Analytes (metals not evaluated) in groundwater were not detected. Not identified as a potential source for soil and groundwater contamination.	Further Sampling Required
11	OWS 014E [6]	OWS inside of Bldg 14; northern portion of building 45 ft east of western wall in room's E-W center line (Engine Canning Area)	Unknown materials and capacity	NFA	Fill data gaps as recommended for OWSs	No SWMU-specific comments on data gaps	EBS (1999) noted significant staining on the floors in certain areas of building consistent with large spills of fuels and oils. Shallow groundwater and soil samples were collected and analyzed for TPH and VOCs. TPH was not detected and VOCs were not detected or were detected at levels less than MCLs. Not identified as a likely source of groundwater or soil contamination.	Further Sampling Required
11	UST(R) 06	Bldg 14	UST 14-4 (1,000-gallons) and contained waste oil. *USTs 14-1, 14-2, 14-3, 14-5, and 14-6 to be addressed under TPH Program per DTSC and EPA on 06-19-2006 site visit.*	Further Action (under UST/Petroleum Corrective Action Program)	UST 14-4 fill data gaps as recommended	No SWMU-specific comments on data gaps	UST 14-4 stored waste oil. Groundwater and soil remediation are in progress at site. Three (USTs 14-1, 14-4, and 14-5) of the six tanks had holes in them as noticed upon removal in November 1994. Over-excavation of soil was performed. USTs 14-2, 14-3, and 14-6 were in good condition. SWMU identified as a source of soil and groundwater contamination and Further Action is recommended.	Further Sampling Required

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
21	NADEP GAP 44	Bldg 398, Shop 96327; outside of building east of northern wing	Lube oil, JP-5, and M-114 solvent in 3 500-gallon drums (1500 gallons total). *Per 06-19-2006 site visit, USTs 398-1 and 398-2 will be addressed under the TPH Program and currently a part of CAA 3A. The drums will be addressed under CERCLA.*	Further Action	Further investigation and characterization of the extent of contamination required	No SWMU-specific comments on data gaps	One DPT location, one soil boring, and two excavations sampled 16-20 ft from GAP site. SWMU cited in RI as a potential source of soil and groundwater contamination in the area. NFA recommended for NADEP GAP 44, but Further Action required for USTs 398-1 and 398-2 under CAA 3A in Technical Memorandum.	Further Sampling Required
21	NADEP GAP 76 [6]	Bldg 113, Shop 96212	Aerosol paint and rust remover, dope and lacquer thinner, some oil, enamel paint, and 1,1,1-TCA in aerosol cans and 55-gallon drums		Further investigation required NFA recommended by DTSC 11/4/1999	No SWMU-specific comments on data gaps	RFA indicated site was low priority because of the low potential for release into soil and groundwater. EBS (1999) did not recommend site for further investigation. DTSC recommended site for NFA in 1999. Not likely a source for soil and groundwater contamination.	Further Sampling Required
21	NAS GAP 11 [6]	Bldg 162; sump to collect waste oils inside of building; not in RFA	Waste oils; unknown capacity and storage	NFA	Further investigation required DTSC recommended NFA for SWMU 11/4/1999	No SWMU-specific comments on data gaps	Investigated during the EBS (2001). Two subsurface soil samples were analyzed for metals, VOCs, and TPH. TPH and VOCs were not detected or detected at levels less than PRGs. No additional soil sampling recommended in the EBS. Not a likely source of soil and groundwater contamination.	Further Sampling Required
II. SWMUs Under TPH Program								

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
3	UST 97A	South across street from Bldg 527	115/145 AVGAS (100,000-gallon tank); tank removed	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	USTs removed. Likely source of soil and groundwater contamination. Elevated concentrations of VOCs appear to have been released to soil in the vicinity of the refueling facilities and USTs. No nearby soil samples. Not included in 2003 Technical Memorandum.	Under TPH Program
3	UST 97B	South across street from Bldg 527	115/145 AVGAS (100,000 gallon tank); tank removed	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	See UST 97A for available information	Under TPH Program
3	UST 97C	South across street from Bldg 527	115/145 AVGAS (100,000-gallon tank); tank removed	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	See UST 97A for available information	Under TPH Program
3	UST 97D	South across street from Bldg 527	115/145 AVGAS (100,000-gallon tank); tank removed	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	See UST 97A for available information	Under TPH Program

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
3	UST 97E	South across street from Bldg 527	115/145 AVGAS (100,000-gallon tank); tank removed	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	See UST 97A for available information	Under TPH Program
4	AST 360A	North side of Bldg 360	Diesel (2,500-gallon tank)	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	ASTs are located adjacent to each other. All but AST 360D are likely sources of soil and groundwater contamination. A groundwater sample was collected nearby and non-detect for VOCs. However, the area falls within elevated benzene and chlorinated VOC plumes. Other likely sources in and around Bldg. 360 also exist. No soil samples collected within 100 feet of ASTs.	Under TPH Program
4	AST 360B	North side of Bldg 360	Diesel (2,500-gallon tank)	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	See AST 360A for available information	Under TPH Program
4	AST 360C	North side of Bldg 360	Diesel (2,500-gallon tank)	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	See AST 360A for available information	Under TPH Program

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
4	AST 372	West of Bldg 372	Fuel or fuel oils (capacity is unknown)	Further Action	Sample site for PCBs	No SWMU-specific comments on data gaps	Likely source of soil and groundwater contamination. Elevated concentrations of TPH-diesel and BTEX in 1 soil sample. Extremely elevated concentrations of TPH-diesel, TPH-gas, and BTEX in one groundwater sample. Concentrations suggest free product is present.	Under TPH Program
4	UST 163-1	East of Bldg 414	Fuel oil (2,000-gallon concrete tank); removed in March 1995	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Removed in March 1995 followed by over-excavation. Several soil samples were collected and analyzed for TPH. Recommended for NFA under the TPH Program. Not included in 2003 Technical Memorandum.	Under TPH Program
11	AST 037A	South of Bldg 14 in open area	Combustible liquids including JP-5, diesel, heavy oils, spilled solvents and fuels (6,500-gallon tank)	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	According to the RI, AST 037A through AST 037D have been integrated with the TPH program and will be conducted as part of activities at CAA 11-A.	Under TPH Program

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
11	AST 037B	South of Bldg 14 in open area	Combustible liquids including JP-5, diesel, heavy oils, spilled solvents and fuels (6,500-gallon tank)	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	See AST 037A for available information.	Under TPH Program
11	AST 037C	South of Bldg 14 in open area	Combustible liquids including JP-5, diesel, heavy oils, spilled solvents and fuels (6,500-gallon tank).	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	See AST 037A for available information.	Under TPH Program
11	AST 037D	South of Bldg 14 in open area	Combustible liquids including JP-5, diesel, heavy oils, spilled solvents and fuels (4,800-gallon tank).	Further Action	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	See AST 037A for available information.	Under TPH Program
21	AOC 398	Building 398	UST 398-1 (10,000-gallons) and 398-2 (10,000-gallons). Contained JP-5 (UST 398-1) and JP-TS (UST 398-2)	Further Action (under UST/Petroleum Corrective Action Program)	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Two USTs stored JP-5 and JP-TS. Removed in 1995 with no over-excavation. Floating product was detected during the removal action. Investigated during the RI, a localized plume of chlorinated hydrocarbons exists in the vicinity commingled with the petroleum hydrocarbon plume.	Under TPH Program

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
21	AST 113	Southeast corner of Bldg 113	Diesel (fiberglass tank); removed as of 8/2002.	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Recommended for NFA in AST Status Report (11/2004).	Under TPH Program
11	UST(R) 06	Bldg 14	UST 14-1 (10,000-gallons), UST 14-2 (10,000-gallons), UST 14-3 (10,000-gallons), UST 14-5 (4,500-gallons), and UST 14-6 (600-gallons). Contained lubricating oil (USTs 14-1, 14-2, and 14-3), gasoline (UST 14-5), and diesel (UST 14-6).	Further Action (under UST/Petroleum Corrective Action Program)	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Groundwater and soil remediation are in progress at site. Three (USTs 14-1, 14-4, and 14-5) of the six tanks had holes in them as noticed upon removal in November 1994. Over-excavation of soil was performed. USTs 14-2, 14-3, and 14-6 were in good condition. SWMU identified as a source of soil and groundwater contamination and Further Action is recommended.	Under TPH Program
21	UST(R) 09	Located on northeast corner of Bldg 162	Diesel fuel in two 100-gallon USTs, 162-1 and 162-2. Collectively known as UST(R) 09	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Recommended for NFA based on "UST No Further Action Report, Request for No Further Action, UST Tanks 162-1 and 162-2" (February 2000). Addressed under TPH Program.	Under TPH Program
III. NFA--Navy and Agencies Concur 4								

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
3	NAS GAP 10	25' x 30' area outside of northeast corner of Bldg 112	55-gallon drums of solvents, lubrication and hydraulic oils, and asbestos. Site includes 3 metal sheds with secondary containment on concrete	NFA	Fill data gaps, further define benzene extent NFA recommended by DTSC 11/4/1999	No SWMU-specific comments on data gaps	2 soil sampling locations 25-30 ft from SWMU. According to RI, DTSC recommended SWMU for NFA in 1999.	No Further Action
4	AST 360D	West side of Bldg 360	Compressed air or steam (3,000-gallon tank)	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Navy recommended NFA for this AST.	No Further Action
4	M-06	Inside Bldg 360	Portable distillation unit up to 15 gallons; materials consist of PD-680, paint thinners, and acetone.	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	The 2002 site visit found a red and white rectangle painted on floor inside Bldg 360. Expansion joint in concrete was visible through area but did not exhibit staining. RI report did not indicate there was any groundwater contamination associated with the SWMU.	No Further Action

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
4	NADEP GAP 01	Inside Bldg 360, Shop 96234	Aluminum oxides; capacity and storage is unknown	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	The 2002 site visit showed the area where the GAP was located, inside Bldg 360, exhibited no staining, corrosion, or other pathways through floor indicating a release. RI report did not indicate there was any contamination associated with the SWMU.	No Further Action
4	NADEP GAP 49A	Inside Bldg 360, Shop 96212	Aluminum oxide and ammonium chloride; capacity and storage is unknown	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	The 2002 site visit showed the area where the GAP was located, inside Bldg 360, exhibited no staining, corrosion, or other pathways through floor indicating a release. RI report did not indicate there was any contamination associated with the SWMU.	No Further Action
4	NADEP GAP 50	Inside Bldg 360, Shop 96223	Blasting grit (glass) and chromic acid; capacity and storage is unknown	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	The 2002 site visit showed the area where the GAP was located, inside Bldg 360, exhibited minor staining on wall behind GAP, but there were no staining, corrosion, or other pathways through the floor indicating a release. RI report did not indicate there was any contamination associated with the SWMU.	No Further Action

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
4	NADEP GAP 51	Inside Bldg 360, Shop 96225	Aerosol paint, epoxy paint, and thinner; capacity and storage is unknown	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	The 2002 site visit showed the area where the GAP was located inside Bldg 360. Exhibited minor cracks in the floor, but there were no staining, corrosion, or other pathways through the floor indicating a release. RI report did not indicate there was any contamination associated with the SWMU.	No Further Action
4	NADEP GAP 52	Outside Bldg 360, Shop 96231	Aerosol paint and lubrication, lubrication and engine oils, JP-5, and PD-68- in varied containers up to 55-gallon drums	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	No sampling conducted in vicinity of GAP. The 2002 site visit confirmed the EBS and RFA observations that the GAP sat on a concrete floor with staining, corrosion, and minor cracks in the vicinity. RI report did indicate that SWMU was not likely a source of soil and groundwater contamination.	No Further Action
4	NADEP GAP 55	Inside Bldg 360, Shop 96215	Blasting grit (glass and plastic) and aluminum oxide; 55-gallon drums and large bags	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	The 2002 site visit noted some small cracks on the floor; however no staining, corrosion, or other pathways through the floor. RI report did indicate that SWMU was not likely a source of soil and groundwater contamination.	No Further Action
4	NADEP GAP 56	Inside Bldg 360, Shop 96215	Blasting grit (glass and plastic) and aluminum oxide; 55-gallon drums and large bags	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	The 2002 site visit noted two adjacent red and white rectangles marking the locations of the hazardous waste containment areas. Hoppers were still present at the site. No staining, corrosion, or other pathways through the floor. RI report did indicate that SWMU was not likely a source of soil and groundwater contamination.	No Further Action
4	NADEP GAP 57A	Bldg 360, Shop 96215; outside of northern wall of Bldg 360; area is 20 ft by 30 ft	Two metal bins on top of concrete containing poly bags of blasting grit (all media) and aluminum oxide	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	The 2002 site visit noted a red and white rectangle marking the location of bins used to store blasting grit. No staining, corrosion, or other pathways through the floor. Subsurface samples were collected in vicinity and analyzed for TPH, VOCs, SVOCs, PAHs, PCBs, and herbicides. Non-detect values for metals and organotins were below PRGs. RI report did indicate that SWMU was not likely a source of soil and groundwater contamination.	No Further Action

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
4	NADEP GAP 58	Bldg 360, Shop 96211	Aerosol cans (Turco Dy-check developer and remover); aerosol cans and 55-gallon drums	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	The 2002 site visit found a red and white rectangle painted on floor inside Bldg 360 marking a hazardous waste containment area. No staining, corrosion, or visible cracks were observed indicating a pathway through the floor. Not likely a source of soil and groundwater contamination.	No Further Action
4	NADEP GAP 61	Inside Bldg 372, Shop 96232	JP-5 with engine oil, shop rags with oil, lubrication and engine oil with JP-5, PD-680, spent sweeping compounds; 55-gallon drums	NFA	NFA (11/4/1999)	No SWMU-specific comments on data gaps	EBS site visit (1999) found no staining, therefore no further investigation was required. Not likely a source of soil and groundwater contamination.	No Further Action

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
4	NADEP GAP 80	Inside Bldg 360, Shop 96223	Cyanide; capacity and storage unknown	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	The 2002 site visit found a faded red and white rectangle painted on floor inside Bldg 360 marking a hazardous waste containment area. Some machinery remains in surrounding areas. No staining, corrosion, or obvious pathways through the floor were observed. Not likely a source of soil and groundwater contamination.	No Further Action
4	OWS 372B	Outside main entrance of Bldg 372	OWS with unknown contents and capacity	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Inactive during the 2002 site visit. Samples collected during the RI 25-30 ft from OWS and analyzed for TPH, VOCs, and/or PAHs. Analytes were not detected or detected at levels below PRGs. Not a likely source for soil and groundwater contamination in area.	No Further Action
11	AST 014A	Inside Bldg 14	Preservative oil (50-gallon tank)	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Subsurface contamination was not suspected during the RI because of the tank's limited capacity, location with Bldg 14 and tank content (preservative oil). Not likely a source of soil and groundwater contamination.	No Further Action
11	AST 014B	Inside Bldg 14	Compressor cleaning fluid (50-gallon tank); AST and piping removed	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Subsurface contamination was not suspected during the RI because of the tank's limited capacity, location with Bldg 14 and tank content (compressor cleaning solution). Not likely a source of soil and groundwater contamination.	No Further Action
11	AST 014C	Inside Bldg 14	Smoke abatement chemical (55-gallon tank); AST and piping removed	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Subsurface contamination was not suspected during the RI because of the tank's limited capacity, location with Bldg 14 and tank content (smoke abatement chemical). Not likely a source of soil and groundwater contamination.	No Further Action
11	AST 014D	Inside Bldg 14	Smoke abatement chemical (55-gallon tank); AST and piping removed	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Subsurface contamination was not suspected during the RI because of the tank's limited capacity, location with Bldg 14 and tank content (smoke abatement chemical). Not likely a source of soil and groundwater contamination.	No Further Action

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
11	NADEP GAP 48 [5]	Inside Bldg 14, Shop 96233	Noted 1010, lubrication, and engine oils; PD-680; aerosol paint, aerosol lubrication spray, solvents, oil rags, and shop paper towels; air filters; contaminated with oil and solvents. Contained in 55-gallon drums	Per 06-19-2006 site visit, agencies agree on NFA. No further sampling will take place.	Per 06-19-2006 site visit, agencies agree on NFA. No further sampling will take place.	Per 06-19-2006 site visit, agencies agree on NFA. No further sampling will take place.	SWMU occupied area 3 ft by 10 ft inside Bldg 014. No further investigation warranted by EBS because there was no observed staining or evidence of spills. DTSC recommended SWMU for NFA in 1999. Not likely a source of soil or groundwater contamination.	No Further Action
11	NADEP GAP 47	Inside Bldg 14, Shop 96233 *Could not be located during visits to site on 06-13-2006 and 06-19-2006.*	Sump with 1010, Mil-L-23699 lubrication, and engine oils	NFA	Further investigation required	No SWMU-specific comments on data gaps	Sump removed prior to 1999 EBS. The 2002 site visit indicated faded red markings painted on concrete inside Bldg 014. No staining, corrosion, or obvious pathway through floor was apparent in vicinity of SWMU. Not likely a source of soil and groundwater contamination.	No Further Action
21	M-07	Inside Bldg 398	PD-680, paint thinners, and acetone in 15-gallon portable solvent distillation unit.	NFA	No SWMU-specific comments on data gaps	No SWMU-specific comments on data gaps	Exact location of 15-gallon distillation unit has not been found during the EBS and 2002 site visits. Building interior has been remodeled, the floor was repaired, cleaned, sealed, and repainted.	No Further Action
21	SWMU 162 [5]	Bldg 162, Shop 0542 - Laboratory	Oil and 1,1,1-TCA; unknown storage and capacity	NFA	Further investigation required NFA recommended by DTSC 11/4/1999	No SWMU-specific comments on data gaps	Phase I EBS (1994) concluded the SWMU did not warrant further investigation because it was located on the second floor of the building. DTSC recommended the SWMU for NFA in 1999. SWMU 162 is not a likely source of soil and groundwater contamination.	No Further Action

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
21	NADEP GAP 45 [5]	Bldg 398, Shop 96327; under a covered walkway outside of building	Aerosol paint and paper towels contaminated with oil in 30-gallon and 55-gallon drums	NFA	Further investigation required	No SWMU-specific comments on data gaps	The 2002 site visit found a red and white rectangle painted on floor in covered hallway outside of Bldg 398. Expansion joint in concrete was visible through area but did not exhibit staining. Based on low frequency of detected analytes, no additional sampling was recommended as a result of the EBS (2001). Not a likely source of soil and groundwater contamination.	No Further Action

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
21	NADEP GAP 46 [5]	Bldg 162	Aerosol paint, 1,1,1-TCA, lubrication oil, PD-680, and acetone in varied containers up to 55-gallon drums	NFA	Further investigation required NFA recommended by DTSC 11/4/1999	No SWMU-specific comments on data gaps	RFA indicated site was low priority because of the low potential for release into soil and groundwater because of its location inside a building on a concrete floor. EBS (1999) did not recommend site for further investigation. DTSC recommended site for NFA in 1999. Not likely a source for soil and groundwater contamination.	No Further Action

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Site	SWMU	Location	Description [1]	2005 RI or 2003 Tech Memo Recommendation [1]	DTSC Recommendation [2]	EPA Recommendation [2]	Available Information	Current Navy Sampling Recommendation
21	NADEP GAP 77	Bldg 113, Shop 96215, southeastern corner of Bldg 113	Blasting grit on concrete floor area	NFA	NFA recommended by DTSC 11/4/1999	No SWMU-specific comments on data gaps	RFA indicated site was low priority because of the low potential for release into soil and groundwater based on its location inside a building on a concrete floor. EBS (1999) did not recommend site for further investigation. DTSC recommended site for NFA in 1999. Not likely a source for soil and groundwater contamination.	No Further Action
21	OWS 162	Bldg 162, southeastern corner *Could not be located during visits to site on 06-13-2006 and 06-19-2006.*	Unknown materials and capacity	NFA	Investigate OWS as recommended	No SWMU-specific comments on data gaps	Soil sample collected at the site was analyzed for TPH, metals, VOCs, and PAHs. Metals and PAHs were not evaluated against PRGs. TPH and VOCs were not detected or were detected at levels less than PRGs. Oil and grease were detected at an estimated concentration. Not a likely source of soil and groundwater contamination.	No Further Action

Notes:

TABLE 2-6

OU-2B SOLID WASTE MANAGEMENT UNIT SAMPLING SUMMARY TABLE

Notes:

[1] Based on the Remedial Investigation Report, Appendix G Solid Waste Management Unit Report for Operable Unit 2B (Sites 3, 4, 11, and 21), (SulTech, 2005b) and the Technical Memorandum: Evaluation of Issues Related to the RCRA Facility Permit EPA ID CA 2170023236, Tiered Permits, and the Nonpermitted Areas at Alameda Point, May 2003.

[2] Based on the Draft Feasibility Study Report (October 2005) comments submitted in correspondence to the Navy by DTSC (April 28, 2006), Water Board (April 28, 2006), and EPA (April 27, 2006).

[3] Additional sampling requested for specific SWMU based on the Feasibility Study Report Agency comments (see footnote 2 above).

[4] Assumption of Agencies' concurrence of NFA is based on their lack of comments pertaining to specific SWMUs evaluated in the FS.

[5] Agencies agreed this SWMU required No Further Action during site visit on 06-19-2006.

[6] SWMU being sampled at the request of the Agencies as a result of the site visit on 06-19-2006.

Abbreviations and Acronyms:

AOC – area of concern
AST – aboveground storage tank
bgs – below ground surface
Bldg – Building (by number)
BTEX – benzene, ethylbenzene, toluene, xylene
CAA – corrective action area
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
CPT – cone penetrometer test
DPT – direct push technology
DTSC – Department of Toxic Substances Control
EBS – Environmental Baseline Survey
EPA – Environmental Protection Agency
ft – foot/feet
FS – Feasibility Study
GAP – generator accumulation point
MCL – Maximum Contaminant Level
NADEP – Naval Aviation Depot
NAS – Naval Air Station
NFA – No further action
OWS – oil water separator
PAH – polynuclear aromatic hydrocarbons
PCB – polychlorinated biphenyls
PRG – Preliminary Remediation Goal
RFA – RCRA Facility Assessment
RFI – RCRA Facility Investigation
RI – Remedial investigation
SVOC – semivolatile organic compound
SWMU – solid waste management unit
1,1,1-TCA – 1,1,1-trichloroethane
TPH – total petroleum hydrocarbons
UST – underground storage tank
VOC – volatile organic compound
Water Board – California Regional Water Quality Control Board

TABLE 3-1

SWMU AND DATA GAP SAMPLING LOCATIONS, DEPTHS, AND ANALYSES

SAMPLING LOCATION				SOIL													GROUNDWATER												
					ANALYSES															ANALYSES									
Site & Sampling Rationale	Sampling Description /Method	Number of Borings	Initial Sampling Depth(s) (ft bgs)[a]	Total Number of Soil Samples	VOCs (including BTEX & MTBE)	SVOCs (including 1,4-Dioxane)	TPH-Purgeable	TPH-Extractable	PCBs	Pesticides	Metals	Hexavalent Chromium	TOC	Grain Size	Bulk Density	Microbial Parameters	Total Number of Groundwater Samples	Depth (ft bgs)	Monitoring Events	VOCs (including BTEX & MTBE)	SVOCs (including 1,4-Dioxane)	TPH-Purgeable	TPH-Extractable	PCBs	Pesticides	Dissolved Metals	Hexavalent Chromium	Microbial Parameters	Natural Attenuation Parameters
Site 9																													
OWS 410A	HA/HP	Approx. 3	1, 5	6	6	6	6	6	6	6	6	--	1	1	1	1	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
OWS 410B	HAHP	Approx. 3	1, 5	6	6	6	6	6	6	6	6	--	1	1	1	1	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
Wash Rack Soil Investigation	HA	2	1,5	4	4	4	4	4	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Groundwater Investigation & Monitoring	HA/DPT/ HP FWBZ	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	15	1	9	9	9	9	--	--	9	--	0	9
	Existing MWs	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6	Midscreen	4	24	24	24	24	--	--	24	--	2[b]	6[c]
	New FWBZ MWs	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	Midscreen	4	8	8	8	8	--	--	8	--	2[c]	2[c]
	New SWBZ MWs	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	Midscreen	4	4	4	4	4	--	--	4	--	1[c]	1[c]
	Subtotals	41	--	16	16	16	16	16	12	12	16	0	2	2	2	2	20	--	--	47	47	47	47	2	2	47	--	7	20
Site 13																													
AOC 009 (ASTs)	HA/HP	Approx. 5	1,5	10	10	10	10	10	--	--	10	--	1	1	1	1	1	FWBZ	--	1	1	1	1	--	--	1	--	1	1
Previous Borings B13-28 thru B13-32, B13-41, and B-IMF-06 Soil Investigation	HA	16	1 / 5	31	--	--	--	--	--	--	31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Incinerator Soil Investigation	HA	15	1,5	30	30	30	--	--	--	--	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Groundwater Investigation & Monitoring	HA/HP FWBZ	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	15	1	4	4	4	4	--	--	4	--	--	4
	Existing MWs	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7	Midscreen	4	28	7[c]	28	28	--	--	28	--	4[d]	7[c]
	New FWBZ MWs	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	Midscreen	4	4	4	4	4	--	--	4	--	1[c]	1[c]
	New SWBZ MWs	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Subtotals	48	--	71	40	40	10	10	0	0	71	0	1	1	1	1	13	15	--	37	16	37	37	0	0	37	--	6	13
Site 19																													
Yard D-13 Soil Investigation	HA	9	1, 5	18	18	18	18	18	--	--	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Groundwater Investigation & Monitoring	HA/HP FWBZ	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	15	1	2	2	2	2	--	--	2	--	2	2
	Existing MWs	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	Midscreen	4	12	3[c]	12	12	--	--	12	--	2[e]	3[c]
	New FWBZ MWs	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	Midscreen	4	4	4	4	4	--	--	4	--	1[c]	1[c]
	New SWBZ MWs	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Subtotals	15	--	18	18	18	18	18	0	0	18	0	0	0	0	0	6	--	--	18	9	18	18	0	0	18	--	5	6
Site 22																													
OWS 547	HA/HP	Approx. 3	1, 5	6	6	6	6	6	6	6	6	--	1	1	1	1	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
Previous Borings 547-5, 547-6, and 547-11 Soil Investigation	HA	9	1 / 5	15	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Subtotals	12	--	21	6	6	6	6	6	6	21	0	1	1	1	1	1	--	--	1	1	1	1	1	1	1	--	1	1
Site 3[f]																													
Building 112 Soil Investigation - Exterior	HA	5	1, 5	10	10	10	--	--	10	--	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Building 112 Soil Investigation - Interior	HA	2	1,5	4	4	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Subtotals	7	--	14	14	10	0	0	10	0	14	0	0	0	0	0	0	--	--	0	0	0	0	0	0	0	--	0	0

TABLE 3-1

SWMU AND DATA GAP SAMPLING LOCATIONS, DEPTHS, AND ANALYSES

SAMPLING LOCATION			SOIL																	GROUNDWATER									
					ANALYSES															ANALYSES									
Site & Sampling Rationale	Sampling Description /Method	Number of Borings	Initial Sampling Depth(s) (ft bgs) [a]	Total Number of Soil Samples	VOCs (including BTEX & MTBE)	SVOCs (including 1,4-Dioxane)	TPH-Purgeable	TPH-Extractable	PCBs	Pesticides	Metals	Hexavalent Chromium	TOC	Grain Size	Bulk Density	Microbial Parameters	Total Number of Groundwater Samples	Depth (ft bgs)	Monitoring Events	VOCs (including BTEX & MTBE)	SVOCs (including 1,4-Dioxane)	TPH-Purgeable	TPH-Extractable	PCBs	Pesticides	Dissolved Metals	Hexavalent Chromium	Microbial Parameters	Natural Attenuation Parameters
Site 4																													
OWS 163	HA/HP	Approx. 3	1, 5	6	6	6	6	6	6	6	6	--	1	1	1	1	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
OWS 360	HA/HP	Approx. 3	1, 5	6	6	6	6	6	6	6	6	--	1	1	1	1	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
OWS 372A	HA/HP	Approx. 3	1, 5	6	6	6	6	6	6	6	6	--	1	1	1	1	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
AST 360E	HA/HP	Approx. 1	1, 5	2	2	2	2	2	2	2	2	--	1	1	1	1	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
AOC 372/SWMU 372	HA/HP	6	1, 5	12	12	12	12	12	12	12	12	--	1	1	1	1	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
NADEP GAP 59	HA/HP	1	1, 5	2	2	2	2	2	2	2	2	--	1	1	1	1	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
Building 163 Soil Investigation	HA	2	1, 5	4	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Building 372 PCB Soil Investigation	HA	9	1, 5	18	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Building 360 Storm Drain Investigation	HA	8	6	8	8	8	--	--	8	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Building 360 Metals Investigation	HA	12	0, 3, 6	36	--	--	--	--	--	--	36	36	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Subtotals		48	--	100	46	42	34	34	60	34	78	36	6	6	6	6	6	--	--	6	6	6	6	6	6	6	--	6	6
Site 11																													
OWS 014A	HA/HP	Approx. 3	1, 5	6	6	6	6	6	6	6	6	--	1	1	1	1	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
OWS 014B	HA/HP	Approx. 3	1, 5	6	6	6	6	6	6	6	6	--	1	1	1	1	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
OWS 014C	HA/HP	Approx. 3	1, 5	6	6	6	6	6	6	6	6	--	1	1	1	1	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
OWS 014D	HA/HP	Approx. 3	1, 5	6	6	6	6	6	6	6	6	--	1	1	1	1	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
OWS 014E	HA/HP	Approx. 3	1, 5	6	6	6	6	6	6	6	6	--	1	1	1	1	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
UST 14-4	HA/HP	1	5	5	5	5	5	5	--	--	5	--	1	1	1	1	1	FWBZ	--	1	1	1	1	0	0	1	--	1	1
Building 265 Soil Investigation	HA	1	1, 5	4	2	2	--	--	4	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Building 118 Soil Investigation	HA	3	1, 5	6	--	--	--	--	4	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Previous Boring M11-03 Soil Investigation	HA	4	0.5 / 2.5	8	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Building 14 Soil Investigation	HA	1	1, 5	2	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Subtotals		25	--	55	39	37	35	35	38	30	51	0	6	6	6	6	6		--	6	6	6	6	5	5	6	--	6	6
Site 21																													
NADEP GAP 44	HA/HP	Approx. 2	1, 5	4	4	4	4	4	4	4	4	--	1	1	1	1	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
NADEP GAP 76	HA/HP	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
NAS GAP 11	HA/HP	1	1, 5	2	2	2	2	2	2	2	2	--	1	1	1	1	1	FWBZ	--	1	1	1	1	1	1	1	--	1	1
Previous Boring 126-002-003 Soil Investigation	HA	3	0.5 / 3	3	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Building 113 Soil Investigation	HA	1	1, 5	2	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Building 162 Soil Investigation	HA	12	1, 5	24	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Buildings 398 Soil Investigation	HA	10	1, 5	20	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Subtotals		32	--	55	32	6	6	6	6	6	29	0	2	2	2	2	3		--	3	3	3	3	3	3	3	--	3	3
OU-2B Site-Wide Groundwater																													
Groundwater Investigation & Monitoring	HP FWBZ	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10	FWBZ	1	6	--	6	6	--	--	10	--	6 [f]	--
	HP SWBZ	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25	15,25,35,45,55	1	125	--	100	100	--	--	125	15 [g]	10 [h]	125
	Existing MWs	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22	Midscreen	4	88	--	22 [c]	22 [c]	--	--	88	--	4 [i]	22 [c]
	New FWBZ MWs	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	Midscreen	4	8	--	2 [c]	2 [c]	--	--	8	--	--	2 [c]
	New SWBZ MWs	12	25-30	12	12	--	--	--	--	--	12	--	12	12	12	12	52	Midscreen	4	208	--	50 [c]	50 [c]	--	--	208	--	25 [j]	50 [c]
Subtotals		71	--	12	12	0	0	0	0	0	12	0	12	12	12	12	111		--	429	--	100	100	--	--	429	--	--	125
Grand Totals		299	--	362	223	175	125	125	132	88	310	36	30	30	30	30	166	--	--	547	88	218	218	17	17	547	15	34	180

Notes:

[a] For soil sampling, approximate depths are presented in this table. At least two unsaturated soil samples will be collected at each proposed soil boring unles otherwise noted. An average depth of 5 ft bgs has been assumed for the vadose zone samples; however, actual vadose zone sample depths may vary. Additional borings may be completed based on the step-out procedure discussed in Section 5.0.

[b] Sampling for microbial parameters will be conducted durnig the first monitoring event at wells MW09-06 and P-9-MWI-05.

[c] These analytical parameters will only be sampled for during the first monitoring event.

TABLE 3-1

SWMU AND DATA GAP SAMPLING LOCATIONS, DEPTHS, AND ANALYSES

SAMPLING LOCATION			SOIL															GROUNDWATER											
					ANALYSES																ANALYSES								
Site & Sampling Rationale	Sampling Description /Method	Number of Borings	Initial Sampling Depth(s) (ft bgs) [a]	Total Number of Soil Samples	VOCs (including BTEX & MTBE)	SVOCs (including 1,4-Dioxane)	TPH-Purgeable	TPH-Extractable	PCBs	Pesticides	Metals	Hexavalent Chromium	TOC	Grain Size	Bulk Density	Microbial Parameters	Total Number of Groundwater Samples	Depth (ft bgs)	Monitoring Events	VOCs (including BTEX & MTBE)	SVOCs (including 1,4-Dioxane)	TPH-Purgeable	TPH-Extractable	PCBs	Pesticides	Dissolved Metals	Hexavalent Chromium	Microbial Parameters	Natural Attenuation Parameters

[d] Sampling for microbial parameters will be conducted during the first monitoring event at wells M13-07, M13-09, MWOR-03, and CA13-01.

[e] Sampling for microbial parameters will be conducted during the first monitoring event at wells MWD13-3 and MWD13-4.

[f] Sampling totals for Site 3 do not include investigation of the former zinc smelter. If the former zinc smelter location can be located, then at least two soil samples will be collected from 1 ft and 5 ft bgs and analyzed for VOCs and metals.

[g] Hexavalent chromium will be included in the analyses of groundwater samples from the three SWBZ HP locations north of Building 360.

[h] Two locations (one north of Building 360 and one north of Building 162) will be sampled at all 5 depths in these SWBZ Hydropunch® locations.

[i] Sampling for microbial parameters will be conducted during the first monitoring event at the following 4 wells: M03-09, M03-13, M03-12, and M03-16.

j Sampling for microbial parameters will be conducted during the first monitoring event at 5 locations (and at all 5 depths) that are located in the core of the two plumes.

For the microbial samples that are shaded, these are sites that contain chlorinated hydrocarbon contamination. Therefore, microbial analysis will include cell counts for Eubacteria (EBAC), Dehalococcoides spp. (DHC), and methanogenic bacteria (MGN) via nucleic acid analysis, and total biomass and microbial community structure via ester-linked phospholipid fatty acid (PFLA).
For all other samples that are not shaded, these are sites that have petroleum hydrocarbon contamination. Microbial analyses for those sites will include qEBAC, qPAH, qNAH and qBSS.

Abbreviations and Acronyms:

-- – no analysis
AST – aboveground storage tank
bgs – below ground surface
BTEX – benzene, toluene, ethylbenzene, and total xylenes
DPT - direct push technology
ft – feet
FWBZ – first water-bearing zone
HA – hand auger
HP - Hydropunch®
MTBE – methyl tertiary butyl ether
MW – monitoring well
NA – natural attenuation
NAS GAP – Naval Air Station Generator Accumulation Point
OWS – oil-water separator
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
SWBZ – second water-bearing zone
SWMU – Solid Waste Management Unit
TOC – total organic carbon
TPH-purgeable – total purgeable petroleum hydrocarbons
TPH-extractable – total extractable petroleum hydrocarbons
UST – underground storage tank
VOC – volatile organic compound
WD – Wash Down Area

TABLE 3-2

EXISTING GROUNDWATER MONITORING WELL SUMMARY

Operable Unit	SITE	WELL	Water-Bearing Zone	Screen Interval (ft bgs)
OU-2A	9	M09-06	FWBZ	4 - 14
		MW410-2	FWBZ	5 - 15
		MW410-3	FWBZ	5 - 15
		P-9-MWI-04	FWBZ	--
		P-9-MWI-05	SWBZ	--
		P-9-MWS-02	FWBZ	--
	Rebound Sampling	DVE 19*	--	--
		F9SMW03*	FWBZ	4.5 - 14.5
		DVE 17*	FWBZ	4.5 - 14.5
		P-9-MWS-04*	FWBZ	5 - 15
		9IF-MW02U*	SWBZ	20 - 30
		P-9-MWI05*	SWBZ	23 - 33
		9IF-MW01L*	SWBZ	30 - 40
		P-9-MWI06*	SWBZ	33 - 43
		9EMW04*	SWBZ	30 - 40
	13	CA13-01	FWBZ	--
		M07C-06	FWBZ	4 - 14
		M13-06	FWBZ	2 - 9.75
		M13-07	FWBZ	2.5 - 12.5
		M13-09	FWBZ	2.5 - 12.5
		MWOR-3	FWBZ	5 - 15
		MWOR-4	FWBZ	5 - 15
	19	M13-P	SWBZ	10 - 35
		MWD13-3	FWBZ	5 - 15
		MWD13-4	FWBZ	5 - 15
OU-2B	3	M03-04	FWBZ	21 - 33
	4	D03-02	SWBZ	46.5 - 56.5
		D03-03	SWBZ	48 - 58
		D03-04	SWBZ	47 - 57
		D04-02	SWBZ	86.5 - 96.5
		D04-03	SWBZ	84 - 94
		M03-06	FWBZ	3 - 12
		M03-10	SWBZ	28 - 38
		M03-12	SWBZ	26 - 36
		M03-13	SWBZ	26.5 - 36.5
		M04-07	FWBZ	3.5 - 13.5
		MW360-1	FWBZ	5 - 15
		MW360-2	FWBZ	5 - 15
		MW360-4	FWBZ	5 - 15
		PP41MW01	SWBZ	31.2 - 36.2
		PP41MW03	SWBZ	30 - 35
		PP41MW08	SWBZ	30.1 - 35.1

TABLE 3-2

EXISTING GROUNDWATER MONITORING WELL SUMMARY

Operable Unit	SITE	WELL	Water-Bearing Zone	Screen Interval (ft bgs)
	11	D11-01	SWBZ	50 - 60
		M03-15	SWBZ	26 - 35.5
		M03-16	SWBZ	24.5 - 34
		OU2B-MW-01	FWBZ	7 - 12
	21	M11-06	FWBZ	4 - 14

Notes:

* Wells to be sampled only once to measure Site 9 Pilot Test rebound.

-- Well screen interval unkown.

Abbreviations and Acronyms:

ft bgs - feet below ground surface

FWBZ - first water-bearing zone

SWBZ - second water-bearing zone

TABLE 6-1

WASTE MANAGEMENT REQUIREMENTS

Waste Types	Characterization Requirements	Containment Requirements	Storage Requirements	Transportation Requirements	Disposal Requirements
Soil Cuttings (including decontamination pad residual solids, filters, and other solids)	Unless a waste determination (e.g., RCRA hazardous, non-RCRA hazardous, or non-hazardous) can be made based on generator knowledge, soil cuttings will be containerized and sampled to determine if the material is either a RCRA or a non-RCRA hazardous waste. Samples will be analyzed for VOCs, SVOCs, oil and grease, and Title 22 metals using total TTLC, STLC, and TCLP, as appropriate.	DOT-approved containers and/or roll-off bins.	Soil cuttings will be stored in containers within a predesignated area pending sampling and analysis. The containers will be labeled as **"POTENTIALLY HAZARDOUS IDW (SOIL CUTTINGS) – PENDING ANALYSIS"** and will include the accumulation start date, composition, and physical state of the waste until a waste determination has been made. Containers will be assumed to contain hazardous waste and will be managed as such, until proven otherwise. Containers determined to contain hazardous waste will be marked as **"HAZARDOUS WASTE"** and will include the accumulation date, composition, and physical state of the waste; hazardous properties; and the name and address of the generator. Hazardous waste will be labeled and managed in accordance with the container use and management regulations of 22 CCR, Section 66265, Article 9. Containers will be sealed when not being filled/unloaded. Where possible, containers will be stored on pallets. A 4-foot aisle will be used if multiple rows are needed. Under no circumstances will containers of hazardous waste be stored on site for more than 90 days.	If hazardous, a hazardous waste manifest and DOT marking, labeling, and vehicle placarding is required. A Cal/EPA-permitted transporter must be used. LDR certifications must be acquired, as applicable for RCRA hazardous wastes. A hazardous waste manifest is to be signed by the DoN. If non-hazardous, a non-hazardous waste manifest will be completed and signed by the DoN. Individuals involved in overseeing or shipping hazardous materials must meet DOT HM-181 and HM-126F training requirements.	Prior to transport, the soil will be segregated as RCRA-hazardous, non-RCRA hazardous, and/or non-hazardous and sent to an appropriate EPA CERCLA off-site, rule-approved disposal facility. An ESQ scientist must approve any TSDF and transporter prior to shipment of waste.

TABLE 6-1

WASTE MANAGEMENT REQUIREMENTS

Waste Types	Characterization Requirements	Containment Requirements	Storage Requirements	Transportation Requirements	Disposal Requirements
Decontamination water, groundwater monitoring well purgewater, and development water	Run TTLC Title 22 metals, SVOCs, VOCs, and oil and grease and use historical and process knowledge to make a waste determination.	DOT-approved, 55-gallon (bunghole-type), metal drums (1A1).	Wastewater will be stored in 55-gallon drums, and the drums will be stored in a predesignated area pending sampling and analysis. Drums will be labeled as **"POTENTIALLY HAZARDOUS IDW – (DECONTAMINATION WATER) – PENDING ANALYSIS"** and will include the accumulation date, composition, and physical state of the waste until a waste determination has been made. Containers will be assumed to contain hazardous waste and will be managed as such, until proven otherwise. The 90-day storage limit applies to containers containing hazardous waste. Containers determined to contain hazardous waste will be marked as **"HAZARDOUS WASTE"** and will include the accumulation date, composition, and physical state of the waste; hazardous properties; and the name and address of the generator. Hazardous waste containers will be labeled and managed in accordance with the container use and management regulations of 22 CCR, Section 66265, Article 9. Containers will be sealed when not being filled/unloaded. Where possible, containers will be elevated to prevent contact with any ponded precipitation and/or liquids.	If hazardous, a hazardous waste manifest and DOT marking, labeling, and vehicle placarding is required. A Cal/EPA-permitted transporter must be used. LDR certifications must be acquired, as applicable, for RCRA-hazardous wastes. A hazardous waste manifest is to be signed by the DoN. If non-hazardous, a non-hazardous waste manifest will be completed and signed by the DoN. Individuals involved in overseeing or shipping hazardous materials must meet DOT HM-181 and HM-126F training requirements.	Wastewater will be containerized and sent off site for disposal at an appropriate CERCLA off-site, Rule-approved facility. An ESQ scientist must approve any TSDF and transporter prior to shipment of waste.

TABLE 6-1

WASTE MANAGEMENT REQUIREMENTS

Waste Types	Characterization Requirements	Containment Requirements	Storage Requirements	Transportation Requirements	Disposal Requirements
PPE and disposable sampling equipment	Use generator/process knowledge to make a waste determination. Uncontaminated PPE can be managed as a non-hazardous solid waste.	Use double plastic bags at point of generation and place into a nonhazardous solid waste roll-off to be picked up by a contracted solid waste disposal contractor. Alternatively, if heavily contaminated, waste may be placed in the drums of soil cuttings for disposal.	PPE will be managed as a non-hazardous waste; therefore, hazardous waste storage requirements are not applicable.	Uncontaminated PPE may be placed into a non-hazardous solid waste roll-off to be picked up by contracted solid waste disposal contractor for disposal at a Class III facility.	Uncontaminated PPE may be disposed of at an approved Class III solid waste landfill.

Abbreviations and Acronyms:

Cal/EPA – California Environmental Protection Agency
CCR – California Code of Regulations
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
DoN – Department of the Navy
DOT – Department of Transportation
EPA – U.S. Environmental Protection Agency
ESQ – Environmental Safety and Quality
HM – hazardous material(s)
IDW – investigation-derived waste
LDR – land disposal restriction
PPE – personal protective equipment
RCRA – Resource Conservation and Recovery Act
STLC – soluble threshold limit concentration
SVOC – semi-volatile organic compound
TCLP – Toxicity Characteristic Leaching Procedure
TSDF – treatment, storage, and disposal facility
TTLC – total threshold limit concentration
VOC – volatile organic compound

This page intentionally left blank.

FIGURES

This page intentionally left blank.

LEGEND

1 STATE HIGHWAY

101 US HIGHWAY

280 INTERSTATE HIGHWAY

ALAMEDA POINT

WATER

5 0 5 10 Miles

Scale: 1" = 10 Miles

N

NOTE:

OU - OPERABLE UNIT

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

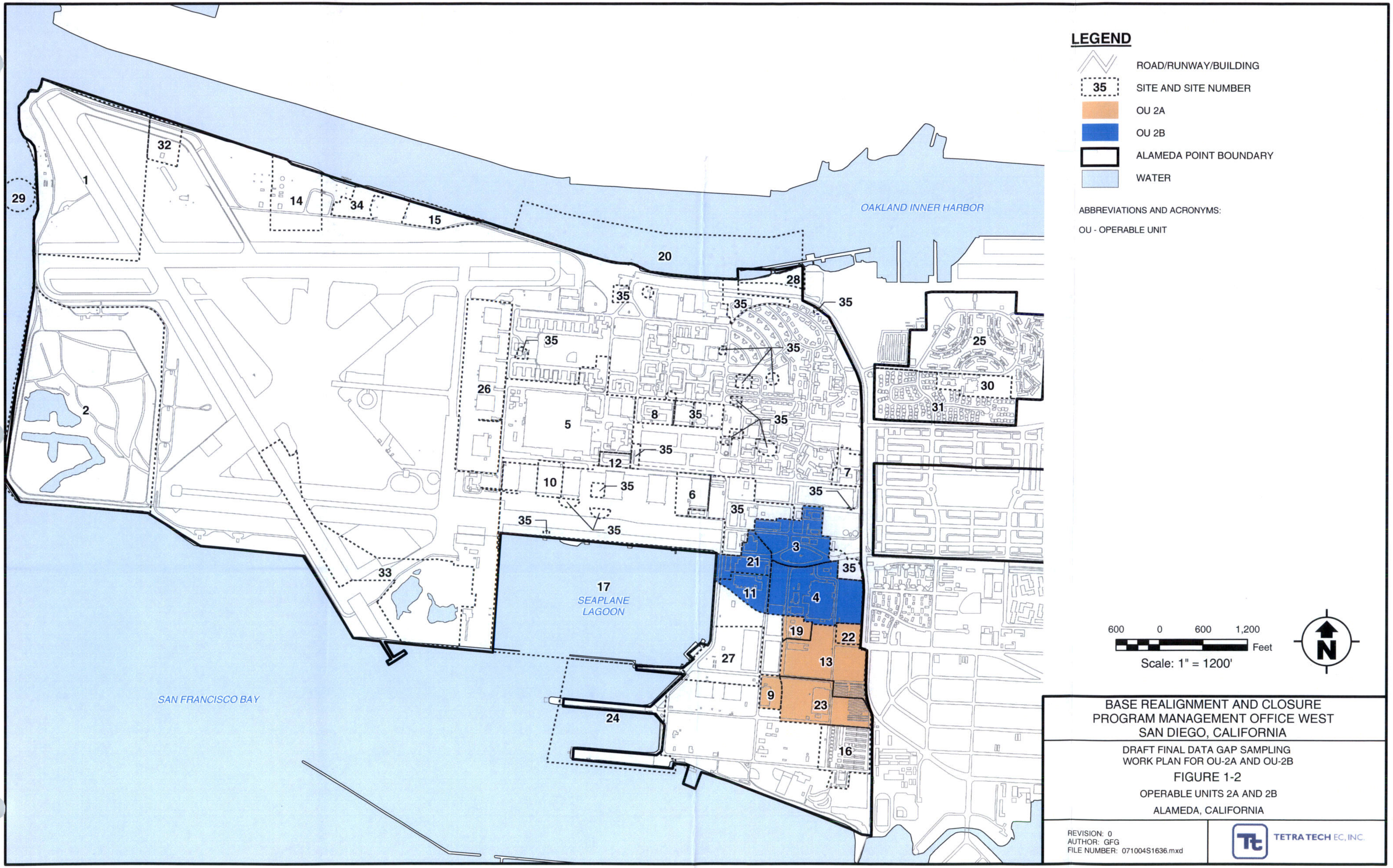
DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

FIGURE 1-1

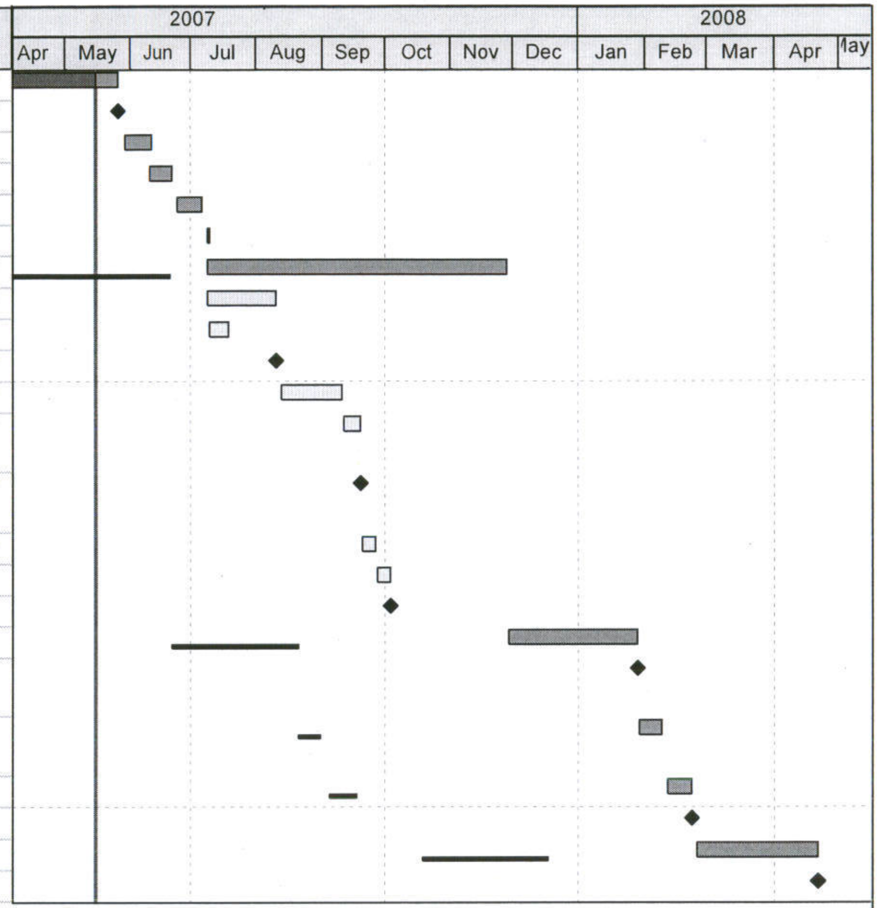
REGIONAL LOCATION MAP
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: GFG
FILE NUMBER: 071004R1635.mxd

TETRA TECH EC, INC.


LEGEND
ROAD/RUNWAY/BUILDING
35 SITE AND SITE NUMBER
OU 2A
OU 2B
ALAMEDA POINT BOUNDARY
WATER
ABBREVIATIONS AND ACRONYMS:
OU - OPERABLE UNIT
OAKLAND INNER HARBOR
SAN FRANCISCO BAY
17 SEAPLANE LAGOON
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
600 0 600 1,200 Feet
Scale: 1" = 1200'
N
BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA
DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B
FIGURE 1-2
OPERABLE UNITS 2A AND 2B
ALAMEDA, CALIFORNIA
REVISION: 0
AUTHOR: GFG
FILE NUMBER: 071004S1636.mxd
TETRA TECH EC, INC.

Activity Name	At Completion Duration	Start	Finish
Internal DF & RTC on the Draft OU-2A, 2B WP	75	12-Feb-07 A	25-May-07
Submit Internal DF OU-2A, 2B WP and RTCs to Navy	0		25-May-07
Navy Review of Internal DF OU-2A, 2B WP and RTCs	10	29-May-07	11-Jun-07
Comment Resolution with Navy, OU-2A, 2B	10	11-Jun-07	22-Jun-07
Final Comment Resolution with Agencies, OU-2A, 2B	10	25-Jun-07	06-Jul-07
Notice to Proceed/Internal Kick Off Meeting - , OU-2A, 2B	1	09-Jul-07	09-Jul-07
Field Implementation, OU-2A, 2B	100	09-Jul-07	28-Nov-07
Prepare Draft Final OU-2A, 2B WP and RTCs	25	09-Jul-07	10-Aug-07
Internal Kick Off Meeting Minutes, OU-2A, 2B	7	10-Jul-07	18-Jul-07
Submit DF OU-2A, 2B WP and RTCs to Regulators	0		10-Aug-07
Regulatory Review of Draft Final OU-2A, 2B WP	20	13-Aug-07	10-Sep-07
Prepare Internal Response to Reg. Comments on DF OU-2A, 2B WP	7	11-Sep-07	19-Sep-07
Submit Internal Response to Reg. Comments to Navy, OU-2A, 2B WP	0		19-Sep-07
Navy Review of Internal RTC on DF OU-2A, 2B WP	5	20-Sep-07	26-Sep-07
Prepare Final OU-2A, 2B WP and RTCs	5	27-Sep-07	03-Oct-07
Submit Final OU-2A, 2B WP and RTCs	0		03-Oct-07
Internal Draft Pre-Design DGS Summary, OU-2A, 2B	41	29-Nov-07	28-Jan-08
Submit Internal Draft Pre-Design DGS Summary Rpt, OU-2A, 2B	0		28-Jan-08
Navy Review/Comment of Internal Draft Pre-Design, OU-2A, 2B	9	29-Jan-08	08-Feb-08
Final Pre-Design DGS Summary Report, OU-2A, 2B	10	11-Feb-08	22-Feb-08
Technical Completion	0		22-Feb-08
CTO Closeout	41	25-Feb-08	21-Apr-08
CTO Complete	0		21-Apr-08



Primary Baseline
Actual Work
Remaining Work
Critical Remaining Work
Milestone
Summary

Draft Final Data Gap Sampling Work Plan for

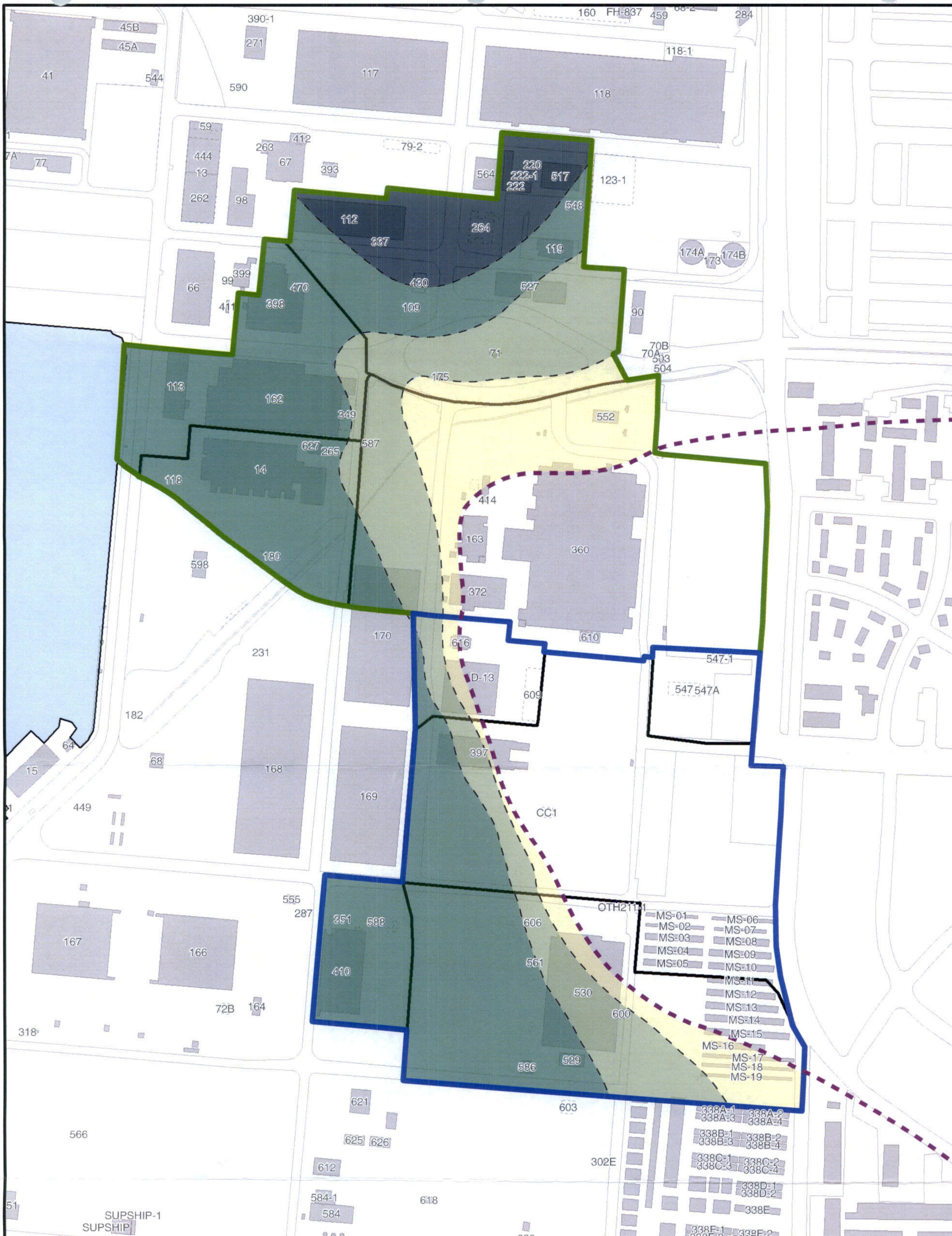
OU-2A and OU-2B

Figure 1-3

Project Schedule

Alameda Point, CA

TETRA TECH EC, INC.



LEGEND

APPROXIMATE EXTENT OF FORMER ALAMEDA ISLAND CIRCA 1859 (UNITED STATES COAST SURVEY, 1877)

ROAD

OPERABLE UNIT 2A BOUNDARY

OPERABLE UNIT 2B BOUNDARY

IR SITE BOUNDARY

530 BUILDING AND BUILDING NUMBER

547A FORMER BUILDING AND BUILDING NUMBER

WATER

BAY SEDIMENT UNIT THICKNESS (APPROXIMATE)

< 2 FEET

2-4 FEET

4-6 FEET

> 6 FEET

150 0 150 300 Feet

Scale: 1" = 300'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

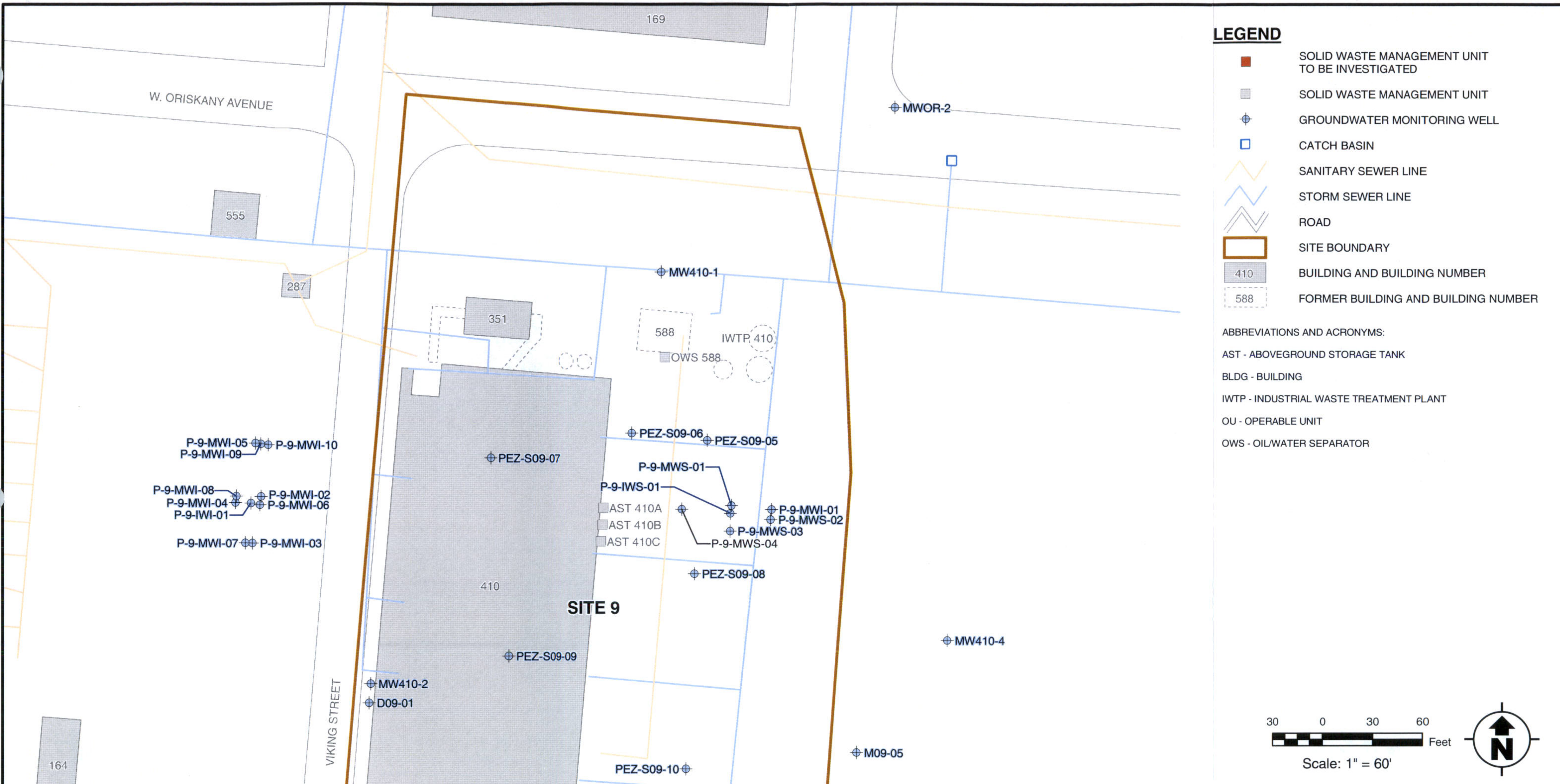
DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

FIGURE 2-1

GENERALIZED BAY SEDIMENT UNIT ISOPACH MAP
AND EXTENT OF FORMER ALAMEDA ISLAND
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: GFG
FILE NUMBER: 071004L1735.mxd

TETRA TECH EC, INC.



BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

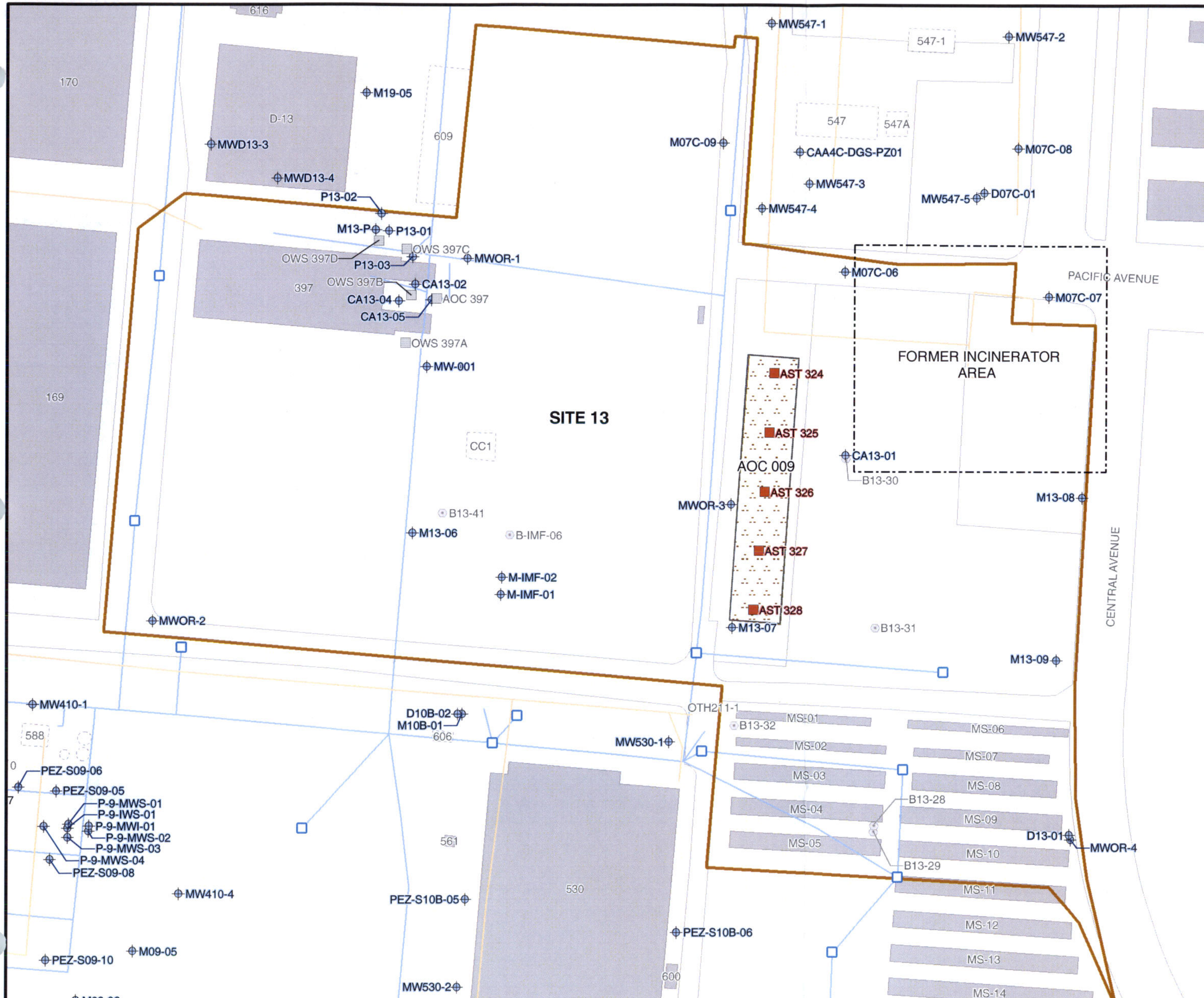
FIGURE 2-2

OU-2A, SITE 9 MAP

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1638.mxd

TETRA TECH EC, INC.



LEGEND

- SOLID WASTE MANAGEMENT UNIT TO BE INVESTIGATED
- SOLID WASTE MANAGEMENT UNIT
- GROUNDWATER MONITORING WELL
- HISTORIC SAMPLE LOCATION
- CATCH BASIN
- SANITARY SEWER LINE
- STORM SEWER LINE
- ROAD
- AREA OF CONCERN
- SITE BOUNDARY
- 530 BUILDING AND BUILDING NUMBER
- 547 FORMER BUILDING AND BUILDING NUMBER

ABBREVIATIONS AND ACRONYMS:

AOC - AREA OF CONCERN

AST - ABOVEGROUND STORAGE TANK

IWTP - INDUSTRIAL WASTE TREATMENT PLANT

NADEP GAP - NAVAL DEPOT GENERATOR ACCUMULATION POINT

OU - OPERABLE UNIT

OWS - OIL/WATER SEPARATOR

SWMU - SOLID WASTE MANAGEMENT UNIT

UST - UNDERGROUND STORAGE TANK

60 0 60 120 Feet

Scale: 1" = 120'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

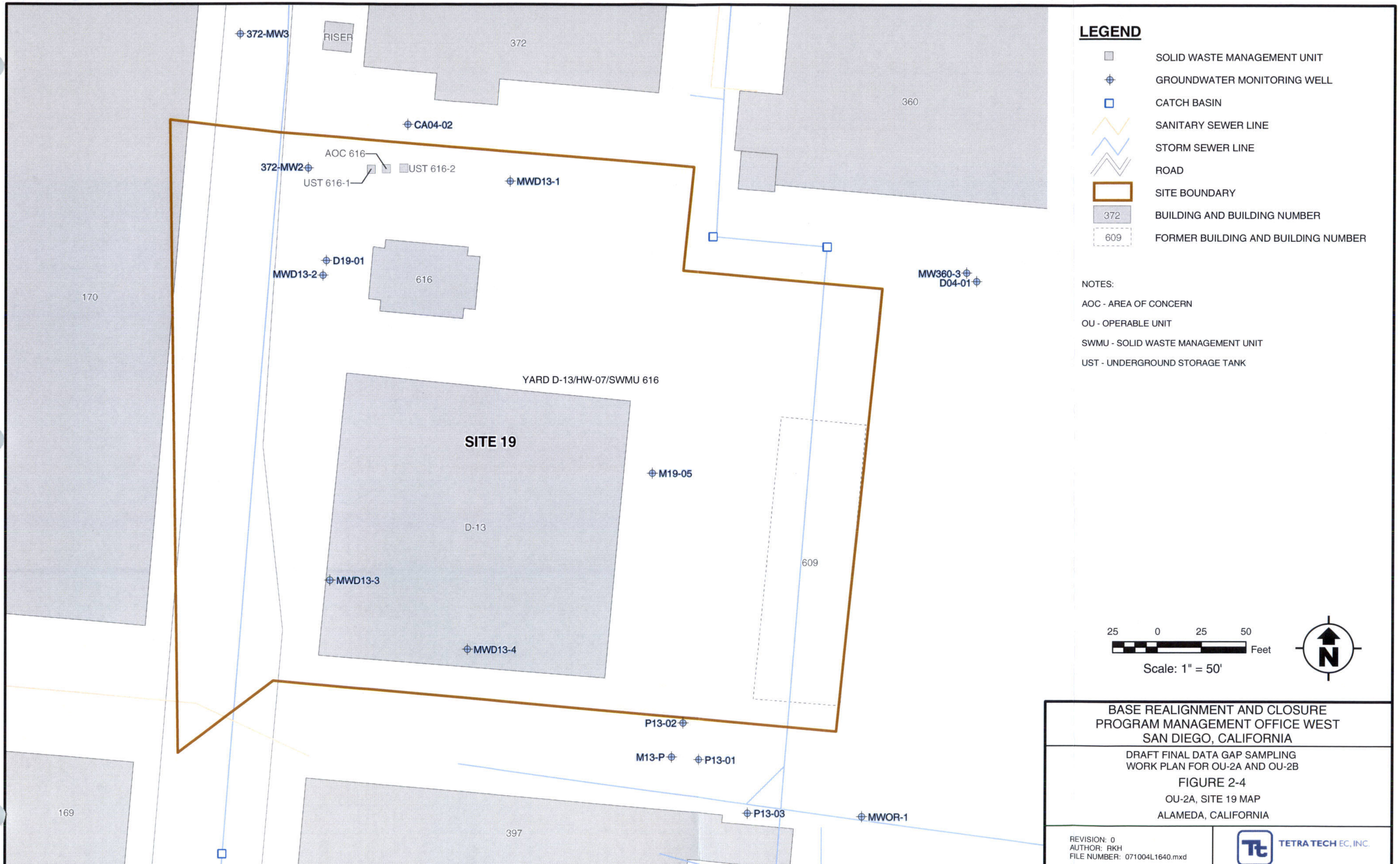
FIGURE 2-3

OU-2A, SITE 13 MAP

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1639.mxd

TETRA TECH EC, INC.



BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

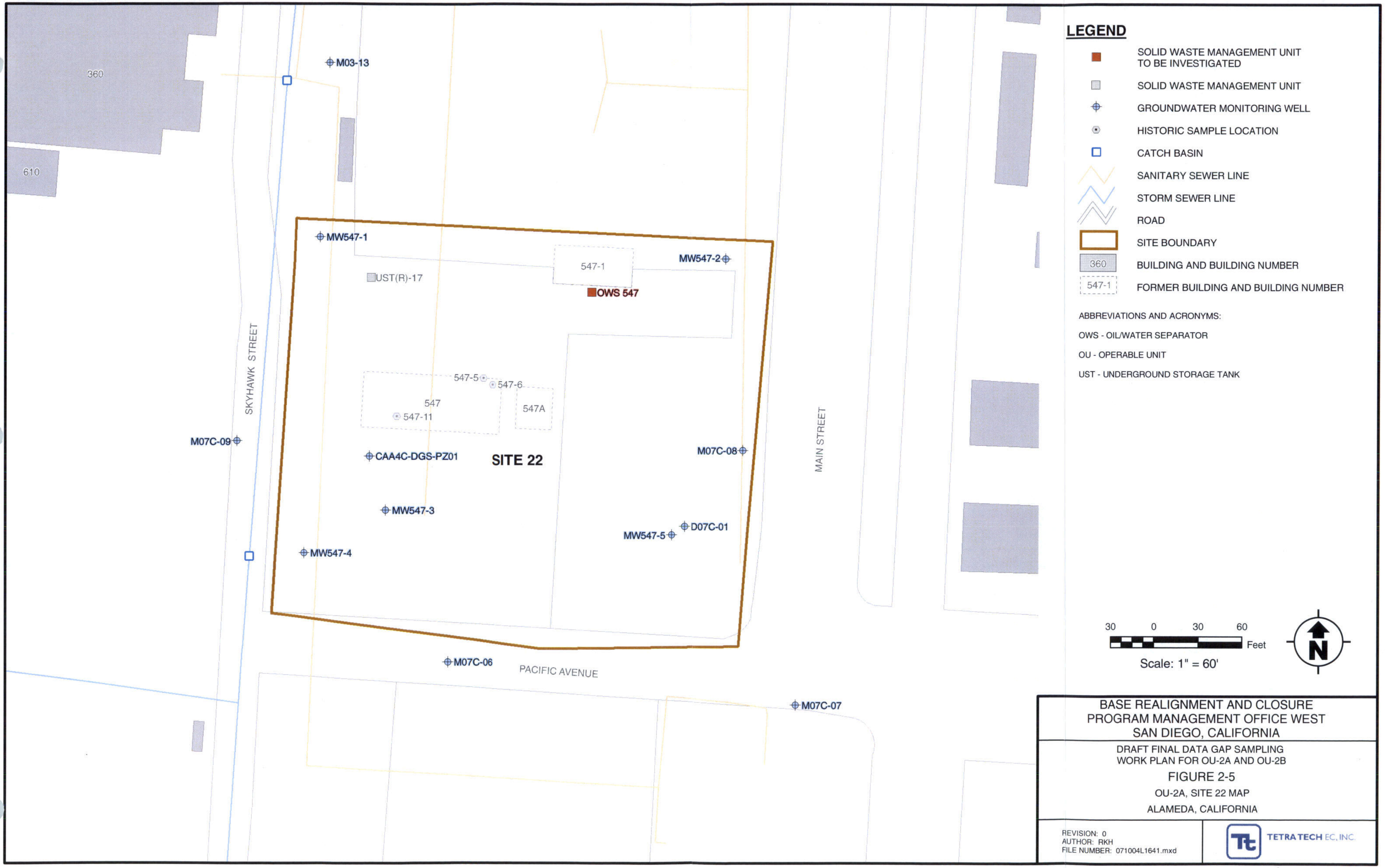
DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

FIGURE 2-4

OU-2A, SITE 19 MAP
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1640.mxd

TETRA TECH EC, INC.



BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

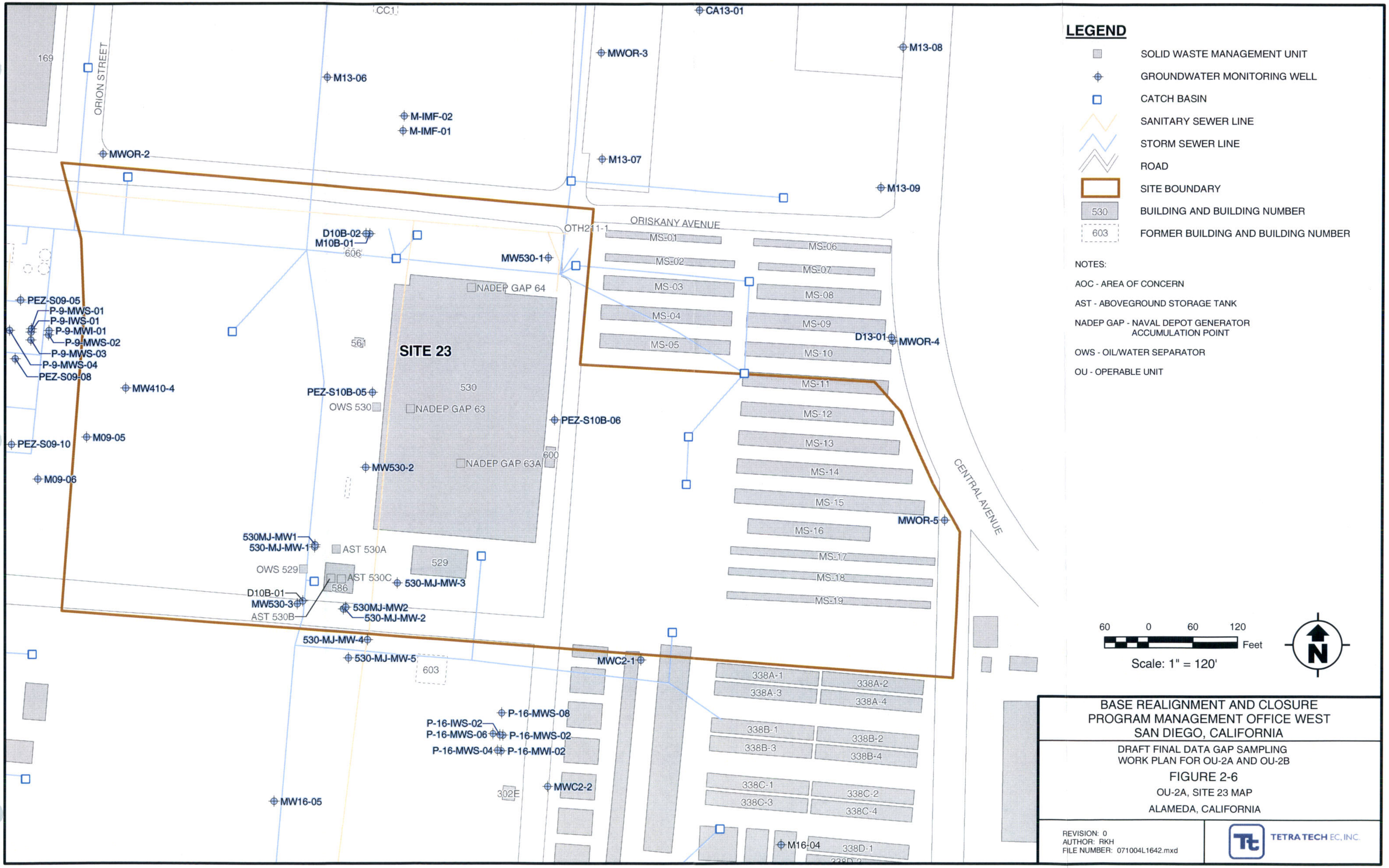
FIGURE 2-5

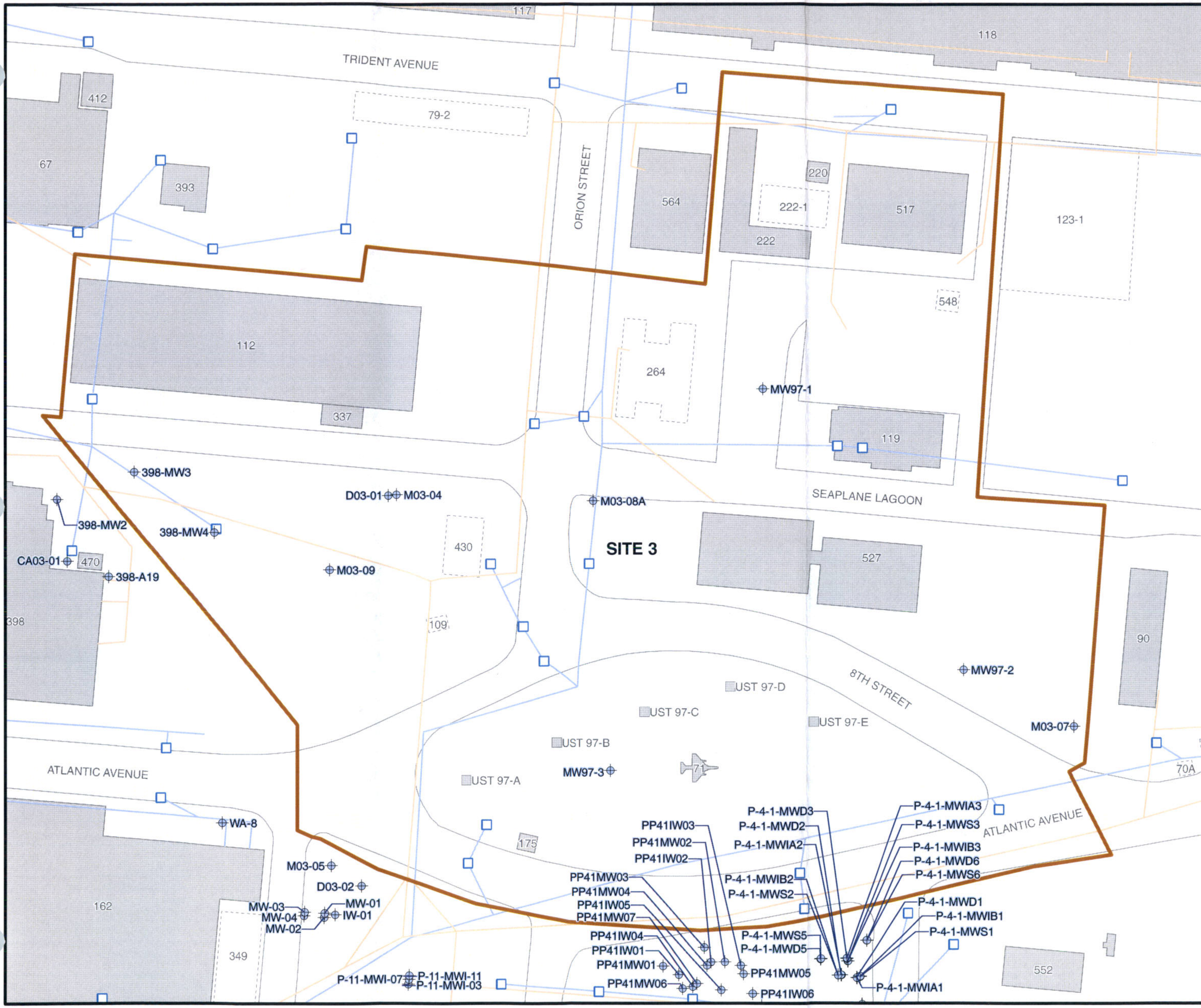
OU-2A, SITE 22 MAP

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1641.mxd

TETRA TECH EC, INC.


LEGEND
SOLID WASTE MANAGEMENT UNIT
GROUNDWATER MONITORING WELL
CATCH BASIN
SANITARY SEWER LINE
STORM SEWER LINE
ROAD
SITE BOUNDARY
530 BUILDING AND BUILDING NUMBER
603 FORMER BUILDING AND BUILDING NUMBER
NOTES:
AOC - AREA OF CONCERN
AST - ABOVEGROUND STORAGE TANK
NADEP GAP - NAVAL DEPOT GENERATOR ACCUMULATION POINT
OWS - OIL/WATER SEPARATOR
OU - OPERABLE UNIT
60 0 60 120 Feet
Scale: 1" = 120'
N
SITE 23
ORION STREET
ORISKANY AVENUE
CENTRAL AVENUE
CC1
CA13-01
MWOR-3
M13-08
M13-06
M-IMF-02
M-IMF-01
MWOR-2
M13-07
M13-09
OTH211-1
D10B-02
M10B-01
606
MW530-1
NADEP GAP 64
MS-01
MS-02
MS-03
MS-04
MS-05
MS-06
MS-07
MS-08
MS-09
MS-10
MS-11
MS-12
MS-13
MS-14
MS-15
MS-16
MS-17
MS-18
MS-19
D13-01
MWOR-4
PEZ-S09-05
P-9-MWS-01
P-9-IWS-01
P-9-MWI-01
P-9-MWS-02
P-9-MWS-03
P-9-MWS-04
PEZ-S09-08
MW410-4
561
PEZ-S10B-05
OWS 530
530
NADEP GAP 63
PEZ-S10B-06
PEZ-S09-10
M09-05
M09-06
MW530-2
NADEP GAP 63A
600
MWOR-5
530MJ-MW1
530-MJ-MW-1
AST 530A
529
OWS 529
AST 530C
586
530-MJ-MW-3
D10B-01
MW530-3
AST 530B
530MJ-MW2
530-MJ-MW-2
530-MJ-MW-4
530-MJ-MW-5
603
MWC2-1
338A-1
338A-2
338A-3
338A-4
338B-1
338B-2
338B-3
338B-4
338C-1
338C-2
338C-3
338C-4
338D-1
P-16-MWS-08
P-16-IWS-02
P-16-MWS-06
P-16-MWS-02
P-16-MWS-04
P-16-MWI-02
302E
MWC2-2
MW16-05
M16-04
169
BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA
DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B
FIGURE 2-6
OU-2A, SITE 23 MAP
ALAMEDA, CALIFORNIA
REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1642.mxd
TETRA TECH EC, INC.



LEGEND

SOLID WASTE MANAGEMENT UNIT
GROUNDWATER MONITORING WELL
CATCH BASIN
SANITARY SEWER LINE
STORM SEWER LINE
ROAD
SITE BOUNDARY
112 BUILDING AND BUILDING NUMBER
430 FORMER BUILDING AND BUILDING NUMBER

ABBREVIATIONS AND ACRONYMS:

NAS GAP - NAVAL AIR STATION GENERATOR ACCUMULATION POINT

OU - OPERABLE UNIT

UST - UNDERGROUND STORAGE TANK

50 0 50 100 Feet

Scale: 1" = 100'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

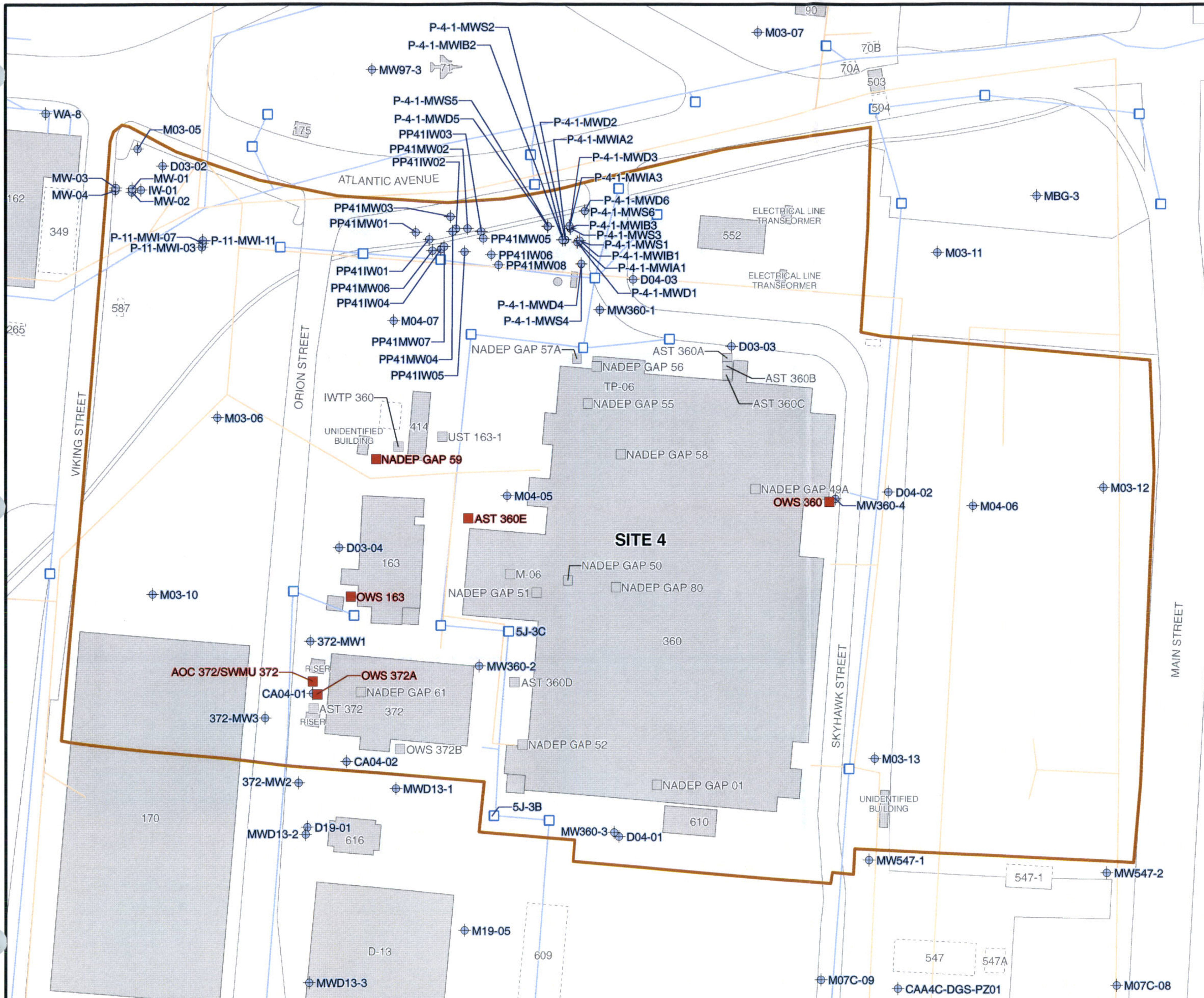
FIGURE 2-7

OU-2B, SITE 3 MAP

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1643.mxd

TETRA TECH EC, INC.



LEGEND

- SOLID WASTE MANAGEMENT UNIT TO BE INVESTIGATED
- SOLID WASTE MANAGEMENT UNIT
- GROUNDWATER MONITORING WELL
- CATCH BASIN
- SANITARY SEWER LINE
- STORM SEWER LINE
- ROAD
- SITE BOUNDARY
- 360 BUILDING AND BUILDING NUMBER
- 547-1 FORMER BUILDING AND BUILDING NUMBER

ABBREVIATIONS AND ACRONYMS:

AOC - AREA OF CONCERN
AST - ABOVEGROUND STORAGE TANK
IWTP - INDUSTRIAL WASTE TREATMENT PLANT
NADEP GAP - NAVAL DEPOT GENERATOR ACCUMULATION POINT
OWS - OIL/WATER SEPARATOR
OU - OPERABLE UNIT
SWMU - SOLID WASTE MANAGEMENT UNIT
TP - TIERED PERMIT
UST - UNDERGROUND STORAGE TANK

60 0 60 120 Feet

Scale: 1" = 120'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

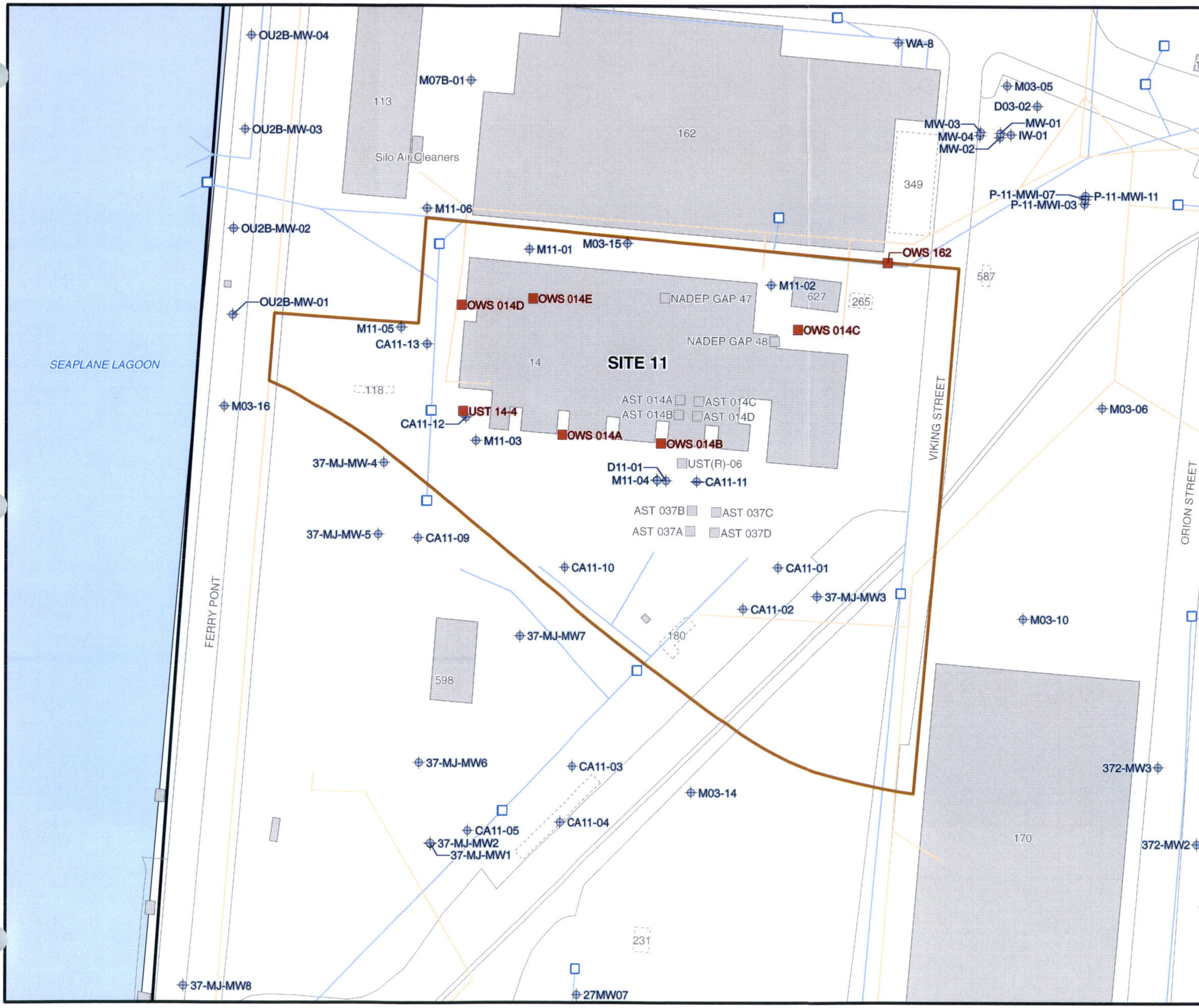
FIGURE 2-8

OU-2B, SITE 4 MAP

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1644.mxd

TETRA TECH EC, INC.



LEGEND

- SOLID WASTE MANAGEMENT UNIT TO BE INVESTIGATED
- SOLID WASTE MANAGEMENT UNIT
- GROUNDWATER MONITORING WELL
- CATCH BASIN
- SANITARY SEWER LINE
- STORM SEWER LINE
- ROAD
- SITE BOUNDARY
- 170 BUILDING AND BUILDING NUMBER
- 118 FORMER BUILDING AND BUILDING NUMBER
- WATER

NOTES:

AST - ABOVEGROUND STORAGE TANK

NADEP GAP - NAVAL DEPOT GENERATOR ACCUMULATION POINT

OU - OPERABLE UNIT

OWS - OIL/WATER SEPARATOR

SWMU - SOLID WASTE MANAGEMENT UNIT

UST - UNDERGROUND STORAGE TANK

50 0 50 100 Feet

Scale: 1" = 100'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

FIGURE 2-9

OU-2B, SITE 11 MAP

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1645.mxd

TETRA TECH EC, INC.

LEGEND

- SOLID WASTE MANAGEMENT UNIT TO BE INVESTIGATED
- SOLID WASTE MANAGEMENT UNIT
- GROUNDWATER MONITORING WELL
- HISTORIC SAMPLE LOCATION
- CATCH BASIN
- SANITARY SEWER LINE
- STORM SEWER LINE
- ROAD
- SITE BOUNDARY
- 112 BUILDING AND BUILDING NUMBER
- 349 FORMER BUILDING AND BUILDING NUMBER
- WATER

ABBREVIATIONS AND ACRONYMS:

AOC - AREA OF CONCERN

AST - ABOVEGROUND STORAGE TANK

NADEP GAP - NAVAL DEPOT GENERATOR ACCUMULATION POINT

NAS GAP - NAVAL AIR STATION GENERATOR ACCUMULATION POINT

OU - OPERABLE UNIT

OWS - OIL/WATER SEPARATOR

SWMU - SOLID WASTE MANAGEMENT UNIT

UST - UNDERGROUND STORAGE TANK

50 0 50 100 Feet

Scale: 1" = 100'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

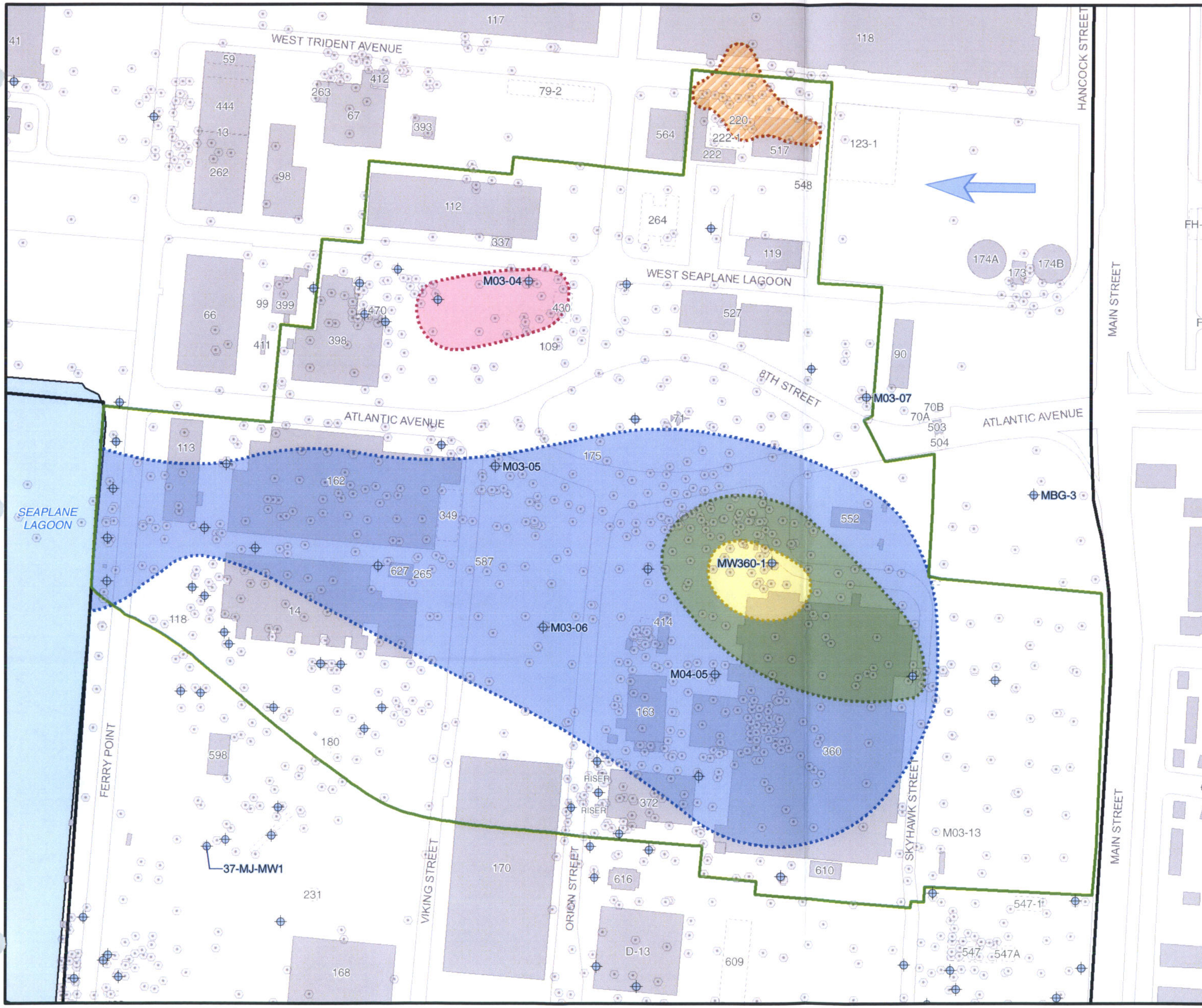
FIGURE 2-10

OU-2B, SITE 21 MAP

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1646.mxd

TETRA TECH EC, INC.



LEGEND

- GROUNDWATER MONITORING WELL
- HISTORIC SAMPLE LOCATION
- APPROXIMATE GROUNDWATER FLOW DIRECTION (FWBZ)
- APPROXIMATE EXTENT OF COMPOSITE VOC PLUME ABOVE MCLS (FWBZ)
- 100 µg/L COMPOSITE VOC PLUME ISOCONCENTRATION CONTOUR (FWBZ)
- 1,000 µg/L COMPOSITE VOC PLUME ISOCONCENTRATION CONTOUR (FWBZ)
- APPROXIMATE EXTENT OF LEAD PLUME ABOVE MCL (FWBZ)
- APPROXIMATE EXTENT OF BENZENE PLUME ABOVE MCL (FWBZ)
- ROAD
- OPERABLE UNIT 2B BOUNDARY
- 564 BUILDING AND BUILDING NUMBER
- 264 FORMER BUILDING AND BUILDING NUMBER
- ALAMEDA POINT BOUNDARY
- WATER

ABBREVIATIONS AND ACRONYMS:

FWBZ - FIRST WATER-BEARING ZONE

OU - OPERABLE UNIT

µg/L - MICROGRAMS PER LITER

VOC - VOLATILE ORGANIC COMPOUND

SOURCES FOR COMPOSITE PLUMES:

SULTECH, 2005a

INNOVATIVE TECHNOLOGY SOLUTIONS, INC., 2006

100 0 100 200 Feet

Scale: 1" = 200'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

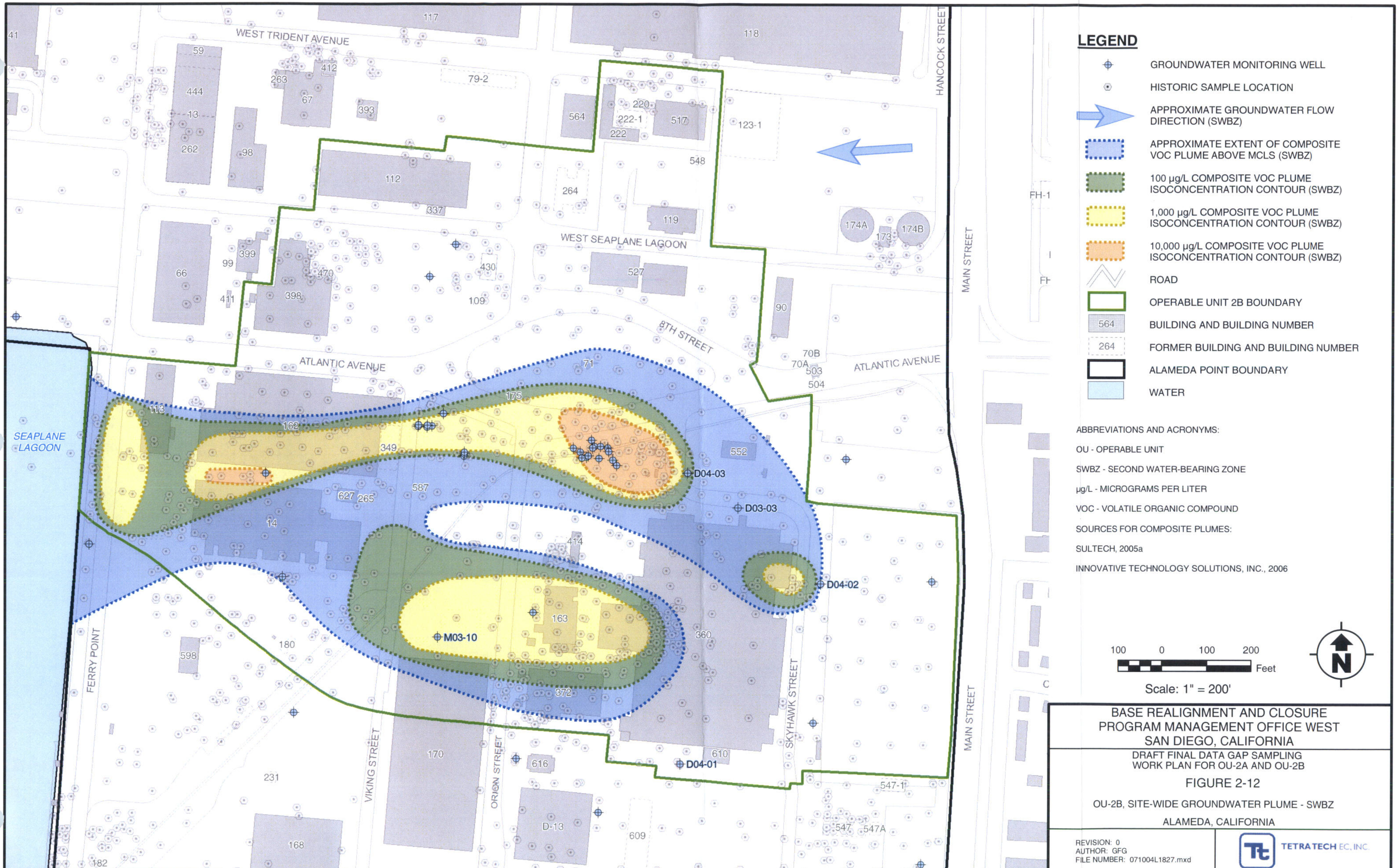
FIGURE 2-11

OU-2B, SITE-WIDE GROUNDWATER PLUMES - FWBZ

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1826.mxd

TETRA TECH EC, INC.



BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

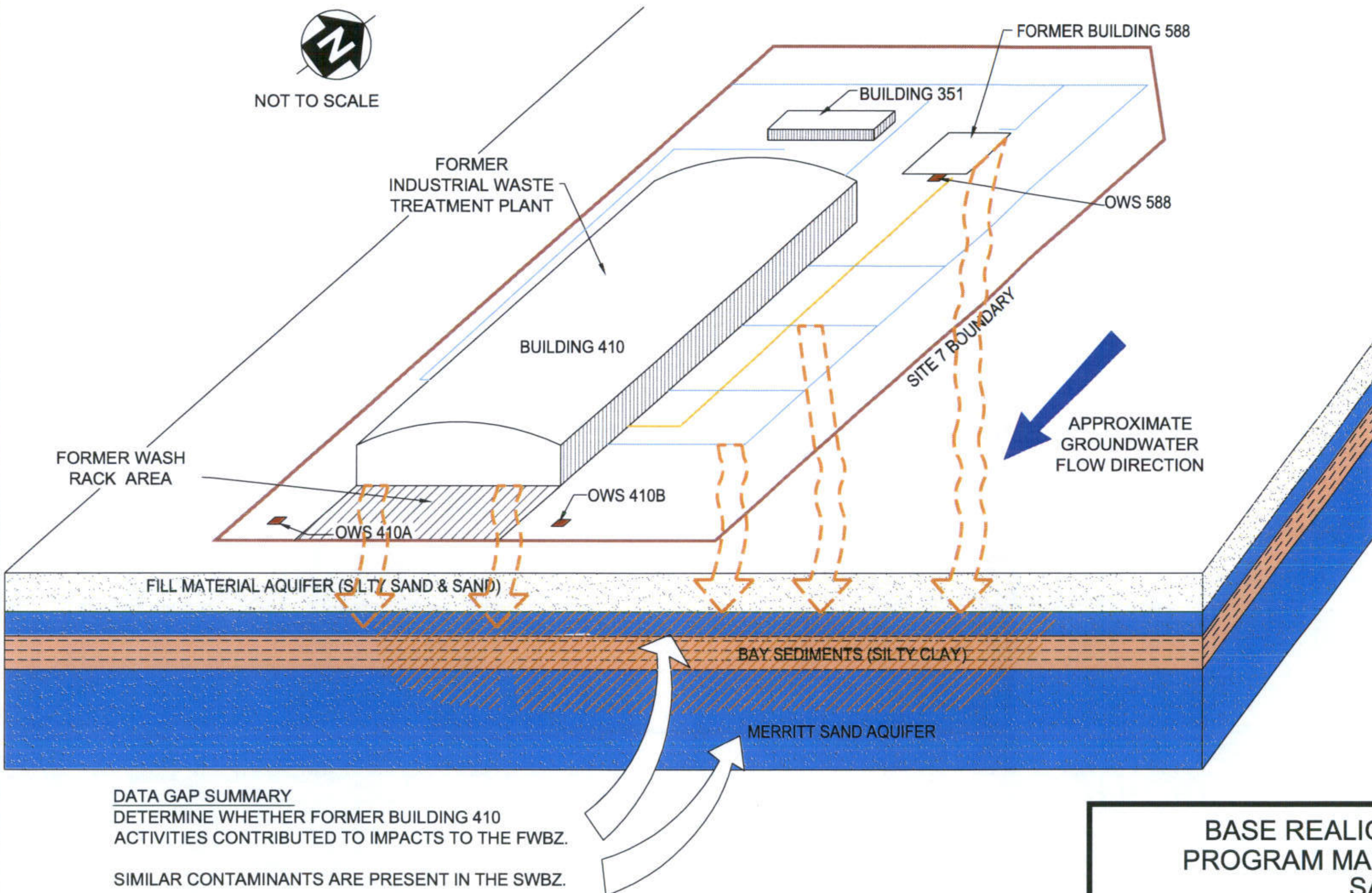
FIGURE 2-12

OU-2B, SITE-WIDE GROUNDWATER PLUME - SWBZ

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: GFG
FILE NUMBER: 071004L1827.mxd

TETRATECH EC, INC.



LEGEND:

- SOLID WASTE MANAGEMENT UNIT
- SANITARY SEWER LINE
- STORM SEWER LINE
- SITE BOUNDARY
- WASHDOWN AREA
- POTENTIAL GROUNDWATER CONTAMINATION
- POTENTIAL GROUNDWATER CONTAMINATION SOURCE

ABBREVIATIONS & ACRONYMS:

FWBZ	FIRST WATER-BEARING ZONE
OWS	OIL/WATER SEPARATOR
SWBZ	SECOND WATER-BEARING ZONE

NOTE:

THIS CONCEPTUAL SITE MODEL IS INTENDED AS A VISUAL TOOL AND IT DOES NOT DEPICT ALL SITE OR SUBSURFACE CONDITIONS. THE MODEL IS BASED ON PREVIOUS INVESTIGATION DATA AND FINDINGS AND MAY BE UPDATED BASED ON OBSERVED SITE CONDITIONS, PROPOSED INVESTIGATION FINDINGS, OR OTHER ADDITIONAL DATA.

DATA GAP SUMMARY

DETERMINE WHETHER FORMER BUILDING 410 ACTIVITIES CONTRIBUTED TO IMPACTS TO THE FWBZ.

SIMILAR CONTAMINANTS ARE PRESENT IN THE SWBZ.

DETERMINE WHETHER STORM DRAINS, SANITARY SEWERS, &/OR INDUSTRIAL WASTE DRAINS ARE SECONDARY SOURCES TO GROUNDWATER IN THE FWBZ AND SWBZ .

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

DRAFT FINAL DATA GAP SAMPLING WORK PLAN
FOR OU-2A AND OU-2B

FIGURE 3-1

OU-2A, SITE 9 PRELIMINARY
CONCEPTUAL SITE MODEL
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: KLD
FILE : 0012000231.DWG

TETRA TECH EC, INC.

LEGEND

- S9-B01 PROPOSED SOIL SAMPLE LOCATION AND ID
- SOLID WASTE MANAGEMENT UNIT TO BE INVESTIGATED
- SOLID WASTE MANAGEMENT UNIT
- GROUNDWATER MONITORING WELLS TO BE SAMPLED QUARTERLY
- HISTORIC SAMPLE LOCATION
- CATCH BASIN
- APPROXIMATE GROUNDWATER FLOW DIRECTION (FWBZ)
- SANITARY SEWER LINE
- STORM SEWER LINE
- ROAD
- SITE BOUNDARY
- WASH DOWN AREA
- WASH RACK AREA
- 410 BUILDING AND BUILDING NUMBER
- 588 FORMER BUILDING AND BUILDING NUMBER

ABBREVIATIONS AND ACRONYMS:

DPT - DIRECT-PUSH TECHNOLOGY
FWBZ - FIRST WATER-BEARING ZONE
ISCO - IN SITE CHEMICAL OXIDATION
OU - OPERABLE UNIT
OWS - OIL/WATER SEPARATOR

25 0 25 50 Feet
Scale: 1" = 50'
N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

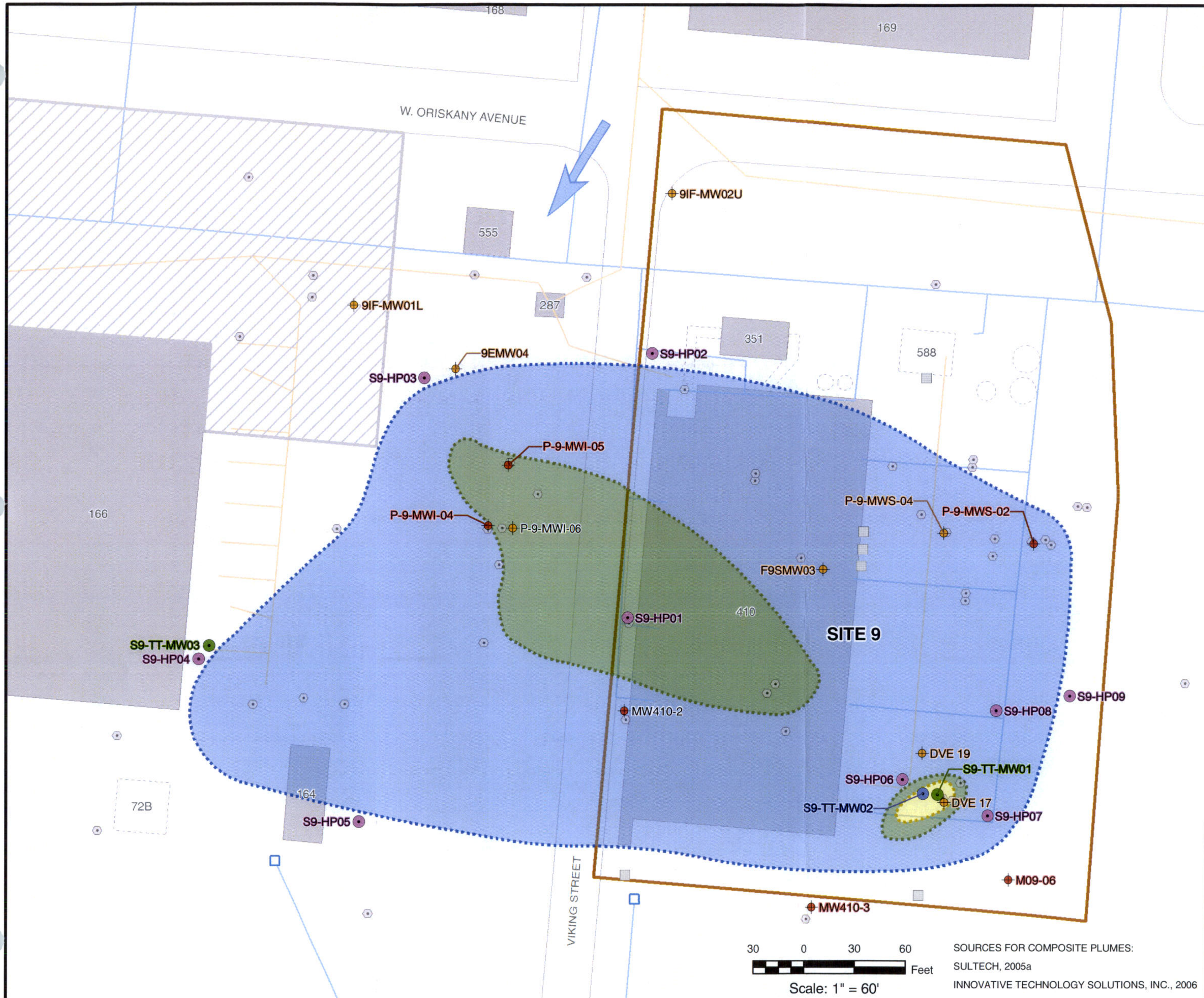
DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

FIGURE 3-2

OU-2A, SITE 9 PROPOSED SOIL INVESTIGATION LOCATIONS
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1648.mxd

TETRA TECH EC, INC.



SOURCES FOR COMPOSITE PLUMES:
SULTECH, 2005a
INNOVATIVE TECHNOLOGY SOLUTIONS, INC., 2006

LEGEND

S9-TT-MW01	PROPOSED FWBZ GROUNDWATER MONITORING WELL AND ID
S9-TT-MW02	PROPOSED SWBZ GROUNDWATER MONITORING WELL AND ID
S9-HP03	PROPOSED HYDROPUNCH SAMPLE LOCATION AND ID
	SOLID WASTE MANAGEMENT UNIT
	GROUNDWATER MONITORING WELLS TO BE SAMPLED QUARTERLY
	GROUNDWATER MONITORING WELLS FOR SITE 9 ISCO REBOUND SAMPLING
	HISTORIC SAMPLE LOCATION
	CATCH BASIN
	SANITARY SEWER LINE
	STORM SEWER LINE
	ROAD
	APPROXIMATE GROUNDWATER FLOW DIRECTION (FWBZ)
	APPROXIMATE EXTENT OF COMPOSITE VOC PLUME ABOVE MCLS (FWBZ)
	100 µg/L COMPOSITE VOC PLUME ISOCONCENTRATION CONTOUR (FWBZ)
	1,000 µg/L COMPOSITE VOC PLUME ISOCONCENTRATION CONTOUR (FWBZ)
	SITE BOUNDARY
	WASH DOWN AREA
410	BUILDING AND BUILDING NUMBER
72B	FORMER BUILDING AND BUILDING NUMBER

ABBREVIATIONS AND ACRONYMS:

FWBZ - FIRST WATER-BEARING ZONE
ISCO - IN SITE CHEMICAL OXIDATION
OU - OPERABLE UNIT
SWBZ - SECOND WATER-BEARING ZONE
µg/L - MICROGRAMS PER LITER
VOC - VOLATILE ORGANIC COMPOUND

N

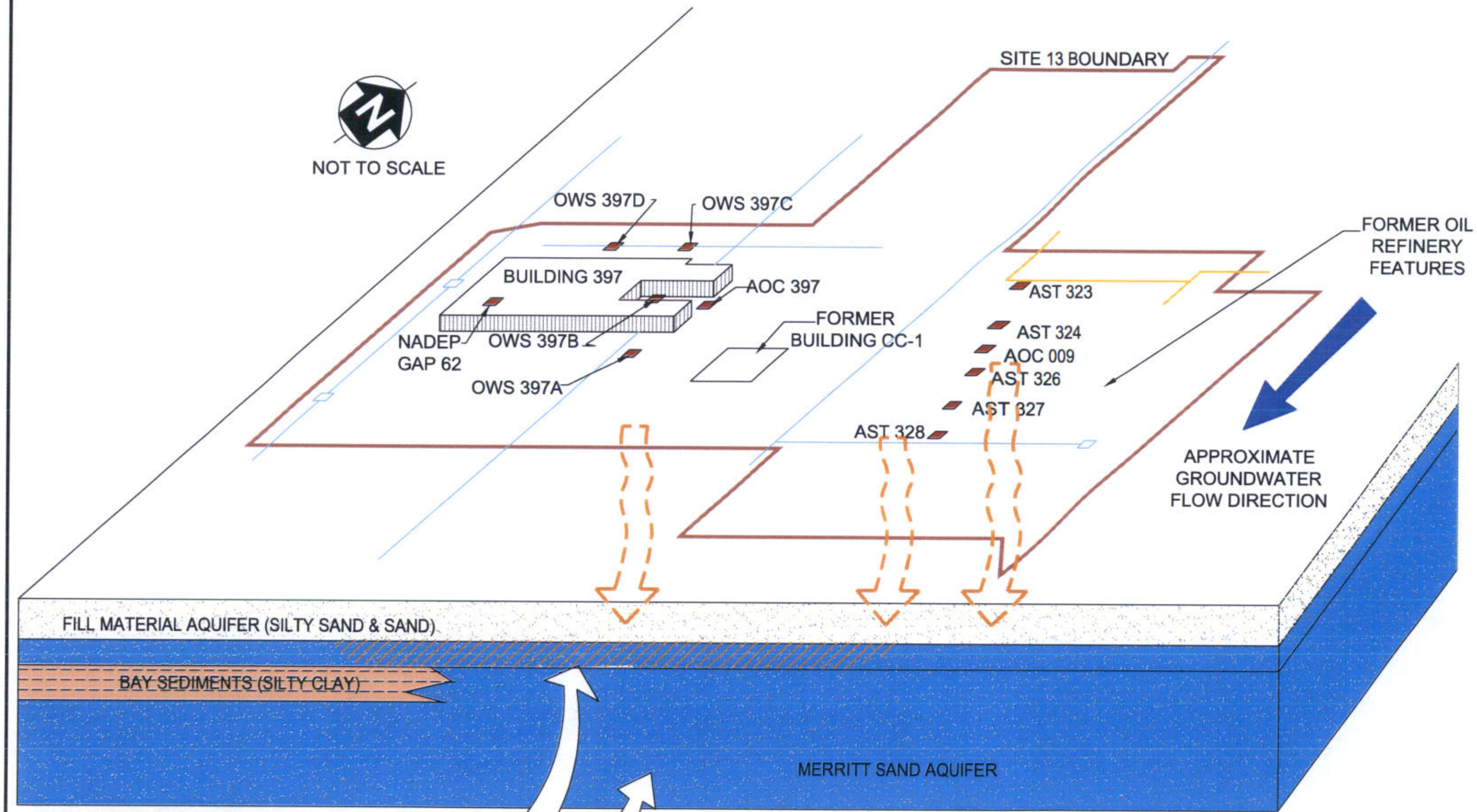
BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

FIGURE 3-3
OU-2A, SITE 9 PROPOSED
GROUNDWATER INVESTIGATION LOCATIONS
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1649.mxd

TETRA TECH EC, INC.



LEGEND:

- SOLID WASTE MANAGEMENT UNIT
- CATCH BASIN
- SANITARY SEWER LINE
- STORM SEWER LINE
- SITE BOUNDARY
- POTENTIAL GROUNDWATER CONTAMINATION
- POTENTIAL GROUNDWATER CONTAMINATION SOURCE

ABBREVIATIONS & ACRONYMS:

AOC	AREA OF CONCERN
AST	ABOVEGROUND STORAGE TANK
COCs	CHEMICALS OF CONCERN
FWBZ	FIRST WATER-BEARING ZONE
NADEP GAP	NAVAL DEPOT GENERATOR ACCUMULATION POINT
OWS	OIL/WATER SEPARATOR
SWBZ	SECOND WATER-BEARING ZONE

DATA GAP SUMMARY
DEFINE LATERAL & VERTICAL EXTENT OF COCs IN FWBZ.

APPEARS TO BE MINIMAL, IF ANY, IMPACT ON SWBZ.

NOTE:
THIS CONCEPTUAL SITE MODEL IS INTENDED AS A VISUAL TOOL AND IT DOES NOT DEPICT ALL SITE OR SUBSURFACE CONDITIONS. THE MODEL IS BASED ON PREVIOUS INVESTIGATION DATA AND FINDINGS AND MAY BE UPDATED BASED ON OBSERVED SITE CONDITIONS, PROPOSED INVESTIGATION FINDINGS, OR OTHER ADDITIONAL DATA.

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

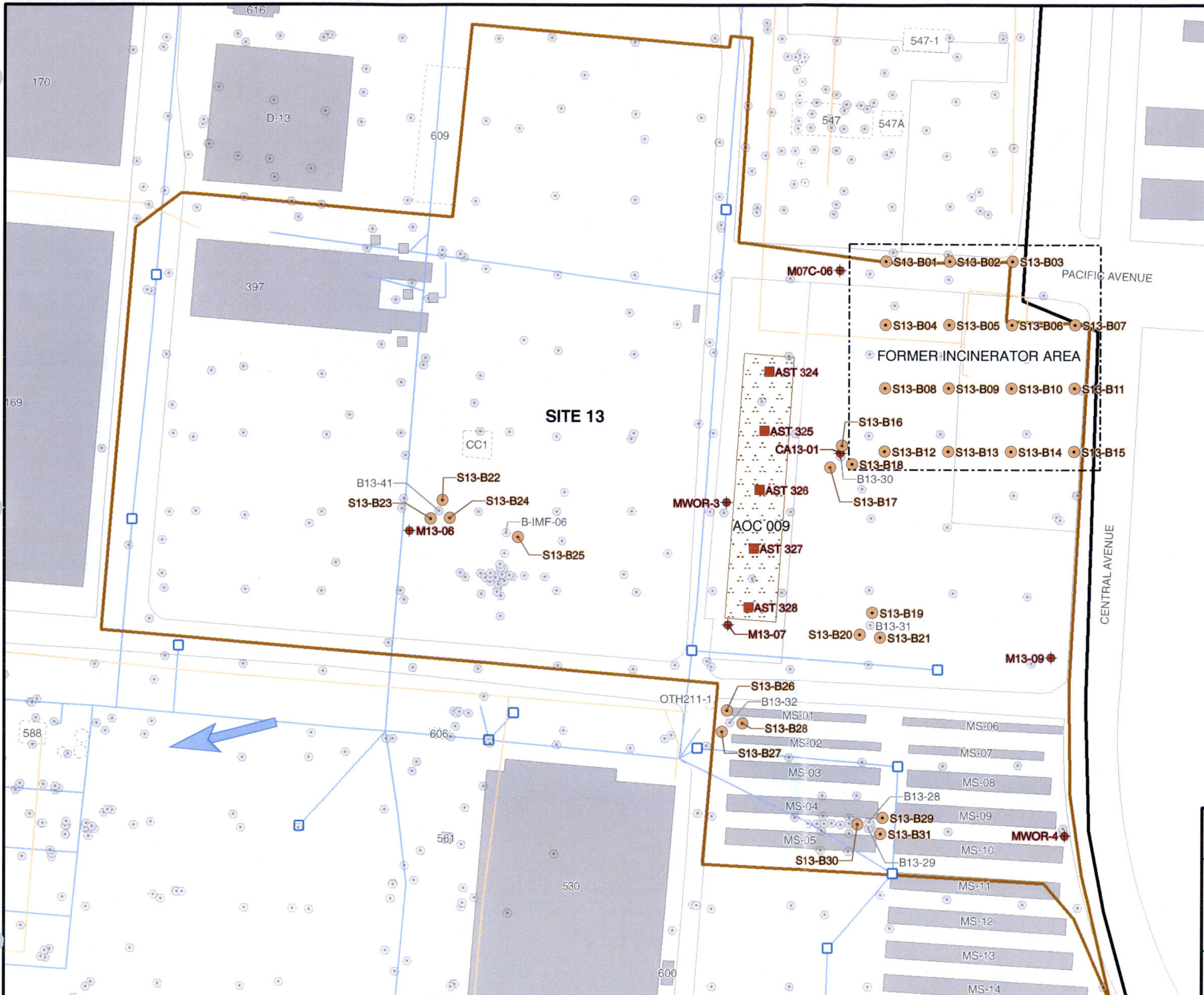
DRAFT FINAL DATA GAP SAMPLING WORK PLAN
FOR OU-2A AND OU-2B

FIGURE 3-4

OU-2A, SITE 13 PRELIMINARY
CONCEPTUAL SITE MODEL
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: KLD
FILE : 0012000234.DWG

TETRA TECH EC, INC.



LEGEND

- S13-B30 — PROPOSED SOIL SAMPLE LOCATION AND ID
- SOLID WASTE MANAGEMENT UNIT TO BE INVESTIGATED
- SOLID WASTE MANAGEMENT UNIT
- GROUNDWATER MONITORING WELLS TO BE SAMPLED QUARTERLY
- HISTORIC SAMPLE LOCATION
- CATCH BASIN
- APPROXIMATE GROUNDWATER FLOW DIRECTION (FWBZ)
- SANITARY SEWER LINE
- STORM SEWER LINE
- ROAD
- SITE BOUNDARY
- AREA OF CONCERN
- 530 — BUILDING AND BUILDING NUMBER
- 547-1 — FORMER BUILDING AND BUILDING NUMBER

ABBREVIATIONS AND ACRONYMS:

AST - ABOVEGROUND STORAGE TANK
DPT - DIRECT-PUSH TECHNOLOGY
FWBZ - FIRST WATER-BEARING ZONE
OU - OPERABLE UNIT
OWS - OIL/WATER SEPARATOR

60 0 60 120 Feet

Scale: 1" = 120'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

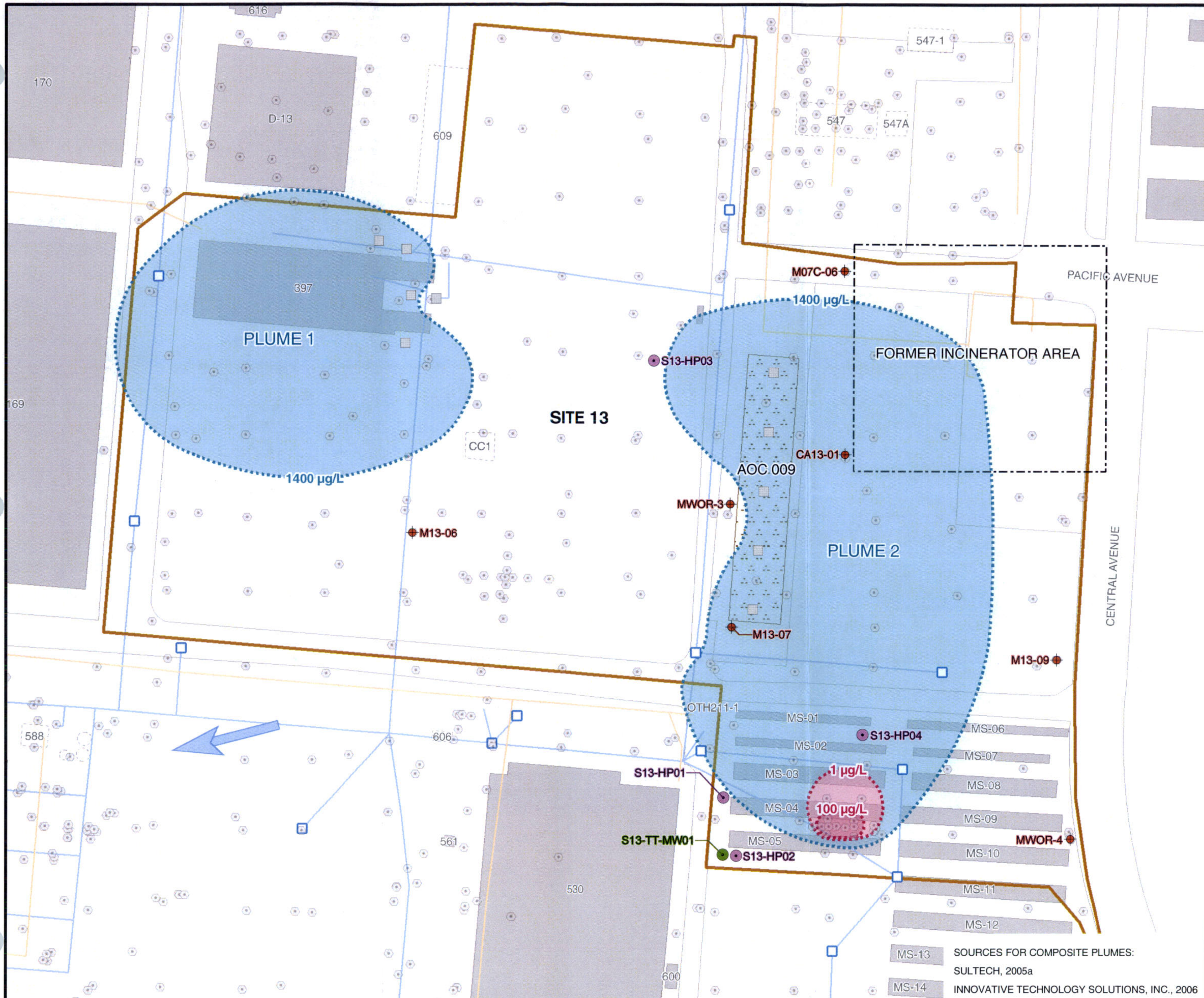
DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

FIGURE 3-5

OU-2A, SITE 13 PROPOSED SOIL INVESTIGATION LOCATIONS
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1650.mxd

TETRA TECH EC, INC.



LEGEND

- S13-HP01 — PROPOSED HYDROPUNCH SAMPLE LOCATION AND ID
- S13-TT-MW01 — PROPOSED FWBZ GROUNDWATER MONITORING WELL
- GROUNDWATER MONITORING WELLS TO BE SAMPLED QUARTERLY
- SOLID WASTE MANAGEMENT UNIT
- HISTORIC SAMPLE LOCATION
- CATCH BASIN
- APPROXIMATE GROUNDWATER FLOW DIRECTION (FWBZ)
- SANITARY SEWER LINE
- STORM SEWER LINE
- ROAD
- BENZENE PLUME
- TPH PLUME
- AREA OF CONCERN
- SITE BOUNDARY
- 530 — BUILDING AND BUILDING NUMBER
- 547A — FORMER BUILDING AND BUILDING NUMBER

ABBREVIATIONS AND ACRONYMS:

AOC - AREA OF CONCERN
AST - ABOVEGROUND STORAGE TANK
DPT - DIRECT-PUSH TECHNOLOGY
FWBZ - FIRST WATER-BEARING ZONE
IWTP - INDUSTRIAL WASTE TREATMENT PLANT
NADEP GAP - NAVAL DEPOT GENERATOR ACCUMULATION POINT
OU - OPERABLE UNIT
OWS - OIL/WATER SEPARATOR
TPH - TOTAL PETROLEUM HYDROCARBONS
µg/L - MICROGRAMS PER LITER
UST - UNDERGROUND STORAGE TANK

60 0 60 120 Feet

Scale: 1" = 120'

N

SOURCES FOR COMPOSITE PLUMES:
SULTECH, 2005a
INNOVATIVE TECHNOLOGY SOLUTIONS, INC., 2006

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

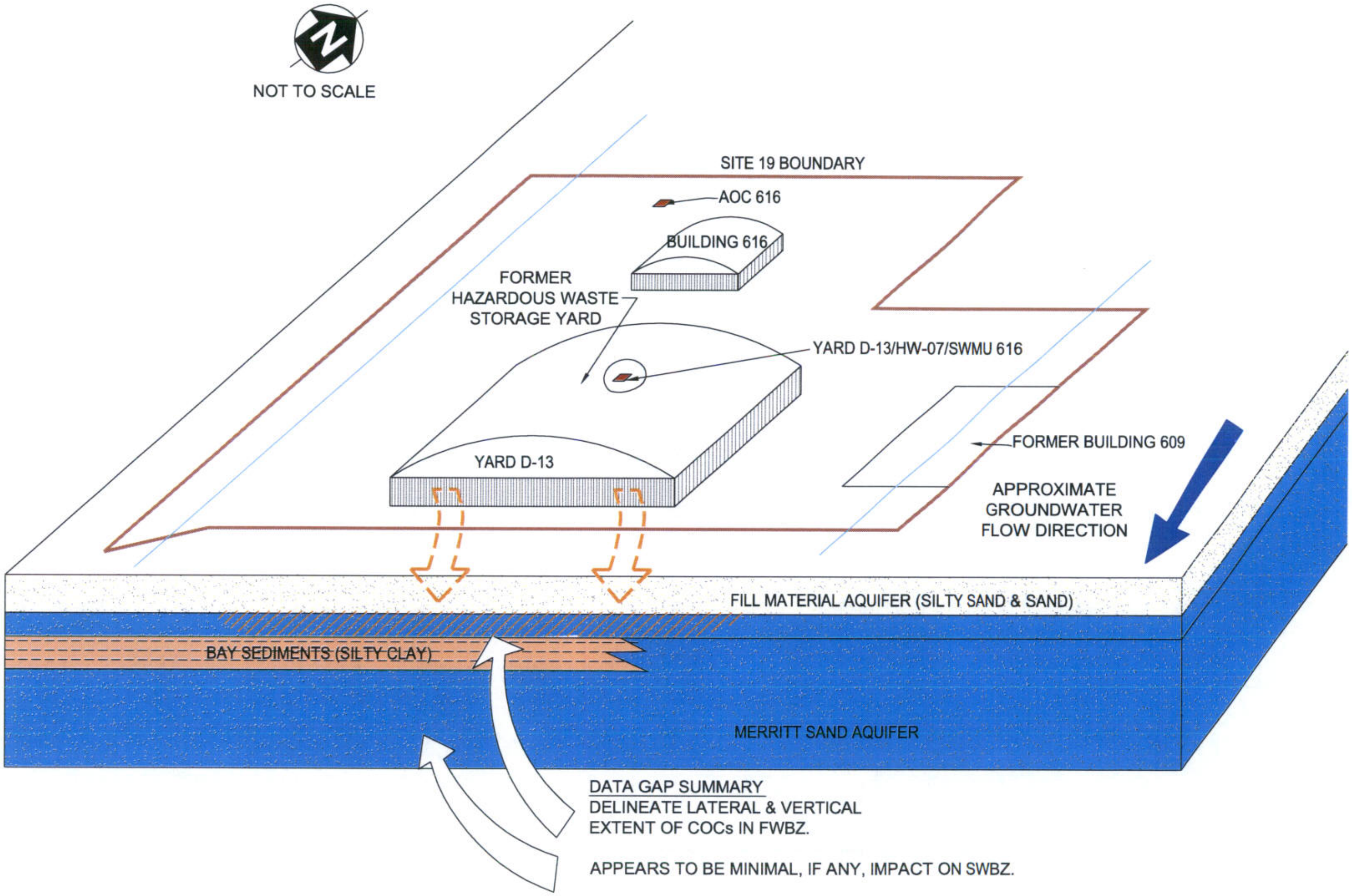
DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

FIGURE 3-6

OU-2A, SITE 13 PROPOSED
GROUNDWATER INVESTIGATION LOCATIONS
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1651.mxd

TETRA TECH EC, INC.



LEGEND:

- SOLID WASTE MANAGEMENT UNIT
- SANITARY SEWER LINE
- STORM SEWER LINE
- SITE BOUNDARY
- POTENTIAL GROUNDWATER CONTAMINATION
- POTENTIAL GROUNDWATER CONTAMINATION SOURCE

ABBREVIATIONS & ACRONYMS:

AOC	AREA OF CONCERN
COCs	CHEMICAL OF CONCERN
FWBZ	FIRST WATER-BEARING ZONE
SWMU	SOLID WASTE MANAGEMENT UNIT
SWBZ	SECOND WATER-BEARING ZONE

NOTE:

THIS CONCEPTUAL SITE MODEL IS INTENDED AS A VISUAL TOOL AND IT DOES NOT DEPICT ALL SITE OR SUBSURFACE CONDITIONS. THE MODEL IS BASED ON PREVIOUS INVESTIGATION DATA AND FINDINGS AND MAY BE UPDATED BASED ON OBSERVED SITE CONDITIONS, PROPOSED INVESTIGATION FINDINGS, OR OTHER ADDITIONAL DATA.

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

DRAFT FINAL DATA GAP SAMPLING WORK PLAN
FOR OU-2A AND OU-2B

FIGURE 3-7

OU-2A, SITE 19 PRELIMINARY
CONCEPTUAL SITE MODEL
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: KLD
FILE : 0012000237.DWG

TETRA TECH EC, INC.

LEGEND

- S19-B01 PROPOSED SOIL SAMPLE LOCATION AND ID
- SOLID WASTE MANAGEMENT UNIT
- HISTORIC SAMPLE LOCATION
- CATCH BASIN
- APPROXIMATE GROUNDWATER FLOW DIRECTION (FWBZ)
- SANITARY SEWER LINE
- STORM SEWER LINE
- ROAD
- SITE BOUNDARY
- 616 BUILDING AND BUILDING NUMBER
- 609 FORMER BUILDING AND BUILDING NUMBER

ABBREVIATIONS AND ACRONYMS:

AOC - AREA OF CONCERN
AST - ABOVEGROUND STORAGE TANK
DPT - DIRECT-PUSH TECHNOLOGY
FWBZ - FIRST WATER-BEARING ZONE
NADEP GAP - NAVAL DEPOT GENERATOR ACCUMULATION POINT
OU - OPERABLE UNIT
OWS - OIL/WATER SEPARATOR
SWBZ - SECOND WATER-BEARING ZONE
SWMU - SOLID WASTE MANAGEMENT UNIT

25 0 25 50 Feet

Scale: 1" = 50'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

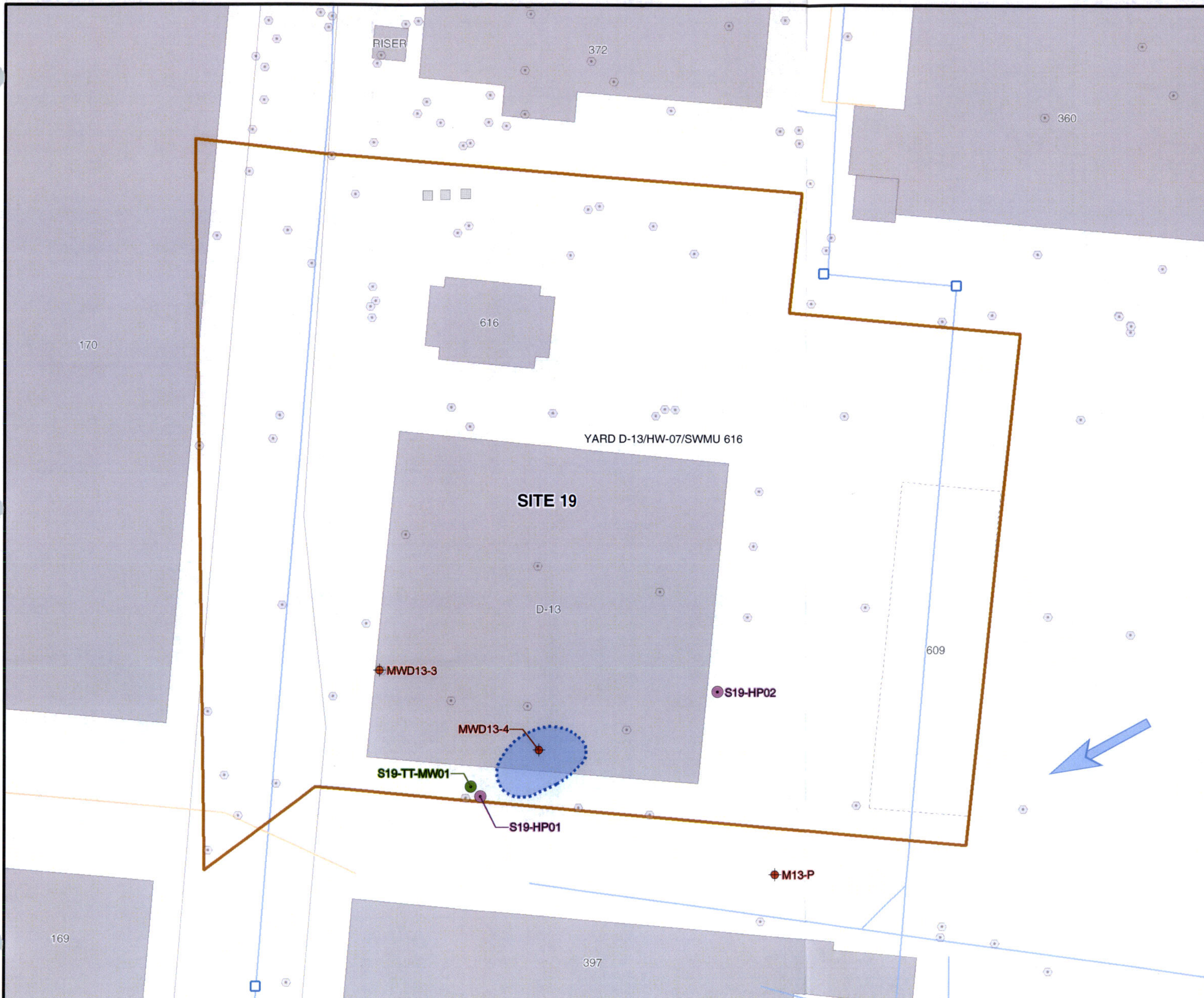
DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

FIGURE 3-8

OU-2A, SITE 19 PROPOSED SOIL INVESTIGATION LOCATIONS
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1652.mxd

TETRA TECH EC, INC.



LEGEND

S19-TT-MW01 — PROPOSED FWBZ GROUNDWATER MONITORING WELL AND ID

S19-HP01 — PROPOSED HYDROPUNCH SAMPLE LOCATION AND ID

SOLID WASTE MANAGEMENT UNIT

GROUNDWATER MONITORING WELLS TO BE SAMPLED QUARTERLY

HISTORIC SAMPLE LOCATION

CATCH BASIN

APPROXIMATE GROUNDWATER FLOW DIRECTION (FWBZ)

SANITARY SEWER LINE

STORM SEWER LINE

ROAD

APPROXIMATE EXTENT OF COMPOSITE VOC PLUME ABOVE MCLS (FWBZ)

SITE BOUNDARY

616 — BUILDING AND BUILDING NUMBER

609 — FORMER BUILDING AND BUILDING NUMBER

ABBREVIATIONS AND ACRONYMS:

AOC - AREA OF CONCERN

AST - ABOVEGROUND STORAGE TANK

DPT - DIRECT-PUSH TECHNOLOGY

FWBZ - FIRST WATER-BEARING ZONE

NADEP GAP - NAVAL DEPOT GENERATOR ACCUMULATION POINT

OU - OPERABLE UNIT

OWS - OIL/WATER SEPARATOR

SWBZ - SECOND WATER-BEARING ZONE

SWMU - SOLID WASTE MANAGEMENT UNIT

SOURCES FOR COMPOSITE PLUMES:

SULTECH, 2005a

INNOVATIVE TECHNOLOGY SOLUTIONS, INC., 2006

25 0 25 50 Feet

Scale: 1" = 50'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

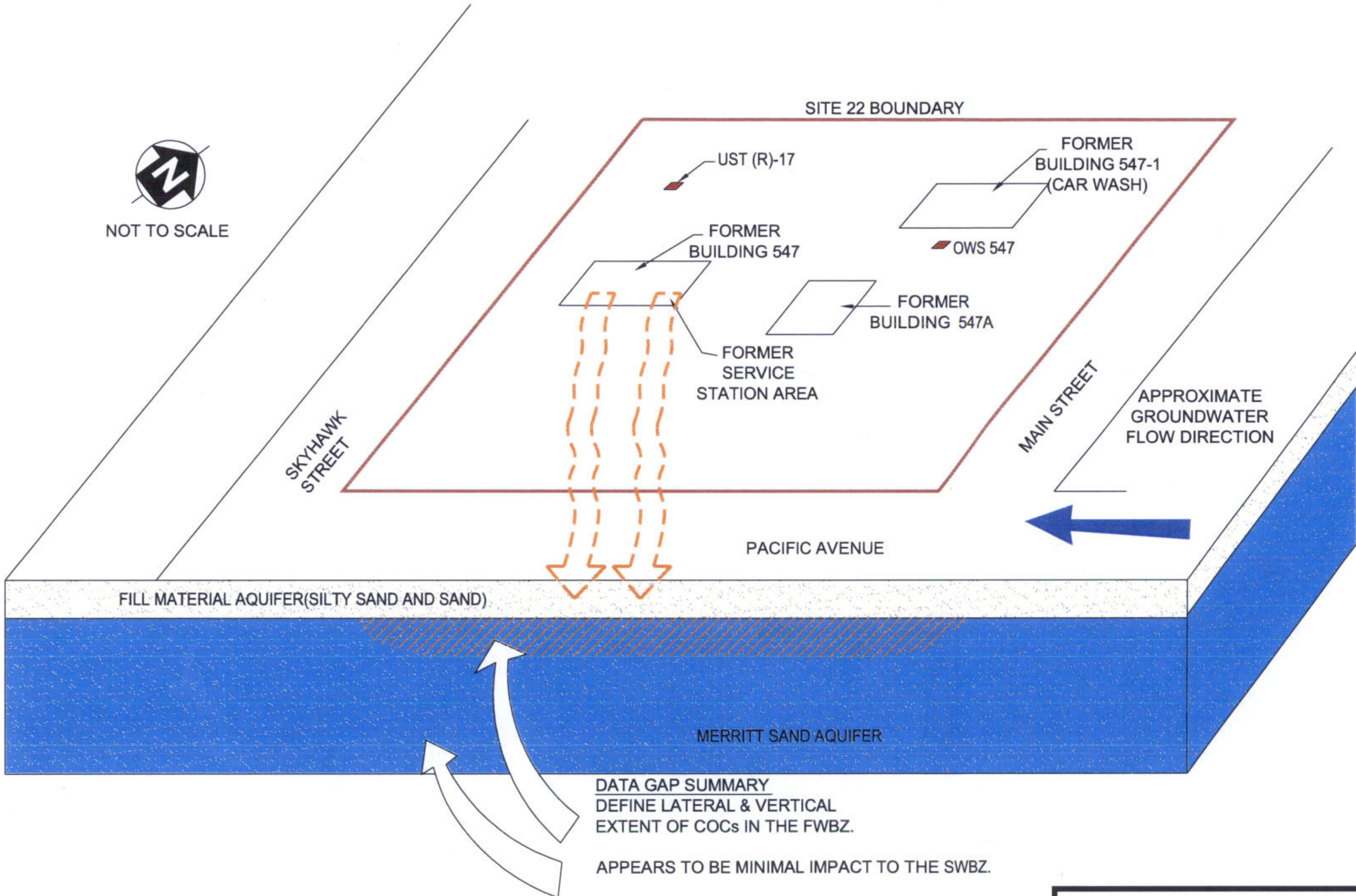
DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

FIGURE 3-9

OU-2A, SITE 19 PROPOSED
GROUNDWATER INVESTIGATION LOCATIONS
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1653.mxd

TETRA TECH EC, INC.



LEGEND:

- SOLID WASTE MANAGEMENT UNIT
- SITE BOUNDARY
- POTENTIAL GROUNDWATER CONTAMINATION
- POTENTIAL GROUNDWATER CONTAMINATION SOURCE

ABBREVIATIONS & ACRONYMS:

COCs	CHEMICAL OF CONCERN
FWBZ	FIRST WATER-BEARING ZONE
OWS	OIL/WATER SEPARATOR
SWBZ	SECOND WATER-BEARING ZONE
UST	UNDERGROUND STORAGE TANK

NOTE:

THIS CONCEPTUAL SITE MODEL IS INTENDED AS A VISUAL TOOL AND IT DOES NOT DEPICT ALL SITE OR SUBSURFACE CONDITIONS. THE MODEL IS BASED ON PREVIOUS INVESTIGATION DATA AND FINDINGS AND MAY BE UPDATED BASED ON OBSERVED SITE CONDITIONS, PROPOSED INVESTIGATION FINDINGS, OR OTHER ADDITIONAL DATA.

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

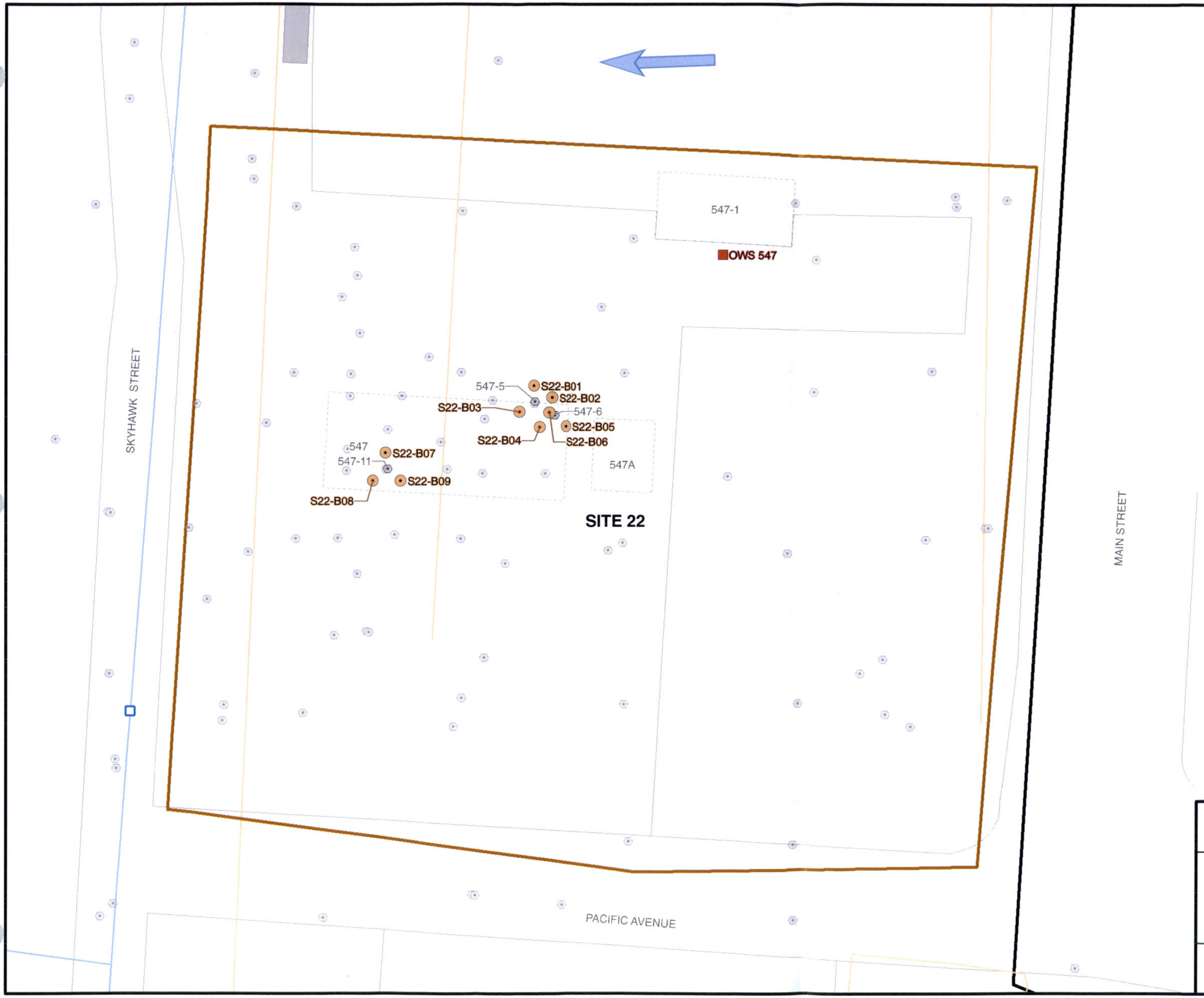
DRAFT FINAL DATA GAP SAMPLING WORK PLAN
FOR OU-2A AND OU-2B

FIGURE 3-10

OU-2A, SITE 22 PRELIMINARY
CONCEPTUAL SITE MODEL
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: KLD
FILE : 00120002310.DWG

TETRA TECH EC, INC.



LEGEND

- S22-B01 — PROPOSED SOIL SAMPLE LOCATION AND ID
- SOLID WASTE MANAGEMENT UNIT TO BE INVESTIGATED
- HISTORIC SAMPLE LOCATION
- CATCH BASIN
- APPROXIMATE GROUNDWATER FLOW DIRECTION (FWBZ)
- SANITARY SEWER LINE
- STORM SEWER LINE
- ROAD
- SITE BOUNDARY
- 610 — BUILDING AND BUILDING NUMBER
- 547A — FORMER BUILDING AND BUILDING NUMBER

NOTES:

AST - ABOVEGROUND STORAGE TANK

DPT - DIRECT-PUSH TECHNOLOGY

FWBZ - FIRST WATER-BEARING ZONE

IR - INSTALLATION RESTORATION

OU - OPERABLE UNIT

OWS - OIL/WATER SEPARATOR

20 0 20 40 Feet

Scale: 1" = 40'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

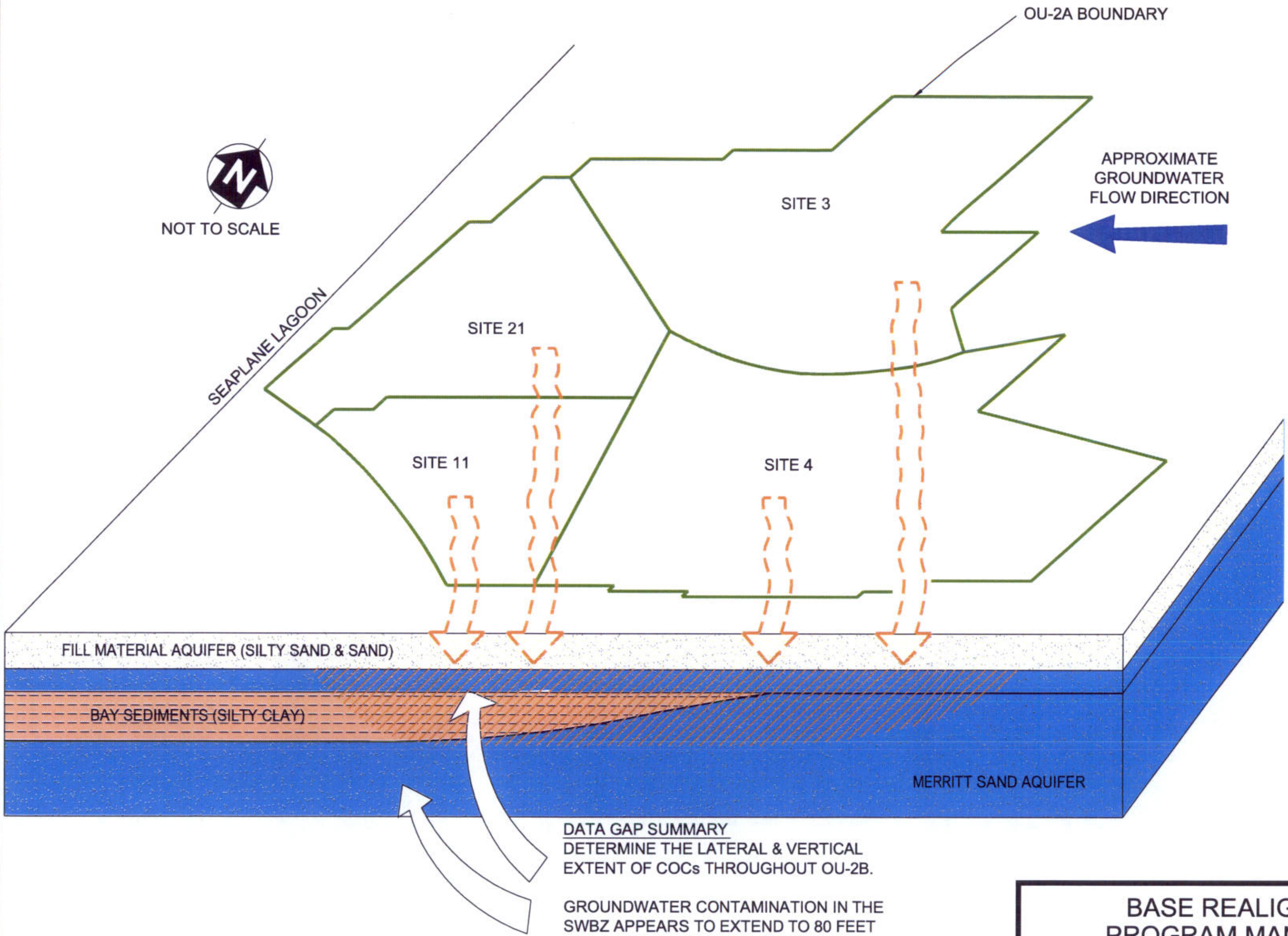
FIGURE 3-11

OU-2A, SITE 22 PROPOSED SOIL INVESTIGATION LOCATIONS

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1654.mxd

TETRA TECH EC, INC.



LEGEND:

- APPROXIMATE SITE BOUNDARY
- POTENTIAL GROUNDWATER CONTAMINATION
- POTENTIAL GROUNDWATER CONTAMINATION SOURCE

ABBREVIATIONS & ACRONYMS:

COCs	CHEMICAL OF CONCERN
FWBZ	FIRST WATER-BEARING ZONE
SWBZ	SECOND WATER-BEARING ZONE

DATA GAP SUMMARY

DETERMINE THE LATERAL & VERTICAL EXTENT OF COCs THROUGHOUT OU-2B.

GROUNDWATER CONTAMINATION IN THE SWBZ APPEARS TO EXTEND TO 80 FEET BGS, BUT IS COMPOUND DEPENDENT. MULTIPLE DEPTHS IN THE SWBZ WILL BE INVESTIGATED.

NOTE:

THIS CONCEPTUAL SITE MODEL IS INTENDED AS A VISUAL TOOL AND IT DOES NOT DEPICT ALL SITE OR SUBSURFACE CONDITIONS. THE MODEL IS BASED ON PREVIOUS INVESTIGATION DATA AND FINDINGS AND MAY BE UPDATED BASED ON OBSERVED SITE CONDITIONS, PROPOSED INVESTIGATION FINDINGS, OR OTHER ADDITIONAL DATA.

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

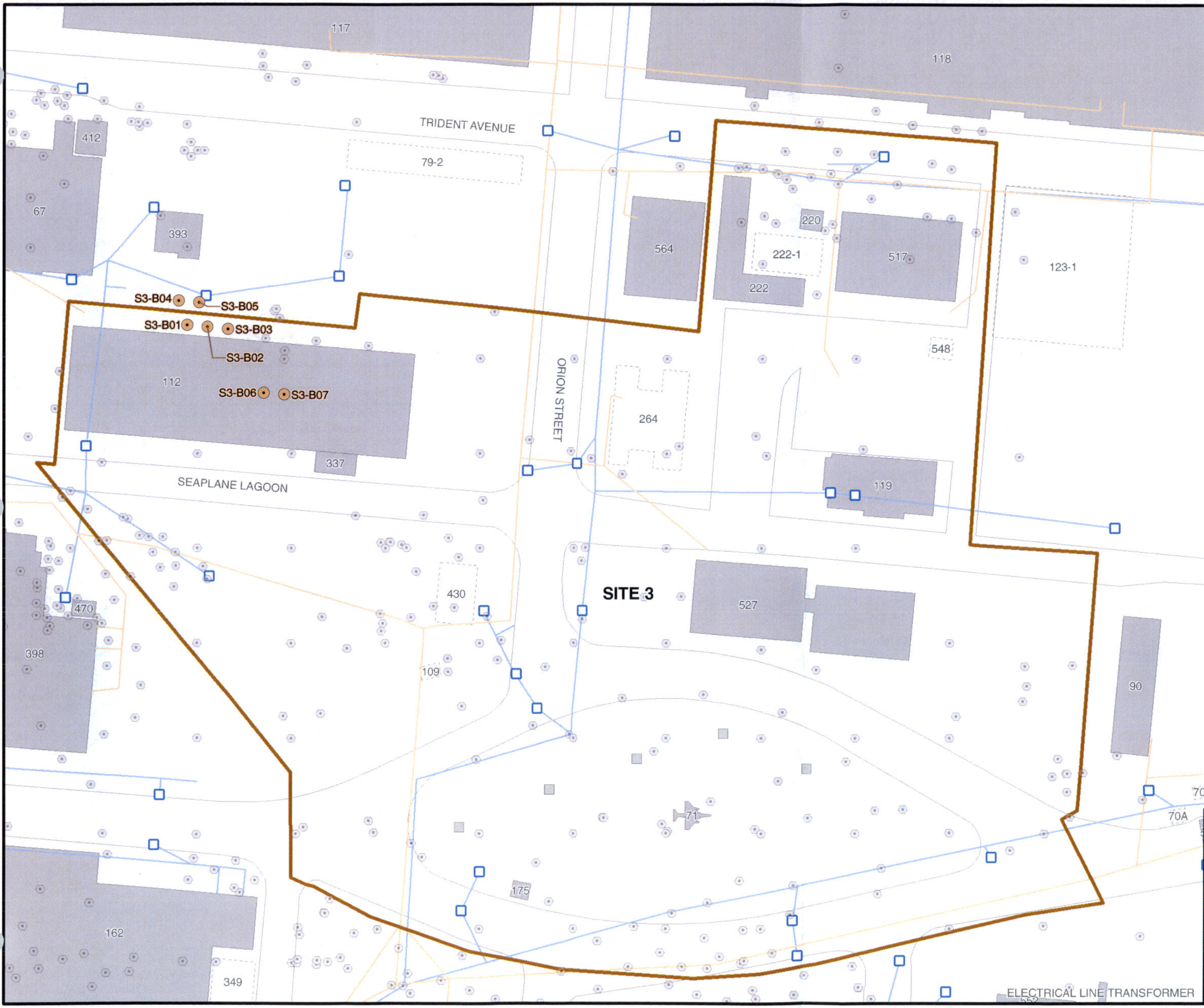
DRAFT FINAL DATA GAP SAMPLING WORK PLAN
FOR OU-2A AND OU-2B

FIGURE 3-12

OU-2B, SITE-WIDE PRELIMINARY
CONCEPTUAL SITE MODEL
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: KLD
FILE : 00120002312.DWG

TETRA TECH EC, INC.



LEGEND

S3-B01 PROPOSED SOIL SAMPLE LOCATION AND ID

SOLID WASTE MANAGEMENT UNIT

HISTORIC SAMPLE LOCATION

CATCH BASIN

SANITARY SEWER LINE

STORM SEWER LINE

ROAD

SITE BOUNDARY

112 BUILDING AND BUILDING NUMBER

430 FORMER BUILDING AND BUILDING NUMBER

ABBREVIATIONS AND ACRONYMS:

AOC - AREA OF CONCERN

NADEP GAP- NAVAL DEPOT GENERATOR ACCUMULATION POINT

NAS GAP - NAVAL AIR STATION GENERATOR ACCUMULATION POINT

OU - OPERABLE UNIT

OWS - OIL/WATER SEPARATOR

UST - UNDERGROUND STORAGE TANK

NOTE:

BASED ON THE RESULTS OF THE SOIL GAS SURVEY, SOIL SAMPLES MAY BE COLLECTED BELOW THE FLOOR OF THE BUILDING. ADDITIONALLY, SOIL SAMPLES WILL BE COLLECTED NEAR THE FORMER SMELTER, IF IT CAN BE LOCATED, AND FROM THE STORAGE AREA OUTSIDE OF BUILDING 112. SOIL SAMPLES WILL BE COLLECTED AT THE DISCRETION OF THE FIELD GEOLOGIST.

50 0 50 100 Feet

Scale: 1" = 100'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

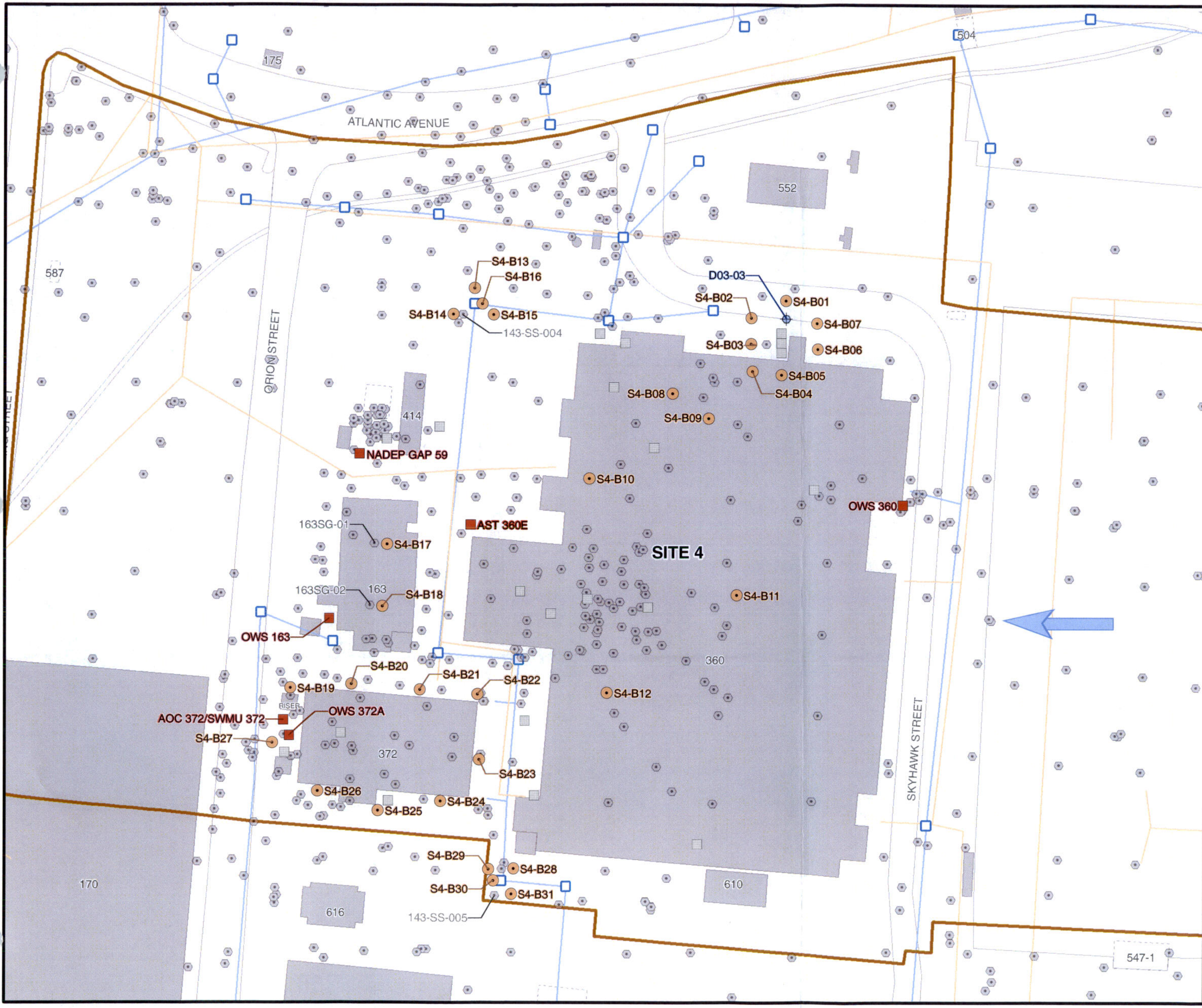
FIGURE 3-13

OU-2B, SITE 3 PROPOSED SOIL INVESTIGATION LOCATIONS

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RH
FILE NUMBER: 071004L1658.mxd

TETRA TECH EC, INC.



LEGEND

S04-B01	PROPOSED SOIL SAMPLE LOCATION AND ID
	SOLID WASTE MANAGEMENT UNIT TO BE INVESTIGATED
	SOLID WASTE MANAGEMENT UNIT
	HISTORIC SAMPLE LOCATION
	CATCH BASIN
	APPROXIMATE GROUNDWATER FLOW DIRECTION (FWBZ)
	SAMPLE GRID
	SANITARY SEWER LINE
	STORM SEWER LINE
	ROAD
	SITE BOUNDARY
360	BUILDING AND BUILDING NUMBER
349	FORMER BUILDING AND BUILDING NUMBER

ABBREVIATIONS AND ACRONYMS:

AOC - AREA OF CONCERN
AST - ABOVEGROUND STORAGE TANK
DPT - DIRECT-PUSH TECHNOLOGY
FWBZ - FIRST WATER-BEARING ZONE
IWTP - INDUSTRIAL WASTE TREATMENT PLANT
NADEP GAP - NAVAL DEPOT GENERATOR ACCUMULATION POINT
OU - OPERABLE UNIT
OWS - OIL/WATER SEPARATOR
SWMU - SOLID WASTE MANAGEMENT UNIT
TPH - TOTAL PETROLEUM HYDROCARBONS
UST - UNDERGROUND STORAGE TANK

50 0 50 100 Feet

Scale: 1" = 100'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

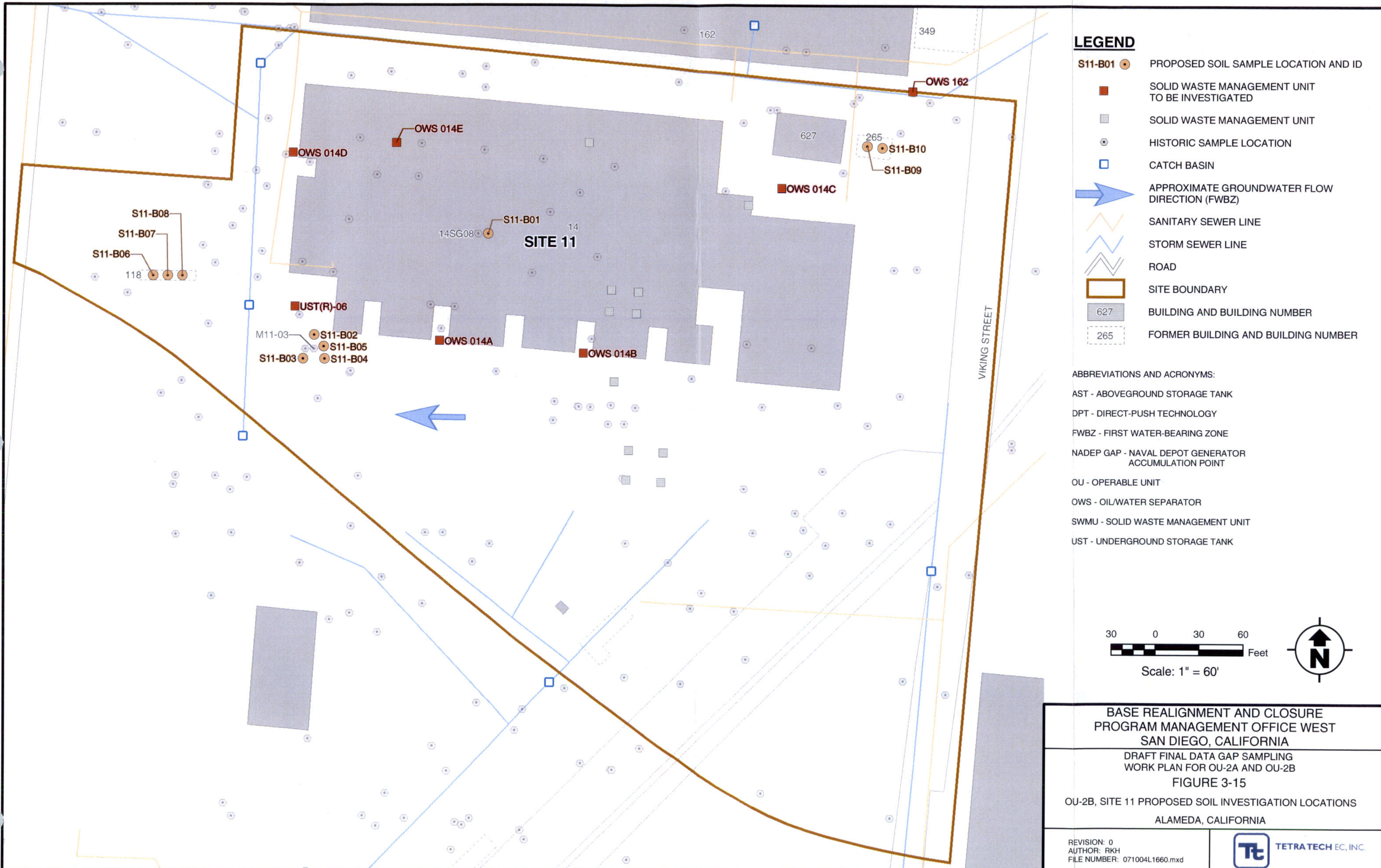
FIGURE 3-14

OU-2B, SITE 4 PROPOSED SOIL INVESTIGATION LOCATIONS

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: GFG
FILE NUMBER: 071004L1659.mxd

TETRA TECH EC, INC.



BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

FIGURE 3-15

OU-2B, SITE 11 PROPOSED SOIL INVESTIGATION LOCATIONS

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1660.mxd

TETRA TECH EC, INC.

LEGEND

S21-B01 PROPOSED SOIL SAMPLE LOCATION AND ID

SOLID WASTE MANAGEMENT UNIT TO BE INVESTIGATED

SOLID WASTE MANAGEMENT UNIT

HISTORIC SAMPLE LOCATION

CATCH BASIN

APPROXIMATE GROUNDWATER FLOW DIRECTION (FWBZ)

SANITARY SEWER LINE

STORM SEWER LINE

ROAD

SITE BOUNDARY

162 BUILDING AND BUILDING NUMBER

349 FORMER BUILDING AND BUILDING NUMBER

WATER

NOTES:

AST - ABOVEGROUND STORAGE TANK

DPT - DIRECT-PUSH TECHNOLOGY

FWBZ - FIRST WATER-BEARING ZONE

NAS GAP - NAVAL AIR STATION GENERATOR ACCUMULATION POINT

OU - OPERABLE UNIT

OWS - OIL/WATER SEPARATOR

SWMU - SOLID WASTE MANAGEMENT UNIT

UST - UNDERGROUND STORAGE TANK

50 0 50 100 Feet

Scale: 1" = 100'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

FIGURE 3-16

OU-2B, SITE 21 PROPOSED SOIL INVESTIGATION LOCATIONS

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1661.mxd

TETRA TECH EC, INC.

LEGEND

S4-TT-MW01	PROPOSED FWBZ GROUNDWATER MONITORING WELL AND ID
S3-HP01	PROPOSED HYDROPUNCH SAMPLE LOCATION AND ID
	GROUNDWATER MONITORING WELLS TO BE SAMPLED QUARTERLY
	APPROXIMATE GROUNDWATER FLOW DIRECTION (FWBZ)
	APPROXIMATE EXTENT OF COMPOSITE VOC PLUME ABOVE MCLS (FWBZ)
	100 µg/L COMPOSITE VOC PLUME ISOCONCENTRATION CONTOUR (FWBZ)
	1,000 µg/L COMPOSITE VOC PLUME ISOCONCENTRATION CONTOUR (FWBZ)
	APPROXIMATE EXTENT OF LEAD PLUME ABOVE MCL (FWBZ)
	APPROXIMATE EXTENT OF BENZENE PLUME ABOVE MCL (FWBZ)
	ROAD
	OPERABLE UNIT 2B BOUNDARY
564	BUILDING AND BUILDING NUMBER
264	FORMER BUILDING AND BUILDING NUMBER
	ALAMEDA POINT BOUNDARY
	WATER

ABBREVIATIONS AND ACRONYMS:

FWBZ - FIRST WATER-BEARING ZONE

OU - OPERABLE UNIT

µg/L - MICROGRAMS PER LITER

VOC - VOLATILE ORGANIC COMPOUND

SOURCES FOR COMPOSITE PLUMES:

SULTECH, 2005a

INNOVATIVE TECHNOLOGY SOLUTIONS, INC., 2006

100 0 100 200 Feet

Scale: 1" = 200'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

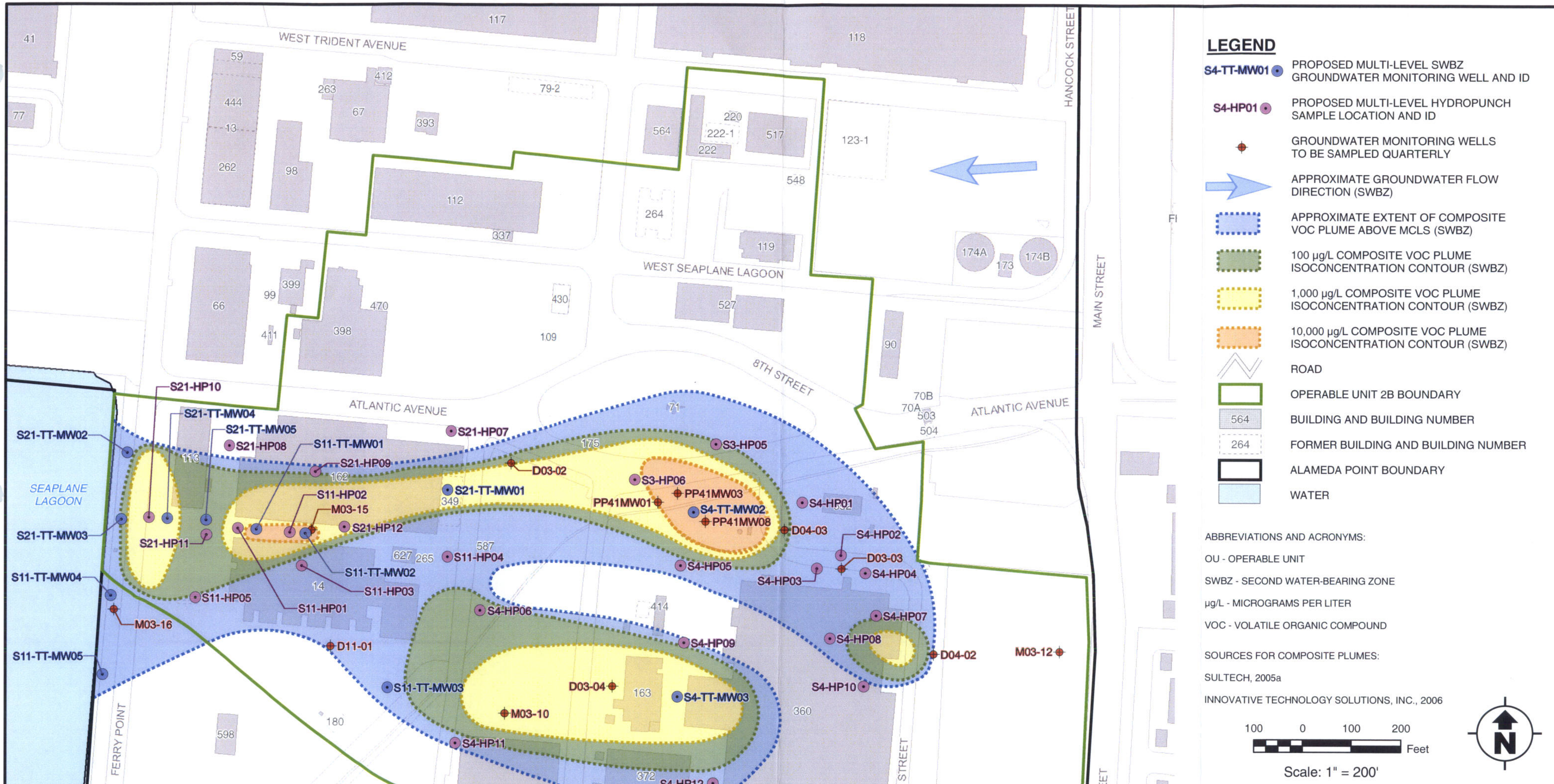
DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

FIGURE 3-17

OU-2B, SITE-WIDE PROPOSED GROUNDWATER
INVESTIGATION LOCATIONS - FWBZ
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1662.mxd

TETRA TECH EC, INC.



BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

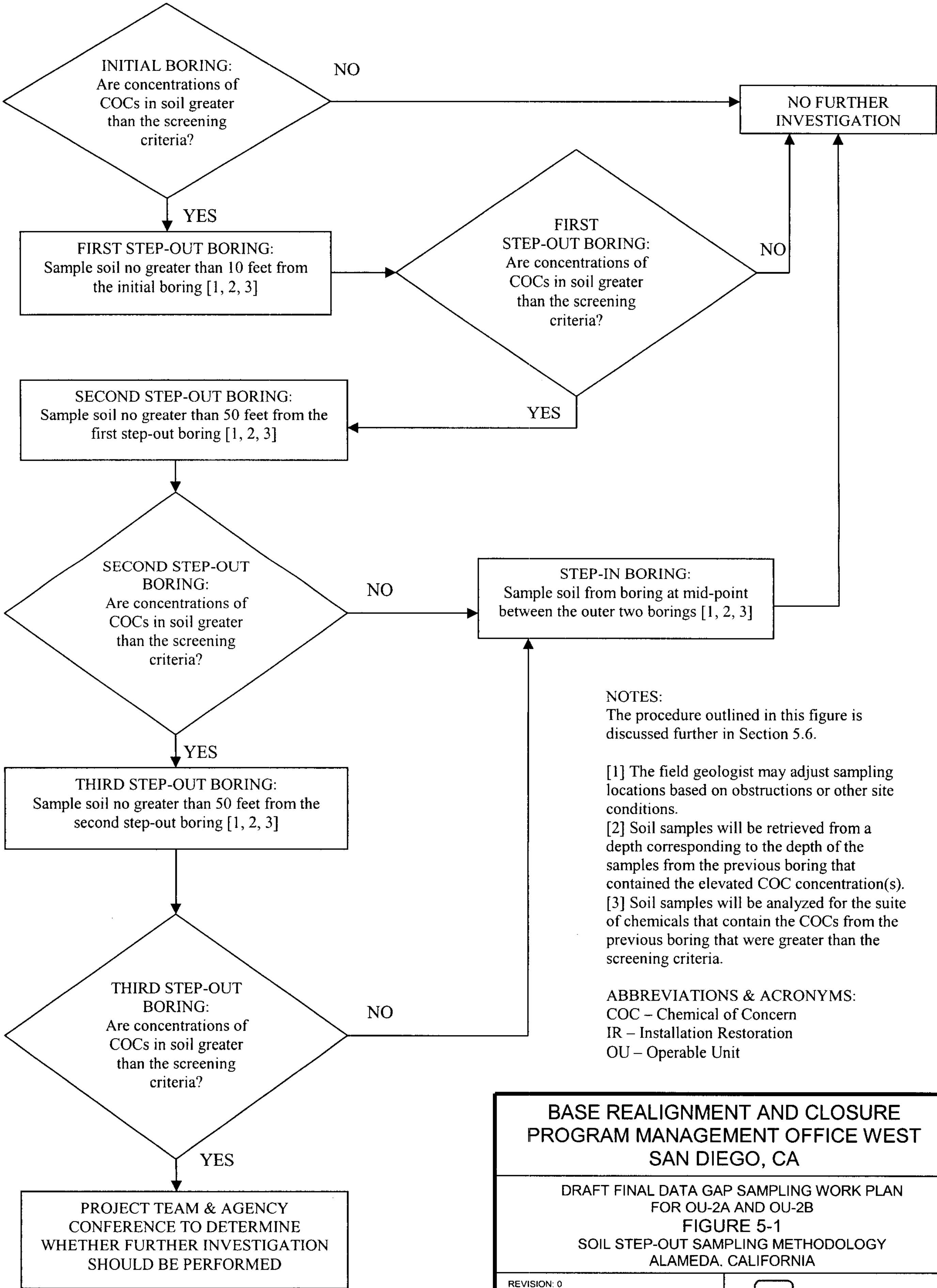
FIGURE 3-18

OU-2B, SITE-WIDE PROPOSED
GROUNDWATER INVESTIGATION LOCATIONS-SWBZ

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: GFG
FILE NUMBER: 071004L1663.mxd

TETRA TECH EC, INC.



NOTES:
The procedure outlined in this figure is discussed further in Section 5.6.

[1] The field geologist may adjust sampling locations based on obstructions or other site conditions.
[2] Soil samples will be retrieved from a depth corresponding to the depth of the samples from the previous boring that contained the elevated COC concentration(s).
[3] Soil samples will be analyzed for the suite of chemicals that contain the COCs from the previous boring that were greater than the screening criteria.

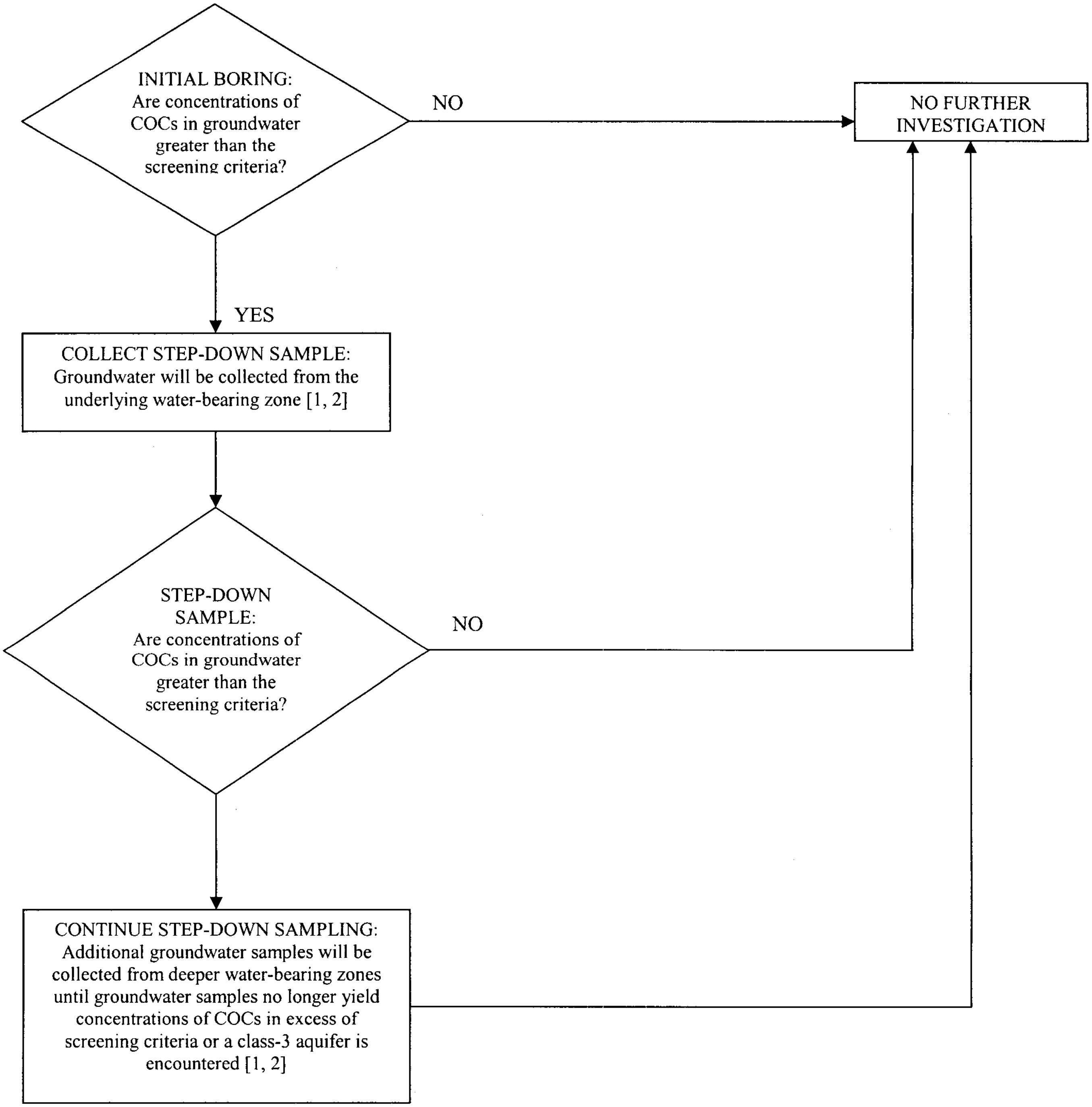
ABBREVIATIONS & ACRONYMS:
COC – Chemical of Concern
IR – Installation Restoration
OU – Operable Unit

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

DRAFT FINAL DATA GAP SAMPLING WORK PLAN
FOR OU-2A AND OU-2B
FIGURE 5-1
SOIL STEP-OUT SAMPLING METHODOLOGY
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: SD
FILE: 0012000251.DOC

TETRA TECH EC, INC



NOTES:
The procedure outlined in this figure is discussed further in Section 5.8.1.
[1] The field geologist may adjust or terminate sampling depths based on obstructions or other site conditions.
[2] Groundwater samples will be analyzed for the suite of chemicals that contain the COCs from the previous sample that were in excess of the screening criteria.

ABBREVIATIONS & ACRONYMS:
COC – Chemical of Concern
IR – Installation Restoration
OU – Operable Unit

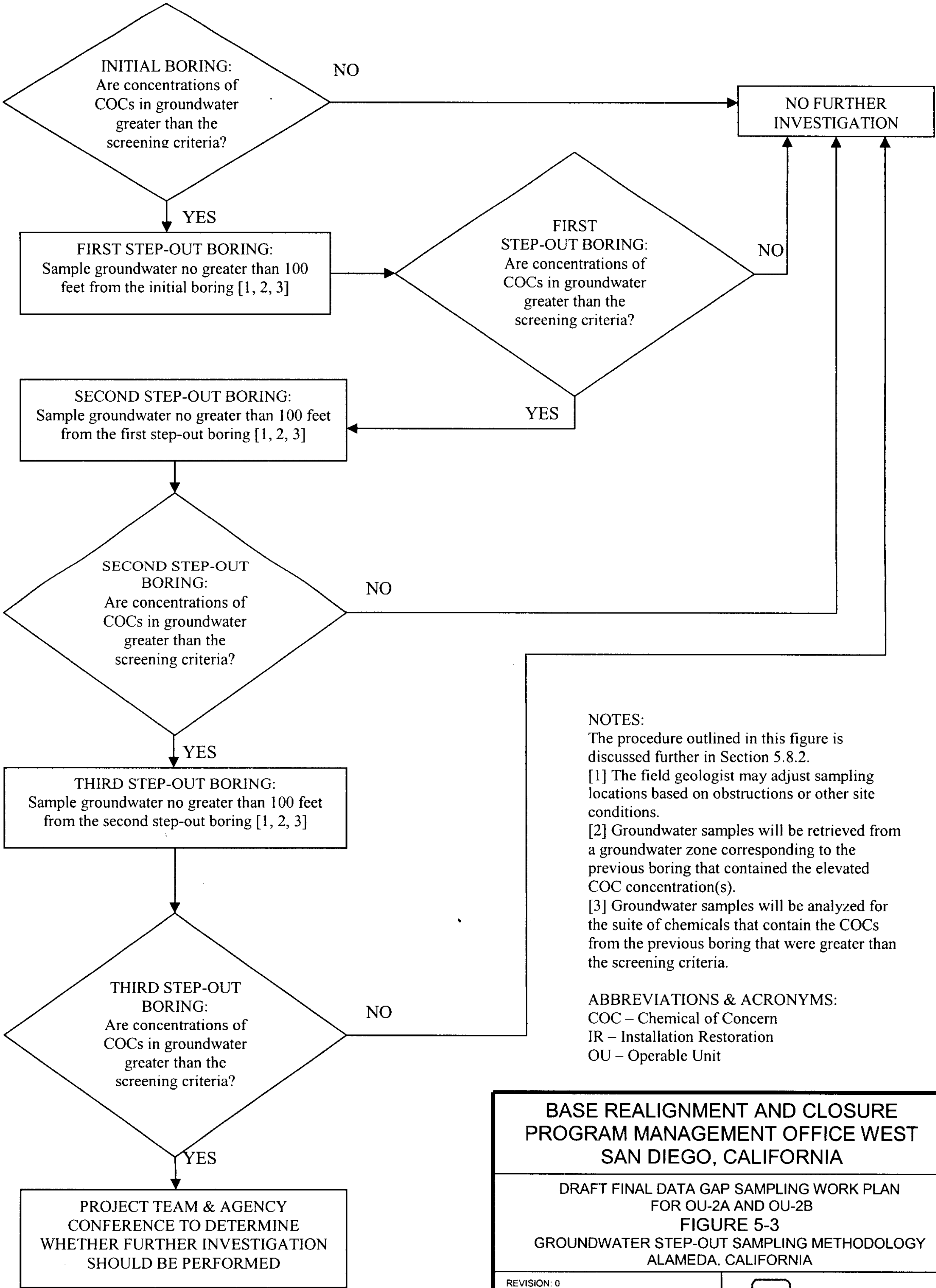
BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING WORK PLAN
FOR OU-2A AND OU-2B

FIGURE 5-2
GROUNDWATER STEP-DOWN SAMPLING METHODOLOGY
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: SD
FILE: 0012000252.DOC

TETRA TECH



NOTES:
The procedure outlined in this figure is discussed further in Section 5.8.2.
[1] The field geologist may adjust sampling locations based on obstructions or other site conditions.
[2] Groundwater samples will be retrieved from a groundwater zone corresponding to the previous boring that contained the elevated COC concentration(s).
[3] Groundwater samples will be analyzed for the suite of chemicals that contain the COCs from the previous boring that were greater than the screening criteria.

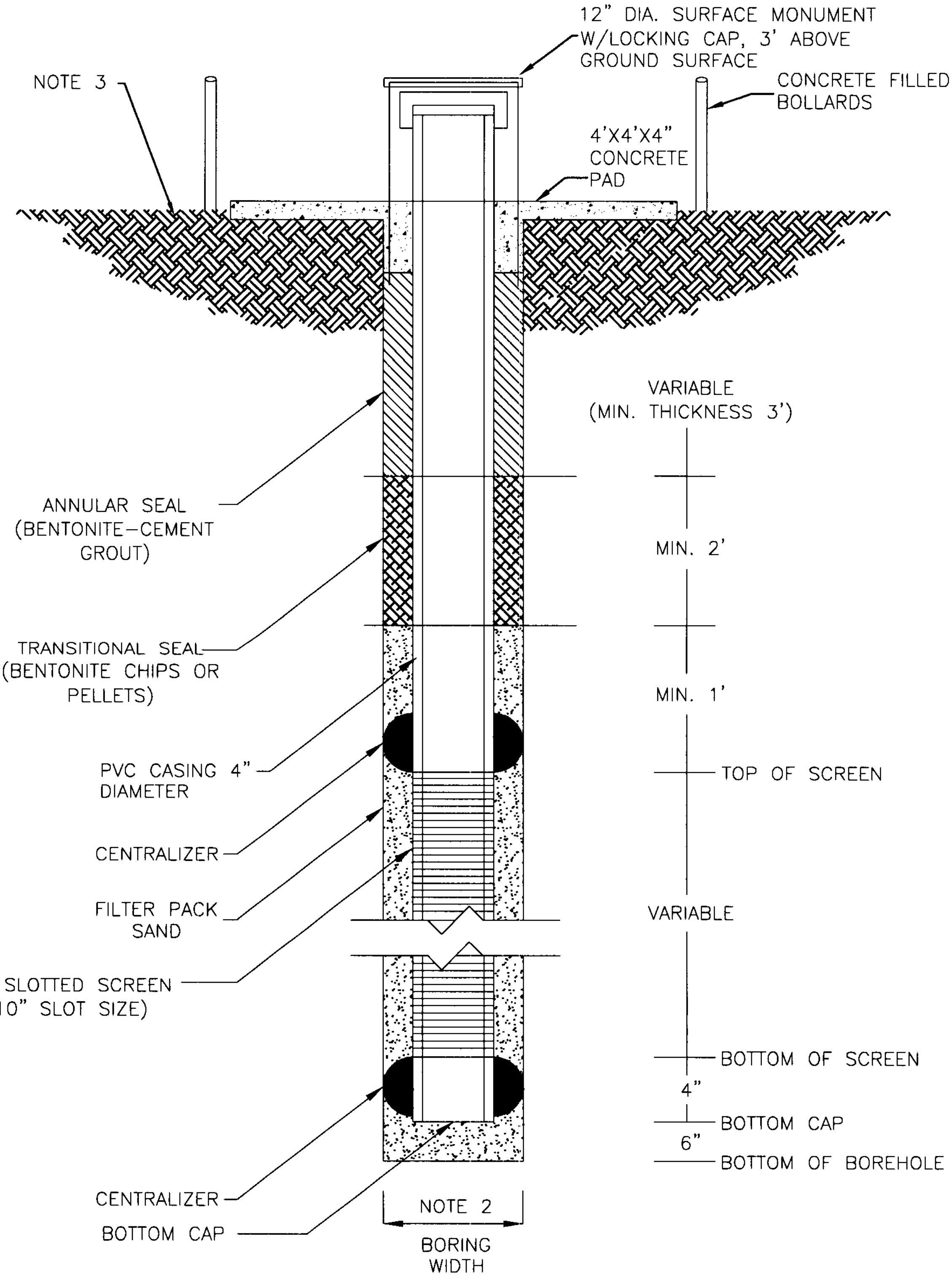
ABBREVIATIONS & ACRONYMS:
COC – Chemical of Concern
IR – Installation Restoration
OU – Operable Unit

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING WORK PLAN
FOR OU-2A AND OU-2B
FIGURE 5-3
GROUNDWATER STEP-OUT SAMPLING METHODOLOGY
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: SD
FILE: 0012000253 DOC

TETRA TECH EC, INC.



NOTES:

1) DIAGRAM COMPRISED OF CALIFORNIA WELL STANDARDS 74–90 AND RESIDENT OFFICER IN CHARGE OF CONSTRUCTION RECOMMENDATIONS.

2) MINIMUM WELL BORING WIDTH 8" FOR 4" MONITORING WELLS.

3) FINISH WITH MATCHING MATERIALS OF EXISTING GRADE.

4) DIAGRAM NOT TO SCALE.

BASE REALIGNMENT AND CLOSURE PROGRAM MANAGEMENT OFFICE WEST SAN DIEGO, CA

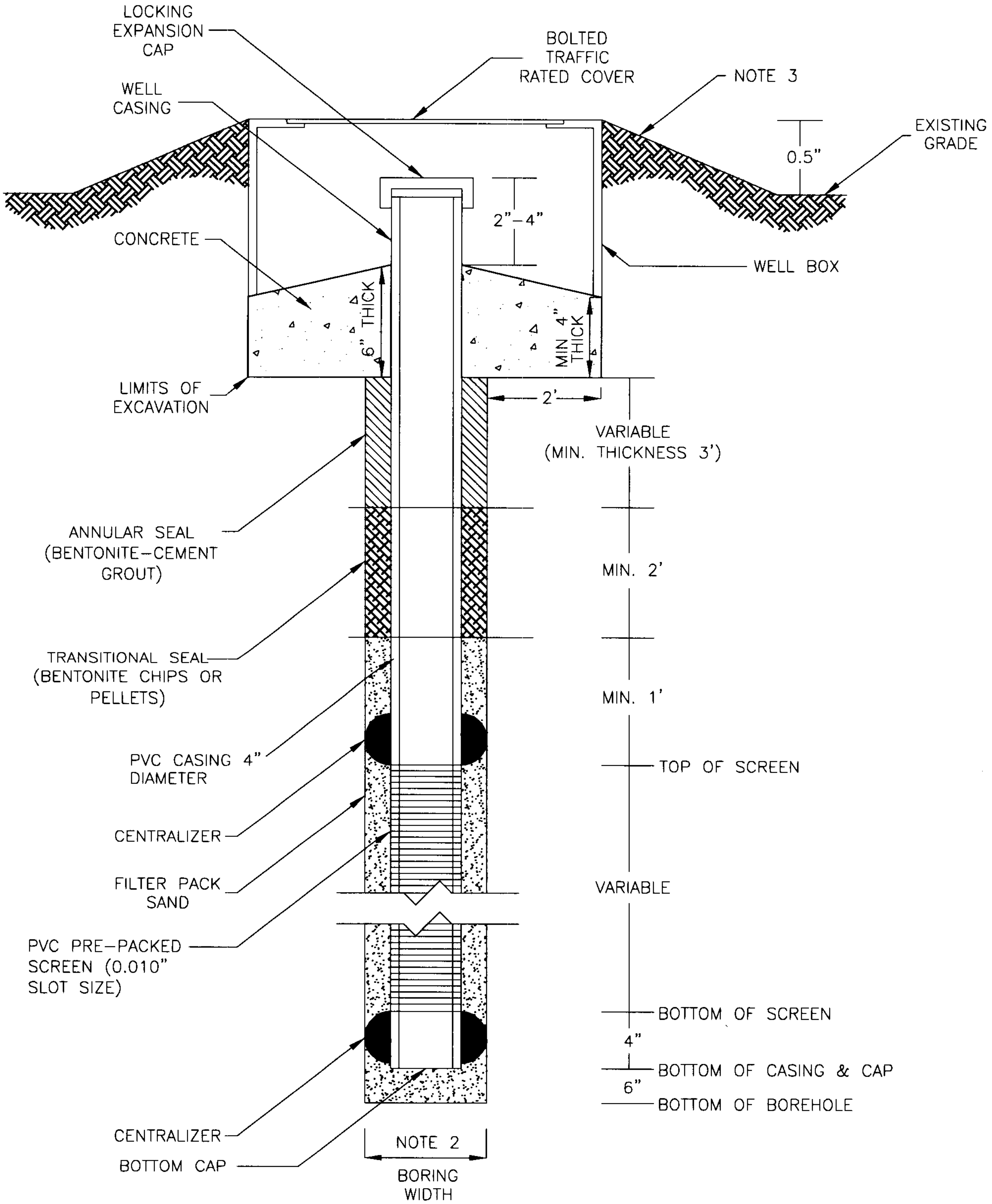
DRAFT FINAL DATA GAP SAMPLING WORK PLAN FOR OU-1, IR SITES 6,7,8 AND 16

FIGURE 5-4

FWBZ MONITORING WELL COMPLETION SCHEMATIC ABOVEGROUND COMPLETION ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: KLD
FILE :0012000154.DWG

TETRA TECH



NOTES:

1) DIAGRAM COMPRISED OF CALIFORNIA WELL STANDARDS 74-90 AND RESIDENT OFFICER IN CHARGE OF CONSTRUCTION RECOMMENDATIONS.

2) MINIMUM WELL BORING WIDTH 8" FOR 4" MONITORING WELLS.

3) FINISH WITH MATCHING MATERIALS OF EXISTING GRADE.

4) DIAGRAM NOT TO SCALE.

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

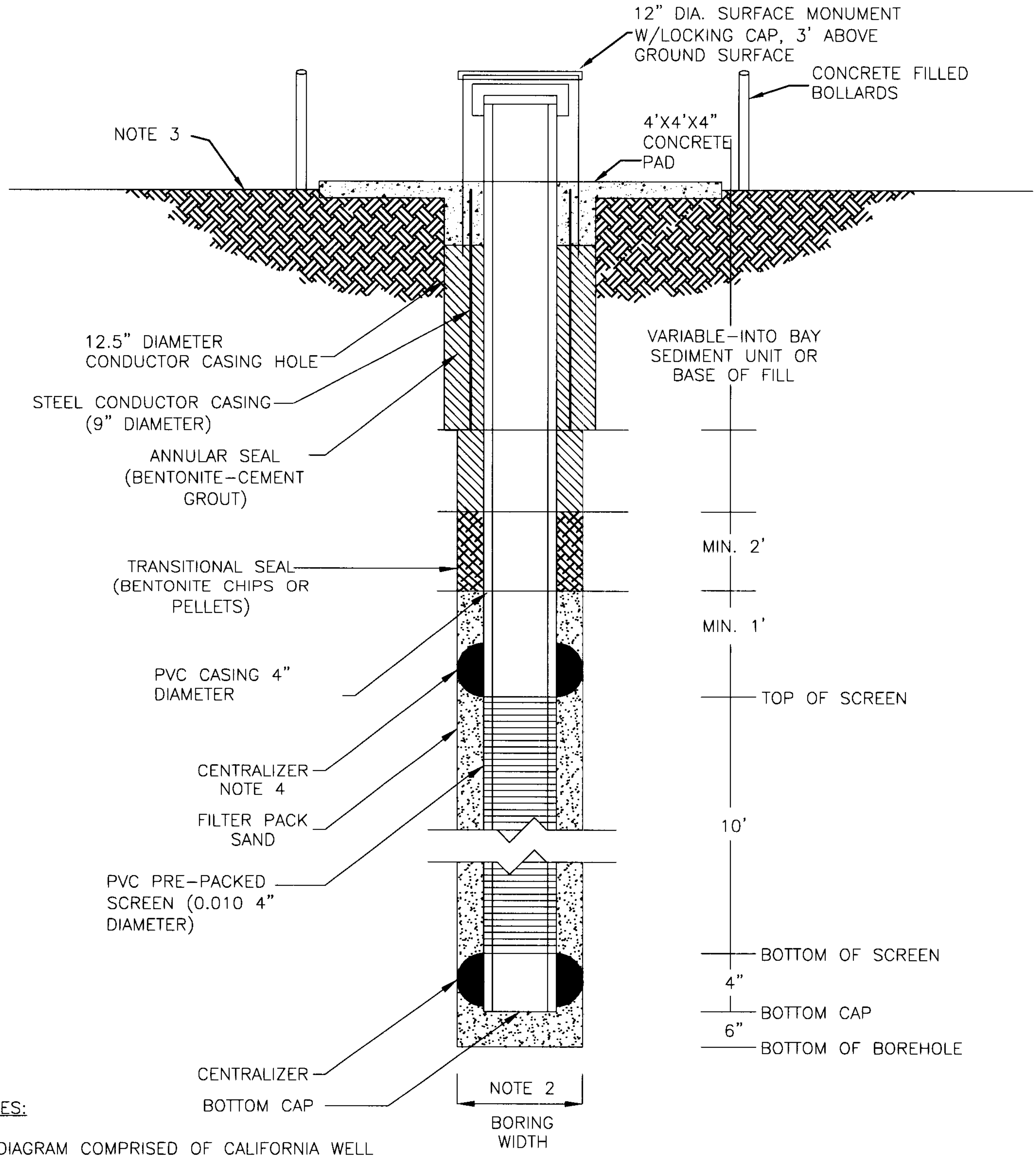
DRAFT FINAL DATA GAP SAMPLING WORK PLAN
FOR OU-2A AND OU-2B

FIGURE 5-5

FWBZ MONITORING WELL COMPLETION SCHEMATIC
FLUSH-MOUNT COMPLETION
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: KLD
FILE : 0012000155.DWG

TETRA TECH



NOTES:

1) DIAGRAM COMPRISED OF CALIFORNIA WELL STANDARDS 74-90 AND RESIDENT OFFICER IN CHARGE OF CONSTRUCTION RECOMMENDATIONS.

2) MINIMUM WELL BORING WIDTH 8" FOR 4" MONITORING WELLS.

3) FINISH WITH MATCHING MATERIALS OF EXISTING GRADE.

4) CENTRALIZERS WILL BE PLACED EVERY 10 FEET.

5) DIAGRAM NOT TO SCALE.

6) SLOT SIZE OF SCREEN AND FILTER PACK MAY VARY.

BASE REALIGNMENT AND CLOSURE PROGRAM MANAGEMENT OFFICE WEST SAN DIEGO, CA

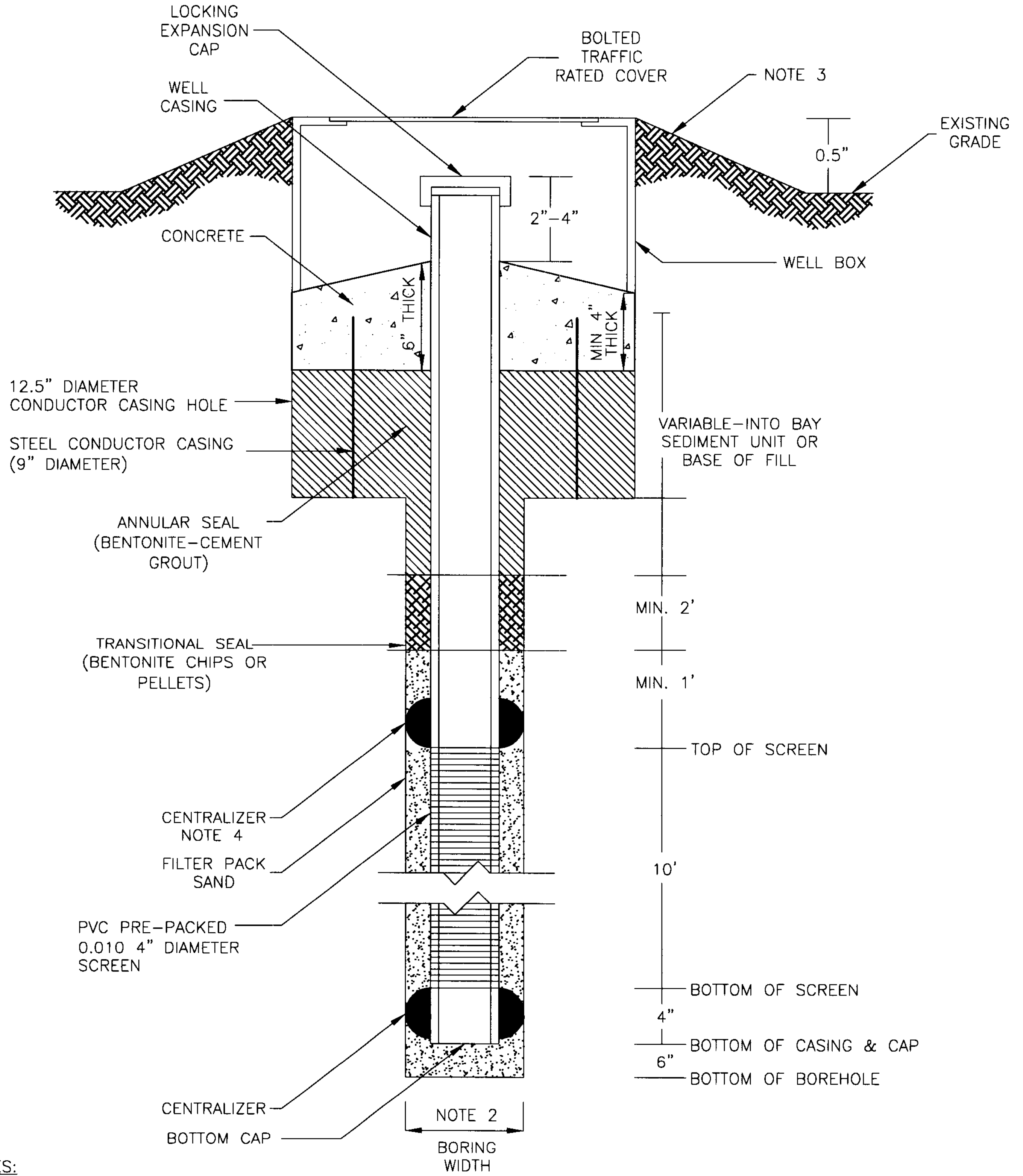
DRAFT FINAL DATA GAP SAMPLING WORK PLAN FOR OU-1, IR SITES 6,7,8 AND 16

FIGURE 5-6

SWBZ MONITORING WELL COMPLETION SCHEMATIC
ABOVEGROUND COMPLETION
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: KLD
FILE : 0012000156.DWG

TETRA TECH



NOTES:

1) DIAGRAM COMPRISED OF CALIFORNIA WELL STANDARDS 74-90 AND RESIDENT OFFICER IN CHARGE OF CONSTRUCTION RECOMMENDATIONS.

2) MINIMUM WELL BORING WIDTH 8" FOR 4" MONITORING WELLS.

3) FINISH WITH MATCHING MATERIALS OF EXISTING GRADE.

4) CENTRALIZERS WILL BE PLACED EVERY 10 FEET.

5) DIAGRAM NOT TO SCALE.

6) SLOT SIZE OF SCREEN AND FILTER PACK MAY VARY.

BASE REALIGNMENT AND CLOSURE PROGRAM MANAGEMENT OFFICE WEST SAN DIEGO, CA

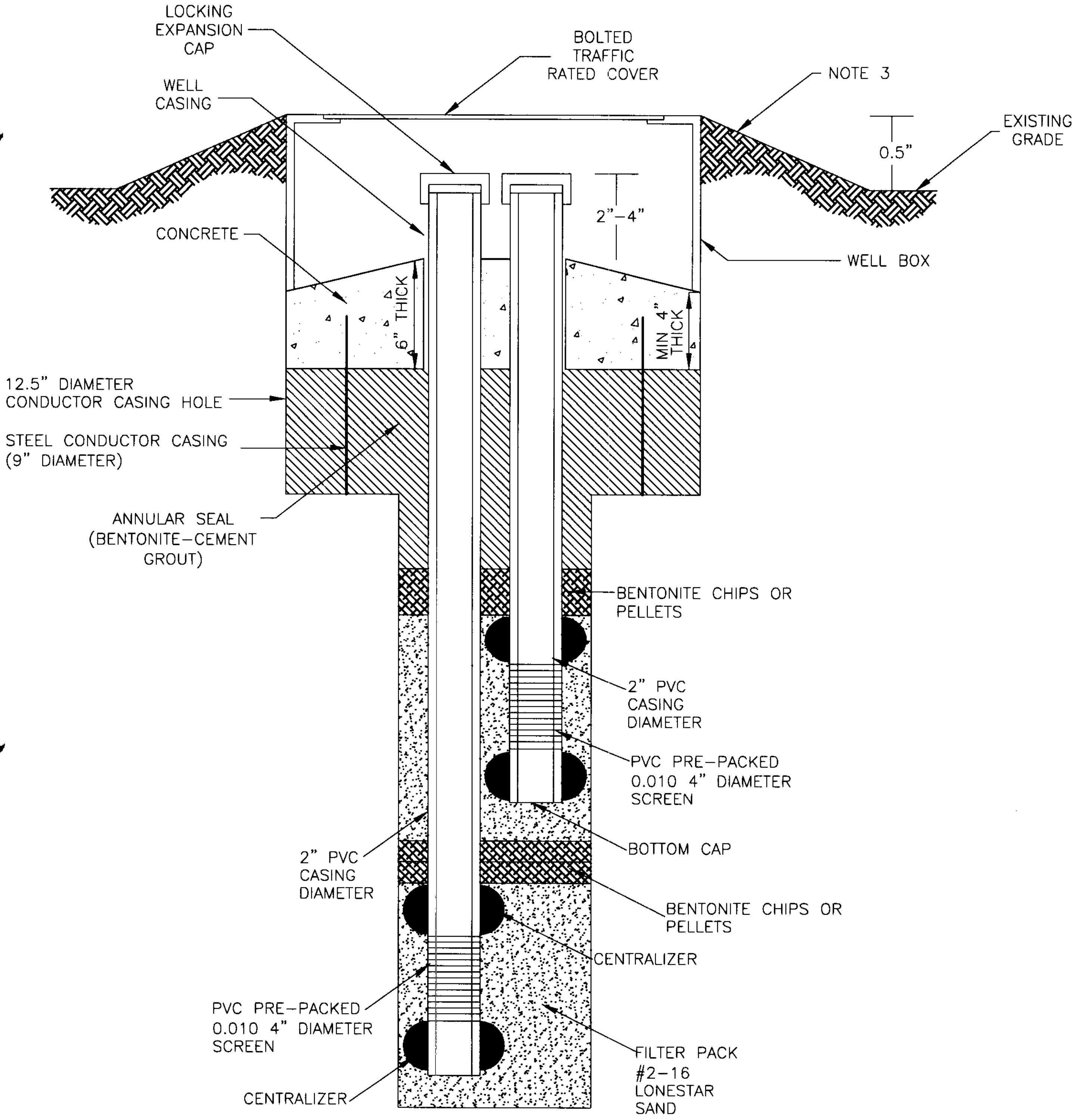
DRAFT FINAL DATA GAP SAMPLING WORK PLAN FOR OU-2A AND OU-2B

FIGURE 5-7

SWBZ MONITORING WELL COMPLETION SCHEMATIC FLUSH-MOUNT COMPLETION ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: KLD
FILE : 0012000157.DWG

TETRA TECH



NOTES:

1) DIAGRAM COMPRISED OF CALIFORNIA WELL STANDARDS 74-90 AND RESIDENT OFFICER IN CHARGE OF CONSTRUCTION RECOMMENDATIONS.

2) MINIMUM WELL BORING WIDTH 8" FOR 4" MONITORING WELLS.

3) FINISH WITH MATCHING MATERIALS OF EXISTING GRADE.

4) CENTRALIZERS WILL BE PLACED EVERY 10 FEET.

5) DIAGRAM NOT TO SCALE.

6) SLOT SIZE OF SCREEN AND FILTER PACK MAY VARY.

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

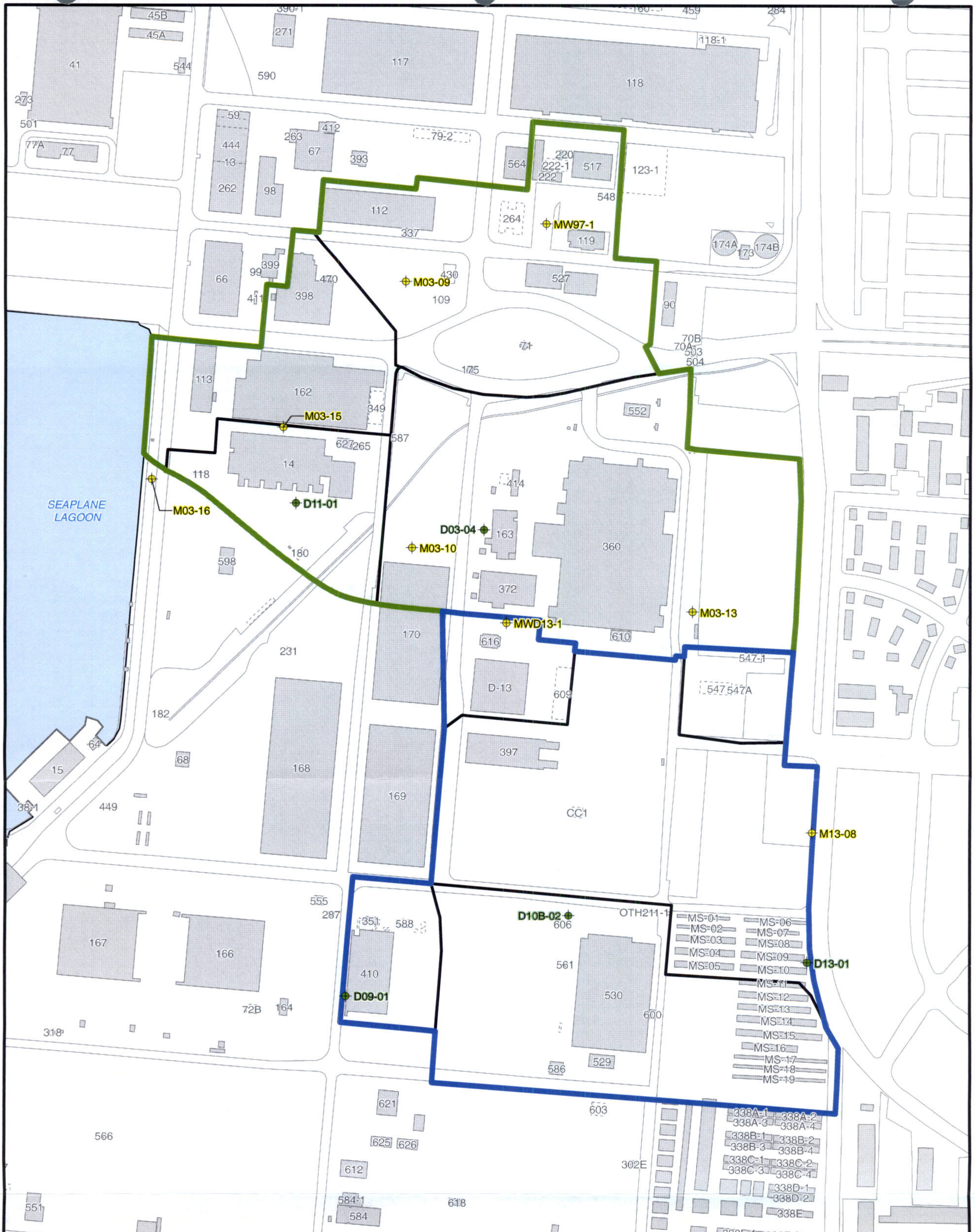
DRAFT FINAL DATA GAP SAMPLING WORK PLAN
FOR OU-2A AND OU-2B

FIGURE 5-8

NESTED SWBZ MONITORING WELL COMPLETION SCHEMATIC
FLUSH-MOUNT COMPLETION
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: KLD
FILE :0012000258.DWG

TETRA TECH EC, INC



LEGEND

M13-08 MONITORING WELL UPPER MERRITT (20-40 FEET)

D09-01 MONITORING WELL MERRITT (50-60 FEET)

ROAD

OPERABLE UNIT 2A

OPERABLE UNIT 2B

IR SITE

547A BUILDING AND BUILDING NUMBER

530 FORMER BUILDING AND BUILDING NUMBER

WATER

150 0 150 300 Feet

Scale: 1" = 300'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

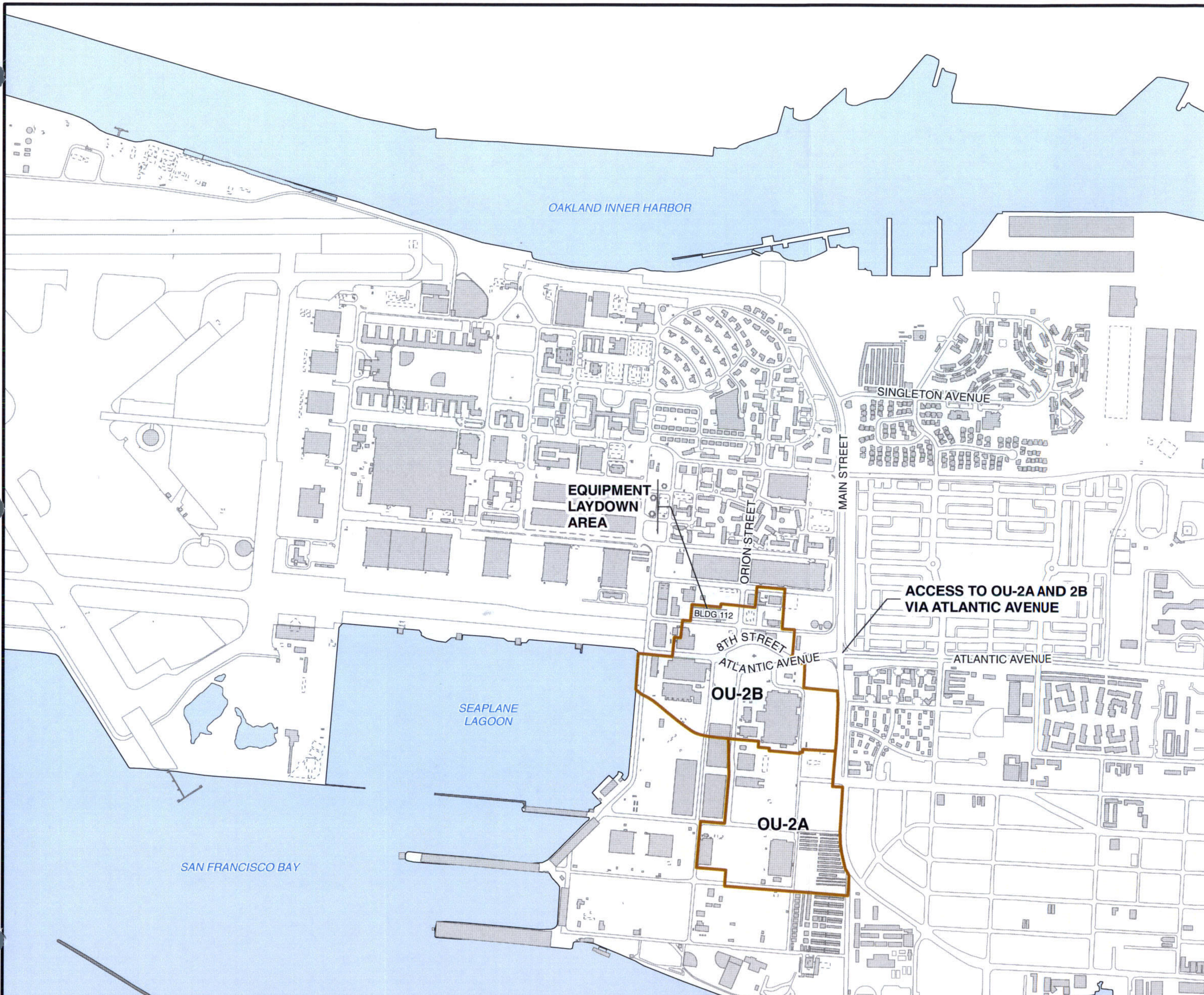
FIGURE 5-9

TIDAL STUDY OBSERVATION WELL LOCATION MAP

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1727.mxd

TETRA TECH EC, INC.



LEGEND

ROAD/RUNWAY

OU-2A SITE BOUNDARY AND SITE NUMBER

BUILDING

FORMER BUILDING

WATER

NOTE:

OU - OPERABLE UNIT

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

DRAFT FINAL DATA GAP SAMPLING
WORK PLAN FOR OU-2A AND OU-2B

FIGURE 7-1

TRAFFIC CONTROL PLAN

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: RKH
FILE NUMBER: 071004L1666.mxd

TETRA TECH EC, INC.

APPENDIX A

SAMPLING AND ANALYSIS PLAN

This page intentionally left blank.

Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, California 92108-4310

CONTRACT NO. N62473-06-D-2201
CTO NO. 0012

APPENDIX A

FINAL

SAMPLING AND ANALYSIS PLAN
(Field Sampling Plan and Quality Assurance Project Plan)
October 11, 2007

DATA GAP SAMPLING
FOR OPERABLE UNITS 2A AND 2B
ALAMEDA POINT
ALAMEDA, CALIFORNIA

DCN: ECSD-2201-0012-0002.R1

TETRA TECH EC, INC.

1230 Columbia Street, Suite 750
San Diego, CA 92101-8536
(619) 234-8696

Gregory D. Joyce — 10·16·07

Gregory Joyce
Quality Control Program Manager — Date

Narciso Allon Ancog — 10/17/2007

Narciso A. Ancog
NAVFAC SW Quality Assurance Officer — Date

ELEMENTS OF THE UFP-QAPP AND EPA QA/R-5 IN RELATION TO THIS SAP

UFP-QAPP Worksheet	EPA QA/R-5	This SAP	Variance from UFP-QAPP
#1 Title and Approval Page	A1. Title and Approval Sheet	Title and Approval Page	None
#2 QAPP Identifying Information	N/A	Section 1.3 and 3.1, Table A.1-1 and A.2-1, Work Plan Sections 2.1 through 2.7	None
#3 Distribution List	A3. Distribution List	Distribution List	None
#4 Project Personnel Sign-Off Sheet	N/A	Project Personnel Sign-Off Sheet	None
#5 Project Organization Chart	A4. Project Task/Organization	Figure A.2-1	None
#6 Communication Pathways	N/A	Table A.2-2	None
#7 Personnel Responsibilities and Qualifications Table	A4. Project/Task Organization	Table A.2-1	None
#8 Special Personnel Training Requirements Table	A8. Special Training/Certification	Table A.2-4, Section 2.2	None
#9 Project Scoping Sessions Participants Sheet	N/A	N/A	Sign-in sheets and meeting minutes of scoping sessions are maintained in the Navy Project file.
#10 Problem Definition	A5. Problem Definition/Background A6. Project/Task Description	Table A.3-1 and Section 3.2	None
#11 Project Quality Objectives/Systematic Planning Process Statements	A7. Quality Objectives and Criteria	Sections 1.1, 1.2, 2.2, 5.0, 6.3, 7.2, 8.0 and Tables A.5-1, A.7-1, A.7-2, A.8-1 and A.8-2	None
#12 Measurement Performance Criteria Table	B5. Quality Control	Table A.7-4	None
#13 Secondary Data Criteria and Limitations Table	N/A	None	Secondary data will not be used in conjunction with this project.

ELEMENTS OF THE UFP-QAPP AND EPA QA/R-5 IN RELATION TO THIS SAP

UFP-QAPP Worksheet	EPA QA/R-5	This SAP	Variance from UFP-QAPP
#14 Summary of Project Tasks	A6. Project/Task Description	Sections 4.0, 5.0, 6.3, 7.0, 8.0, and 9.0	None
#15 Reference Limits and Evaluation Table	N/A	Tables A.7-1, and A.7-2	None
#16 Project Schedule/Timeline Table	N/A	Figure 1-3 of the Work Plan	None
#17 Sampling Design and Rationale	B1. Sample Process Design	Table A.3-1, Section 5.0	None
#18 Sampling Locations and Methods/SOP Requirement Table	N/A	Tables A.5-1 and A.5-2	None
#19 Analytical SOP Requirement Table	N/A	Table A.6-2	None
#20 Field Quality Control Sample Summary Table	B5. Quality Control	Table A.7-5	None
#21 Project Sampling SOP Reference Table	B2. Sampling Methods	Section 6.3	None
#22 Field Equipment Calibration, Maintenance, Testing, and Inspection Table	B6. Instrument/Equipment Testing, Inspection, and Maintenance B7. Instrument/Equipment Calibration and Frequency	Table A.6-1	None
#23 Analytical SOP Reference Table	B4. Analytical Methods	Not Included	Laboratory to be used has not been identified. Information will be provided with laboratory analytical data package.
#24 Analytical Instrument Calibration Table	N/A	Section 7.1.4.1	None

ELEMENTS OF THE UFP-QAPP AND EPA QA/R-5 IN RELATION TO THIS SAP

UFP-QAPP Worksheet	EPA QA/R-5	This SAP	Variance from UFP-QAPP
#25 Analytical Instrument and Equipment, Maintenance, Testing, and Inspection Table	N/A	Not included	Laboratory to be used has not been identified. Information on analytical instruments will be in accordance with laboratories QA plan as described in Section 7.1.5.
#26 Sampling Handling System	B3. Sample Handling and Custody	Section 6.6	None
#27 Sample Custody Requirements	B3. Sample Handling and Custody	Section 4.1.4 and 7.1.2	None
#28 QC Samples Table	B5. Quality Control	Section 7.1.4, Table A.7-3	None
#29 Project Documents and Records Table	A9. Project Documents and Records	Table A.4-1	None
#30 Analytical Services Table	N/A	Not included.	Laboratory has not been identified. However, analytical data package turnaround time is identified in Section 8.1.2.
#31 Planned Project Assessment Table	C1. Assessment and Response Actions	Table A.9-1	None
#32 Assessment Findings and Response Actions	C1. Assessment and Response Actions	Table A.9-2	None
#33 QA Management Reports Table	C2. Reports to Management	Table A.9-3	None
#34 Sampling and Analysis Verification (Step 1) Process Table	D1. Data Review, Verification, and Validation D2. Verification and Validation Methods	Table A.8-1	None
#35 Sampling and Analysis Validation (Steps 2a and 2b) Process Table	D1. Data Review, Verification, and Validation	Table A.8-2	None

ELEMENTS OF THE UFP-QAPP AND EPA QA/R-5 IN RELATION TO THIS SAP

UFP-QAPP Worksheet	EPA QA/R-5	This SAP	Variance from UFP-QAPP
#36 Sampling and Analysis Validation (Steps 2a and 2b) Summary Table	D1. Data Review, Verification, and Validation	Section 8.2	None
#37 Data Usability Assessment	D3. Reconciliation with User Requirements	Section 8.2, Tables A.7-1, A.7-4, and A.7-5	None

I certify that this SAP is in compliance with the latest version of the UFP-QAPP and the EPA QA/R-5

Gregory Joyce　　Lisa A. Binkowski for　　08/23/07

PRINT NAME (Quality Control Program Manager)　　SIGNATURE　　DATE

DISTRIBUTION LIST

(UFP-QAPP Worksheet #3)

This document will be distributed to the project participants listed below once all approval signatures have been received.

SAP Recipients	Title	Organization	Telephone Number	E-mail Address
Steve Peck, P.E.	Remedial Project Manager	BRAC	(619) 532-0786	steve.peck@navy.mil
Mr. Thomas Macchiarella	BRAC Environmental Coordinator	BRAC	(619) 532-0923	thomas.macchiarella@navy.mil
Mr. Kofi Asante-Duah	Remedial Technical Manager	BRAC	(619) 532-0792	kofi.asante-duah@navy.mil
Mr. Narciso Ancog	Quality Assurance Officer	NAVFAC SW	(619) 532-3046	narciso.ancog@navy.mil
Ms. Diane Silva	Administrative Record Manager	NAVFAC SW	(619) 532-3676	diane.silva@navy.mil
Mr. Gregory Grace	Resident Officer in Charge of Construction	Navy	(510) 749-5940	gregory.grace@navy.mil
Mr. Doug DeLong	Caretaker Site Office	Navy	(415) 743-4713	douglas.delong@navy.mil
Ms. Anna Marie Cook	EPA – Remedial Project Manager	EPA Region 9	(415) 972 3141	cook.anna-marie@epamail.epa.gov
Mr. Erich Simon	Remedial Project Manager	RWQCB	(510) 622-2355	ERSimon@waterboards.ca.gov
Ms. Dot Lofstrom	Geologist	DTSC	(916) 255-6449	dlofstro@dtsc.ca.gov
Craig Hunter, Ph.D.	Alameda Point Installation Coordinator	TtEMI	(916) 853-4507	craig.hunter@ttemi.com
Mr. George Humphreys	Co-Chair	Restoration Advisory Board	(510) 521-2380	None
Ms. Debbie Potter	Base Reuse and Redevelopment Manager	City of Alameda, ARRA	(510) 749-5833	dpotter@ci.alameda.ca.us
Mr. Peter Russell	Consultant	Russell Resources	(415) 492-0540	peter@russellresources.com

DISTRIBUTION LIST

(UFP-QAPP Worksheet #3)

SAP Recipients	Title	Organization	Telephone Number	E-mail Address
Mr. Pete Everds	Project Manager	TtEC	(619) 471-3504	pete.everds@tteci.com
Mr Gregory Joyce	Quality Control Program Manager	TtEC	(360) 598-8117	greg.joyce@tteci.com
Ms. Lisa A. Bienkowski	Program Chemist	TtEC	(949) 756-7592	lisa.bienkowski@tteci.com

PROJECT PERSONNEL SIGN-OFF SHEET
(UFP-QAPP Worksheet #4)

I have read and understand this SAP and will perform the tasks as described.

Project Personnel	Organization	Title	Signature	Date SAP Reviewed
Mr. Pete Everds	TtEC	Project Manager		
Ms. Diane Suzuki	TtEC	Project Chemist		
Ms. Lisa A. Bienkowski	TtEC	Program Chemist		
Mr. Gregory Joyce	TtEC	Quality Control Program Manager		

Abbreviations and Acronyms:

SAP – Sampling and Analysis Plan
TtEC – Tetra Tech EC, Inc.

This page intentionally left blank.

TABLE OF CONTENTS

PAGE

TABLE OF CONTENTS
(Continued)

PAGE

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

PAGE

LIST OF TABLES

LIST OF FIGURES

ATTACHMENTS

ABBREVIATIONS AND ACRONYMS

°C	degree Celsius
%R	percent recovery
AOC	area of concern
AST	aboveground storage tank
ASTM	American Society of Testing Materials
bgs	below ground surface
BRAC	Base Realignment and Closure
BSU	Bay Sediment Unit
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CAS	Chemical Abstract Service
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminants of concern
CoC	chain-of-custody
CPT	cone penetrometer testing
CSM	Conceptual Site Model
CTO	Contract Task Order
DCA	dichloroethane
DHS	Department of Health Services
DO	dissolved oxygen
DoD	Department of Defense
DoN	Department of the Navy
DPT	direct-push technology
DQA	data quality assessment
DQI	data quality indicators
DQO	data quality objective
DTSC	Department of Toxic Substances Control
EBAC	eubacteria
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
ER	equipment rinsate

ABBREVIATIONS AND ACRONYMS
(Continued)

EWI	Environmental Work Instruction
FCR	Field Change Request
FD	field duplicate
FID	flame ionization detector
FWBZ	first water-bearing zone
GAP	generator accumulation point
GC/MS	gas chromatograph/mass spectrometer
GPR	ground-penetrating radar
GPS	global positioning system
GSDS	groundwater sampling data sheet
HCl	hydrochloric acid
HDPE	high-density polyethylene
HNO_3	nitric acid
H&S	health and safety
ICAL	initial calibration
ICP-AES	inductively coupled plasma atomic emission spectroscopy
ICV	initial calibration verification
ID	identification
IDW	investigation-derived waste
IR	Installation Restoration
IRCDQM	Navy Installation Resotration Chemical Data Quality Manual
L	liter
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
MCL	maximum contaminant level
MDL	method detection limit
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MGN	methanogens

ABBREVIATIONS AND ACRONYMS
(Continued)

mL	milliliter
mL/min	milliliters per minute
MS	matrix spike
MSA	Method of Standard Addition
MSD	matrix spike duplicate
MTBE	methyl tert-butyl ether
N/A	not applicable
NAD	North American Datum
NADEP	Naval Aviation Depot
NAS	Naval Air Station
NAVD	North American Vertical Datum
NAVFAC SW	Naval Facilities Engineering Command, Southwest
NE	none established
NEDD	Navy electronic data deliverable
NFESC	Naval Facilities Engineering Service Center
ng/kg	nanogram per kilogram
NIST	National Institute for Standards and Testing
NTU	Nephelometric Turbidity Unit
ORP	oxidation/reduction potential
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
OWS	oil-water separator
PAH	polynuclear aromatic hydrocarbons
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
pH	measure of hydrogen ion activity
PjM	Project Manager
PID	photoionization detector
PLFA	phospholipids fatty acids
PPE	personal protection equipment

ABBREVIATIONS AND ACRONYMS
(Continued)

PQCM	Project Quality Control Manager
PRG	preliminary remediation goal
PVC	polyvinyl chloride
Q-PCR	quantitative polymerase chain reaction
QA	quality assurance
QAO	Quality Assurance Officer
QC	quality control
QCM	Quality Control Program Manager
QL	quantitation limit
QSM	Quality Systems Manual
R	rejected
RA	remedial action
RD	Remedial Design
RI	Remediation Investigation
RPD	relative percent difference
RPM	Remedial Project Manager
RWQCB	Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SDG	sample delivery group
SHSP	Site Health and Safety Plan
SIM	Selective Ion Monitoring
SOP	Standard Operating Procedure
STLC	Soluble Threshold Limit Concentration
SVOC	semi-volatile organic compound
SWBZ	second water bearing zone
SWDIV	Southwest Division Naval Facilities Engineering Command
SWMU	Solid Waste Management Unit
TAT	turnaround time
TBD	to be determined
TCLP	Toxicity Characteristic Leaching Procedure
TKN	total kjedhal nitrogen

ABBREVIATIONS AND ACRONYMS
(Continued)

TOC	total organic carbons
TPH	total petroleum hydrocarbons
TtEC	Tetra Tech EC, Inc.
TTLC	total threshold limit concentration
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plans
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USCS	Unified Soil Classification System
UST	underground storage tank
VOA	volatile organic analysis
VOC	volatile organic compound

This page intentionally left blank.

1.0 INTRODUCTION

This project-specific Sampling and Analysis Plan (SAP) has been prepared by Tetra Tech EC, Inc. (TtEC) on behalf of the Department of the Navy's (DoN's) Base Realignment and Closure (BRAC) Program Management Office West. This project will be conducted under Remedial Action Contract No. N62473-06-D-2201, Contract Task Order (CTO) No. 0012.

The purpose of this SAP is to provide guidance on sampling, analysis, and quality assurance (QA) developed to acquire the data necessary to support the remedial design for Operable Unit (OU) -2A and OU-2B located on the former Naval Air Station (NAS) Alameda on Alameda Point, California. During this project, soil and groundwater samples will be collected to provide supplemental information on the nature and extent of contamination, aquifer properties, and natural attenuation parameters prior to preparing the remedial design.

Site boundaries for OU-2A and OU-2B are shown on Figure 1-2 of the Work Plan. OU-2A is composed of Alameda Point Sites 9, 13, 19, 22, and 23. OU-2B is composed of Alameda Point Sites 3, 4, 11, and 21. During this program, soil and groundwater samples will be collected to provide supplemental information on the nature and extent of contamination, aquifer properties, and natural attenuation parameters prior to preparing the remedial design. Data gaps and Solid Waste Management Units (SWMUs) identified as a result of the remedial investigations (RIs) conducted for OU-2A and OU-2B (SulTech, 2005a, b) served as the basis for the locations that require further characterization.

This SAP will be used as a reference document by all field and laboratory personnel engaged in the sampling and analysis for this project. This document will be provided to individuals listed in the distribution list. Included in this SAP are data quality objectives (DQOs), field sampling procedures, QA/quality control (QC) requirements, and data gathering methods that will be used during this project. This SAP is prepared in accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP)* (U.S. Environmental Protection Agency [EPA], 2005) and *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5* (EPA, 2006a).

1.1 OBJECTIVES

The objectives of this SAP are to: (1) provide guidance for the field sampling activities; (2) describe field sampling procedures; (3) describe data gathering, handling, and documentation methods; and (4) define QA/QC measures to meet DQOs established for this project.

The objective of this project is to facilitate preparation of the remedial design/remedial action (RD/RA) work plan by collecting supplemental information that will fill the data gaps identified in the RIs for each OU (SulTech, 2005a, b), as well as collecting the necessary parameters to support remedial design activities. The information collected during this program will facilitate the following:

- Investigate soil and groundwater adjacent to individual SWMUs located at OU-2A and OU-2B identified for further action under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).
- Refine the nature and extent of soil contamination at OU-2A and OU-2B that was identified as a result of previous investigations.
- Refine the lateral and vertical extent of contaminant plumes in groundwater at each OU and determine aquifer parameters at these sites, including groundwater flow direction within the first and second water-bearing zones (FWBZ and SWBZ, respectively).

Activities associated with sampling and analysis for this project will include the following:

- Utility clearance prior to intrusive activities
- Hand auger and direct push technology (DPT) borings for soil sampling
- Cone penetrometer testing (CPT) borings for characterization of lithology
- Soil and discrete groundwater sampling (Hydropunch®)
- Groundwater monitoring well installation and development
- Groundwater monitoring well sampling
- Laboratory analysis of soil and groundwater
- Location and elevation survey of sampling locations

1.2 SCREENING CRITERIA

The analytical results of soil sampling for the chemicals of concern (COCs) for each site will be compared to residential preliminary remediation goals (PRGs) (EPA, 2004) or site-specific background concentrations. Groundwater results will be compared to maximum contaminant levels (MCLs) (Department of Health Services [DHS], 2003).

1.3 REGULATORY OVERSIGHT

The DoN is the lead agency responsible for the project, and the EPA Region 9, California Department of Toxic Substances Control (DTSC), and the California Regional Water Quality Control Board (RWQCB) will provide regulatory oversight.

2.0 PROJECT ORGANIZATION AND TRAINING REQUIREMENTS

This section describes project organization, communication pathways that will be used, and general and specialized training requirements.

2.1 PROJECT ORGANIZATION

Key personnel from DoN and TtEC who are responsible for the oversight and/or implementation of the proposed field activities include the Naval Facilities Engineering Command, Southwest (NAVFAC SW) Quality Assurance Officer (QAO), NAVFAC SW Remedial Project Manager (RPM), Project Manager (PjM), Technical Lead, Project Geologist, Quality Control Program Manager (QCM), Program Chemist, Project Chemist, and Data Manager. Responsibilities of each of the key personnel are listed in Table A.2-1. In addition, the project organization chart shown in Figure A.2-1 provides lines of responsibility and communication.

Table A.2-2 describes the communication pathways and modes of communication that will be used during the project. These pathways include obtaining approval between project personnel, subcontractors, and DoN.

2.2 TRAINING REQUIREMENT

Project personnel are required to meet the Occupational Safety and Health Administration (OSHA) training requirements defined in Title 29 Code of Federal Regulations (29 CFR, Part 1910.120[e]). These requirements include 40 hours of formal off-site instruction, a minimum of 3 days of actual on-site field experience under the supervision of a trained and experienced field supervisor, and 8 hours of annual refresher training.

Before work begins, project personnel will receive site-specific training that thoroughly covers the following areas:

- Names of personnel and alternates responsible for health and safety at the project site
- Health and safety hazards present on site
- Selection of the appropriate personal protection levels
- Correct use of personal protection equipment (PPE)
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment on site
- Medical surveillance requirements, including recognition of symptoms and signs that might indicate over-exposure to hazardous substances

The project files will include copies of health and safety training records, including course completion certifications for the initial and refresher health and safety training, specialized supervisor training, and first aid and Cardiopulmonary Resuscitation training.

In addition to the health and safety (H&S) training, the samplers will be provided with the following training:

- Soil, sediment, debris, and/or water sampling as applicable to the project
- Sample handling, packaging, and shipping
- Use of related field equipment
- Handling of investigation-derived waste (IDW)

All training will be documented and training records will be maintained in the project file. Sampling personnel will be required to read and understand the SAP prior to any sample collection activities. The project personnel sign-off sheet will be signed by any on-site personnel conducting sampling to indicate that they have read the SAP and will perform the tasks as described. The sign-off sheet will be maintained in the project file.

2.2.1 Specialized Training

In addition to the general training described above, the sampler(s) must received specialized training as listed in Table A.2-3.

TABLE A.2-1

PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS

(UFP-QAPP Worksheet #7)

Name	Title	Organizational Affiliation	Responsibilities
Mr. Narciso Ancog	Quality Assurance Officer	NAVFAC SW	Reviewing and approving this Sampling and Analysis Plan Providing the DoN oversight of TtEC's Quality Assurance Program Providing technical and administrative oversight of TtEC's surveillance audit activities Acting as point of contact for matters concerning quality assurance and the DoN's Laboratory Quality Assurance Program Coordinating training on matters pertaining to generation and maintenance of quality of data Authorizing the suspension of project execution if quality assurance requirements are not adequately followed
Steve Peck, P.E.	Remedial Project Manager	BRAC	Performing project management for the DoN Ensuring that the project scope of work requirements are fulfilled Overseeing the project cost and schedule Providing formal technical direction to the TtEC project team, as needed Acting as lead interface with agencies
Mr. Pete Everds	Project Manager	TtEC	Coordinating work activities of subcontractors and TtEC personnel and ensuring that all personnel adhere to the administrative and technical requirements of the project Monitoring and reporting the progress of work and ensuring that the project deliverables are completed on time and within project budget Monitoring the budget and schedule and notifying the client and the RPM of any changes that may require administration actions Ensuring adherence to the quality requirements of the contract, project scope of work, and the QC Plans

TABLE A.2-1

PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS

(UFP-QAPP Worksheet #7)

Name	Title	Organizational Affiliation	Responsibilities
			Ensuring that all work meets the requirements of the technical specifications and complies with applicable codes and regulations Ensuring that all work activities are conducted in a safe manner in accordance with the Site Health and Safety Plan (SHSP), USACE's *Safety and Health Requirements* (EM-385-1-1), and all applicable OSHA regulations Serving as the primary contact between the DoN and TtEC for actions and information related to the work and including appropriate TtEC technical personnel in the decision-making Coordinating satisfactory resolution and completion of evaluation and acceptance report for nonconformance reports
Marianne Binkin, PG	Technical Lead	TtEC	Ensuring that all technical work meets the requirements of the technical specifications and complies with applicable codes and regulations Ensuring that all work is conducted in accordance with the Work Plan
Mr. Bryan Graham	Project Geologist	TtEC	Ensuring that all fieldwork is conducted in accordance with the Work Plan, SAP, and QC plans, Providing direction to field staff and subcontractors Reporting field information to Project Manager, Project Chemist, and Technical Lead
Mr. Gregory Joyce	Quality Control Program Manager	TtEC	Establishing and maintaining the Quality Program Overseeing program QC, including construction and chemical data acquisition Working directly with the PjM and the DoN to ensure implementation of the Program QC Plans Acting as a focal point for coordination for quality matters across all projects and resolving quality issues Suspending project activities if quality standards are not maintained

TABLE A.2-1

PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS

(UFP-QAPP Worksheet #7)

Name	Title	Organizational Affiliation	Responsibilities
			Interfacing with the DoN, including NAVFAV SW Quality Assurance Officer, on quality-related items Conducting field QC audits to ensure project plans are being followed Performing reviews of audit and surveillance reports conducted by others Implementing the DoN technical direction letters related to quality topics
Mr. Bill Ogle	Project Quality Control Manager	TtEC	Oversees overall implementation and project objectives at the site. Directly reports to Quality Control Program Manager
Ms. Lisa A. Bienkowski	Program Chemist	TtEC	Implementing contract requirements for chemical data collection Supporting projects as the technical lead for chemical data collection and analysis Ensuring Project Chemist has adequate training in sample collection and analytical methods Monitoring performance of subcontract laboratory and data validator
Ms. Diane Suzuki	Project Chemist	TtEC	Developing the SAP Ensuring that sampling personnel have documented training on sampling procedures for specific project requirements. Evaluating and selecting a qualified subcontract laboratory Performing audit of sample collection activities Reviewing laboratory data prior to use against requirements in this SAP Evaluating and selecting a qualified data validation subcontractor Reviewing data validation reports Preparing data quality assessment report to ensure the quality of the data meets the intended use of the data

TABLE A.2-1

PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS

(UFP-QAPP Worksheet #7)

Name	Title	Organizational Affiliation	Responsibilities
Mr. Jonathan Karnath	Data Manager	TtEC	Uploading field information and laboratory data into the database Checking all data for completeness (e.g., all required fields are entered) and providing output to the project team as requested in the format requested Submitting Navy electronic data deliverable (NEDD) formatted data to the DoN in accordance with the requirements set forth in *Environmental Work Instruction EVR.6, Environmental Data Management and Required Electronic Delivery Standards* (SWDIV, 2005)

Abbreviations and Acronyms:

BRAC – Base Realignment and Closure
DoN – Department of the Navy
NAVFAC SW – Naval Facilities Engineering Command, Southwest
NEDD – Navy electronic data deliverable
OSHA – Occupational Safety and Health Administration
PjM – Project Manager
QC – quality control
RPM – Remedial Project Manager
SAP – Sampling and Analysis Plan
SHSP – Site Health and Safety Plan
SWDIV – Southwest Division Naval Facilities Engineering Command
TtEC – Tetra Tech EC, Inc.
UFP-QAPP – Uniform Federal Policy for Quality Assurance Project Plans
USACE – United States Army Corps of Engineers

TABLE A.2-2

COMMUNICATION PATHWAYS

(UFP-QAPP Worksheet #6)

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure
SAP approval	NAVFAC SW QAO	Mr. Narciso Ancog	(619) 532-3046	NAVFAC SW QAO will review and approve SAP. Field sampling will not begin without an approved SAP.
DoN project management	BRAC RPM	Steve Peck, P.E.	(619) 532-0786	RPM will perform project management for the DoN by providing formal technical direction to the TtEC project team, as needed, and acting as the lead interface with agencies.
Project management	Project Manager	Mr. Pete Everds	(619) 471-3504	Project Manager will manage field and project personnel.
SAP review	Program Chemist or QCM	Ms. Lisa A. Bienkowski or Mr. Gregory Joyce	(949) 756-7592 or (360) 598-8117	SAP will be reviewed by Program Chemist or QCM prior to submittal to the NAVFAC SW QAO.
Technical oversight	Technical Lead	Marianne Binkin, PG	(619) 471-3543	Communication of relevant technical information to project manager and field team.
Coordination and communication of fieldwork activities related to sampling	Project Geologist	Mr.Bryan Graham	(425) 785-2685	Project Geologist will communicate relevant field information to the Project Manager and Project Chemist.
Coordination of laboratory supplies for field activities	Project Chemist	Ms. Diane Suzuki	(949) 756-7584	Project Chemist will contact the laboratory to provide all necessary sample containers and appropriate shipping materials (such as coolers and bubble wrap) to be delivered on site prior to commencement of field sampling activities and throughout the course of the project.
Submittal of samples to the laboratory	Sampling Personnel	TBD	TBD	Sampling personnel will package and ship samples in accordance with this SAP.

TABLE A.2-2

COMMUNICATION PATHWAYS

(UFP-QAPP Worksheet #6)

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure
Daily CoC reports and shipping documentation	Sampling Personnel	TBD	TBD	CoCs and shipping documentation will be submitted via fax or email to the Project Chemist at the end of each day that samples are collected.
Reporting laboratory data quality issues	Laboratory Project Manager	TBD	TBD	All QA/QC issues will be reported by the Laboratory Project Manager to the Project Chemist in writing within 2 business days.
Field and analytical corrective actions	Project Chemist	Ms. Diane Suzuki	(949) 756-7584	The Project Chemist will immediately notify the PQCM, QCM, and Program Chemist in writing of any field or analytical procedures that were not performed in accordance with this SAP. The Project Chemist, in coordination with the PQCM, will complete documentation of the non-conformance and corrective actions to be taken. The PQCM or Project Chemist will verify the corrective actions have been implemented.
Release of analytical data	Project Chemist	Ms. Diane Suzuki	(949) 756-7584	The Project Chemist will review faxed/emailed data to verify that data quality is met as described in this SAP prior to releasing the data. Analytical data will be released to the Project Manager (or their designee) after the Project Chemist has verified the data is in accordance with the SAP requirements.
SAP procedure revision during field activities	Project Chemist	Ms. Diane Suzuki	(949) 756-7584	The Project Chemist or their designee will prepare a FCR for any changes in sampling procedures that occur due to conditions in the field.

TABLE A.2-2

COMMUNICATION PATHWAYS

(UFP-QAPP Worksheet #6)

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure
SAP amendments	Project Chemist	Ms. Diane Suzuki	(949) 756-7584	Any changes to the SAP will require the Project Chemist prepare an addendum which will be approved by NAVFAC SW QAO prior to any field activities.

Abbreviations and Acronyms:

BRAC – Base Realignment and Closure
CoC – chain-of-custody
FCR – field change request
NAVFAC SW – Naval Facilities Engineering Command, Southwest
PQCM – Project Quality Control Manager
QA – quality assurance
QC – quality control
QCM – Quality Control Program Manager
RPM – Remedial Project Manager
SAP – Sampling and Analysis Plan
TBD – to be determined
UFR-QAPP – Uniform Federal Policy for Quality Assurance Project Plans

This page intentionally left blank.

TABLE A.2-3

SPECIAL PERSONNEL TRAINING REQUIREMENTS

(UFP-QAPP Worksheet #8)

Project Function	Specialized Training – Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Low-flow purging techniques	On-site demonstration of sampling technique	Project Chemist or their designee	Prior to sampling activities at the site	Sampling personnel	Sampling Technician/TtEC	Project File
VOA vial, dissolved metals, and En Core sampling	On-site demonstration of sampling technique	Project Chemist or their designee	Prior to sampling activities at the site	Sampling Personnel	Sampling Technician/TtEC	Project File
Sample handling, packaging, and documentation	On-site demonstration of sampling technique	Project Chemist or their designee	Prior to sampling activities at the site	Sampling personnel	Sampling Technician/TtEC	Project File

Abbreviations and Acronyms:

TtEC – Tetra Tech EC, Inc.
UFR-QAPP – Uniform Federal Policy for Quality Assurance Project Plans
VOA – volatile organic analysis

This page intentionally left blank.

3.0 PROJECT OVERVIEW

This section describes the project background, scope, and DQOs for this project.

3.1 BACKGROUND

Alameda Point is located on Alameda Island at the base of a gently sloping plain that extends from the Berkeley Hills on the east to the shore of the San Francisco Bay on the west. Originally a peninsula, Alameda Island was detached from the mainland in 1902 when a channel was cut linking San Leandro Bay to San Francisco Bay. A summary of historical use of Alameda Point and the former Alameda NAS is presented in Section 2.1 of the Work Plan.

Sites 9, 13, 19, 22, and 23 are designated as OU-2A under CERCLA and have been the subject of environmental investigations due to historical activities in the area, including aircraft repair and maintenance, operation of two service/fuel stations, storage of hazardous waste and chemicals, and storage and supply of fuels. These sites have been characterized with relatively low levels of contamination. Previous investigations have been conducted under the Installation Restoration (IR) Program and consist of data collection of soil, groundwater, and soil gas samples at and adjacent to Sites 9, 13, 19, 22, and 23.

Sites 3, 4, 11, and 21 are designated as OU-2B under CERCLA and have been the subject of environmental investigations due to historical documentation of petroleum, oil, and lubricant usage related to bulk fuel service, ship and aircraft maintenance and repair. Previous investigations have been conducted under the IR Program, and include collection of soil, groundwater, and soil gas samples at and adjacent to Sites 3, 4, 11, and 21.

3.2 SCOPE

Elements of the scope of work that will be implemented to meet the project objectives consist of the following types of sampling:

- Hand auger and DPT borings for soil investigation sampling
- Hydropunch® methods for groundwater investigation sampling
- Groundwater monitoring well sampling

3.3 DATA QUALITY OBJECTIVES

The DQOs specify the project objectives, the data collection boundaries and limitations, the most appropriate type of data to collect, and the level of decision error that will be acceptable for the decision. The quality and quantity of data required to implement environmental remedial action are also defined. The scope, level of detail, and verification for the design and planning documents may vary from project to project, depending on the project-specific conditions and the nature and complexity of the proposed activities. The project-specific DQOs, as defined through the seven-step process (EPA, 2006b), are as follows:

1. State the problem
2. Identify the goals of the study
3. Identify information inputs
4. Define the boundaries of the study
5. Develop the analytic approach
6. Specify performance or acceptance criteria
7. Develop the plan for obtaining data

DQOs are included in Table A.3-1.

TABLE A.3-1

DATA QUALITY OBJECTIVES

State the Problem	Identify the Goals of the Study	Identify Information Inputs	Define the Boundaries of the Study	Develop the Analytical Approach	Specify Performance or Acceptance Criteria	Develop the Plan for Obtaining Data
STEP 1	**STEP 2**	**STEP 3**	**STEP 4**	**STEP 5**	**STEP 6**	**STEP 7**
OU–2A AND -2B SWMU INVESTIGATIONS						
SWMUs (which include OWSs, ASTs, USTs, AOCs, and GAPs) have not been investigated previously at OU-2A and 2B. These SWMUs have been identified as a data gap by the Navy and the Agencies, and thus need to be investigated to determine if the SWMUs released contaminants to the environment and the extent of horizontal and vertical contamination. The SWMUs to be investigated are listed in Table A.5-1. The locations of the SWMUs are also shown on the figures supporting Section 3.0 of the Work Plan.	Have the SWMUs released COCs to the environment at concentrations greater than the screening criteria (Tables A.7-1 and A.7-2)? What is the horizontal and vertical extent of contamination?	Known/reported historic activity, as detailed in Section 2.0 of the Work Plan. Sample results obtained from the proposed data gap investigation. Analyses requested for each type of sample are listed in Table A.5-1. Analytical methods are listed in Table A.6-2.	The field geologist will determine the following regarding the condition and nature of the SWMU: • Are liquids present within the SWMU? • What are the dimensions of the SWMU? • Are cracks present in the surface, sides or base of the SWMU? • Where are influent and effluent piping locations for the SWMU? Prior to commencing sampling, as-builts, historic aerial photos, site inspection, and previous reports will be used to locate the SWMUs as required. Prior to sampling, the area will be cleared of debris and examined for visible signs of the former tank boundaries and any visible signs of leaks or spills (e.g., staining). The field geologist may bias the proposed boring locations to nearby areas of surface discoloration or cracks, if present. The proposed project schedule is presented in Figure 1-3 of the Work Plan.	If the COC concentrations in initial samples are less than the screening criteria (Tables A.7-1 and A.7-2), then the SWMUs have not leaked contaminants to the environment and no further investigation is required. Otherwise, the SWMUs have leaked contaminants to the environment and step-out/down sampling (as described in Sections 5.11 and 5.12) will be performed. If the COC concentrations in step-out/step-down samples (as described in Sections 5.11 and 5.12) are less than the screening criteria (Tables A.7-1 and A.7-2), then the horizontal and vertical extent has been defined and no further investigation is required. Otherwise, up to three more additional step-out/down locations (as described in Sections 5.11 and 5.12) will be sampled to define the horizontal and vertical extent of contamination.	Initial soil boring locations and sample depths will be selected where contaminants are most likely to be present based on the condition of each SWMU (Step 4). To limit decision errors, analytical method requirements and project-specific DQOs were established. Published analytical method and laboratory-specific performance requirements are the primary determiners of DQOs for precision and accuracy. The laboratory selected will be able to achieve project required quantitation limits, which are below screening criteria. Field crews will review the SAP before collection of samples, perform the tasks as described in the SAP, and sign off on the personnel sign-off sheet. Third–party data validation will be performed on all samples prior to usage, except waste characterization samples.	<u>The OWSs will be investigated as follows:</u> • If sufficient liquids are present, a sample of the liquid will be collected and the remaining liquid will be removed from the OWS. • If accessible, a boring will be placed through the base of the OWS. The initial soil sample will be retrieved from immediately below the bedding of the OWS, but no deeper than 1 ft below the bottom of the OWS and from the vadose zone. • A boring will be placed adjacent to each end of the OWS where influent and effluent piping is connected to the OWS. The initial sample from each piping area will be collected from approximately 0.5 ftft below the piping connection to the OWS. A second sample will be collected from the vadose zone. • If a crack in a sidewall of the OWS is observed, a soil sample will be collected adjacent to the base of the crack and from the vadose zone. • To obtain parameters necessary to support the remedial design, the field geologist will select one boring from each OWS that will be completed to the saturated soil in the FWBZ. The field geologist will select the location based on accessibility, condition of the OWS, and field conditions. The rationale behind the location selected will be recorded in the field logbook, and a saturated soil sample will be retrieved from this boring. • The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. <u>The location of former ASTs will be investigated as follows:</u> • If there are visible signs of staining, a soil boring will be placed at the location of the most obvious stained area for each concrete pad. • If no staining is apparent, then one boring will be placed beyond the edge of the concrete pad in the downgradient direction. • Initial soil samples will be retrieved from 1 ft bgs. A second soil sample will be collected from the vadose zone in each boring. • To obtain parameters necessary to support the remedial design, the field geologist will select one boring that will be completed to the saturated soil in the FWBZ. The field geologist will select the location based on accessibility, condition of the AST, and field conditions. The rationale behind the location selected will be recorded in the field logbook, and a saturated soil sample will be retrieved from this boring. • The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods. <u>The location of existing ASTs will be investigated according the following:</u> • One boring will be placed outside the edge of the secondary containment, on the downgradient side of the AST. The initial soil sample will be retrieved from 1 ft bgs. A second soil sample will be collected from the vadose zone. Additional borings may be placed at locations where visible signs of leaks or spills are observed. • To obtain parameters necessary to support the remedial design, one boring will be completed to

TABLE A.3-1

DATA QUALITY OBJECTIVES

State the Problem	Identify the Goals of the Study	Identify Information Inputs	Define the Boundaries of the Study	Develop the Analytical Approach	Specify Performance or Acceptance Criteria	Develop the Plan for Obtaining Data
STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6	STEP 7
						the saturated soil in the FWBZ. The field geologist will select the location based on accessibility, condition of the AST, and field conditions. The rationale behind the location selected will be recorded in the field logbook, and a saturated soil sample will be retrieved from this boring. • The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods. <u>AOC 372/SWMU 372 will be investigated as follows:</u> • If the location of the former UST remains in question, GPR will be used to locate the tank excavation. • Four borings will be placed at locations outside of the former UST excavation, one on each side. • Two borings will be placed within the area of the surface release if the location can be determined. • Initial soil samples will be collected from approximately 1 ft bgs. A second soil sample will be retrieved from the vadose zone in each boring to determine the vertical extent of soil contamination. • To obtain parameters necessary to support the remedial design, the field geologist will select one boring from the investigation area that will be completed to the saturated soil in the FWBZ. The field geologist will select the location based on accessibility, condition of the investigation area, and field conditions. The rationale behind the location selected will be recorded in the field logbook, and a saturated soil sample will be retrieved from this boring. • The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods. <u>UST 14-4 will be investigated as follows:</u> • If the location of the former UST remains in question, GPR will be used to locate the tank (if abandoned in place) or tank excavation. • One boring will be placed near the center of the excavation. Sampling will be initiated from the bottom of the excavation if it can be determined by the field geologist, but no deeper than 5 ft bgs or the water table, whichever is shallower. • To obtain parameters necessary to support the remedial design, the boring will be completed to the saturated soil in the FWBZ. A saturated soil sample will be retrieved from this boring. • The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods. <u>NADEP GAP 59 will be investigated as follows:</u> • One sample location will be biased towards areas of staining or cracks, if present. Otherwise, one boring will be advanced through the center of the GAP area. • The initial sample will be collected below any bedding material for the concrete or asphalt flooring, but no deeper than 1 ft below the concrete or asphalt flooring. A second soil sample will be retrieved from the vadose zone in each boring. • To obtain parameters necessary to support the remedial design, the boring will be completed to the saturated soil in the FWBZ.. A saturated soil sample will be retrieved from this boring. • The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

TABLE A.3-1

DATA QUALITY OBJECTIVES

State the Problem	Identify the Goals of the Study	Identify Information Inputs	Define the Boundaries of the Study	Develop the Analytical Approach	Specify Performance or Acceptance Criteria	Develop the Plan for Obtaining Data
STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6	STEP 7
						NAS GAP 11 will be investigated as follows: • One boring will be advanced through the bottom of the sump. The final sample location will be biased towards cracks, if present. • The initial sample will be collected below any bedding material for the concrete, but no deeper than 1 ft below the concrete floor. A second soil sample will be retrieved from the vadose zone. • To obtain parameters necessary to support the remedial design, the boring will be completed to the saturated soil in the FWBZ. A saturated soil sample will be retrieved from this boring. • The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods. NADEP GAP 44 will be investigated as follows: • One sample location will be biased towards areas of staining or cracks, if present. Otherwise, one boring will be advanced through the center of the exposed area. A second boring will be advanced at the other end of the GAP from the exposed area. • The initial samples will be collected below any bedding material for the concrete or asphalt flooring, but no deeper than 1 ft below the concrete or asphalt flooring. A second soil sample will be retrieved from the vadose zone in each boring. • To obtain parameters necessary to support the remedial design, the field geologist will select one boring from each GAP that will be completed to the saturated soil in the FWBZ. The field geologist will select the location based on accessibility, condition of the GAP, and field conditions. The rationale behind the location selected will be recorded in the field logbook, and a saturated soil sample will be retrieved from this boring. • The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods. NADEP GAP 76 will be investigated as follows: • The field geologist will retrieve a groundwater sample from a soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods. Detailed sampling design and approach for soil samples are presented in Section 5.0 of the SAP. Step-out and/or step-down sampling will be performed as described in Step 5

TABLE A.3-1

DATA QUALITY OBJECTIVES

State the Problem	Identify the Goals of the Study	Identify Information Inputs	Define the Boundaries of the Study	Develop the Analytical Approach	Specify Performance or Acceptance Criteria	Develop the Plan for Obtaining Data
STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6	STEP 7
OU-2A AND -2B SOIL DATA GAP INVESTIGATIONS						
Based on activities conducted in or around the Sites 9, 13, 19, 22, 3, 4, 11, and 21, previous investigations determined the sites were either impacted by COCs or that the site(s) had not been sampled to determine any impact. Further investigation is required to determine the impact to the soil and define the horizontal and vertical extent of soil contamination. The soil investigation areas are listed in Table A.5-1. The locations of the proposed soil investigations are also shown on the figures supporting Section 3.0 of the Work Plan.	What is the horizontal and vertical extent of contamination?	Known/reported historic activity, as detailed in Section 2.0 of the Work Plan. Sample results obtained from the proposed data gap investigation. Analyses requested for each type of sample are listed in Table A.5-1. Analytical methods are listed in Table A.6-2.	Aerial photos, as-builts, and differential GPS coordinates from current maps were used to locate footprint of each area. Prior to sampling, the area will be cleared of debris and examined for visible signs of visible signs of leaks or spills (e.g., staining). The proposed project schedule is presented in Figure 1-3 of the Work Plan.	If the COC concentrations in initial soil samples are less than the screening criteria (Table A.7-1), then vertical and horizontal extent of contamination has been defined and no further investigation is required. Otherwise, step-out sampling (as described in Section 5.11) will be performed. If the COC concentrations in step-out soil samples (as described in Section 5.11) are less than the screening criteria (Table A.7-1) then the horizontal and vertical extent has been defined and no further investigation is required. Otherwise, up to three more additional step-out locations (as described in Section 5.11) will be sampled to define the horizontal and vertical extent of contamination.	To limit decision errors, analytical method requirements and project-specific DQOs were established. Published analytical method and laboratory-specific performance requirements are the primary determiners of DQOs for precision and accuracy. The laboratory selected will be able to achieve project required quantitation limits, which are below screening criteria. Field crews will review the SAP before collection of samples, perform the tasks as described in the SAP, and sign-off on the personnel sign-off sheet. Third–party data validation will be performed on all samples prior to usage, except for waste characterization samples.	<u>Site 9 Wash Rack</u> • If there are cracks and/or open joints within the wash rack, soil borings will be placed at the locations of two of the most obvious cracks or open joints that could be a pathway to underlying soil. If there are no cracks and/or open joints, two soil borings will be placed within the former wash rack area, as shown on Figure 3-2. • A soil sample will be collected from each boring from immediately below the base of the bedding material used for construction of the wash rack flooring or a maximum of 1 ft below the bottom of the current wash rack flooring. A second soil sample will be collected from the vadose zone in each boring. <u>Site 13 Previous Borings B13-28 through B13-32, B13-41, and B-IMF-06 Soil Investigation:</u> • Three soil borings each will be completed in a triangular placement approximately 10 ft from each of the following previous borings: B13-30, B13-31, B13-32, and B13-41. A total of 12 borings will be installed. For each of the proposed borings, initial soil samples will be collected at a depth of 0.5 to 1 ft bgs in unpaved areas, or where paved, the bottom of the bedding material used for construction of the pavement or a maximum of 1 ft below the bottom of the pavement. A second soil sample will be collected from the vadose zone in each boring. • Previous borings B13-28 and B13-29 are in close proximity to each other. A total of three borings will be completed in a triangular placement approximately 10 ft from the locations of these borings. For each of the proposed borings, initial soil samples will be collected at a depth of 0.5 to 1 ft bgs in unpaved areas, or where paved, the bottom of the bedding material used for construction of the pavement or a maximum of 1 ft below the bottom of the pavement. A second soil sample will be collected from the vadose zone in each boring. • One boring will be placed immediately adjacent to previous boring B-IMP-06. A sample will be retrieved from approximately 5 ft bgs in this boring, or immediately above the vadose zone, which ever is shallower. • For each of the proposed borings, initial soil samples will be collected at a depth of 0.5 to 1 ft bgs in unpaved areas, or where paved, the bottom of the bedding material used for construction of the pavement or a maximum of 1 ft below the bottom of the pavement. A second soil sample will be collected from the vadose zone in each boring. <u>Site 13 Incinerator Soil Investigation:</u> • The investigation area comprises approximately 79,200 ft^2. Soil borings will be placed throughout the former yard on 75-ft centers, resulting in 15 borings. • The field geologist may bias the placement of borings to areas exhibiting surface discoloration or cracks. The rationale behind placement of the borings will be recorded in the field logbook. • At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs. A second soil sample will be retrieved from the vadose zone in each boring. <u>Site 19 Yard D-13 Soil Investigation:</u> • The investigation area comprises approximately 26,400 ft^2. Soil borings will be placed throughout the former yard on 50-ft centers, resulting in nine borings.

TABLE A.3-1

DATA QUALITY OBJECTIVES

State the Problem	Identify the Goals of the Study	Identify Information Inputs	Define the Boundaries of the Study	Develop the Analytical Approach	Specify Performance or Acceptance Criteria	Develop the Plan for Obtaining Data
STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6	STEP 7
						• The field geologist may bias the placement of borings to areas exhibiting surface discoloration or cracks. The rationale behind placement of the borings will be recorded in the field logbook. • At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in each boring. Site 22 Previous Borings MW-547-5, 547-6, and 547-11 Lead Soil Investigation: • Three soil borings will be placed in a triangular pattern approximately 10 ft from the following previous boring MW-547-5. Soil will be collected from 0.5 to 1 ft bgs in each boring. Deeper samples are not necessary, as historical results have determined the vertical extent of contamination. • Three soil borings each will be placed in a triangular pattern approximately 10 ft from each of the previous borings: 547-11 and 547-06. Soil will be collected from 0.5 to 1 ft bgs in each boring. A second soil sample will be retrieved from the vadose zone in each boring to determine the vertical extent of soil contamination. Site 3 Building 112 Soil Investigation: • Two soil borings will be placed within Building 112 in the vicinity of the former carpentry shop identified as Target Area 1 in the EBS (EMR-West, 1994). Soil samples will be collected from each boring from just below the base of the building foundation. A second soil sample will be retrieved from the vadose zone in each boring to determine the vertical extent of soil contamination. • Aerial photographs, previous documents, and/or a field inspection will be performed to locate the former storage area outside Building 112. If thc area can be identified, a maximum of five initial soil borings will be placed in the area. Soil samples will be collected from each boring from the base of the bedding material that was used for the asphalt pavement, or from a maximum of 1 ft below the bottom of the pavement. • If further information is obtained to locate the area of the former zinc smelter, soil samples will be retrieved from this area. The number of samples will be determined by the field geologist based on the investigation area. The placement of soil borings will be biased to areas with staining, cracks, joints, and/or piping through the flooring around the zinc smelter, if present. The rationale behind placement of the borings will be recorded in the field logbook. Samples will be collected from below the base of the bedding material that was used for construction of the flooring, or from a maximum of 1 ft below the bottom of the current flooring. Site 4 Building 163 Soil Investigation: • Soil borings will be placed in Building 163A adjacent to the previous soil gas borings. • At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in each boring. Site 4 Building 372 PCB Soil Investigation: • Nine soil borings will be placed every 60 ft around the perimeter of the building, at a distance of about 5 ft from the outside of the building, as shown on Figure 3-14.

TABLE A.3-1

DATA QUALITY OBJECTIVES

State the Problem	Identify the Goals of the Study	Identify Information Inputs	Define the Boundaries of the Study	Develop the Analytical Approach	Specify Performance or Acceptance Criteria	Develop the Plan for Obtaining Data
STEP 1	**STEP 2**	**STEP 3**	**STEP 4**	**STEP 5**	**STEP 6**	**STEP 7**
						• Initial soil samples will be collected at the bottom of the bedding material that was used for construction of the current pavement or from a maximum of 1 ft below the bottom of the current pavement. A second soil sample will be retrieved from the vadose zone in each boring to determine the vertical extent of soil contamination. Site 4 Building 360 Soil Investigation: • Borings will be installed to define the horizontal extent of VOCs detected in previous samples collected from borings 143-SS-SS04 and 143-SS-SS05. As shown in Figure 3-14, three borings will be placed 10 ft from each storm drain to define the horizontal extent of VOC-impacted soil found at 5 ft bgs. • In addition, a soil sample will be collected from immediately above the saturated zone adjacent to each storm drain to define the vertical extent of contamination detected in the previous sample. Site 11 Building 118 Soil Investigation: • The investigation area comprises approximately 750 ft^2. Three borings will be placed in the footprint of the previous building, as shown in Figure 3-15. • The field geologist may bias the placement of borings to areas exhibiting surface discoloration or cracks. The rationale behind placement of the borings will be recorded in the field logbook. • At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in each boring. Site 11 Previous Boring M11-03 Lead in Soil Investigation: • Three initial sample locations will be placed in a triangular arrangement approximately 10 ft from previous boring M11-03 to define the horizontal extent of lead-impacted soil found at 0.3 to 0.8 ft bgs. Soil samples from these locations will be retrieved from about 0.5 ft bgs. • A soil boring will also be placed immediately adjacent to boring M11-03. A soil sample will be collected from 2.5 ft bgs to determine the vertical extent of lead contamination identified in the historical sample. Site 11 Building 265 Soil Investigation: • The investigation area comprises approximately 375 ft^2. Two soil borings will be placed in the footprint of the previous building, as shown in Figure 3-15. • The field geologist may bias the placement of borings to areas exhibiting surface discoloration or cracks. The rationale behind placement of the borings will be recorded in the field logbook. • At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in each boring. Site 11 Building 14 Soil Investigation: • One soil boring will be placed adjacent to a previous soil gas boring, in which elevated VOCs were indicated. • At the boring, an initial soil sample will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in the boring.

TABLE A.3-1

DATA QUALITY OBJECTIVES

State the Problem	Identify the Goals of the Study	Identify Information Inputs	Define the Boundaries of the Study	Develop the Analytical Approach	Specify Performance or Acceptance Criteria	Develop the Plan for Obtaining Data
STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6	STEP 7
						Site 21 Previous Boring 126-002-003 Lead Soil Investigation: • Two initial borings will be placed 10 ft from 126-002-003 to define the horizontal extent of lead-impacted soil found at 0.5 to 1 ft bgs. One boring will be placed southwest of 126-002-003 and one boring will be placed southeast of 126-002-003. To define the horizontal extent of contamination found in the previous boring, initial soil samples will be collected from about 0.5 to 1 ft bgs. • To define the vertical extent of lead-impacted soil, a third boring will be installed adjacent to previous boring 126-002-003. A soil sample will be retrieved from about 3 ft bgs in this boring. Site 21 Building 113 Soil Investigation: • One soil boring will be placed within Building 113 adjacent to the previous soil gas sample, which indicated the presence of elevated VOCs (113SG03). • An initial soil sample will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in the soil boring. Site 21 Buildings 162 and 398 Soil Investigation: • Soil sampling will be performed in Building 162 adjacent to 12 previous soil gas collection borings, as shown in Figure 3-16. • The mercury investigation area within Building 398 comprises approximately 28,900 ft^2. Borings will be placed on 75-ft centers, resulting in seven borings. • The investigation area between Building 398 and 399 comprises approximately 500 ft^2. Borings will be placed on 50-ft centers, resulting in three borings. • The field geologist may bias the placement of borings to areas exhibiting surface discoloration or cracks. The rationale behind placement of the borings will be recorded in the field logbook. • At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in each boring. Detailed sampling design and approach for soil samples are presented in Section 5.0 of the SAP. Step-out sampling will be performed as described in Step 5.
OU-2A and -2B GROUNDWATER DATA GAP INVESTIGATIONS						
Previous investigations have determined that groundwater at Sites 9, 13, 19, 22, and OU-2B Site-Wide has been impacted by COCs; however, further investigation is required to define the horizontal and vertical extent of the groundwater plumes. The groundwater	What is the horizontal and vertical extent of contamination?	Known/reported historic activity, as detailed in Section 2.0 of the Work Plan. Previous soil gas, soils, and groundwater sampling data collected for previous investigations, the RI, and on-going monitoring.	Approximate plume boundaries have been delineated using data from previous investigations and from the on-going basewide groundwater monitoring program for each groundwater investigation. The proposed project schedule is presented in Figure 1-3 of the Work	If the COC concentrations in the Hydropunch® samples and the quarterly groundwater monitoring samples are less than the screening criteria (Table A.7-2), the vertical and horizontal extent of COC contamination has been defined and no further investigation is required.	Initial sample locations have been selected based on interpreted COC groundwater isoconcentrations from previous sampling data. To limit decision errors, analytical method requirements and project-specific DQOs were established.	Site 9 Groundwater: • A tidal study for select monitoring wells. • Collection of groundwater samples in at least four locations adjacent to sewer lines. Locations were selected along bends or joints in the sewer lines that are located within the groundwater plume. • Collection of groundwater samples in at least five locations to delineate the extent of the groundwater plume. • Installation of at least two FWBZ groundwater monitoring wells. One monitoring well will be placed immediately downgradient of the plume based on recent groundwater flow direction. An additional monitoring well will be placed in the southeast corner of the plume, which contains

TABLE A.3-1

DATA QUALITY OBJECTIVES

State the Problem	Identify the Goals of the Study	Identify Information Inputs	Define the Boundaries of the Study	Develop the Analytical Approach	Specify Performance or Acceptance Criteria	Develop the Plan for Obtaining Data
STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6	STEP 7
investigations areas are listed in Table A.5-1. The locations of proposed groundwater investigations are also shown on the figures supporting Section 3.0 of the Work Plan.		Aquifer parameters, including groundwater flow direction(s) from previous investigations, and from on-going basewide groundwater monitoring. Sample results obtained from the proposed data gap investigation. Analyses requested for each type of sample are listed in Table A.5-1. Analytical methods are listed in Table A.6-2.	Plan.	Otherwise, step-out/down sampling (as described in Section 5.11) will be performed for the Hydropunch® samples and the Navy and the Agencies will be consulted to determine further action regarding the monitored groundwater wells. If the COC concentrations in step-out/down (as described in Section 5.11) samples are less than the screening criteria (Table A.7-2) then the horizontal and vertical extent has been defined and no further investigation is required. Otherwise, up to three more additional step-out/down locations (as described in Section 5.11) will be sampled to define the horizontal and vertical extent of contamination.	Published analytical method and laboratory-specific performance requirements are the primary determiners of DQOs for precision and accuracy. The laboratory selected will be able to achieve project required quantitation limits, which are below screening criteria. Field crews will review the SAP before collection of samples, perform the tasks as described in the SAP, and sign-off on the personnel sign-off sheet. Field measurement equipment will be calibrated at least daily according to manufactures specifications using current standards (as required). Third-party data validation will be performed on all samples prior to usage, except for waste characterization samples.	elevated concentrations of VOCs. • Installation of at least one SWBZ groundwater monitoring well located in the southeast corner of the plume to determine if elevated concentrations of VOCs in the FWBZ have impacted the SWBZ. • A slug test for newly installed monitoring wells. • Quarterly sampling of select groundwater monitoring wells at the site for one year. • One-time rebound sampling of chemical oxidation pilot test groundwater monitoring wells. <u>Site 13 Groundwater:</u> • A tidal study for select monitoring wells. • Collection of groundwater samples in at least four locations to further delineate the lateral and vertical extent of contaminants above MCLs • Installation of at least one FWBZ groundwater monitoring well downgradient of the southern edge of Plume 2, which contains elevated concentrations of benzene. • A slug test for the newly installed monitoring well. • Quarterly sampling of select groundwater monitoring wells at the site for one year. <u>Site 19 Groundwater:</u> • A tidal study for select monitoring wells. • Collection of groundwater samples in at least two locations to further delineate VOCs above the MCLs (upgradient and downgradient). • Installation of at least one FWBZ groundwater monitoring well downgradient of VOCs above the MCLs. • A slug test for the newly installed monitoring well. • Quarterly sampling of select groundwater monitoring wells at the site for one year. <u>OU-2B Site-Wide Groundwater:</u> • A tidal study for select monitoring wells. • Installation of 2 FWBZ groundwater monitoring wells. • Installation of 10 multi-level groundwater monitoring wells with completions at each of the 10 locations at 15-20 ft, 25-30 ft, 35-40ft, 45-50 ft and 55-60 ft bgs to define the vertical profile of the groundwater contamination. • Installation of 16 CPT/Hydropunchs with groundwater sampling at each of the 16 locations at 15-20 ft, 25-30 ft, 35-40ft, 45-50 ft and 55-60 ft bgs to define the horizontal and vertical profile of the groundwater contamination. • Collection of Hydropunch® samples at 6 six locations adjacent to sewers near Buildings 162 and 349. • A slug test for newly installed monitoring wells. • Quarterly sampling of select groundwater monitoring wells at the site for one year. • Detailed sampling design and approach for groundwater samples is presented in Section 5.0 of the SAP. Step-out/down sampling for the Hydropunch® locations will be performed as described in Step 5.

TABLE A.3-1

DATA QUALITY OBJECTIVES

Abbreviations and Acronyms:

bgs – below ground surface
COC – contaminants of concern
DQO – data quality objective
FWBZ – first water bearing zone
GPR – ground penetrating radar
GPS – global positioning system
OU – Operable Unit
OWS – oil-water separator
SAP – Sampling and Analysis Plan
SWBZ – second water bearing zone
SWMU – solid waste management unit
UST – underground storage tank

4.0 DOCUMENTATION AND RECORDS

This section discusses the types of documentation and records required for this project, and Table A.4-1 lists where the documentation and records will be maintained.

4.1 FIELD DOCUMENTATION

Field documentation associated with sampling activities includes logbooks, field forms, sample labels, chain-of-custodies (CoCs), supplies certification, sample shipping records, field surveillance reports, and Field Change Request (FCR) forms. These types are described in the following sections.

4.1.1 Logbooks

A permanently bound field logbook with consecutively numbered pages, used for sampling activities only, will be assigned to this project. All entries will be recorded in indelible black or blue ink. At the end of each workday, the logbook pages will be signed by the responsible sampler and any unused portions of the logbook pages will be crossed out, signed, and dated. If it is necessary to transfer the logbook to another person, the person relinquishing the logbook will sign and date the last page used and the person receiving the logbook will sign and date the next page to be used. At a minimum, the logbook will contain the following information:

- Project name and site location
- Date and time
- Personnel in attendance
- General weather information
- Work performed
- Field observations
- Sampling performed, including specifics such as location, type of sample, type of analyses, and sample identification
- Field analyses performed, including results, instrument checks, problems, and calibration records for field instruments
- Descriptions of deviations from this SAP
- Problems encountered and corrective action taken
- Identification of field QC samples
- QC activities

- Verbal or written instructions
- Any other events that may affect the samples

4.1.2 Field Forms

In addition to field logbooks, on-site personnel will use the following forms: (1) boring logs for DPT borings; (2) well construction logs for each monitoring well construction to record subsurface geology; (3) a well data sheet during purging/sampling of each monitoring well; and, (4) calibration forms for any field instrumentation. Examples of these forms are in Attachment 1.

4.1.3 Sample Labels

Sample labels will be filled out in indelible black or blue ink and affixed to sample containers at the time of sample collection. An example sample label is provided in Attachment 2. Each sample label will be covered with clear tape. Each sample container will be labeled with the following, at a minimum:

- Sample identification number
- Sample collection date (month/day/year)
- Time of collection (24-hour clock) from the start of sampling
- Sampler's initials
- Analyses required
- Preservative (if any)

4.1.4 Chain-of-Custody

An overriding consideration for data resulting from laboratory analyses is the ability to demonstrate that the data are legally defensible; i.e., that the samples were obtained from the locations stated and that they reached the laboratory without alteration. To accomplish this, evidence of collection, shipment, laboratory receipt, and laboratory custody until disposal will be documented through the CoC record.

A sample is considered to be in custody if the following conditions have been observed:

- In actual possession or in view of the person who collected the samples
- Locked in a secure area
- Placed in an area restricted to authorized personnel
- Placed in a container and secured with an official seal, such that the sample cannot be reached without breaking the seal

Attachment 2 presents an example of the CoC record. The CoC record lists each sample and the individuals performing the sample collection, shipment, and receipt. Attachment 2 also presents an example of a custody seal that will seal samples and the cooler during transportation to the laboratory.

The CoC record will be the controlling document to ensure that the sample custody is maintained. Sampling personnel upon collecting a sample will initiate the CoC record in the field. Each time the sample custody is transferred, the former custodian will sign the CoC on the "Relinquished By" line, and the new custodian will sign the CoC on the "Received By" line. The date, time, and the name of their project or company affiliation will accompany each signature. The waybill number and courier name will be recorded on the CoC when a commercial carrier is used. The shipping container will be secured with two custody seals, thereby allowing for custody to be maintained by the shipping personnel until receipt by the laboratory.

Sample custody will be the responsibility of sampling personnel from the time of sample collection until the samples are accepted by the laboratory via courier or FedEx. Thereafter, the laboratory performing the analysis will maintain custody. Laboratory sample custody is described in Section 7.1.2.

In addition to providing a custody exchange record for the samples, the CoC record serves as a formal request for sample analyses. The CoC records will be completed, signed, and distributed as follows:

- White and pink copies sent to the analytical laboratory with the sample shipment
- Yellow copy retained on site for inclusion in the project files
- A copy faxed/e-mailed to the Project Chemist on a daily basis to allow tracking of samples during shipment and confirm laboratory receipt of samples
- Manila copy sent to the Project Chemist

4.1.5 Supplies Certification

Certificates from the supplier demonstrating that containers for sampling, tubing for well purging, deionized water for decontamination, and laboratory-grade water for rinsate samples are analyte-free will be provided for each lot. In addition, a certificate will accompany calibration gases for field screening instruments to ensure that gases are the manufacturer's specified grade. Certificates will be placed in the project files.

4.1.6 Sample Shipping Records

Samples will be transported to the laboratory via courier or FedEx. For samples received by a courier, the courier will sign the CoC and accept the samples. For samples shipped via FedEx®, the CoC will be packaged within the cooler and the sender's copy of the airbill will serve as custody documentation and will be maintained onsite in the project file. Sample shipping procedures are detailed in Section 6.6.

4.1.7 Field Surveillance Reports

On-site field inspections will be performed by the Project Quality Control Manager (PQCM) once at the beginning of field sampling activities, once during field activities, and once as a follow-up near the end of field activities. The PQCM will use the surveillance checklist during inspection. Surveillance reports will be prepared and provided to the PjM and QCM.

4.1.8 Field Change Request

An FCR will be prepared by the Project Chemist or designee if a change to the SAP occurs during the project.

Major changes to work scope affecting the original DQOs or meeting criteria described in *EWI #2, 3EVR.2, Review, Approval, Revision, and Amendment of Sampling and Analysis Plans (SAPs)* (NAVFAC SW, 2006) will require preparation of an SAP addendum. The SAP addendum must be approved by NAVFAC SW QAO prior to conducting sampling and analysis.

4.2 LABORATORY DOCUMENTATION

Laboratory records associated with project samples that are analyzed will include the following at a minimum:

- Sample receipt and login
- Laboratory internal CoC
- Instrument calibration logs
- Sample preparation logs
- Sample analysis/run logs
- Sample results
- Case narrative
- Sample disposal records
- Nonconformance reports including corrective actions

The laboratory will prepare analytical data packages comprising the above documentation for each sample delivery group (SDG) and provide them to TtEC. Laboratory deliverables will include two copies of the hardcopy data package, submitted as either EPA Level III- or IV-equivalent packages as specified on the CoC. Detailed information on the requirement of hardcopy data packages is provided below. The report pages will be sequentially numbered. The report will contain a table of contents referencing individual sections in the data package, the original, white copy of CoC records, a copy of all corrective action reports, and a narrative documenting the resolution of all corrective actions and non-conformances. All samples will be cross-referenced to the associated QC samples. The packages will be assembled in the following sequence:

- Cover page (with laboratory name, address, phone number, contact person, and SDG number, as well as the project name and project number)
- Table of contents
- Case narrative
- Sample management records, including the original, white copy of CoC records (including cooler temperature and sample condition), shipping documents, and laboratory sample receipt forms
- Cross-reference table
- Analytical results and QA/QC information by test as follows:
    - <u>Organic raw data sequence</u>
        - Sample result forms
        - Sample raw data after each result form (EPA Level IV only)
        - Surrogate summaries (surrogate results may appear on the sample result forms)
        - QC summaries
        - Tune data (gas chromatograph/mass spectrometer [GC/MS] only)
        - Initial calibration (ICAL)
        - Initial calibration verification (ICV) checks via second source standard
        - Daily calibration checks, including related continuing calibration verifications (CCVs)
        - Resolution check standards (GC/MS and pesticides), if applicable
        - QC raw data including method blank, laboratory control sample (LCS), matrix spike/matrix spike duplicate (MS/MSD) for EPA Level IV only
        - Instrument run log
        - Sample preparation log
    - <u>Inorganic raw data sequence</u>
        - Sample results forms
        - Sample raw data (EPA Level IV only)
        - QC summaries
        - ICAL
        - Daily calibration checks, including all related CCVs
        - Calibration blanks, including all related continuing calibration blanks

- Interference check standards A and B for inductively coupled plasma-atomic emission spectrometer (ICP-AES) only
- QC raw data including method blank, LCS, MS/MSD for EPA Level IV only
- Post-digestion spike results
- Analytical spike results
- Method of standard additions
- ICP-AES serial dilutions
- Instrument run log
- Sample preparation log

All relevant laboratory raw data and documentation including but not limited to logbook, data sheets, electronic files, and reports, will be maintained by the laboratory for at least 7 years. TtEC must be notified 30 days before disposal of any relevant records.

In addition to the hardcopy data, an electronic data deliverable (EDD) will be submitted in ASCII format. The EDD will be compatible with the Navy electronic data deliverable (NEDD) standard. Both the EDD and the hardcopy report will present results to two or three significant figures. For organic results, two significant figures will be used for all results. For inorganic results, two significant figures will be used for results less than 10, and three significant figures will be used for results greater than 10. Results for QC analyses (method blanks, MS/MSD, LCS, and duplicates) will be reported up to three significant figures.

When revisions to data reports are required, the revised pages (an original and copy) will be stamped with the notation "amended or revised report." If revisions affect the EDD, a revised EDD will then be sent along with the revised hardcopy pages. In addition, a hardcopy or electronic copy of items submitted to the validator (as discussed in Section 4.3) by the laboratory will also be submitted to the Project Chemist.

4.3 DATA VALIDATION REPORTS

All analytical data generated from laboratories, with the exception of waste characterization samples, will be validated by an independent data validation company. The validator shall provide one original and one copy of the data validation reports, which includes analytical result pages with appropriate qualifiers and the data validation findings worksheets. The original and copy reports will be submitted in separate sets. The reports will be arranged in increasing SDG numbers and grouped by the type of analysis; i.e., a group of reports will consist of SDGs with the same analysis arranged in increasing numerical order. Each SDG will be submitted as a separate data validation report. Reports covering multiple SDGs are <u>not</u> acceptable.

The validation reports will contain the following information:

- Title page that includes project name, sample collection date, validator subcontractor name, report date, type of analysis, laboratory, SDG, sample identifications (including MS/MSD, duplicate, reanalysis, or dilution samples), sample matrix (e.g., soil, water), and validation level (EPA Level III or IV).
- Introduction page that includes the number of samples per matrix, analytical method reference, validation guideline reference, section references to summary qualification flags, and denotes QC samples. Statements regarding flag classification (protocol/ advisory) and whether a raw data check was performed will also be included.
- Section headings for each analytical method will include the following:
  - Technical holding times
  - GC/MS instrument performance check (Tune) if applicable
  - Calibration
    a. ICAL
    b. ICV
    c. CCV
  - Laboratory blanks
  - Accuracy and precision data
    a. Surrogate spike recoveries
    b. MS/MSD
    c. LCS/LCS duplicates
    d. Internal standards
  - Target compound identification
  - System performance checks
  - Analyte quantitation and quantitation limit (QLs)
  - Field QC samples (if not applicable, report will note)
  - Overall assessment of data
  - Assessment of compliance with Scope of Work requirements
- QC deviation summaries, which will include the following in a tabular format:
  - Unique identification of QC run (e.g., date/time, etc.)
  - Associated project and sample numbers (not the laboratory internal sample identifications [IDs])
  - Associated constituents
  - Actual value for noted deviation
  - Applicable QC criteria
  - Applicable qualifiers
  - Qualifier classifications (advisory or protocol)

- Copy of analytical result pages that will be flagged with the appropriate changes in results/qualifiers based on the data validation findings. Each analytical result page with changes will be initialed and dated. If there are no changes in results/qualifiers, the analytical result pages should still be included.
- Validation findings worksheets
- Qualifier classification

The following format will be used when preparing and submitting revised data validation reports and analytical result pages:

- The cover letter and revised text pages will clearly identify the revision number (i.e., **Revision 1**) typed in the upper-right hand corner of the page.
- A statement in the cover letter will be included indicating that an asterisk will be placed in the margin to the left of any revised item in the text.
- Every revised page in the text will have the following statement placed at the bottom of the page:

  ***Indicates revision based on report review.**

- The summary table will have an asterisk placed to the left of every revised item and a statement at the bottom of the page as follows:

  ***Indicates change as a result of report review.**

- The analytical result pages will be stamped:

  ***Indicates change as a result of report review.**

Revisions will be submitted within 1 week of receiving the review comments from the Project Chemist. Report revision submittal packages will include an original and copy of the cover page, revised pages, and revised analytical result pages.

The data validation subcontractor will maintain validation records for at least 7 years. TtEC will be notified 30 days before disposal of any records.

TABLE A.4-1

PROJECT DOCUMENTS AND RECORDS

(UFP-QAPP Worksheet #29)

Document	Where Maintained
Field logbook	Project file
Field forms	Project file
Sample labels	Laboratory
CoC	Project file and laboratory
Supplies certification	Project file
Shipping Records	Project file
Field surveillance reports	Project file
Laboratory data package including: Sample receipt and login Laboratory internal CoC Instrument calibration logs Sample preparation logs Sample analysis/run logs Sample results Case narrative Nonconformance reports including corrective actions	Laboratory and project file; NAVFAC SW Administrative Record will receive original copy
Data validation report	Validator and project file; NAVFAC SW Administrative Record will receive original copy

Abbreviations and Acronyms:

CoC – Chain-of-Custody

This page intentionally left blank.

5.0 SAMPLING STRATEGY

This section provides a description of the approach that will be used to collect samples. The sampling strategy is presented by site.

Table A.5-1 summarizes the initial sampling locations, matrix, depths, and analytical requirements for each Site at OU-2A and OU-2B. The analytical methods used for this project will be in conjunction with the *Test Methods for Evaluating Solid Waste, Physical Chemical Methods, SW-846*, Third Edition and final updates (EPA, 1986). Procedures for each type of sampling to be performed are detailed in Section 6.3.

5.1 OU-2A SITE 9 INVESTIGATION

The SWMUs and soil and groundwater investigation locations for Site 9 are discussed in the following sections. A conceptual site model (CSM) for the site is provided as Figure 3-1 of the Work Plan. Figures 3-2 and 3-3 of the Work Plan show the proposed sampling locations.

5.1.1 OWS 410A and OWS 410B

The locations of the OWSs in Site 9 are shown on Figure 3-2 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to commencing soil sampling at these OWSs, the field geologist will visually inspect each OWS to determine whether there are visible liquids within the feature. If sufficient liquids are present, a sample of the liquid will be collected to characterize the contents prior to disposal and the remaining liquid will be removed from each OWS.
- Once liquids have been removed from the OWS, the field geologist will determine the depth of the feature using a measuring tape.
- The field geologist will visually inspect the sides and base of each OWS for cracks.
- The field geologist will identify the influent and effluent piping locations for each OWS.
- If accessible, a boring will be placed through the base of the OWS. Soil samples will be retrieved from immediately below the bedding of the OWS, but no deeper than 1 foot (ft) below the bottom of the OWS. An additional soil sample will be retrieved from the vadose zone to ensure a total of two unsaturated soil samples are collected.
- A boring will be placed adjacent to each end of the OWS where influent and effluent piping is connected to the OWS. The initial sample from each piping area will be collected from approximately 0.5 ft below the piping connection to the OWS.

- If a crack in a sidewall of the OWS is observed, a soil sample will be collected adjacent to the base of the crack.
- To obtain parameters necessary to support the remedial design, the field geologist will select one boring from each OWS that will be completed to the saturated soil in the FWBZ. The field geologist will select the location based on accessibility, condition of the OWS, and field conditions. A saturated soil sample will be retrieved from this boring.
- The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.
- Holes in the base of the OWS will be sealed with concrete after samples are collected.

Collected samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out and step-down procedures described in Sections 5.11 and 5.12, subsequent samples may be necessary to delineate the impacted area(s).

5.1.2 Site 9 Wash Rack Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine whether the wash rack contributed contaminants to soil. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to commencing soil sampling, the field geologist will inspect the wash rack for cracks and open joints that could be a preferred pathway to soil and groundwater.
- If there are cracks and/or open joints within the wash rack, soil borings will be placed at the locations of two of the most obvious cracks or open joints that could be a pathway to underlying soil. If there are no cracks and/or open joints, two soil borings will be placed within the former wash rack area, as shown on Figure 3-2 of the Work Plan.
- A soil sample will be collected from each boring from immediately below the base of the bedding material used for construction of the wash rack flooring or a maximum of 1 ft below the bottom of the current wash rack flooring. A second soil sample will be collected from the vadose zone in each boring.

Soil samples will be collected using a hand auger. Collected soil samples will be submitted for analyses, as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.1.3 Site 9 Groundwater Investigation

As described in the RI for OU-2A, additional groundwater sampling and monitoring is necessary to delineate the lateral and vertical extent of contamination in groundwater (see Section 2.0 of the Work Plan). Initial groundwater sampling, including the installation of groundwater monitoring wells, will be performed at locations shown in Figure 3-3 of the Work Plan. The current understanding of the extent of the groundwater plume was developed from information in the RI (SulTech, 2005a) and recent sampling results from site-wide groundwater sampling (ITSI, 2006). There have been two areas identified with elevated VOCs in the FWBZ. One area is under and west of Building 410. The second is near the southeast corner of Building 410, as identified by an elevated DPT sample in 1994. It should be noted that monitoring well MW410-3, which is directly downgradient of this area, is sampled in the quarterly basewide groundwater sampling and no exceedances above MCLs have been detected in the samples from this monitoring well. Monitoring wells MW410-1, MW410-2, and D09-01 are also sampled on a quarterly basis and no exceedances above MCLs have been detected in the samples from these monitoring wells.

Storm and sanitary sewers are to be investigated as secondary sources contributing to the groundwater contamination. They will be investigated only in areas inside the groundwater plume. They are not contributing to groundwater contamination in areas where groundwater contaminants are below the MCLs.

In conjunction with the data gap sampling, the final round of rebound sampling will be performed for chemical oxidation pilot test wells in Site 9.

The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- A tidal study for select monitoring wells to determine if contaminant distribution is tidally influenced.
- Collection of groundwater samples using Hydropunch® methods in at least four locations adjacent to sewer lines. Locations were selected along bends or joints in the sewer lines that are located within the groundwater plume.
- Collection of groundwater samples using Hydropunch® methods in at least five locations to delineate the extent of the groundwater plume.
- Installation of two FWBZ groundwater monitoring wells. One monitoring well will be placed immediately downgradient of the plume based on recent groundwater flow direction. An additional monitoring well will be placed in the southeast corner of the plume, which contains elevated concentrations of VOCs.
- Installation of one SWBZ groundwater monitoring well located in the southeast corner of the plume to determine if elevated concentrations of VOCs in the FWBZ have impacted the SWBZ.
- A slug test for newly installed monitoring wells to determine hydraulic conductivity.
- Quarterly sampling of all new groundwater monitoring wells and select existing groundwater monitoring wells at the site for one year.
- One-time rebound sampling of chemical oxidation pilot test groundwater monitoring wells.

Groundwater samples will be retrieved and groundwater monitoring wells will be installed. Collected groundwater samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out and step-down procedures described in Section 5.12, subsequent samples may be necessary to delineate the impacted area(s) for the Hydropunch® locations.

5.2 OU-2A SITE 13 INVESTIGATION

The SWMUs and soil and groundwater investigation locations for Site 13 are discussed in the following sections. A CSM for the site is provided as Figure 3-4 of the Work Plan. Figures 3-5 and 3-6 of the Work Plan show the proposed sampling locations.

5.2.1 AOC 009

AOC 009 is comprised of five former ASTs that stored fuel (Figure 3-5 of the Work Plan). Concrete foundations are still present at the site. The ASTs were removed in 1990. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to sampling, the area will be cleared of debris and examined for visible signs of the former tank boundaries and any visible signs of leaks or spills (e.g., staining).
- If there are visible signs of staining, a soil boring will be placed at the location of the most obvious stained area for each concrete pad.
- If no staining is apparent, one boring will be placed beyond the edge of the concrete pad in the downgradient direction.
- Initial soil samples will be retrieved from 1 ft bgs. A second soil sample will be collected from the vadose zone in each boring.
- To obtain parameters necessary to support the remedial design, the field geologist will select one boring that will be completed to the saturated soil in the FWBZ. The field geologist will select the location based on accessibility, condition of the AST and field conditions. A saturated soil sample will be retrieved from this boring.
- The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

Collected samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out and step-down procedures described in Sections 5.11 and 5.12, subsequent samples may be necessary to delineate the impacted area(s).

5.2.2 Site 13 Previous Borings B13-28 thru B13-32, B13-41, and B-IMF-06 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to delineate soil contamination above PRGs. Soil samples will be collected at the locations shown in Figure 3-5 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Three soil borings each will be completed in a triangular placement approximately 10 ft from each of the following previous borings: B13-30, B13-31, B13-32, and B13-41. A total of 12 borings will be installed. For each of the proposed borings, initial soil samples will be collected at a depth of 0.5 to 1 ft bgs in unpaved areas, or where paved, the bottom of the bedding material used for construction of the pavement or a maximum of 1 ft below the bottom of the pavement. A second soil sample will be collected from the vadose zone in each boring.
- Previous borings B13-28 and B13-29 are in close proximity to each other. A total of three borings will be completed in a triangular placement approximately 10 ft from the locations of these borings. For each of the proposed borings, initial soil samples will be collected at a depth of 0.5 to 1 ft bgs in unpaved areas, or where paved, the bottom of the bedding material used for construction of the pavement or a maximum of 1 ft below the bottom of the pavement. A second soil sample will be collected from the vadose zone in each boring.
- One boring will be placed immediately adjacent to previous boring B-IMF-06. A sample will be retrieved from approximately 5 ft bgs in this boring, or immediately above the vadose zone, whichever is shallower.

Soil samples will be collected using a hand auger. Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.2.3 Site 13 Incinerator Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine whether the former incinerator at Site 13 contributed contaminants to soil. Soil samples will be collected at the locations shown in Figure 3-5 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- The investigation area comprises approximately 79,200 ft^2. Soil borings will be placed throughout the former yard on 75-ft centers, resulting in 15 borings.
- The field geologist may bias the placement of borings to areas exhibiting surface discoloration or cracks.
- At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs. A second soil sample will be retrieved from the vadose zone in each boring.

Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.2.4 Site 13 Groundwater Investigation

Additional groundwater sampling and monitoring is necessary to delineate the lateral and vertical extent of groundwater contamination at Site 13. Site 13 contains two distinct plumes, which are shown on Figure 3-6 of the Work Plan. Plume 1 is currently being evaluated under the TPH Program as CAA-13 and will not be investigated as part of this project scope. However, Plume 2 is being investigated under this project scope for commingled contaminants. The current understanding of the extent of the groundwater Plume 2 was developed from information in the RI (SulTech, 2005a) and recent sampling results from the quarterly site-wide groundwater sampling (ITSI, 2006). The quarterly sampling includes nine monitoring wells at Site 13, seven wells in the fill and two in the Merritt Sands. Plume 2 is well defined to the north and east by quarterly sampling of monitoring wells M07-06, M07-07, and M13-09.

The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Conduct a tidal study for select monitoring wells to determine if contaminant distribution is tidally influenced.
- Collect groundwater samples in at least four locations using Hydropunch® methods to further delineate the lateral and vertical extent of contaminants above MCLs.
- Install one FWBZ groundwater monitoring well downgradient of the southern edge of Plume 2, which contains elevated concentrations of benzene.
- Conduct a slug test for the newly installed monitoring well to determine hydraulic conductivity.
- Conduct quarterly sampling of the new groundwater monitoring well and select existing groundwater monitoring wells at the site for 1 year.

Groundwater samples will be retrieved and groundwater monitoring wells will be installed. Collected groundwater samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out and step-down procedures described in Section 5.12, subsequent samples may be necessary to delineate the impacted area(s) for the Hydropunch® locations.

5.3 OU-2A SITE 19 INVESTIGATION

The SWMUs and soil and groundwater investigation locations for Site 19 are discussed in the following sections. A CSM for the site is provided as Figure 3-7 of the Work Plan. Figures 3-8 and 3-9 of the Work Plan show the proposed sampling locations.

5.3.1 Site 19 Yard D-13 Soil Investigation

As described in the RI for this site, to support the selected remedy for soil, additional soil sampling is necessary to determine whether Yard D-13 contributed contaminants to soil. Soil samples will be collected at the locations shown in Figure 3-8 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to sampling, the investigation area will be cleared of debris.
- The investigation area comprises approximately 26,400 ft^2. Soil borings will be placed throughout the former yard on 50-ft centers, resulting in nine borings.
- The field geologist may bias the placement of borings to areas exhibiting surface discoloration or cracks.
- At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in each boring.

Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.3.2 Site 19 Groundwater Investigation

As described in the RI document for this site, additional groundwater sampling and monitoring is necessary to delineate the lateral and vertical extent of groundwater contamination. The proposed groundwater investigation and approximate plume boundary are shown in Figure 3-9 of the Work Plan. The current understanding of the extent of the groundwater contamination was developed from information in the RI (SulTech, 2005a) and recent sampling results from the quarterly site wide groundwater sampling (ITSI, 2006). The current quarterly sampling includes three monitoring wells, two monitoring wells in the FWBZ and one in the SWBZ. The only sample exceeding MCLs for VOCs is located in monitoring well MWD13-4 with exceedances of 1,2-DCA and PCE. The plume is well defined to the west and east by former DPTs and quarterly sampled monitoring wells MWD13-3 and M13-P.

The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- A tidal study for select monitoring wells to determine if contaminant distribution is tidally influenced.
- Collection of groundwater samples in at least two locations using Hydropunch® methods to further delineate VOCs above the MCLs (upgradient and downgradient).
- Installation of one FWBZ groundwater monitoring well downgradient of VOCs above the MCLs.
- A slug test for the newly installed monitoring well to determine hydraulic conductivity.

- Quarterly sampling of the new groundwater monitoring well and select existing groundwater monitoring wells at the site for one year.

Groundwater samples will be retrieved and groundwater monitoring wells will be installed. Collected groundwater samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out and step-down procedures described in Section 5.12, subsequent samples may be necessary to delineate the impacted area(s) for the Hydropunch® locations.

5.4 OU-2A SITE 22 DATA GAP INVESTIGATION

The SWMUs and soil and groundwater investigation locations for Site 22 are discussed in the following sections. A CSM for the site is provided as Figure 3-10 of the Work Plan. Figure 3-11 of the Work Plan shows the proposed sampling locations.

5.4.1 OWS 547

Sampling at OWS 547 will be conducted according to the procedure described in Section 5.1.1. The location of OWS 547 is provided on Figure 3-11 of the Work Plan.

5.4.2 Site 22 Previous Borings 547-5, 547-6, and 547-11 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine the horizontal and vertical extent of lead above the PRG in soil. Soil samples will be collected at the locations shown in Figure 3-11 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Three soil borings will be placed in a triangular pattern approximately 10 ft from the previous boring 547-5. Soil samples will be collected from 0.5 to 1 ft bgs in each boring. Deeper samples are not necessary, as historical results have determined the vertical extent of contamination.
- Three soil borings each will be placed in a triangular pattern approximately 10 ft from each of the previous borings: 547-11 and 547-6. If fill material from previous fuel line excavations is encountered, then locations will be moved outside of the excavated area. Soil samples will be collected from 0.5 to 1 ft bgs in each boring. A second soil sample will be retrieved from the vadose zone in each boring to determine the vertical extent of soil contamination.

Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.4.3 Site 22 Groundwater Investigation

As described in the RI for this site, the presence of petroleum in soil and groundwater at Site 22 is attributed to gas station and fuel releases and is addressed under CAA-4C of the TPH Program.

Additional investigation will not be conducted as part of this project scope. However, select monitoring wells in Site 22 may be utilized to assist in the OU-wide tidal study, which is described in Section 5.0 of the Work Plan.

5.5 OU-2A SITE 23 INVESTIGATION

No SWMUs or site soil are data gaps for Site 23. As described in the RI for this site, the presence of petroleum in soil and groundwater at Site 23 is addressed under CAA-13 of the TPH Program. Additional investigation will not be conducted as part of this project scope. However, select monitoring wells in Site 23 may be utilized to assist in the OU-wide tidal study, which is described in Section 5.0 of the Work Plan.

5.6 OU-2B SITE 3 INVESTIGATION

No SWMUs require investigation at Site 3.

The soil investigations for Site 3 are discussed in the following sections. A CSM for the site is provided as Figure 3-12 of the Work Plan. Figure 3-13 of the Work Plan shows the proposed sampling locations for Site 3. The OU-2B site-wide groundwater assessment includes groundwater sampling to define the western extent of the lead plume in the northern portion of Site 3. This investigation is detailed in Section 5.10.

5.6.1 Site 3 Building 112 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine the horizontal and vertical extent of contaminants in soil. Soil samples will be collected at the locations shown in Figure 3-13 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Two soil borings will be placed within Building 112 in the vicinity of the former carpentry shop identified as Target Area 1 in the EBS (EMR-West, 1994). Soil samples will be collected from each boring from just below the base of the building foundation. A second soil sample will be retrieved from the vadose zone in each boring to determine the vertical extent of soil contamination.
- Aerial photographs, previous documents, and/or a field inspection will be performed to locate the former storage area outside Building 112. If the area can be identified, a maximum of five initial soil borings will be placed in the area. Soil samples will be collected from each boring from the base of the bedding material that was used for the asphalt pavement, or from a maximum of 1 ft below the bottom of the pavement.

- If further information is obtained to locate the area of the former zinc smelter, soil samples will be retrieved from this area. The number of samples will be determined by the field geologist based on the investigation area. The placement of soil borings will be biased to areas with staining, cracks, joints, and/or piping through the flooring around the zinc smelter, if present. Samples will be collected from below the base of the bedding material that was used for construction of the flooring, or from a maximum of 1 ft below the bottom of the current flooring.

Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.7 OU-2B SITE 4 INVESTIGATION

The SWMUs and soil investigation locations for Site 4 are discussed in the following sections. A CSM for the site is provided as Figure 3-12 of the Work Plan. Figure 3-14 of the Work Plan shows the proposed sampling locations in Site 4. The OU-2B site-wide groundwater assessment includes groundwater sampling and well installation surrounding Building 360. This investigation is detailed in Section 5.10.

5.7.1 OWS 163, OWS 360, OWS 372A

Sampling at the OWSs for Site 4 will be conducted according to the procedure described in Section 5.1.1. The locations of the OWSs are provided on Figure 3-14 of the Work Plan.

5.7.2 AST-360E

The location of the AST-360E is provided on Figure 3-14 of the Work Plan. The AST is still present and located within secondary containment. To determine the nature and extent of possible contamination due to historical waste management activities, the proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to sampling, the area will be cleared of debris and the secondary containment pad will be examined for visible signs of leaks or spills (e.g., staining).
- One boring will be placed outside the edge of the secondary containment, on the downgradient side of the AST. The initial soil sample will be retrieved from 1 ft bgs. A second soil sample will be collected from the vadose zone. Additional borings may be placed at locations where visible signs of leaks or spills are observed.
- To obtain parameters necessary to support the remedial design, one boring will be completed to the saturated soil in the FWBZ. The field geologist will select the location based on accessibility, condition of the AST, and field conditions. A saturated soil sample will be retrieved from this boring.

- The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

Collected samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out and step-down procedures described in Sections 5.11 and 5.12, subsequent samples may be necessary to delineate the impacted area(s).

5.7.3 AOC 372/ SWMU 372

The location of AOC 372/SWMU 372 is shown on Figure 3-14 of the Work Plan. AOC 372 is the location of two former USTs that were located one above the other. SWMU 372 is the location of a former surface release of JP-5 fuel. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to initiating sampling, the field geologist will confirm the location of both features by reviewing as-built drawings, historic aerial photographs, site inspection, and previous reports. If the location of the former UST remains in question, ground penetrating radar (GPR) will be used to locate the tank excavation.
- Prior to sampling, the area will be cleared of any debris.
- Four borings will be placed at locations outside the former UST excavation, one on each side.
- Two borings will be placed within the area of the surface release if the location can be determined.
- Initial soil samples will be collected from approximately 1 ft bgs. A second soil sample will be retrieved from the vadose zone in each boring to determine the vertical extent of soil contamination.
- To obtain parameters necessary to support the remedial design, the field geologist will select one boring from the investigation area that will be completed to the saturated soil in the FWBZ. The field geologist will select the location based on accessibility, condition of the investigation area, and field conditions. A saturated soil sample will be retrieved from this boring.
- The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

Collected samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out and step-down procedures described in Sections 5.11 and 5.12, subsequent samples may be necessary to delineate the impacted area(s).

5.7.4 NADEP GAP 59

NADEP GAP 59 was located outside of Building 163. The location of the Generator Accumulation Point (GAP) is provided on Figure 3-14 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to initiating sampling, the field geologist will confirm the former GAP location by reviewing as-built drawings, historic aerial photographs, site inspection, and previous reports.
- Prior to sampling, the area will be cleared of any debris.
- The GAP area will be visually inspected for visible staining and cracks in the pavement or concrete floor.
- One sample location will be biased based on the above criteria towards areas of staining or cracks, if present. Otherwise, one boring will be advanced through the center of the GAP area.
- The initial sample will be collected below any bedding material for the concrete or asphalt flooring, but no deeper than 1 ft below the concrete or asphalt flooring. A second soil sample will be retrieved from the vadose zone in each boring.
- To obtain parameters necessary to support the remedial design, the boring will be completed to the saturated soil in the FWBZ. A saturated soil sample will be retrieved from this boring.
- The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.7.5 Site 4 Building 163 Soil Investigation

As described in the RI document for this site, additional soil sampling is necessary to determine whether Building 163 contributed contaminants to soil. Soil samples will be collected at the locations shown in Figure 3-14 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Two soil borings will be placed in Building 163 to determine the horizontal and vertical extent of soil contamination. The locations have been placed adjacent to the previous soil gas borings (163SG-01 and 163SG-02) in which elevated VOCs were indicated.
- At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in each boring.

Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.7.6 Site 4 Building 372 PCB Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine the horizontal and vertical extent of PCBs in soil. Soil samples will be collected at the locations shown in Figure 3-14 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Nine soil borings will be placed every 60 ft around the perimeter of the building, at a distance of about 5 ft from the outside of the building, as shown on Figure 3-14 of the Work Plan.
- Initial soil samples will be collected at the bottom of the bedding material that was used for construction of the current pavement or from a maximum of 1 ft below the bottom of the current pavement. A second soil sample will be retrieved from the vadose zone in each boring to determine the vertical extent of soil contamination.

Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.7.7 Site 4 Building 360 Storm Drain Investigation

As described in the RI for this site, additional soil sampling is necessary to determine the horizontal and vertical extent of contaminants in soil. Soil samples will be collected at the locations shown in Figure 3-14 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Six borings will be installed to define the horizontal extent of VOCs detected in previous samples collected from borings 143-SS-004 and 143-SS-005 located northwest and southwest of Building 360 respectively. As shown in Figure 3-14 of the Work Plan, three borings will be placed 10 ft from each nearby storm drain to define the horizontal extent of VOC-impacted soil found at 5 ft bgs. Soil samples will be collected at 6 ft bgs. In addition, two borings will be installed adjacent to each storm drain to define the vertical extent of contamination detected in the previous sample. At these two locations, a soil sample will be collected from immediately above the saturated zone to define the vertical extent of contamination above PRGs.

Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s)

5.7.8 Site 4 Building 360 Metals Investigation

As described in the RI, additional sampling is necessary in the vicinity of Building 360 to delineate the horizontal and vertical extent of VOC and metals contamination in soil. Since SPH treatment was recently conducted at Building 360, the investigation activities will focus on metals contamination in soil beneath and adjacent to Building 360. Soil samples will be collected at locations shown in Figure 3-14 of the Work Plan. The proposed sampling activities are as follows:

- Nine borings will be installed at the northern end of Building 360, in the vicinity of monitoring well D03-03 to define the horizontal and vertical extent of metals detected in soil.
- Three borings will be installed at locations north, east and south of the SPH system in order to define the extent of metals contamination in soil in the vicinity of the former plating area.
- At each boring location, soil samples will be collected from the surface soil beneath the building, from approximately 3 ft bgs, and from the vadose zone.

Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.8 OU-2B SITE 11 INVESTIGATION

The SWMUs and soil investigation locations for Site 11 are discussed in the following sections. A CSM for the OU-2B site is provided as Figure 3-12 of the Work Plan. Figure 3-15 of the Work Plan shows the proposed sampling locations to Site 11. The OU-2B site-wide groundwater assessment includes groundwater sampling and well installation in the vicinity of Building 14. This investigation is detailed in Section 5.10.

5.8.1 OWS 014A, OWS 014B, OWS 014C, OWS 014D, OWS 014E

Sampling at the OWSs for Site 11 will be conducted according to the procedure described in Section 5.1.1. The location of the OWSs is provided on Figure 3-15 of the Work Plan.

5.8.2 UST 14-4

The location of former UST 14-4 is shown in Figure 3-15 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to initiating sampling, the field geologist will confirm the former UST location by reviewing as-built drawings, historic aerial photographs, site inspection, and previous reports.

- If the location of the former UST remains in question, GPR will be used to locate the tank (if abandoned in place) or tank excavation.
- Prior to sampling, the area will be cleared of debris and examined for visible signs of the former tank boundaries and any visible signs of leaks or spills (e.g., staining).
- One boring will be placed near the center of the former tank location. Sampling will be initiated from the bottom of the tank excavation backfill if apparent, but no deeper than 5 ft bgs or the water table, whichever is shallower.
- To obtain parameters necessary to support the remedial design, the boring above will be completed to the saturated soil in the FWBZ. A saturated soil sample will be retrieved from this boring.
- The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

Collected samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out and step-down procedures described in Sections 5.11 and 5.12, subsequent samples may be necessary to delineate the impacted area(s).

5.8.3 Site 11 Building 118 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine whether Building 118 contributed contaminants to soil. Soil samples will be collected at the locations shown in Figure 3-15 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to sampling, the investigation area will be cleared of debris.
- The investigation area comprises approximately 750 ft^2. Three borings will be placed in the footprint of the previous building, as shown in Figure 3-15 of the Work Plan.
- The field geologist may bias the placement of borings to areas exhibiting surface discoloration or cracks.
- At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in each boring.

Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.8.4 Site 11 Previous Boring M11-03 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine the horizontal and vertical extent of lead above the PRG in soil. Soil samples will be collected at the locations shown in Figure 3-15 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Three initial sample locations will be placed in a triangular arrangement approximately 10 ft from previous boring M11-03 to define the horizontal extent of lead-impacted soil found at 0.3 to 0.8 ft bgs. Soil samples from these locations will be retrieved from about 0.5 ft bgs.
- A soil boring will also be placed immediately adjacent to boring M11-03. A soil sample will be collected from 2.5 ft bgs to determine the vertical extent of lead contamination identified in the historical sample.

Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.8.5 Site 11 Building 265 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine whether Building 265 contributed contaminants to soil. Soil samples will be collected at the locations shown in Figure 3-15 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to sampling, the investigation area will be cleared of debris.
- The investigation area comprises approximately 375 ft^2. Two soil borings will be placed in the footprint of the previous building, as shown in Figure 3-15 of the Work Plan.
- The field geologist may bias the placement of borings to areas exhibiting surface discoloration or cracks.
- At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in each boring.

Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.8.6 Site 11 Building 14 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine whether Building 14 contributed contaminants to soil. Soil samples will be collected at the locations shown in Figure 3-15 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to sampling, the investigation area will be cleared of debris.
- One soil boring will be placed adjacent to a previous soil gas boring (14SG08), in which elevated VOCs were indicated.
- At the boring, an initial soil sample will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in the boring.

Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.9 OU-2B SITE 21 INVESTIGATION

The SWMUs and soil investigation locations for Site 21 are discussed in the following sections. A CSM for OU-2B is provided as Figure 3-12 of the Work Plan. Figure 3-16 of the Work Plan shows the proposed sampling locations for Site 21. The OU-2B site-wide groundwater assessment includes groundwater sampling and well installation surrounding Buildings 113 and 162. This investigation is detailed in Section 5.10.

5.9.1 NAS GAP 11

NAS GAP 11 is a sump located inside Building 162. The location of NAS GAP 11 is provided on Figure 3-16 of the Work Plan. Per the June 16, 2006 site visit, it was agreed upon with agencies that one sample would be collected from beneath the floor of the sump. The sampling activity is summarized as follows:

- Prior to sampling, the area will be cleared of any debris.
- The sump floor will be visually inspected for visible cracks.
- One boring will be advanced through the bottom of the sump. The final sample location will be biased based on the above criteria towards cracks, if present.
- The initial sample will be collected below any bedding material for the concrete, but no deeper than 1 ft below the concrete floor. A second soil sample will be retrieved from the vadose zone.
- To obtain parameters necessary to support the remedial design, the boring above will be completed to the saturated soil in the FWBZ. A saturated soil sample will be retrieved from this boring.
- The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

Collected samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out and step-down procedures described in Sections 5.11 and 5.12, subsequent samples may be necessary to delineate the impacted area(s).

5.9.2 NADEP GAP 44

NADEP GAP 44 is located outside Building 398 and consisted of three 500-gallon bowser containers. The only remnant visible of the GAP location is a partial square of concrete painted red and white. The remainder of the GAP area has been asphalted over during remediation activities conducted at CAA-3A. The location of NADEP GAP 44 is provided on Figure 3-16 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations at the site are summarized as follows:

- Prior to initiating sampling, the field geologist will confirm the former GAP location by reviewing as-built drawings, historic aerial photographs, site inspection, and previous reports.
- Prior to sampling, the area will be cleared of any debris.
- The exposed area will be visually inspected for visible staining and cracks in the pavement or concrete floor.
- One sample location will be biased based on the above criteria towards areas of staining or cracks, if present. Otherwise, one boring will be advanced through the center of the exposed area. A second boring will be advanced at the other end of the GAP from the exposed area.
- The initial samples will be collected below any bedding material for the concrete or asphalt flooring, but no deeper than 1 ft below the concrete or asphalt flooring. A second soil sample will be retrieved from the vadose zone in each boring.
- To obtain parameters necessary to support the remedial design, the field geologist will select one boring from the GAP that will be completed to the saturated soil in the FWBZ. The field geologist will select the location based on accessibility, condition of the GAP, and field conditions. A saturated soil sample will be retrieved from this boring.
- The field geologist will retrieve a groundwater sample from the soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

Collected samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out and step-down procedures described in Sections 5.11 and 5.12, subsequent samples may be necessary to delineate the impacted area(s).

5.9.3 NADEP GAP 76

NADEP GAP 76 is located within Building 113. The location of the GAP is provided on Figure 3-16 of the Work Plan. Per the June 16, 2006 site visit, it was agreed upon with the agencies that one groundwater sample would be collected from a location outside Building 113, adjacent to the location of the GAP. The sampling activity is summarized as follows:

- The field geologist will retrieve a groundwater sample from a soil boring completed into the FWBZ. The groundwater sample will be retrieved using Hydropunch® methods.

Collected samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out and step-down procedures described in Section 5.12, subsequent samples may be necessary to delineate the impacted area(s).

5.9.4 Site 21 Previous Boring 126-002-003 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine the horizontal and vertical extent of lead above the PRG in soil. Soil samples will be collected at the locations shown in Figure 3-16 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Two initial borings will be placed 10 ft from 126-002-003 to define the horizontal extent of lead-impacted soil found at 0.5 to 1 ft bgs (Figure 3-16 of the Work Plan). One boring will be placed southwest of 126-002-003 and one boring will be placed southeast of 126-002-003. Initial soil samples will be collected from about 0.5 to 1 ft bgs.
- To define the vertical extent of lead-impacted soil, a third boring will be installed adjacent to previous boring 126-002-003. A soil sample will be retrieved from about 3 ft bgs in this boring.

Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.9.5 Site 21 Building 113 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine whether Building 113 contributed contaminants to soil. Soil samples will be collected at the locations shown in Figure 3-16 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to sampling, the investigation area will be cleared of debris.
- One soil boring will be placed within Building 113 adjacent to the previous soil gas sample (113SG-03), which indicated the presence of elevated VOCs.

- An initial soil sample will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in the soil boring.

Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.9.6 Site 21 Buildings 162 and 398 Soil Investigation

As described in the RI for this site, additional soil sampling is necessary to determine whether these buildings contributed contaminants to soil. Soil samples will be collected at the locations shown in Figure 3-16 of the Work Plan. The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Prior to sampling, the investigation area will be cleared of debris.
- Soil sampling will be performed in Building 162 adjacent to 12 previous soil gas collection borings with elevated VOCs, as shown in Figure 3-16 of the Work Plan.
- The mercury investigation area within Building 398 comprises approximately 28,900 ft^2. Borings will be placed on 75-ft centers, resulting in seven borings.
- The investigation area between Building 398 and 399 comprises approximately 500 ft^2. Borings will be placed on 50-ft centers, resulting in three borings.
- The field geologist may bias the placement of borings to areas exhibiting surface discoloration or cracks.
- At each boring, initial soil samples will be collected from immediately below the bottom bedding or at 1 ft bgs, whichever is shallower. A second soil sample will be retrieved from the vadose zone in each boring.

Collected soil samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out procedure described in Section 5.11, subsequent samples may be necessary to delineate the impacted area(s).

5.10 OU-2B SITE-WIDE GROUNDWATER INVESTIGATION

As described in the RI for this site, additional groundwater sampling and monitoring is necessary to delineate the lateral and vertical extent of groundwater contamination. The proposed groundwater investigations and approximate plume boundaries are shown in Figures 3-17 and 3-18 of the Work Plan. The site-wide investigation will focus on delineating the extent of benzene, VOC, and lead contamination in the FWBZ and the extent of VOC and metals (chromium and nickel) contamination in the SWBZ.

The extent of the VOC groundwater contamination in the FWBZ has been well-defined in most areas of OU-2B from former studies and the basewide groundwater sampling program. Two FWBZ groundwater monitoring wells will be installed at the locations depicted on Figure 3-17 of the Work Plan. The monitoring well in the northeast portion of OU-2B will be installed to complete the delineation in the southern direction of a small benzene plume. The remainder of the plume is defined with other existing monitoring wells and DPTs. The monitoring well north of Building 360 near Atlantic Avenue will be installed to complete delineation of the VOC plume in this area.

Storm sewers south of Buildings 162 and 349 could be acting as secondary sources for groundwater contamination of the FWBZ in OU-2B in the Site 21 area. Previous investigations identified that most of the storm sewer lines south of Buildings 162 and 349 are below the water table. Hydropunch® locations will be installed in the FWBZ along the storm sewer lines at the six locations depicted in Figure 3-17 of the Work Plan. The locations selected are biased to line connections, manholes, catch basins, and bends in the lines, where releases are most likely to originate. The remainder of the storm sewer lines in the area are located outside of the groundwater plume in the FWBZ. These storm sewer lines are not contributing to groundwater contamination in areas where groundwater contaminants are below the MCLs and, therefore, will not be sampled.

Four Hydropunch® locations will be installed in the FWBZ as depicted in Figure 3-17 of the Work Plan in the northern portion of Site 3, to delineate a lead plume identified during previous investigations in 2001 and 2002 (SulTech, 2005b). Groundwater samples will be collected from three locations to delineate the western boundary and the vertical extent of the plume. Groundwater samples will be collected from one location adjacent to previous sample location (S03-DGS-DP14) with the highest concentration of lead in order to assess current concentrations and define the vertical extent of the plume.

The extent of the VOC groundwater contamination in the SWBZ (below the fill and BSU) has not been well-defined in OU-2B. Figure 3-18 of the Work Plan depicts the current understanding of the horizontal extent of groundwater contamination at OU-2B from previous investigations and the basewide groundwater sampling program. There appear to be four source areas of VOC contamination in the groundwater. One location is northwest of Building 360, the second is at the northeast corner of Building 360, the third is on the west side of Building 360, and the fourth is located between Buildings 14 and 162.

Multi-level monitoring wells will be installed at twelve locations, as depicted in Figure 3-18 of the Work Plan, and screened at the five discrete depths of 15 to 20 ft, 25 to 30 ft, 35 to 40 ft, 45 to 50 ft, and 55 to 60 ft bgs. The four multi-level monitoring wells located along the Seaplane Lagoon will be installed to determine the chemistry of the groundwater prior to discharging into the lagoon. Seven of the multi-level monitoring wells will be placed along the center line of the groundwater contamination and in source areas to obtain a vertical profile of the contamination and determine the depth intervals where the bulk of the contaminant mass is migrating. The multi-level monitoring well located south of Building 14 will be used to determine if the contaminant plume emanating from the west side of Building 360 is limited to the current understanding or migrating further to the west towards Seaplane Lagoon.

Twenty-five CPT/Hydropunchs® will be installed, as depicted in Figure 3-18 of the Work Plan, with groundwater sampling at 15 to 20 ft, 25 to 30 ft, 35 to 40 ft, 45 to 50 ft, and 55 to 60 ft bgs. The CPT/Hydropunch® locations will assist in developing a 3-dimensional understanding of the contaminant distribution at OU-2B along with the 10 multi-level monitoring wells and existing wells. The three CPT/Hydropunch® locations in the area of the contaminant plume on the east side of Building 360 will be advanced an additional 10 ft and samples will be collected from 65 to 70 ft bgs because previous sampling suggests that contamination may extend to this depth. The three CPT/ Hydropunch® locations in the area of monitoring well D03-03 will be used to define the vertical and horizontal extent of chromium and nickel contamination.

The proposed sampling activities and rationale for the selection of sample locations are summarized as follows:

- Conduct a tidal study for select monitoring wells to determine if the plumes at OU-2B are tidally influenced.
- Install two FWBZ groundwater monitoring wells to delineate the benzene plume and the northern extent of a VOC plume (Figure 3-17 of the Work Plan).
- Collect Hydropunch® samples from the FWBZ at six locations adjacent to sewers near Buildings 162 and 349 (Figure 3-17 of the Work Plan) to determine whether the sewers are a contributing source to groundwater contamination.
- Collect Hydropunch® samples from the FWBZ at four locations north of Buildings 222 and 517 to define the horizontal and vertical profile of lead contamination (Figure 3-17 of the Work Plan).
- Install 10 multi-level groundwater monitoring wells in the SWBZ with completions at each of the 10 locations at 15 to 20 ft, 25 to 30 ft, 35 to 40 ft, 45 to 50 ft, and 55 to 60 ft bgs to define the vertical profile of the groundwater contamination (Figure 3-18 of the Work Plan).
- Collect saturated soil samples at the 25- to 30-ft interval at each multi-level monitoring well location and analyze for remediation design parameters.
- Install 20 CPT/Hydropunchs® from the SWBZ with groundwater sampling at each of the 20 locations at 15 to 20 ft, 25 to 30 ft, 35 to 40 ft, 45 to 50 ft, and 55 to 60 ft bgs to define the horizontal and vertical profile of the groundwater contamination (Figure 3-18 of the Work Plan).
- Conduct a slug test for newly installed monitoring wells to determine hydraulic conductivity..

- Conduct quarterly sampling of all new groundwater monitoring wells (Figures 3-17 and 3-18 of the Work Plan) and select existing groundwater monitoring wells at the site for 1 year.

Saturated soil and groundwater samples will be retrieved and groundwater monitoring wells will be installed. Collected soil and groundwater samples will be submitted for analyses as indicated on Table A.5-1. Consistent with the step-out and step-down procedures described in Sections 5.11 and 5.12, subsequent samples may be necessary to delineate the impacted area(s) for the Hydropunch® locations.

5.11 SOIL SAMPLING STEP-OUT CRITERIA

Soil samples will be collected by various methods at numerous sites. If the screening criteria for site-specific contaminants of concern (COCs) are exceeded in the initial sample, additional samples will be required to characterize the horizontal extent of contamination above the screening criteria. The initial soil samples will be analyzed for the suite of analytes specified for the specific area. Step-out samples will be analyzed for the suite of analytes related to the exceedance of the initial soil samples (i.e., if TCE exceeds the screening criteria in the initial samples, then step-down and step-out samples will be analyzed for VOCs). The step-out sampling procedure for soil is described below:

- The first step-out boring will be placed 10 ft from the initial sample location. The soil sample will be retrieved from this boring at a depth corresponding to the depth of the sample from the initial boring that contained the elevated COC concentration(s).
- If the first step-out boring yields concentrations of COCs in excess of the screening criteria, a second step-out boring will be placed no greater than 50 ft from the first step-out boring. Soil samples will be retrieved from this boring at a depth corresponding to the depth of the samples from the first step-out boring that contained the elevated COC concentration(s).
- If the second step-out boring yields concentrations of COCs in excess of the screening criteria, a third step-out boring will be placed no greater than 50 ft from the second step-out boring. Soil samples will be retrieved from this boring at a depth corresponding to the depth of the samples from the second step-out boring that contained the elevated COC concentration(s).
- If the second step-out boring yields no detectable concentrations of the COCs, a third boring will be placed at the mid-point between the first and second step-out borings. Soil samples will be retrieved from this boring at a depth corresponding to the depth of the sample(s) from the first step-out boring that contained the elevated COC concentration(s). At the completion of this boring, the lateral extent of contamination will be considered to be well-defined.
- If the third step-out sample reveals a COC concentration greater than the screening criteria, the project team will confer with agency representatives to determine whether further sampling is warranted.

The step-out criteria for soil sampling is also provided in Figure A.5-1. The field geologist may adjust, amend, or terminate step-out boring locations based on obstructions or other site conditions. Additionally, the field geologist may terminate or otherwise amend a portion of the step-out procedure if a step-out boring would overlap with another soil boring.

5.12 GROUNDWATER STEP-DOWN AND STEP-OUT CRITERIA

Groundwater samples will be collected by Hydropunch® methods at various locations at the sites. If the screening criteria (MCLs) for site-specific COCs are exceeded in the initial sampling, additional samples will be required to characterize the vertical and horizontal extent of groundwater contamination above the screening criteria. The following sections describe the step-down and step-out procedures for groundwater sampling.

5.12.1 Groundwater Step-Down Criteria

If initial groundwater samples in the FWBZ yield concentrations of COCs in excess of the screening criteria, step-down groundwater sampling will be performed into the underlying water-bearing zone. The collected samples will be analyzed for the suite of chemicals that contain the COCs from the upper groundwater zone. If the step-down sample yields no detectable concentrations of the COCs, the vertical extent of contamination will be considered to be well-defined. If the step-down sample yields concentrations of COCs in excess of the screening criteria, further step-down sampling will be performed.

The groundwater step-down procedure is also provided in Figure A.5-2. The field geologist may adjust sampling locations based on obstructions or other site conditions. Additionally, the field geologist may terminate or otherwise amend a portion of the step-down procedure if sufficient groundwater data for the COCs exceeding screening criteria are available from previous investigations at the depth of interest within 50 feet of the location.

5.12.2 Groundwater Step-Out Criteria

If groundwater samples contain COC concentrations in excess of the screening criteria (MCLs), step-out sampling will be performed within the groundwater zone. The collected samples will be analyzed for the suite of chemicals that contain the COCs from the previous groundwater sample. The step-out sampling procedure for groundwater is described below:

- The first step-out boring will be placed no greater than 100 ft from the initial groundwater sample location. If the first step-out boring yields no detectable concentrations of the COCs, the lateral extent of contamination in the groundwater zone will be considered to be well-defined.
- If the first step-out boring yields concentrations of COCs in groundwater in excess of the screening criteria, a second step-out boring will be placed no greater than 100 ft from the first step-out boring. If the second step-out boring yields no detectable

concentrations of the COCs, the lateral extent of contamination in the groundwater zone will be considered to be well-defined.

- If the second step-out boring yields concentrations of COCs in excess of the screening criteria, a third step-out boring will be placed no greater than 100 ft from the second step-out boring. If the third step-out boring yields no detectable concentrations of the COCs, the lateral extent of contamination in the groundwater zone will be considered to be well-defined.
- If the third step-out sample reveals a COC concentration in groundwater greater than the screening criteria, the project team will confer with agency representatives to determine whether further step-out sampling is warranted.

The step-out criteria for groundwater sampling are also provided in Figure A.5-3. The field geologist may adjust step-out boring locations based on obstructions or other site conditions. Additionally, the field geologist may terminate or otherwise amend a portion of the step-out procedure if a step-out boring would overlap with another soil boring and/or Hydropunch® location.

5.13 WASTE CHARACTERIZATION SAMPLING

Wastes generated during the field activities that will require sampling may include: (1) drill cuttings, (2) wastewater from monitoring well development and purging, and (3) wastewater from decontamination. Wastes will be stored in appropriate containers on site.

Soil cuttings and wastewater will be sampled at a frequency determined in the field based on quantity and type of containers. Samples will be analyzed for VOCs, SVOCs, pesticides, PCBs, TPH-purgeable, TPH-extractable, and metals. Subsequently, Soluble Threshold Limit Concentration (STLC) and Toxicity Characteristic Leaching Procedure (TCLP) will be added to soil samples as required. Additional analyses may be added as required by the disposal facility. Waste characterization sampling procedures are detailed in Section 6.3.6.

PPE generated from field activities will be stored in containers on site. PPE will not be sampled for waste characterization, but will be characterized based on knowledge of the process generating the waste and the results of the sampling associated with this work.

This page intentionally left blank.

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location*				
2A	9	OWS 410A	Unsaturated soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, and metals [b]	Section 6.3.2
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3
2A	9	OWS 410B	Unsaturated soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, and metals [b]	Section 6.3.2
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3
2A	9	Wash Rack Soil Investigation Locations: S9-B01 S9-B02	Soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, and metals [b]	Section 6.3.2
2A	9	Groundwater Investigation Locations: S9-HP01 S9-HP02 S9-HP02 S9-HP04 S9-HP05 S9-HP06 S9-HP07 S9-HP08 S9-HP09	Water	15	VOCs, SVOCs, TPH-purgeable, TPH-extractable, PCBs, dissolved metals [b], and natural attenuation parameters [d]	Section 6.3.3

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location*				
		MWs to include: M09-06 MW410-2 MW410-3 P-9-MWI-04 P-9-MWI-05 P-9-MWS-02 S9-TT-MW-01 S9-TT-MW02D S9-TT-MW03	Water	Midscreen	VOCs, SVOCs, TPH-purgeable, TPH-extractable, PCBs, dissolved metals [b], microbial [c,e], and natural attenuation parameters [d, e]	Section 6.3.4
2A	9	MWs for rebound sampling of chemical oxidation pilot test wells: DVE 19 F9SMW03 DVE 17 P-9-MWS-04 9IF-MW02U P-9-MWI05 9IF-MW01L P-9-MWI06 9EMW04	Water	Midscreen	VOCs, hexavalent chromium, and field test kits for hydrogen peroxide and ferrous iron	Section 6.3.4
2A	13	AOC 009	Unsaturated soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, and metals [b]	Section 6.3.2
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location*				
2A	13	Previous Borings B13-28 thru B13-32, B13-41, and B-IMF-06 Soil Investigation Locations: S13-B16 S13-B17 S13-B18 S13-B19 S13-B20 S13-B21 S13-B22 S13-B23 S13-B24 S13-B25* (vadose only) S13-B26 S13-B27 S13-B28 S13-B29 S13-B30 S13-B31	Soil	1 / 5	Metals [b]	Section 6.3.2

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location*				
2A	13	Incinerator Soil Investigation Locations: S13-B01 S13-B02 S13-B03 S13-B04 S13-B05 S13-B06 S13-B07 S13-B08 S13-B09 S13-B10 S13-B11 S13-B12 S13-B13 S13-B14 S13-B15	Soil	1, 5	VOCs, SVOCs, and metals[b]	Section 6.3.2
2A	13	Groundwater Investigation Locations: S13-HP01 S13-HP02 S13-HP03 S13-HP04	Water	15	VOCs, SVOCs, TPH-purgeable, TPH-extractable, dissolved metals[b], and natural attenuation parameters[d]	Section 6.3.3

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location*				
2A	13	MWs to include: CA13-01 M07C-06 M13-06 M13-07 M13-09 MWOR-3 MWOR-4 S13-TT-MW01	Water	Midscreen	VOCs, SVOCs, TPH-purgeable, TPH-extractable, dissolved metals [b], microbial parameters [c, e], and natural attenuation parameters [d, e]	Section 6.3.4
2A	19	Yard D-13 Soil Investigation Locations: S19-B01 S19-B02 S19-B03 S19-B04 S19-B05 S19-B06 S19-B07 S19-B08 S19-B09	Soil	1, 5	VOCs, SVOCs, metals [b]	Section 6.3.2
2A	19	Groundwater Investigation Locations: S19-HP01 S19-HP02	Water	15	VOCs, SVOCs, TPH-purgeable, TPH-extractable, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3
2A	19	MWs to include: M13-P MWD13-3 MWD13-4 S19-TT-MW01	Water	Midscreen	VOCs, SVOCs [e], TPH-purgeable, TPH-extractable, dissolved metals [b], microbial parameters [c, e], and natural attenuation parameters [d, e]	Section 6.3.4
2A	22	OWS 547	Unsaturated soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, and metals [b]	Section 6.3.2

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location*				
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3
2A	22	Previous Borings 547-5, 547-6, and 547-11 Soil Investigation Locations: S22-B01 (no vadose) S22-B02 (no vadose) S22-B03 (no vadose) S22-B04 S22-B05 S22-B06 S22-B07 S22-B08 S22-B09	Soil	1 / 5	Metals [b]	Section 6.3.2
2B	3	Building 112 Soil Investigation - Exterior Locations: S3-B01 S3-B02 S3-B03 S3-B04 S3-B05	Soil	1, 5	VOCs, SVOCs, PCBs, and metals [b]	Section 6.3.2
2B	3	Building 112 Soil Investigation – Interior Locations: S3-B06 S3-B07	Soil	1, 5	VOCs and metals [b]	Section 6.3.2
2B	4	OWS 163	Unsaturated soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, and metals [b]	Section 6.3.2
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.2

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location[*]				
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3
2B	4	OWS 360	Unsaturated soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, and metals [b]	Section 6.3.2
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3
2B	4	OWS 372A	Unsaturated soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, and metals [b]	Section 6.3.2
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3
2B	4	AST 360E	Unsaturated soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, and metals [b]	Section 6.3.2
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3
2B	4	AOC 372/SWMU 372	Unsaturated soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, and metals [b]	Section 6.3.2
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3
2B	4	NADEP GAP 59	Unsaturated soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, and metals [b]	Section 6.3.2
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3
2B	4	Building 163 Soil Investigation Locations S4-B17 S4-B18	Soil	1, 5	VOCs	Section 6.3.2

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location*				
2B	4	Building 372 PCB Soil Investigation Locations: S4-B19 S4-B20 S4-B21 S4-B22 S4-B23 S4-B24 S4-B25 S4-B26 S4-B27	Soil	1, 5	PCBs	Section 6.3.2
2B	4	Building 360 Storm Drain Investigation Locations: S4-B13 S4-B14 S4-B15 S4-B16 S4-B28 S4-B29 S4-B30 S4-B31	Soil	6	VOCs, SVOCs, PCBs, and metals [b]	Section 6.3.2

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location*				
2B	4	Building 360 Metals Investigation Locations: S4-B01 S4-B02 S4-B03 S4-B04 S4-B05 S4-B06 S4-B07 S4-B08 S4-B09 S4-B10 S4-B11 S4-B12	Soil	0, 3, 6	Metals [b] and hexavalent chromium	Section 6.3.2
2B	11	OWS 014A	Unsaturated soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, and metals [b]	Section 6.3.2
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3
2B	11	OWS 014B	Unsaturated soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, and metals [b]	Section 6.3.2
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3
2B	11	OWS 014C	Unsaturated soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, and metals [b]	Section 6.3.2
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3
2B	11	OWS 014D	Unsaturated soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, and metals [b]	Section 6.3.2
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location*				
2B	11	OWS 014E	Unsaturated soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, and metals[b]	Section 6.3.2
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters[c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals[b], microbial parameters[c], and natural attenuation parameters[d]	Section 6.3.3
2B	11	UST 14-4	Unsaturated soil	5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, and metals[b]	Section 6.3.2
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters[c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals[b], microbial parameters[c], and natural attenuation parameters[d]	Section 6.3.3
2B	11	Building 265 Soil Investigation Locations: S11-B09 S11-B10	Soil	1, 5	VOCs, SVOCs, PCBs, and metals[b]	Section 6.3.2
2B	11	Building 118 Soil Investigation Locations: S11-B06 S11-B07 S11-B08	Soil	1, 5	PCBs and metals[b]	Section 6.3.2
2B	11	Previous Boring M11-03 Soil Investigation Locations: S11-B02 S11-B03 S11-B04 S11-B05	Soil	0.5 / 2.5	Metals[b]	Section 6.3.2
2B	11	Building 14 Soil Investigation Location: S11-B01	Soil	1, 5	VOCs	Section 6.3.2
2B	21	NADEP GAP 44	Unsaturated soil	1, 5	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, and metals[b]	Section 6.3.2

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location*				
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3
2B	21	NADEP GAP 76	Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3
2B	21	NAS GAP 11	Unsaturated soil	1	VOCs, SVOCs, TPH-purgeable, TPH-extractable, and metals [b]	Section 6.3.2
			Saturated soil	FWBZ	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.2
			Groundwater	FWBZ	VOCs, SVOCs, TPH-purgeable, TPH-extractable, pesticides, PCBs, dissolved metals [b], microbial parameters [c], and natural attenuation parameters [d]	Section 6.3.3
2B	21	Previous Boring 126-002-003 Soil Investigation Locations: S21-B11 S21-B12 S21-B13	Soil	0.5 / 3	Metals [b]	Section 6.3.2
2B	21	Building 113 Soil Investigation Location: S21-B14	Soil	1, 5	VOCs	Section 6.3.2

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES
(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location*				
2B	21	Building 162 Soil Investigation Locations: S21-B15 S21-B16 S21-B17 S21-B18 S21-B19 S21-B20 S21-B21 S21-B22 S21-B23 S21-B24 S21-B25 S21-B26	Soil	1, 5	VOCs	Section 6.3.2
2B	21	Buildings 398 Soil Investigation Locations: S21-B01 S21-B02 S21-B03 S21-B04 S21-B05 S21-B06 S21-B07 S21-B08 S21-B09 S21-B10	Soil	1, 5	Metals [b]	Section 6.3.2
2B	FWBZ Groundwater Investigation		Water	6-10	VOCs, TPH-purgeable, TPH-extractable, dissolved metals [b], and microbial parameters [c, e]	Section 6.3.3

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location*				
		Locations: S3-HP01 S3-HP02 S3-HP03 S3-HP04 S21-HP01 S21-HP02 S21-HP03 S21-HP04 S21-HP05 S21-HP06				

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location*				
	SWBZ Groundwater Investigation Locations: S3-HP05 S3-HP06 S4-HP01 S4-HP02 S4-HP03 S4-HP04 S4-HP05 S4-HP06 S4-HP07 S4-HP08 S4-HP09 S4-HP10 S4-HP11 S4-HP12 S11-HP01 S11-HP02 S11-HP03 S11-HP04 S11-HP05 S21-HP07 S21-HP08 S21-HP09 S21-HP10 S21-HP11 S21-HP12		Water	15,25,35,45,55	VOCs, TPH-purgeable, TPH-extractable, dissolved metals [b], microbial parameters [c, e], and natural attenuation parameters [d, e]	Section 6.3.3

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location*				
		New SWBZ MWs S4-TT-MW02 S4-TT-MW03 S11-TT-MW01 S21-TT-MW01 S21-TT-MW02 S21-TT-MW03 S21-TT-MW04 S21-TT-MW05 S21-TT-MW06 S21-TT-MW07 S21-TT-MW08 S21-TT-MW09	Soil	25	TOC, grain size, bulk density, and microbial parameters [c]	Section 6.3.3
	3	MWs to include: S3-TT-MW01 M03-04	Water	Midscreen	VOCs, TPH-purgeable, TPH-extractable, dissolved metals [b], microbial parameters [c, e], and natural attenuation parameters [d, e]	Section 6.3.4

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location*				
	4	MWs to include: D03-02 D03-03 D03-04 D04-02 D04-03 M03-06 M03-10 M03-12 M03-13 M04-07 MW360-1 MW360-2 MW360-4 PP41MW01 PP41MW03 PP41MW08 S4-TT-MW02 S4-TT-MW03	Water	Midscreen	VOCs, TPH-purgeable, TPH-extractable, dissolved metals [b], microbial parameters [c, e], and natural attenuation parameters [d, e]	Section 6.3.4
	11	MW to include: D11-01 M03-15 M03-16 OU2B-MW-01 S11-TT-MW01 S11-TT-MW02 S11-TT-MW03 S11-TT-MW04 S11-TT-MW05	Water	Midscreen	VOCs, TPH-purgeable, TPH-extractable, dissolved metals [b], microbial parameters [c, e], and natural attenuation parameters [d, e]	Section 6.3.4

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

Sampling Location			Matrix	Depth[a] (ft bgs)	Analytical Group	SAP Section
OU	Site	Location*				
	21	MWs to include: M11-06 S21-TT-MW01 S21-TT-MW02 S21-TT-MW03 S21-TT-MW04 S21-TT-MW05	Water	Midscreen	VOCs, TPH-purgeable, TPH-extractable, dissolved metals [b], microbial parameters [c, e], and natural attenuation parameters [d, e]	Section 6.3.4

Notes:

* All sampling locations (except for monitoring wells) may include step-out/down sampling as described in Sections 5.11 and 5.12 of this SAP.

[a] First unsaturated soil sample depth is based on the initial sample depth described in the SAP. Subsequent sample depths are + or - 1 ft and will be determined by the geologist in the field. Saturated soil depth and groundwater sample depth assumes a 10-ft depth to groundwater.

[b] Metals analysis includes the following analytes: antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc.

[c] For site 9 and 19, microbial analysis will include cell counts for Eubacteria (EBAC), Dchalococcoides spp. (DHC), and methanogenic bacteria (MGN) via nucleic acid analysis, and total biomass and microbial community structure via ester-linked phospholipid fatty acid (PFLA). For all other sites, microbial analyses will include qEBAC, qPAH, qNAH and qBSS.

[d] Natural attenuation parameters include field monitoring parameters (dissolved oxygen and oxidation/reduction potential), field test kit analysis (for ferrous iron and carbon dioxide), and laboratory analysis (nitrate, sulfate, and alkalinity). Nutrients include laboratory analysis for ammonia as nitrogen, TKN, and phosphate. (Nitrate is also considered a nutrient.)

[e] Frequency of analyses is listed in Table 3-1 of the Work Plan.

Abbreviations and Acronyms:

AOC – Area of Concern
AST – aboveground storage tank
bgs – below ground surface
BTEX – benzene, toluene, ethylbenzene, and total xylenes
MTBE – methyl tert-butyl ether
OWS – oil-water separator
PAH – polynuclear aromatic hydrocarbons
PCB – polychlorinated biphenyl
SVOC – semi-volatile organic compound
TOC – total organic carbons
TPH – total petroleum hydrocarbons

TABLE A.5-1

SAMPLING LOCATIONS, SAMPLE DEPTHS, SAMPLE ANALYSES, AND SAMPLING PROCEDURES

(UFP-QAPP Worksheet #18)

UST – underground storage tank
VOC – volatile organic compound

6.0 SAMPLING PROCEDURES

The following section describes the field instrument calibration and maintenance procedures, inspection of supplies and consumables, and sample collection procedures.

6.1 FIELD INSTRUMENTATION

Field equipment for this project will include the following:

- A photoionization detector (PID) and/or a flame ionization detector (FID) will be used to determine the presence and concentration of organic vapors. Contaminants such as the volatile petroleum hydrocarbons and benzene are detectable with a PID. The FID would be required to detect some halogenated hydrocarbons.
- A water level meter will be used to measure the water level during groundwater purging.
- A low-flow bladder pump will be used during Hydropunch® groundwater sampling and monitoring well sampling.
- A water quality meter will be used to measure water quality parameters during groundwater purging.

Field equipment will be maintained in accordance with manufacturer's manual specifications. A check of the field equipment will be performed before field activities begin, and any potential spare parts (e.g., batteries, connectors, etc.) and maintenance tools will be brought on site to minimize equipment downtime during field activities. Visual checks of the equipment will be conducted on a daily basis.

Routine preventative maintenance will be performed to ensure proper operation of the equipment. Any maintenance performed on the equipment will be documented on the instrument calibration form or in the field logbook. Information to be recorded includes (as applicable):

- Name of device/instrument repaired, including serial/identification number
- Manufacturer
- Date of rental/purchase
- Date of maintenance
- Reason for maintenance
- Maintenance performed
- Adjustments made (if any)

- Signature of field personnel conducting repair
- Comments

Table A.6-1 lists the field equipment calibration, maintenance, testing, and inspection frequency, acceptance criteria, and corrective action.

6.2 SUPPLIES AND CONSUMABLES

Supplies and consumables necessary for field activities will be obtained through the appropriate commercial markets and will meet any supply-specific requirements outlined in this section. All supplies and consumables will be inspected by field sampling personnel prior to use. Any supplies and consumables that do not meet requirements will be discarded or returned to the supplier.

Supply-specific requirements include the following:

- Sample bottle containers will meet all guidelines specified in *Specification and Guidance for Obtaining Contaminant-Free Sample Containers,* EPA 540/R-93/051 and OSWER Directive 9240.0-05A (EPA, 1992). Certifications from the supplier will be retained in the project files.
- Deionized water will be used as the final step for equipment decontamination. Certification from the supplier will be retained in the project file.
- The laboratory water used for collecting equipment rinsate samples will be certified to be below project QLs. Certification or sampling results from the supplier will be retained in the project files.
- Field instrumentation calibration standards will be of manufacturer specified grade. Certifications from the supplier will be retained in the project file.

Supplies and consumables will be stored, as necessary, in a designated area on the site. The storage area will be protected from adverse conditions (e.g., weather, heat, fuels, etc.) to protect the supplies/consumables from possible outside contamination and breakage.

6.3 SAMPLING PROCEDURES

The types of sampling for this project include the following:

- Grab sampling
- Hand auger
- DPT and Hydropunch®
- Monitoring well sampling using low flow bladder pump

The following sections provide sampling procedures and sample handling protocols for each type of sampling, and Table A.6-2 lists the sample containers, preservatives, and holding time requirements for each analytical method.

6.3.1 OWS Content Sampling Procedures

OWS will be visually inspected for the presence of liquid. A field determination will be made whether or not there is sufficient liquid volume to collect a sample. Liquid samples will be collected as follows.

1. Sample containers for each location will be stored in a cooler and will not be brought out before sample collection. The cooler containing the sample containers will be kept in the shade (if possible) or in the cab of the sampling vehicle with the windows down.
2. Sampling personnel will don a new pair of disposable nitrile gloves immediately before collecting samples at each location.
3. Samples will be collected using disposable bailers into appropriate containers as required by analyses listed in Table A.5-1. Samples will be transferred from the bailers to sample containers as follows:
    a. Once the bailer is retrieved from the container, the small diameter emptying tube (that is supplied with the bailer) will be placed in the bottom of the bailer to dislodge the ball holding the water in the bailer.
    b. As water begins to flow from the tube, it will be carefully collected into a 40-mL VOA vial to minimize aeration by allowing the water to flow down the inside of the vial instead of directly into the bottom of the vial.
    c. The vial will be filled up to the lid until a positive meniscus is formed.
    d. The vial will be capped immediately, but slowly.
    e. The sample will be checked for the presence of air bubbles by inverting the vial and gently tapping the side of the vial.
    f. If an air bubble is present, then the collected sample will be discarded and resampled using a new vial.
    g. The previous steps will be repeated until three air-bubble-free vials are collected.
    h. After collection of the VOA vials, sample collection will continue by placing the larger diameter emptying tube (that is also supplied with the bailer) into the bottom of the bailer.
    i. As the water begins to flow from the tube, glass containers will be collected followed by plastic containers as required by analyses listed in Table A.5-1.
4. Each container will be labeled and clear packing tape will be placed over the label to secure it.

5. Samples will be custody sealed and packaged in accordance with Section 6.6 of this SAP.
6. After packaging, samples will be stored in a cooler with sufficient ice (cooler will be approximately half full of wet ice that is below and above sample containers).
7. Field documentation (including field logbooks and CoCs) will be filled out during sample collection in accordance with Section 4.0.

6.3.2 Grab Soil and Groundwater Sampling Procedures

Grab soil samples will be collected at select sites. Prior to intrusive activities, staff will notify Underground Service Alert to obtain utility clearance. Existing base utility drawings will also be reviewed. In addition, a subcontracted geophysical company will verify the location of underground utilities using a variety of methods, including metal-locating techniques and GPR. Locations in paved areas such as parking lots, oil water separatorsOWS, roads, or floors, will be cored prior to sampling. Soil samples will be collected as follows:

1. Each sample location will be marked with a stake/flag by a surveyor and will have the location number written on it.
2. Sample containers for each location will be stored in a cooler and will not be brought out before sample collection. The cooler containing the sample containers will be kept in the shade (if possible) or in the cab of the sampling vehicle with the windows down.
3. Sampling personnel will don a new pair of disposable nitrile gloves immediately before collecting samples at each location.
4. For some sites, a hand-auger will be used to dig down to the desired sampling depth. If the sample location is not accessible using a hand-auger, then a trowel or equivalent will be used to collect the sample.
5. Once the depth has been accessed, the sampling equipment will be used to collect soil at the desired depth. The soil will be placed into appropriate containers for analyses listed in Table A.5-1. Containers will be filled to minimize headspace.
6. For each VOC analysis (VOCs or TPH-purgeable), three En Core samplers will immediately be collected from the sample container (or from the hand auger bucket, if applicable) as follows:
   a. Holding the coring body, the plunger rod will be pushed down until the small o-ring rests against the tabs. This will ensure that the plunger will move easily.
   b. The locking lever on the En Core T-handle will be depressed. The coring body, with the plunger end first, will be placed into the open end of the T-handle, aligning the slots of the coring body with the locking pins in the T-handle. The coring body will be twisted clockwise to lock the pins in the slots. The sampler will be checked to ensure that it is locked in place. The sampler will now be ready for use.

c. By holding the T-handle, the coring body will be pushed into the soil until the coring body is full. When full, the small o-ring will be centered in the T-handle viewing hole. The sampler will then be removed from the soil and any excess soil will be wiped from the coring body exterior.

d. The coring body will be capped while it is still on the T-handle. The cap should be pushed over the flat area of the ridge. To lock the cap in place, the cap will be pushed and twisted so that it seals the sampler.

e. The capped sampler will be removed by depressing the locking lever on the T-handle while twisting and pulling the sampler from the T-handle.

f. The En Core sampler will be placed in its En Core sampler bag.

g. This procedure will be performed two more times for a total collection of three En Core samplers. All three En Cores will be placed in one En Core sampler bag.

h. A completed sample label will be placed on the outside of the bag.

7. Each container will be labeled and clear packing tape will be placed over the label to secure it.
8. Five percent of locations will require the collection of an MS/MSD. In order to collect an MS/MSD, two additional sets of En Cores and containers will be collected in the same location after the collection of the original sample. One set will be labeled with the same sample number (as the original sample) and "MS," and the other set will be labeled with the same sample number and "MSD." MS/MSD will be noted on the CoC in the QC column for that sample and in the comments column as "RUN MS/MSD".
9. Sample containers will be custody sealed and packaged in accordance with Section 6.6 of this SAP.
10. After packaging, samples will be stored in a cooler with sufficient ice (cooler will be approximately half full of wet ice that is below and above sample containers).
11. Field documentation (including field logbooks and CoCs) will be filled out during sample collection in accordance with Section 4.0.
12. Non-disposable sampling equipment will be decontaminated per Section 6.4 between each sample acquisition, and an equipment rinsate sample will be collected from the sampling equipment at a frequency of one per day. Laboratory reagent-grade water (that is certified to be analyte-free by the supplier) will be used as an additional rinse after Step 4 of the decontamination procedure. Water that is falling off of the equipment will be collected for the same organic and inorganic analyses required by the samples collected for that day. ER (equipment rinsate) will be noted on the CoC in the QC column for that sample.
13. Sample locations will be backfilled with cuttings and the surface will be restored to pre-sample conditions.

At locations where groundwater is encountered, the following procedures for groundwater sample collection will be followed:

1. Sampling personnel will don a new pair of disposable nitrile gloves immediately before collecting samples at each location.
2. Sample containers for each location will be stored in a cooler and will not be brought out before sample collection. The cooler containing the sample containers will be kept in the shade (if possible) or in the cab of the sampling vehicle with the windows down.
3. A length of 1-inch-diameter slotted polyvinyl chloride (PVC) screen and casing will be inserted into the boring.
4. Sample containers will be brought out of the cooler, the caps will be loosened, and placed on plastic sheeting. Solar warming of the sample containers will be avoided as much as possible. Filling of sample containers will be conducted over a 5-gallon bucket on plastic sheeting to contain any spills.
5. A groundwater sample will be collected from the PVC casing using a low-flow bladder pump. The samples will be collected directly from the end of the pharmaceutical-grade tubing from the discharge end of the pump. Filling of sample bottles will be conducted over a 5-gallon bucket on plastic sheeting to contain any spills. Groundwater sampling and preservation procedures will be conducted as follows:
    - The pump tubing will be completely full of groundwater (no bubbles) to prevent the groundwater from being aerated as it flows through the tubing. Tubing will not touch vials during sampling.
    - Prior to collecting samples for VOCs, the pump flow rate will be reduced to between 100 and 200 milliliters per minute (mL/min) such that a steady stream of water exists. Volatile organic analysis (VOA) vials will be filled by initially tilting the vials, allowing the pump discharge to flow gently down the inside of the vial with minimal turbulence. Each vial will be filled until a positive meniscus is formed at the top of the VOA vial. After the vial is full, it will be capped immediately, inverted, tapped lightly, and checked for the presence of air bubbles. If air bubbles are present, the sample will be discarded and resampled using a new vial.
    - Subsequently, other organic and inorganic analyses will be collected as required in the following order: TPH-extractable, SVOCs, SVOCs by SIM, pesticides, PCBs, natural attenuation parameters, dissolved metals, and microbial parameters. The pump flow rate may be increased up to 500 mL/min to collect these containers or a low-flow Grundfos pump, peristaltic pump, or bailer may be used to collect non-volatile samples. For dissolved metals, the sample will be collected through an in-line 0.45 micron filter. For microbial parameters, 1-L 1 liter of water will be passed thru through an in-line filter (for quantitative polymerase chain reaction [Q-PCR] analysis) and

2-L 2 liters of water will be passed through an in-line filter (for phospholipids fatty acids [PLFA] analysis).

6. Ten percent of locations will require the collection of a field duplicate if there is sufficient water present, which will be documented in the field logbook. In order to collect a field duplicate, one additional set of sample containers will be collected in the same location after the collection of the original sample. The field duplicate (FD) will be identified with a unique sample number, and FD will be noted on the CoC in the QC column for that sample. (The QC column is not part of the CoC submitted to the laboratory; therefore, the identity of the FD will not be revealed.)
7. Five percent of locations will require the collection of an MS/MSD if there is sufficient water present, which will be documented in the field logbook. In order to collect an MS/MSD, two additional sets of sample containers will be collected in the same location after the collection of the original sample. One set will be labeled with the same sample number (as the original sample) and "MS," and the other set will be labeled with the same sample number and "MSD." MS/MSD will be noted on the CoC in the QC column for that sample and in the comments column as "RUN MS/MSD".
8. Each container will be labeled and clear packing tape will be placed over the label to secure it.
9. Sample containers will be custody sealed and packaged in accordance with Section 6.6 of this SAP.
10. After packaging, samples will be stored in a cooler with sufficient ice (cooler will be approximately half full of wet ice that is below and above sample containers).
11. Field documentation (including field logbooks and CoCs) will be filled out during sample collection in accordance with Section 4.0.
12. A new length of PVC screen and new tubing for the low-flow bladder pump will be used between each sampling location.
13. Non-disposable sampling equipment will be decontaminated per Section 6.4 between each sample acquisition, and an equipment rinsate sample will be collected from the low-flow bladder pump at a frequency of one per day. Laboratory reagent-grade water (that is certified to be analyte-free by the supplier) will be used as an additional rinse after Step 4 of the decontamination procedure. Water that is falling off of the equipment will be collected for the same organic and inorganic analyses required by the samples collected for that day. ER (equipment rinsate) will be noted on the CoC in the QC column for that sample.

6.3.3 DPT and Hydropunch® Sampling Procedures

Continuous soil cores and groundwater samples will be collected in the FWBZ at select sites using a DPT rig. Prior to intrusive activities, Underground Service Alert will be notified to obtain utility clearance. Existing base utility drawings will be reviewed if available. A subcontracted geophysical company will verify the location of underground utilities in the investigation areas using a variety of methods, including metal-locating techniques and GPR.

Two borings will be advanced at each proposed FWBZ sampling location. The first boring will be continuously cored to (1) log the geology, and (2) collect soil samples for field screening and chemical and physical analysis. The second boring, located no more than 5 ft from the first boring (pending site-specific conditions), will be used to collect a groundwater sample using Hydropunch® sampling equipment.

Access through concrete-paved areas will be gained by coring through the pavement. Access through asphalt-paved areas will be gained using a DPT rig. A hand-auger, the same diameter as the sampling equipment, will be used to clear each boring to 5 ft bgs to avoid underground utilities and/or obstructions. Samples of hand-auger cuttings will be collected in 2.5-ft increments and will be field screened and logged for lithology.

At each location, the first boring will be advanced, using a DPT rig and the Geoprobe® DT325 dual tube sampling system (or equivalent), through the FWBZ (the artificial fill). Artificial fill thickness ranges from approximately <1 to 8 ft depending on site location. The artificial fill may lie on top of the Marsh Crust, an organic rich peat and grass layer forming the uppermost portion of the BSU. The BSU, which acts as an aquitard between the FWBZ and the SWBZ, is present at OU-2A Sites 9, 13, 19 and 23 and at OU-B Sites 3, 4, 11, and 21. Prior to field activities, the top and base of the BSU will be mapped using all available geologic data.

Soil cores will be collected using a DPT rig. The DPT rig will push the Geoprobe® DT325 dual tube sampling system or the equivalent into the ground by percussive hammering, hydraulic pushing or static pushing. An outer tube and inner soil-coring liner will be simultaneously advanced. The outer tube serves to hold back formation material while the inner liner is retrieved and soil samples are extracted. The outer tube typically consists of nominal 3¼-inch-diameter, steel, flush-threaded rods typically 3 to 5 ft in length. An inner clear PVC liner or equivalent is fitted inside the outer tube. The liner is typically as long as the outer tube and contains an integrated core catcher. The dual tube sampling system is advanced into the formation filling the PVC liner or equivalent. The liner is retrieved with an inner rod string. A new liner and additional length of inner rod is added and the liner is lowered to the bottom of the outer tube. An additional length of outer tube is added and the dual tube sampling system is advanced until the bottom of the artificial fill is reached. The outer casing will be left in place until after groundwater samples are collected from a second boring located no more than 5 ft from the first boring (pending site-specific conditions).

The soil cores in the recovered PVC liners or equivalent will be logged in accordance with the Unified Soil Classification System (USCS) visual-manual procedure (Howard, 1986) and Munsell® (GretagMacbeth, 1994) soil chart. Soil core samples will be collected and field-screened for organic vapors using PID headspace analysis in accordance with the following procedures:

- The PVC liners or equivalent will be retrieved and sliced open to expose the soil core. One half of the soil core will be immediately placed in a clean plastic bag, sealed, labeled, and placed on ice in a cooler. The other half of the core (exposed) will be initially screened by passing a PID approximately 1 inch from the surface of the core. PID readings will be recorded in the field logbook and on the boring log.
- Head space field screening increments will be based on initial PID readings, lithology, color change, odor, or staining. A portion of the core sample will be placed in a clean, plastic resealable bag. The bag will be filled approximately one-half with soil, leaving one-half empty.
- After a minimum of 5 minutes, the bag will be pierced with the probe of the PID, and the probe will be inserted into the bag to sample the headspace.
- Field screening readings and ambient background readings will be recorded in the field logbook and on the boring log at the appropriate interval.

After core logging and field screening, soil samples will be collected for chemical and/or physical testing. Soil samples will be collected as follows:

1. Sampling personnel will don a new pair of disposable nitrile gloves immediately before collecting samples at each location.
2. Sample containers for each location will be stored in a cooler and will not be brought out before sample collection. The cooler containing the sample containers will be kept in the shade (if possible) or in the cab of the sampling vehicle with the windows down.
3. A disposable plastic scoop will be used to remove an inch of soil within the PVC liner prior to sampling.
4. For VOC analysis, En Core samplers will be collected directly from the PVC liner as described in Steps 6a through 6h of Section 6.3.2.
5. The scoop will then be used to dig up soil to fill containers as required by analyses listed in Table A.5-1 with soil directly from the split PVC liner.
6. Five percent of locations will require the collection of an MS/MSD. In order to collect an MS/MSD, two additional sets of En Cores and containers will be collected in the same location after the collection of the original sample. One set will be labeled with the same sample number (as the original sample) and "MS," and the other set will be labeled with the same sample number and "MSD." MS/MSD will be noted on the CoC in the QC column for that sample and in the comments column as "RUN MS/MSD".
7. Each container will be labeled and clear packing tape will be placed over the label to secure it.
8. Sample containers will be custody sealed and packaged in accordance with Section 6.6 of this SAP.
9. After packaging, samples will be stored in a cooler with sufficient ice (cooler will be approximately half full of wet ice that is below and above sample containers).

10. Field documentation (including field logbooks and CoCs) will be filled out during sample collection in accordance with Section 4.0.

11. Non-disposable sampling equipment will be decontaminated per Section 6.4 between each sample acquisition, and an equipment rinsate sample will be collected from the soil coring equipment at a frequency of one per day. Laboratory reagent-grade water (that is certified to be analyte-free by the supplier) will be used as an additional rinse after Step 4 of the decontamination procedure. Water that is falling off of the equipment will be collected for the same organic and inorganic analyses required for the samples collected for that day. ER will be noted on the CoC in the QC column for that sample.

At each FWBZ sampling location, a second boring will be advanced to collect groundwater samples from the same depth intervals as the soil samples that were collected. Groundwater samples will be collected using a DPT rig and Hydropunch® sampler. The second boring will be located no more than 5 ft from the first boring (pending site-specific conditions). The following steps summarize the sampling procedures.

1. Sampling personnel will don a new pair of disposable nitrile gloves immediately before collecting samples at each location.
2. Sample containers for each location will be stored in a cooler and will not be brought out before sample collection. The cooler containing the sample containers will be kept in the shade (if possible) or in the cab of the sampling vehicle with the windows down.
3. The DPT rig will be used to drive the Hydropunch® sampling equipment to the desired sampling depth. The Hydropunch® sampling system will consist of a ¾-inch-inside-diameter PVC-slotted screen, 3 to 5 ft in length, attached to a metal, conical drive tip. The screen will be housed inside a 2-inch-outside-diameter drive casing.
4. When the Hydropunch® sampler reaches the sampling depth (straddling the depth of the corresponding soil sample interval), the drive casing will be retracted, exposing the 3- to 5-ft Hydropunch® screen interval to the saturated formation.
5. The Hydropunch® screen interval will be developed using a low-flow bladder pump until the following conditions have been met or a maximum of 1 hour of pumping time has elapsed:
    - Turbidity has stabilized to less than 50 nephelometric turbidity units (NTUs)
    - Consecutive readings are within +/-5 percent for conductivity, within +/-0.2 units for pH, and +/-1 degree Celsius for temperature
6. Development parameters and approximate water volumes will be recorded on the Groundwater Sampling Data Sheet (GSDS) every 3 to 5 minutes. Field instruments for measurement of water parameters including temperature, pH, turbidity, and conductivity will be calibrated prior to use.

7. Once the field parameters have stabilized, gloves worn during purging activities will be discarded, a new pair of nitrile gloves will be donned, the sample containers will be brought out, and the caps will be loosened and placed on plastic sheeting. Solar warming of the sample bottles will be avoided as much as possible. The pharmaceutical-grade tubing connecting the low-flow bladder pump discharge to the water-quality meter flow-through cell will be disconnected from the flow-through cell. The samples will be collected directly from the end of the pharmaceutical-grade tubing. The pump will not be turned off, and the tubing will not be removed from the well between purging and sampling. Filling of sample bottles will be conducted over a 5-gallon bucket on plastic sheeting to contain any spills. Groundwater sampling and preservation procedures will be conducted as follows:

    - The pump tubing will be completely full of groundwater (no bubbles) to prevent the groundwater from being aerated as it flows through the tubing. Tubing will not touch vials during sampling.
    - Prior to collecting samples for VOCs, the pump flow rate will be reduced to between 100 and 200 mL/min such that a steady stream of water exists. The sampling rate will be recorded on the GSDS.
    - VOA vials will be filled by initially tilting the vials, allowing the pump discharge to flow gently down the inside of the vial with minimal turbulence. Each vial will be filled until a positive meniscus is formed at the top of the VOA vial. After the vial is full, it will be capped immediately, inverted, tapped lightly, and checked for the presence of air bubbles. If air bubbles are present, the sample will be discarded and resampled using a new vial.
    - Subsequently, other organic and inorganic analyses will be collected as required in the following order: TPH-extractable, SVOCs, SVOCs by SIM, pesticides, PCBs, natural attenuation parameters, dissolved metals, and microbial parameters. The pump flow rate may be increased up to 500 mL/min to collect these containers or a low-flow Grundfos pump, peristaltic pump, or bailer may be used to collect non-volatile samples. For dissolved metals, the sample will be collected through an in-line 0.45 micron filter. For microbial parameters, 1-L of water will be passed thru through an in-line filter (for Q-PCR analysis) and 2-L of water will be passed through an in-line filter (for PLFA analysis).

8. Ten percent of locations will require the collection of a field duplicate if there is sufficient water present, which will be documented in the field logbook. In order to collect a field duplicate, one additional set of containers will be collected in the same location after the collection of the original sample. The field duplicate will be identified with a unique sample number, and "FD" will be noted on the CoC in the QC column for that sample. (The QC column is not part of the CoC submitted to the laboratory; therefore, the identity of the FD will not be revealed.)

9. Five percent of locations will require the collection of an MS/MSD if there is sufficient water present, which will be documented in the field logbook. In order to collect an MS/MSD, two additional sets of sample containers will be collected in the same location after the collection of the original sample. One set will be labeled with

the same sample number (as the original sample) and "MS," and the other set will be labeled with the same sample number and "MSD." MS/MSD will be noted on the CoC in the QC column for that sample and in the comments column as "RUN MS/MSD".

10. Each container will be labeled and clear packing tape will be placed over the label to secure it.
11. Samples will be custody sealed and packaged in accordance with Section 6.6 of this SAP.
12. After packaging, samples will be stored in a cooler with sufficient ice (cooler will be approximately half full of wet ice that is below and above sample containers).
13. Field documentation (including field logbooks and CoCs) will be filled out during sample collection in accordance with Section 4.0.
14. A new length of PVC screen and new tubing for the low-flow bladder pump will be used between each sampling location.
15. Non-disposable sampling equipment will be decontaminated per Section 6.4 between each sample acquisition, and an equipment rinsate sample will be collected from the Hydropunch® and low-flow bladder pump at a frequency of one per day. Laboratory reagent-grade water (that is certified to be analyte-free by the supplier) will be used as an additional rinse after Step 4 of the decontamination procedure. Water that is falling off of the equipment will be collected for the same organic and inorganic analyses required by the samples collected for that day. ER will be noted on the CoC in the QC column for that sample.

After completing groundwater sampling at each DPT location, the Hydropunch® boring, followed by the soil core boring, will be properly decommissioned. Boring abandonment will occur in this order to eliminate the possibility of bentonite-cement grout migrating from the soil core boring and impacting groundwater sample quality. The Hydropunch® borings will be backfilled after the last (deepest) groundwater sample is collected. The soil core boring will be backfilled from the bottom with a bentonite-cement slurry using a tremie pipe as the outer tube is removed. The ground surface will be restored to pre-boring conditions.

6.3.4 Monitoring Well Sampling Procedures

Groundwater monitoring well installation and development for the FWBZ and SWBZ is described in Sections 5.9 through 5.11 of the Work Plan.

Groundwater monitoring will be conducted for four quarters. Existing and newly installed monitoring wells will be sampled each quarter and analyzed for constituents described in Table A.5-1. Groundwater samples will be collected from the new monitoring wells no sooner than 72 hours following development of the last well.

Groundwater sampling procedures are as follows:

1. After removing the well cap and allowing the well to equilibrate, the headspace of the well at the rim of each well casing and above the well casing in the breathing zone will be measured for VOCs using a calibrated PID. All readings will be recorded on the low-flow GSDS. The PID will be calibrated daily according to the manufacturer's specifications, using current (unexpired) standards.
2. The well will be measured (to nearest 0.01 ft) relative to a known surveyed reference point.
3. To ensure accuracy, the well will be measured three times. The probe will be lowered slowly into the well until the light or sound alarm is activated, indicating that the probe has touched the water surface. The static depth-to-water will be read directly from the tape by holding the tape to the surveyed reference point on the well casing. Water level measurements should be within 0.01 ft of each other. If they are not, the process will be repeated until measurements are within 0.01 ft of each other, thus allowing the well to stabilize. For consistency, depth-to-water measurements will be recorded to two decimal places. The three measurements, time, and calculated average measurement for each well will be recorded on the GSDS. The depth to the bottom of the well will not be measured at this time (to avoid disturbing any sediment that may have accumulated).
4. The condition of the well will be checked for any damage or evidence of tampering. Information will be recorded on the GSDS.
5. Groundwater sampling at monitoring wells will be conducted using the low-flow purge and sampling method, as defined in Steps 9 and 10 of these procedures. Disposable nitrile gloves will be worn during all purging and sampling activities. Nitrile gloves will be disposed after purging activities, and a new pair will be donned before sampling each well to avoid possible contamination. All monitoring, purging, and sampling equipment will be placed on polyethylene sheeting on the ground around the well. Sample collection bottles for each well will be left in the laboratory-supplied styrofoam vial cubes in a closed dry cooler (without ice) and will not be brought out before sample collection. The cooler containing sample bottles will be kept in the shade (if possible) or in the cab of the sampling vehicle with the windows down.
6. The screen interval will be determined from the construction logs. High-density polyethylene (HDPE) tubing will be measured with a cloth measuring tape, marked, and cut prior to being attached to the bladder pump. Care will be taken not to allow the tubing to touch the ground surface during measurement. The pump intake will be lowered into the well to the midpoint of the screen interval. The depth of the pump intake will be recorded on the GSDS. Care will be taken to place the pump intake more than 2 ft above the bottom of the well to avoid mobilization of any sediment present in the bottom.
7. The depth–to-water will be measured (to nearest 0.01 ft) again after lowering the pump into the well. The information will be recorded on the GSDS. The water level indicator probe will be left in the monitoring well above the water level.

8. The top end of the pump discharge tubing will be attached to the bottom end of a water-quality meter flow-through cell. The discharge tubing (if required) from the top end of the flow-through cell will be directed into a 5-gallon bucket to collect the groundwater during purging activities.

9. Personnel will start pumping the well at 200 to 500 mL/min. The water level in the well will be checked, and the discharge rate of the pump will be measured by using a graduated cylinder and stopwatch every minute for the first 5 minutes. All readings will be recorded in the field notebook. Ideally, the pumping rate should be equal to the recharge rate with little or no water level drawdown (drawdown should be less than 0.33 ft). The water level, discharge rate, and water quality indicator parameters will be measured and recorded on the GSDS every 3 to 5 minutes during purging.

10. There should be at least 1 ft of water over the tubing intake so that there is no risk of the suction being broken. Breaking the suction could entrap air in the sample. If necessary, pumping rates will be reduced to the minimum capability of the pump (100 to 200 mL/min) to avoid purging the well dry. Under no circumstances will the well be pumped dry. If a stabilized drawdown in the well cannot be maintained at less than 0.33 ft, and the water level is approaching the pump intake, the flow rate will be reduced. If drawdown cannot be maintained at less than 0.33 ft, the well will be allowed to recover. The depth to water and the time for well recovery will be measured and recorded in a field notebook. Once groundwater in the well has recovered, groundwater sampling will begin.

11. During purging activities, the tubing will be checked for air bubbles.

12. Once the flow-rate has been established, water quality parameters will be recorded. Temperature, pH, turbidity, specific conductance, oxidation reduction potential (ORP), and dissolved oxygen (DO) will be monitored during purging approximately every 3 to 5 minutes with a calibrated water-quality meter calibrated to the manufacturer's specifications using current (unexpired) standards. A 2-point calibration procedure will be conducted on each water-quality meter, if appropriate, twice a day (morning and afternoon) to account for temperature variance. Calibration results will be documented on the Field Calibration Form. A flow-through cell will be used to monitor the water-quality indicator parameters. Turbidity will be monitored using a LaMott 2020 turbidity meter.

13. Groundwater will be purged until indicator parameters have stabilized (or well has recovered from drawdown). The well will be considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings, as follows:

    - Consecutive readings within ± 0.1 standard units for pH
    - Consecutive readings within ± 1 degree Celsius for temperature
    - Consecutive readings within ± 10 percent for turbidity (when turbidity is greater than 10 NTUs)
    - Consecutive readings within ± 3 percent microohms per centimeter for specific conductance

- Consecutive readings within ± 10 millivolts for ORP
- Consecutive readings within ± 0.3 for DO (in units of milligrams per liter [mg/L])

14. Bottles for the specific well to be sampled will be pre-labeled as much as possible during purging activities. To ensure accuracy, the date and time of sampling will not be filled out prior to sampling. If the team consists of two people, one teammate will label while the other teammate monitors the indicator parameters.
15. Once the field parameters have stabilized, gloves worn during purging activities will be discarded, a new pair of nitrile gloves will be donned, the collection bottles for the specific well will be brought out, the caps will be loosened, and the bottles will be placed on plastic sheeting. Solar warming of the sample bottles will be avoided as much as possible. The tubing connecting the bladder pump discharge to the water-quality meter flow-through cell will be disconnected from the flow-through cell. The samples will be collected directly from the end of the tubing. The pump will not be turned off or removed from the well between purging and sampling. Filling of sample bottles will be conducted over the plastic sheeting to contain any spills. Groundwater sampling and preservation procedures will be conducted as follows:
    - The pump tubing will be completely full of groundwater (no bubbles) to prevent the groundwater from being aerated as it flows through the tubing. Tubing will not touch vials during sampling.
    - Prior to collecting samples for VOCs, the pump flow rate will be reduced to between 100 to 200 mL/min such that a steady stream of water exists. The sampling rate will be recorded on the GSDS.
    - VOA vials will be filled by initially tilting the vials, allowing the pump discharge to flow gently down the inside of the vial with minimal turbulence. Each vial will be filled until a positive meniscus is formed at the top of the VOA vial. After the vial is full, it will be capped immediately, inverted, tapped lightly, and checked for the presence of air bubbles. If air bubbles are present, the sample will be discarded and resampled using a new vial.
    - Subsequently, other organic and inorganic analyses will be collected as required in the following order: TPH-extractable, SVOCs, SVOCs by SIM, pesticides, PCBs, natural attenuation parameters, dissolved metals, and microbial parameters. The pump flow rate may be increased up to 500 mL/min to collect these containers or a low-flow Grundfos pump, peristaltic pump, or bailer may be used to collect non-volatile samples. For dissolved metals, the sample will be collected through an in-line 0.45 micron filter. For microbial parameters, 1-L of water will be passed thru an in-line filter (for Q-PCR analysis) and 2-L of water will be passed through an in-line filter (for PLFA analysis).
16. Ten percent of locations will require the collection of a field duplicate if there is sufficient water present, which will be documented in the field logbook. In order to collect a field duplicate, one additional set of containers will be collected in the same location after the collection of the original sample. The field duplicate will be

identified with a unique sample number, and "FD" will be noted on the CoC in the QC column for that sample. (The QC column is not part of the CoC submitted to the laboratory; therefore, the identity of the FD will not be revealed.)

17. Five percent of locations will require the collection of an MS/MSD if there is sufficient water present, which will be documented in the field logbook. In order to collect an MS/MSD, two additional sets of sample containers will be collected in the same location after the collection of the original sample. One set will be labeled with the same sample number (as the original sample) and "MS," and the other set will be labeled with the same sample number and "MSD." MS/MSD will be noted on the CoC in the QC column for that sample and in the comments column as "RUN MS/MSD".
18. Each container will be labeled and clear packing tape will be placed over the label to secure it.
19. Samples will be custody sealed and packaged in accordance with Section 6.6 of this SAP.
20. Immediately after collection, the samples will be stored in a cooler with sufficient ice (cooler will be approximately half full of wet ice placed below and above sample containers).
21. Field documentation including field logbooks and CoCs will be filled out during sample collection in accordance with Section 4.0.
22. The pump and water level indicator probe will be removed and decontaminated. All equipment will be disassembled, and the used tubing will be placed in a large plastic garbage bag for disposal.
23. Before locking the well, the total well depth (to 0.01 ft) will be measured and recorded on the GSDS. The well will be closed and locked.
24. Non-disposable sampling equipment will be decontaminated per Section 6.4 between each sample acquisition, and an equipment rinsate sample will be collected daily from the low-flow bladder pump. Laboratory reagent-grade water (that is certified to be analyte-free by the supplier) will be used as an additional rinse after Step 4 of the decontamination procedure. Water that is falling off the equipment will be collected for the same organic and inorganic analyses required by the samples collected for that day. "ER" for equipment rinsate will be noted on the CoC in the QC column for that sample.

6.3.5 Waste Characterization Sampling Procedures

Soil cuttings and wastewater will be generated during field activities and will require proper disposal. Soil and wastewater will be stored in containers and sampled as follows.

1. Sampling personnel will don a new pair of disposable nitrile gloves immediately before collecting samples at each location.
2. The top of the drum or other approved container will be carefully opened.

3. Using a new, individually packaged, disposable plastic scoop, grab soil samples will be collected into sample containers as required by analyses listed in Table A.5-1 so as to minimize headspace. En Cores will be collected from one of the containers as described in Section 6.3.2, Step 6.
4. Wastewater samples will be collected using disposable bailers into containers as required by analyses listed in Table A.5-1. Samples will be transferred from the bailers to sample containers as follows:
    a. Once the bailer is retrieved from the container, the small diameter emptying tube (that is supplied with the bailer) will be placed in the bottom of the bailer to dislodge the ball holding the water in the bailer.
    b. As water begins to flow from the tube, it will be collected into a 40-mL VOA vial carefully to minimize aeration by allowing the water to flow down the inside of the vial instead of directly into the bottom of the vial.
    c. The vial will be filled up to the lid until a positive meniscus is formed.
    d. The vial will be capped immediately, but slowly.
    e. The sample will be checked for the presence of air bubbles by inverting the vial and gently tapping the side of the vial.
    f. If an air bubble is present, then the collected sample will be discarded and resampled using a new vial.
    g. The previous steps will be repeated until three air-bubble-free vials are collected.
    h. After collection of the VOA vials, sample collection will continue by placing the larger diameter emptying tube (that is also supplied with the bailer) into the bottom of the bailer.
    i. As the water begins to flow from the tube, glass containers will be collected followed by plastic containers as required by analyses listed in Table A.5-1.
5. Each container will be labeled and clear packing tape will be placed over the label to secure it.
6. Samples will be custody sealed and packaged in accordance with Section 6.6 of this SAP.
7. After packaging, samples will be stored in a cooler with sufficient ice (cooler will be approximately half full of wet ice that is below and above sample containers).
8. Field documentation including field logbooks and CoCs will be filled out during sample collection in accordance with Section 4.0.

6.4 DECONTAMINATION PROCEDURES

Decontamination of hand auger (or trowel or equivalent) sampling equipment will be performed to prevent the introduction of extraneous material into samples, and to prevent cross-contamination between samples. All sampling equipment will be decontaminated by washing with a nonphosphate detergent such as Liquinox™ as follows:

1. The nonphosphate detergent will be diluted with potable water in a bucket as directed by the manufacturer. The equipment will be washed with the nonphosphate detergent and potable water solution.
2. A second bucket with potable water will be used to rinse the equipment.
3. A third bucket with potable water will be used to rinse the equipment again.
4. A fourth bucket with deionized water will be used as a final rinse for the equipment. (Certificates from the supplier demonstrating that the deionized water is analyte-free will be kept in the project files for each lot.)

Decontamination of low-flow bladder pumps and the tip of water level probes will also be performed by washing with a nonphosphate detergent such as Liquinox™ as described above to prevent cross-contamination between sample locations. The flow-through cell and turbidity meter used for groundwater sampling will be decontaminated by rinsing with deionized water.

Decontamination of equipment such as drive casings, sample casings, and Hydropunch® sample equipment will consist of high-pressure, hot-water washing.

Equipment rinsate samples will be applicable to the collection of soil and groundwater samples as described throughout Section 6.3. Laboratory reagent-grade water (certified to be analyte-free by the supplier) will be used as an additional rinse after Step 4. Water falling off the sampling equipment as it is being rinsed will be collected in appropriate sample bottles and analyzed for organic and inorganic analyses as required by the samples collected for that day.

Decontamination water will be collected in containers on site as described in Section 6.0 of the Work Plan.

6.5 SAMPLE NUMBER

Samples will be uniquely designated using a numbering system that identifies the CTO number, OU number, site number, and a sequential number (i.e., 12-OU2A-9-001).

The sample number will be recorded in the field logbook, on the labels, and CoC record at the time of sample collection. A complete description of the sample and sampling conditions will be recorded in the field logbook and referenced using the unique sample identification number.

6.6 SAMPLE PACKAGING AND SHIPMENT

Sample packaging and shipment procedures for this project will conform to Department of Transportation/International Air Transport Association procedures as applicable for packaging.

Immediately after sample labeling, custody seals will be affixed to each sample container. For vials and En Cores, the custody seal will be placed on the outside of the first resealable bag; then the container will be placed in a second resealable bag. This will prevent any contact with the adhesive from the custody seal and the sample. Other sample containers will be placed in double-resealable plastic bags to protect the sample from moisture and to prevent breakage and potential cross-contamination during transportation to the laboratory. All glass sample containers will first be protected with bubble wrap if transported by a commercial carrier. Vials should be wrapped with bubble wrap, then placed in a resealable bag, a custody seal placed over the bag, and then placed in another resealable bag.

Each cooler will be shipped with a temperature blank. A temperature blank is a vial filled with tap water and stored in the cooler during sample collection and transportation. The temperature of the cooler will be recorded by the laboratory on the CoC record immediately upon receipt of the samples.

Sample cooler drain spouts will be taped from the inside and outside of the cooler to prevent any leakage.

Samples transported by a laboratory-assigned courier will be packed in a sample cooler with sufficient ice (cooler will be approximately half full of wet ice that is below and above sample containers). Two custody seals will be taped across the cooler lid: one seal in the front and one seal in the back. The CoC record will be completed and signed by the courier. The cooler and the top two copies (white and pink) of the CoC record will then be released to the courier for transportation to the laboratory.

Samples to be shipped by a commercial carrier will be packed in a sample cooler lined with a plastic bag. Ice will be double-bagged and placed at the bottom of the cooler, one layer of sample containers will be placed on the ice, and more double-bagged ice will be placed on top of the containers. This will be repeated until the cooler is filled with ice as the top layer in the cooler. The CoC record will include the airbill number, and the Received By box will be labeled with the commercial courier's name. The top two copies of the CoC record will be sealed in a double-resealable bag and then taped to the inside of the sample cooler lid. The cooler will be taped shut with strapping tape. Two custody seals will be taped across the cooler lid: one seal in the front and one seal in the back. Clear tape will be applied to the custody seals to prevent accidental breakage during shipment. The pouch for the airbill will be placed on the cooler and secured with clear tape. The airbill will be completed for priority overnight delivery and placed in the pouch. If multiple coolers are being shipped, the original airbill will be placed on the cooler with the CoC record, and copies of the airbill will be placed on the other coolers. The number of packages should be included on each airbill (1 of 2, 2 of 2). Saturday deliveries should be coordinated with the laboratory in advance, and field sampling personnel or their designee must ensure that Saturday delivery stickers are placed on each cooler by the commercial courier. Dangerous goods declarations will also be completed as applicable.

TABLE A.6-1

FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION

(UFP-QAPP Worksheet #22)

Field Equipment	Calibration Activity [a]	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SAP Section [b]
PID/FID	Isobutylene/Methane	Daily [a]	Within manufacturer's recommended value	According to manufacturer's instructions	Project Geologist	Section 6.1
Water quality meter	Calibration standards for pH, turbidity, conductivity, oxidation reduction potential, and dissolved oxygen per manufacturer's recommendation	Daily [a]	Within manufacturer's recommended value	According to manufacturer's instructions	Sampling personnel	Section 6.1

Notes:

[a] A function check is first performed on the equipment on a daily basis. The calibration gas is tested to ensure that it falls within manufacturer's criteria. If the function check is acceptable, then the instrument is ready for use. Otherwise, the instrument will be calibrated according to manufacturer's instructions.

[b] SAP Section that describes the calibration/maintenance/testing/inspection procedures.

Abbreviations and Acronyms:

FID – flame ionization detector
PID – photoionization detector
SAP – Sampling and Analysis Plan
SOP – Standard Operating Procedure
UFP-QAPP – Uniform Federal Policy for Quality Assurance Project Plans

This page intentionally left blank.

TABLE A.6-2

ANALYTICAL METHODS, CONTAINERS, PRESERVATIVES, AND HOLDING TIMES REQUIREMENTS

(UFP-QAPP Worksheet #19)

Matrix	Analytical Group	Analytical and Preparation Method	Container (number, size, type)	Preservation Requirements (chemical, temperature, etc.)	Maximum Holding Time (preparation/analysis)
Soil	VOCs	EPA Method 5035A/8260B	Three 5-g En Core	4±2°C	48 hours/14 days
Soil	TPH-purgeable	EPA Method 5035A/8015B	Three 5-g En Core	4±2°C	48 hours/14 days
Soil	TPH-extractable	EPA Method 3550B/8015B	Two 8-ounce glass jars [a]	4±2°C	14 days/40 days
Soil	SVOCs	EPA Method 3550B/8270C		4±2°C	14 days/40 days
Soil	SVOCs by SIM	EPA Method 3550B/8270C SIM		4±2°C	14 days/40 days
Soil	1,4-dioxane by SIM	EPA Method 3550B/8270C SIM		4±2°C	14 days/40 days
Soil	Pesticides	EPA Method 3550B/8081A		4±2°C	14 days/40 days
Soil	PCBs	EPA Method 3550B/8082		4±2°C	14 days/40 days
Soil	Metals	EPA Method 3050B/6010B/6020		4±2°C	180 days
Soil	Mercury	EPA Method 7471A		4±2°C	28 days
Soil	Hexavalent chromium	EPA Method 3060A/7196A		4±2°C	28 days
Soil	TOC	Walkey-Black		4±2°C	28 days
Soil	Grain size	ASTM D6913-04/D422-63	One 8-ounce glass jar [a]	N/A	N/A
Soil	Bulk density	ASA-13.2 or equivalent		N/A	N/A
Soil	Microbial analysis	Q-PCR (qEBAC, qDHC, qMGN) and PLFA	One 8-ounce glass jar [a]	4±2°C	24 hours
Water	VOCs	EPA Method 5030B/8260B	Three 40-mL VOA vials	pH ≤ 2 w/HCl, 4±2°C	14 days

TABLE A.6-2

ANALYTICAL METHODS, CONTAINERS, PRESERVATIVES, AND HOLDING TIMES REQUIREMENTS

(UFP-QAPP Worksheet #19)

Matrix	Analytical Group	Analytical and Preparation Method	Container (number, size, type)	Preservation Requirements (chemical, temperature, etc.)	Maximum Holding Time (preparation/analysis)
Water	TPH-purgeable	EPA Method 5030B/8015B	Three 40-mL VOA vials	pH ≤ 2 w/HCl, 4±2°C	14 days
Water	TPH-extractable	EPA Method 3520C/8015B	Two 1-L amber bottles	4±2°C	7 days/40 days
Water	SVOCs	EPA Method 3520C/8270C	Two 1-L amber bottles	4±2°C	7 days/40 days
Water	SVOCs by SIM	EPA Method 3520C/8270C SIM	Two 1-L amber bottles	4±2°C	7 days/40 days
Water	1,4-dioxane by SIM	EPA Method 3520C/8270C SIM	Two 1-L amber bottles	4±2°C	7 days/40 days
Water	Pesticides	EPA Method 3520C/8081A	Two 1-L amber bottles	4±2°C	7 days/40 days
Water	PCBs	EPA Method 3520C/8082	Two 1-L amber bottles	4±2°C	7 days/40 days
Water	Dissolved Metals	EPA Method 3010A/6010B/6020	One 250-mL HDPE bottle	pH ≤ 2 w/HNO_3	180 days
Water	Dissolved Mercury	EPA Method 7470A			28 days
Water	Hexavalent Chromium	EPA Method 7196A	One 250-mL HPDE	4±2°C	24 hours
Water	Anions (including nitrate, sulfate, phosphate) [b]	EPA Method 300.0	One 1-L HDPE	4±2°C	48 hours
Water	Alkalinity [b]	EPA Method 310.1	One 125-mL HPDE	4±2°C	14 days
Water	Ammonia as nitrogen [b]	SM4500-NH3F	One 125-mL HDPE	pH ≤ 2 w/H_2SO_4 4±2°C	28 days
Water	TKN [b]	SM4500N B	One 125-mL HPDE	pH ≤ 2 w/H_2SO_4 4±2°C	28 days

TABLE A.6-2

ANALYTICAL METHODS, CONTAINERS, PRESERVATIVES, AND HOLDING TIMES REQUIREMENTS

(UFP-QAPP Worksheet #19)

Matrix	Analytical Group	Analytical and Preparation Method	Container (number, size, type)	Preservation Requirements (chemical, temperature, etc.)	Maximum Holding Time (preparation/analysis)
Water	Ferrous Iron [b]	Field test kit	One 125-mL HPDE	None	1 hour
Water	Carbon Dioxide [b]	Field test kit			
Water	Hydrogen Peroxide	Field test kit			
Water	Microbial parameters	Q-PCR (qEBAC, qDHC, qMGN) and PLFA	One filter with 1-L of water passed through for Q-PCR and one filter with 2-L of water passed through for PLFA	4±2°C	24 hours

Notes:

[a] Additional jars may be collected based on volume needed by the laboratory for analyses.

[b] Natural attenuation parameters include field monitoring parameters (dissolved oxygen and oxidation/reduction potential), field test kit analysis (for ferrous iron and carbon dioxide), and laboratory analysis (nitrate, sulfate, and alkalinity). Nutrients include laboratory analysis for ammonia as nitrogen, TKN, and phosphate. (Nitrate is also considered a nutrient.)

Abbreviations and Acronyms:

°C – degrees Celsius
ASTM – American Society of Testing Materials
BTEX – benzene, toluene, ethylbenzene, and total xylenes
DHC – *Dehalococcoides spp.*
DPT – direct-push technology
EBAC –eubacteria
EPA – Environmental Protection Agency
HCl – hydrochloric acid
HDPE – high-density polyethylene
HNO_3 – nitric acid
L – liter
MGN – methanogens
mL – milliliter
MTBE – methyl, tert-butyl ether
N/A – not applicable
PAH – polynuclear aromatic hydrocarbons
PCB – polychlorinated biphenyl
pH – measure of hydrogen ion activity

TABLE A.6-2

ANALYTICAL METHODS, CONTAINERS, PRESERVATIVES, AND HOLDING TIMES REQUIREMENTS

(UFP-QAPP Worksheet #19)

PLFA – phospholipids fatty acids
Q-PCR – quantitative polymerase chain reaction
SAP – Sampling and Analysis Plan
SIM – Selective Ion Monitoring
SVOC – semi-volatile organic compound
TKN – total kjedhal nitrogen
TOC – total organic carbon
TPH – total petroleum hydrocarbons
VOA – volatile organic analysis
VOC – volatile organic compound

7.0 ANALYTICAL DATA QUALITY OBJECTIVES

This section identifies the laboratory quality objectives, data quality indicators, and field quality objectives.

7.1 LABORATORY QUALITY OBJECTIVES

The following sections describe analytical laboratory requirements including qualifications, sample custody, and QC procedures.

7.1.1 Laboratory Qualifications

The laboratory that will provide analytical services for this project will be a State of California DHS Environmental Laboratory Accreditation Program-certified analytical laboratory. All environmental analytical laboratories would have successfully completed the Naval Facilities Engineering Service Center (NFESC) Laboratory Evaluation Program. NFESC does not conduct evaluation of geotechnical testing laboratories. Geotechnical laboratories do not require certification by DHS but do require ASTM certification, and the technicians conducting the analyses will be certified by the National Institute of Certified Engineering Technologists. Any deviations from these requirements will require approval by the NAVFAC QA Officer.

A laboratory has not been procured at this time for this project. However, once selected, the laboratory must be capable of meeting all the requirements listed in this SAP including turnaround time (to be determined), QLs, QC criteria, data deliverables, and requirements in the *Navy Installation Restoration Chemical Data Quality Manual (IRCDQM)* (NFESC, 1999) and the *Quality Systems Manual (QSM) for Environmental Laboratories* (DoD, 2006).

7.1.2 Laboratory Sample Custody and Documentation

The integrity and traceability of samples from the time they are collected through the time data are reported are essential in any sampling and analysis program. The handling of the samples and transferring of custody must be well-documented given the evidentiary nature of the analytical data.

The sample custodian will sign the CoC from the courier or FedEx®, inventory each shipment, and note on the original CoC record any discrepancy in the sample custody, temperature of the cooler, or broken samples. The laboratory will note discrepancies on the sample receipt form. The laboratory project manager will immediately notify the Project Chemist, who, in consultation with the project team, will provide instructions in writing to the laboratory.

The laboratory will have a system for tracking samples that is consistent with Section 5.8 of the Quality Systems Manual (QSM) (DOD, 2006). The laboratory will archive the samples and maintain their custody up to 90 calendar days after sample collection, at which time the samples will be disposed by the laboratory.

7.1.3 Laboratory Quality Control Requirements

The analytical laboratory will have written Standard Operating Procedures (SOPs) defining the instrument operation and maintenance, tuning, calibration, method detection limit (MDL) determination, QC acceptance criteria, blank requirements, and stepwise procedures for each analytical method. At a minimum, SOPs will be written for procedures and methods including sample receipt/control/disposal, sample preparation/extraction, sample analysis, result calculation, database management, health and safety, and corrective action. The SOPs, and all revisions, will be available to the analysts in the laboratory. The SOPs must meet the requirements of the analytical methods and the IRCDQM (NFESC, 1999). In addition, Tables B-2 through B-6 of the QSM (DOD, 2006) define the frequency, acceptance criteria, and corrective action for the following QC checks for each type of analytical method.

<u>Organics by GC (EPA Methods 8015B, 8081A, 8082):</u>

- Demonstrate acceptable analyst capability
- MDL study
- Retention time window width calculated for each analyte and surrogate
- Breakdown check (8081A only)
- Minimum five-point initial calibration
- Second source calibration verification
- Retention time window position establishment for each analyte and surrogate
- Retention time window verification for each analyte and surrogate
- Calibration verification (initial and continuing calibration)
- Method blank
- LCS
- MS/MSD
- Surrogate spike
- Confirmation of positive results by second column (8081A only)

<u>Organics by GC/MS (EPA Methods 8260B and 8270C):</u>

- Demonstrate acceptable analyst capability
- MDL study
- Tuning
- Minimum five-point initial calibration
- Second source calibration verification
- Retention time window position establishment for each analyte and surrogate

- Retention time window verification for each analyte and surrogate
- Evaluation of relative retention times
- Calibration verification (initial and continuing calibration)
- Internal standards verification
- Method blank
- LCS
- MS/MSD
- Surrogate spike

Metals (EPA Method 6010B/7000):

- Demonstrate acceptable analyst capability
- MDL study
- Instrument detection limit study (ICP-AES only)
- Linear dynamic range of high-level check standard (ICP-AES only)
- Initial calibration for all analytes (minimum one high standard and calibration blank for ICP-AES and minimum 5 standards and calibration blank for cold vapor atomic absorption)
- Second source calibration verification
- Continuing calibration verifications
- Low-level calibration check standard (ICP-AES only)
- Method blank
- Calibration blank
- Interference check solutions (ICP-AES only)
- LCS
- Dilution test
- Post-digestion spike addition (ICP-AES only)
- Method of standard additions (MSA)
- MS/MSD

The laboratory must also maintain written records of all activities that have an impact on the quality of the laboratory results.

Any portion of the method subcontracted by the laboratory to another laboratory or sent to another facility of the same network of laboratories must have the prior approval of the Project Chemist.

7.1.4 Laboratory Quality Control Checks

The following subsections describe in detail the laboratory QC checks required by this project.

7.1.4.1 Calibration

All instruments will be calibrated and the calibration acceptance criteria met before samples are analyzed. Calibration standards will be prepared with National Institute for Standards and Testing (NIST)-traceable standards and analyzed per method requirements. ICAL acceptance criteria documented in the laboratory SOPs will meet those of applicable guidance documents. The ICAL will meet the following requirements:

- The lowest concentration of the calibration standard is less than or equal to the project quantitation limit (QL) based on the final volume of extract or sample.
- For each target analyte, at least one of the calibration standards will be at or below the regulatory limit (screening criteria), as defined by the DQOs.
- Before samples are analyzed, ICAL will be verified with a second source standard prepared at the mid-point of the calibration curve. ICAL verification will meet the acceptance criteria, which are expressed in the laboratory SOPs.
- Daily calibration verification will be conducted at the method-prescribed frequencies and will meet the acceptance criteria of applicable guidance documents. Daily calibration verification will not be used for quantitation of target analytes.
- Calibration data (calibration tables, chromatograms, instrument printouts, and laboratory logbooks) will be clearly labeled to identify the source and preparation of the calibration standard, and therefore be traceable to the standard preparation records.

7.1.4.2 Instrument Blanks

An instrument blank is used to monitor the cleanliness of the instrument system during sample analysis. Instrument blanks are solvent or acid solutions of the standard used to calibrate the instrument. During metals analyses, one instrument blank is usually analyzed for every ten samples. For GC/MS analysis, instrument blanks are analyzed on an as-needed basis for troubleshooting and chromatography column carryover determination.

7.1.4.3 Method Blanks

Method blanks are prepared in the same manner as the samples, using the same reagents and glassware used for samples. The purpose of the method blank is to ensure that the equipment and reagents used in preparing the samples are free of contaminants that could interfere with the analysis. The method blank must be prepared and analyzed for each batch of 20 project samples or less per matrix (aqueous and solid) type.

The method blank must not exhibit analytes at concentrations greater than half the required QLs. If contaminants are found that either contribute to the apparent concentration of a particular target analyte or interfere with the analysis, the analysis must be stopped, the source of contamination identified and corrected, and the analysis repeated. Contamination in the method blank above half the QLs will require that the entire associated batch of extracts or digestates be reprepared and reanalyzed. Hence, it is very important to make sure that no such contamination is present.

Some methods of inorganic analysis do not have a distinctive preparation step. For these tests, an instrument blank, which contains all reagents used with samples, is considered to be the method blank.

7.1.4.4 Laboratory Control Samples

Laboratory control samples are matrix equivalent QC check samples (analyte-free water, laboratory sand, or sodium sulfate) spiked with a known quantity of specific analytes carried through the entire sample preparation and analysis process. The spiking solution used for LCS/laboratory control sample duplicate (LCSD) preparation is of a source different from the stock used to prepare calibration standards.

The LCS is prepared and run at a frequency of one per 20 project samples per matrix with the associated samples, using the same reagents and volumes. If insufficient quantity of sample is available for the MS/MSD, the LCS will be prepared and analyzed in duplicates.

7.1.4.5 Laboratory Duplicates

For laboratory sample duplicate analyses, a sample is prepared and analyzed twice. Laboratory sample duplicates are prepared and analyzed with each batch of samples for most inorganic analyses.

7.1.4.6 Matrix Spikes

MSs are QC check samples that measure matrix-specific method performance. An MS sample is prepared by adding a known quantity of target analytes to a sample prior to sample digestion or extraction. In general, for organic compound and metal analyses, an MS/MSD pair is prepared and analyzed with each preparation batch or for every 20 project samples. For inorganic compound analysis, a single MS and a laboratory sample duplicate are often prepared and analyzed with each batch. The MS results allow verifying the presence of matrix effects.

7.1.4.7 Surrogate Standards

Organic compound analyses include the addition, quantitation, and recovery calculation of surrogate standards. Compounds selected to serve as surrogate standards must meet all of the following requirements:

- Are not the target analytes
- Do not interfere with the determination of target analytes
- Are not naturally occurring, yet are chemically similar to the target analytes
- Are compounds exhibiting similar response to target analytes

Surrogate standards are added to every analytical and QC check sample at the beginning of the sample preparation. The surrogate standard recovery is used to monitor matrix effects and losses during sample preparation. Surrogate standard control criteria are applied to all analytical and QC check samples, and if surrogate criteria are not met, re-extraction and reanalysis may be performed.

7.1.4.8 Post-digestion Spikes and the Method of Standard Addition

A post-digestion spike is used during metal analysis to assess analytical interferences that may be caused by general matrix effects or high concentrations of analytes present in the sample. A digested sample is spiked with the analyte of interest at a known concentration, and the spike recovery is used to estimate the presence and the magnitude of interferences.

If a post-digestion spike recovery fails to meet acceptance criteria, MSA will be used to quantify the sample result. The MSA technique compensates for a sample constituent that enhances or depresses the analyte signal. To perform the MSA, known amounts of a standard at different concentrations are added to aliquots of digested sample, and each spiked sample and the original unspiked sample are analyzed. The absorbance is then plotted against the concentration, and the resulting line is extrapolated to zero absorbance. The point of interception with the concentration axis is the indigenous concentration of the analyte in the sample.

7.1.5 Preventative Maintenance

All instruments must be maintained in accordance with the manufacturers' recommended procedures. The laboratory must define in its QA plan the frequency and type of maintenance for each instrument. The laboratory must also record all maintenance activities in an instrument logbook. The laboratory must maintain the instruments in working condition required by the methods specified for the analyses. Sufficient redundancy in equipment must be available in the laboratory to handle downtime situations. Method substitution because of instrument failure will not be permitted without approval from the Project Chemist.

In addition to preventive maintenance, the laboratory must keep a sufficient supply of replacement parts on hand for those parts known to require frequent changes due to wear and tear or contamination. Whenever preventive or corrective maintenance is applied to an instrument, the laboratory must demonstrate the instrument's return to operating conditions and must recalibrate the instrument prior to resumption of sample analyses.

7.2 DATA QUALITY INDICATORS

In order to meet project DQOs, the QLs listed in Table A.7-1 (soil) and A.7-2 (water) were established below screening criteria, and the QC criteria presented in Table A.7-3 are in accordance with the QSM (DOD, 2006).

Analytical DQOs will be assessed through application of precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters discussed in this section.

7.2.1 Precision

Precision is the measure of the reproducibility of a set of replicate results or the agreement among repeat observations made under the same conditions. Analytical precision is the measurement of the variability associated with duplicate or replicate analyses. Field duplicate, laboratory duplicate, MSD, and LCSD (if analyzed) samples will be used to assess field and analytical precision. The precision measurement will be determined using the relative percent difference (RPD) between the duplicate sample results as follows:

$$RPD = 100 \times 2 \times (\text{result - duplicate result})/(\text{result + duplicate result})$$

The RPD limits for laboratory duplicate, MSD, and LCSD are presented in Table A.7-3, and the field duplicate limits are listed in Table A.7-4. Associated samples that do not meet the criteria will be evaluated by the validator as described in Section 8.2.

7.2.2 Accuracy

Accuracy is defined as the nearness of a result or the mean of a set of results to the true or accepted value. Analytical accuracy is measured by comparing the percent recovery (%R) of analytes spiked into a sample against a control limit. Spiked samples include MS, MSD, and LCS analyzed for every batch of up to 20 samples. They serve as a measure of analytical accuracy and surrogate standards added to all samples, blanks, MS, MSD, and LCS analyzed for organic contaminants to evaluate the method's accuracy and help to determine matrix interferences. Percent recovery is calculated as follows:

$$\%R = 100 \times (\text{spiked sample result - unspiked sample result})/\text{amount of spike added}$$

The laboratory will review the QC samples and surrogate standard recoveries for each analysis to ensure that the percent recovery lies within the control limits listed in Table A.7-3. Otherwise, data will be flagged as discussed in Section 8.2.

7.2.3 Representativeness

Unlike precision and accuracy, which can be expressed in quantitative terms, representativeness is a qualitative parameter. Representativeness is the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. It is a qualitative parameter that depends on proper design of the sampling program.

Field personnel will be responsible for ensuring that samples are representative of field conditions by collecting and handling samples according to the procedures in this SAP. Errors in sample collection, packaging, preservation, or CoC procedures may result in samples being judged non-representative and may form a basis for rejecting the data.

7.2.4 Completeness

Completeness is the percentage of measurements made that is judged to be valid. The completeness goal is to generate a sufficient amount of valid data to meet project needs. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified with a rejected (R) flag. The requirement of completeness is 95 percent for samples and is determined using the following equation:

% completeness = 100 x (number of valid analyte results/number of possible results)

7.2.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another, whether it was generated by a single laboratory or during interlaboratory studies. The use of standardized field and analytical procedures ensures comparability of analytical data.

Sample collection and handling procedures will adhere to EPA-approved protocols. Laboratory procedures will follow standard analytical protocols, use standard units, use standardized report formats, follow the calculations as referenced in approved analytical methods, and use a standard statistical approach for QC measurements.

7.3 FIELD QUALITY OBJECTIVES

Field QC samples will be collected and analyzed during the project to assess the consistency and performance of the sampling program. Field QC samples are necessary for establishing data comparability, for determining the total measurement error (the overall precision of the measurement system from sample collection to analysis), and for QA during sample handling and shipment. Field QC samples may include field duplicates, equipment rinsates, source blanks, trip blanks, and temperature blanks. Measurement performance criteria for field QC samples are listed in Table A.7-4, and field QC sample frequency is listed in Table A.7-5.

Field QC samples associated with waste sampling will not be collected.

7.3.1 Field Duplicates

Field duplicates consist of two distinct samples (an original and a duplicate) of the same matrix collected at the same time and location to the extent possible and using the same sampling techniques. The purpose of field duplicates is to measure the consistency of field sampling. Field duplicates will be collected at a frequency of 1 for every 10 groundwater samples and will be analyzed for the same parameters as the original samples. Field duplicates are uniquely identified so that the identity of the field duplicates is blind to the analytical laboratory. Exact locations of field duplicate samples and their identifications will be recorded in the field logbook. Field duplicates will not be collected for soil samples, due to 1) the heterogeneity of the soil matrix and 2) collection of samples at specific depths which does not facilitate the collection of a duplicate.

7.3.2 Equipment Rinsate Samples

Equipment rinsate is a sample of analyte-free, reagent-grade water collected from a final rinse of sampling equipment after the decontamination procedure has been performed. Rinsate samples will be collected directly from the sampling equipment, placed in appropriate pre-cleaned containers supplied by the analytical laboratory, and analyzed for the same analytes as the field samples under the same analytical conditions. Equipment rinsate samples, collected at a frequency of one per each day of sampling, will help determine the effectiveness of the decontamination procedure and potential for cross-contamination during sampling events.

7.3.3 Source Blank Samples

A source blank consists of analyte-free, reagent-grade water provided by the laboratory to be used for the collection of equipment rinsate samples as described in Section 7.3.2. Source blank water will be provided by the laboratory since equipment rinsate samples are to be collected for this project.

In order to ensure that the source blank is free of contamination, one of two courses of action will be followed before the source blank water is used. First, the laboratory will be asked to provide a certificate of analysis that the water provided for the equipment rinsate samples does not contain analytes above the project QLs. If the laboratory cannot provide a certificate of analysis, a sample of the laboratory water will then be collected for each lot of water provided by the laboratory and analyzed to verify that the results are not above the project QLs.

7.3.4 Trip Blanks

Trip blanks are hydrochloric acid-preserved, analyte-free, deionized water prepared by the laboratory in 40-mL VOA vials that will be carried to the field, stored with water samples collected for volatile analysis, and returned to the laboratory for volatile analysis. Trip blanks will be required for this project and will be included in each cooler with VOCs. Trip blanks will be analyzed for VOCs and TPH-purgeable (as applicable) for the groundwater samples.

7.3.5 Temperature Blanks

A temperature blank is a container of tap water that is shipped in each cooler containing field samples and ice. Laboratory personnel will use the temperature blank to measure the temperature of the cooler upon arrival at the laboratory.

TABLE A.7-1

REFERENCE LIMITS FOR SOIL SAMPLES

(UFP-QAPP Worksheet #15)

Analytical Group/Method	Analyte	CAS Number	Project Screening Criteria for Soil Samples [a]	Regulatory Limit for Soil Waste Samples [b]	Project Quantitation Limit	Analytical Method MDLs [c]	Analytical Method QLs [c]	Units
VOC/8260B	1,1,1-Trichloroethane	71-55-6	1,200,000	NE	5	2	5	µg/kg
	1,1,2,2-Tetrachloroethane	79-34-5	410	NE	5	2	5	µg/kg
	1,1,2-Trichloroethane	79-00-5	730	NE	5	2	5	µg/kg
	1,1-Dichloroethane	75-34-3	2,800	NE	5	2	5	µg/kg
	1,1-Dichloroethene	75-35-4	120,000	NE	5	2	5	µg/kg
	1,2-Dichloroethane	107-06-2	280	NE	5	2	5	µg/kg
	1,2-Dichloropropane	78-87-5	340	NE	5	2	5	µg/kg
	2-Hexanone	591-78-6	NE	NE	50	5	50	µg/kg
	Acetone	67-64-1	14,000,000	NE	50	5	50	µg/kg
	Benzene	71-43-2	640	NE	5	2	5	µg/kg
	Bromodichloromethane	75-27-4	820	NE	5	2	5	µg/kg
	Bromoform	75-25-2	62,000	NE	5	2	5	µg/kg
	Bromomethane	74-83-9	3,900	NE	10	2	10	µg/kg
	Carbon tetrachloride	56-23-5	250	NE	5	2	5	µg/kg
	Chlorobenzene	108-90-7	150,000	NE	5	2	5	µg/kg
	Chloroethane	75-00-3	3,000	NE	5	2	5	µg/kg
	Chloroform	67-66-3	940	NE	5	2	5	µg/kg
	Chloromethane	74-87-3	47,000	NE	10	2	10	µg/kg
	cis-1,2-Dichloroethene	156-59-2	43,000	NE	5	2	5	µg/kg
	cis-1,3-Dichloropropene	10061-01-5	780 [d]	NE	5	2	5	µg/kg
	Dibromochloromethane	124-48-1	1,100	NE	5	2	5	µg/kg
	Ethylbenzene	100-41-4	400,000	NE	5	2	5	µg/kg

TABLE A.7-1

REFERENCE LIMITS FOR SOIL SAMPLES

(UFP-QAPP Worksheet #15)

Analytical Group/Method	Analyte	CAS Number	Project Screening Criteria for Soil Samples [a]	Regulatory Limit for Soil Waste Samples [b]	Project Quantitation Limit	Analytical Method MDLs [c]	Analytical Method QLs [c]	Units
	2-Butanone	78-93-3	22,000,000	NE	50	5	50	µg/kg
	Methyl tert-butyl ether	1634-04-4	32,000	NE	5	2	5	µg/kg
	Methylene chloride	75-09-2	9,100	NE	10	2	10	µg/kg
	Methyl isobutyl ketone	108-10-1	5,300,000	NE	50	5	50	µg/kg
	Styrene	100-42-5	1,700,000	NE	5	2	5	µg/kg
	Tetrachloroethene	127-18-4	480	NE	5	2	5	µg/kg
	Toluene	108-88-3	520,000	NE	5	2	5	µg/kg
	trans-1,2-Dichloroethene	156-60-5	69,000	NE	5	2	5	µg/kg
	trans-1,3-Dichloropropene	10061-02-6	780 [d]	NE	5	2	5	µg/kg
	Trichloroethene	79-01-6	2,900	2,040,000	5	2	5	µg/kg
	Vinyl chloride	75-01-4	79	NE	5	2	5	µg/kg
	Xylenes (Total)	1330-20-7	270,000	NE	10	2	10	µg/kg
TPH-purgeable/ 8015B	Gasoline (C_6-C_{10})	8006-61-9	NE	NE	1	0.5	1	mg/kg
TPH-extractable/ 8015B	Diesel (C_{10}-C_{24})	-3527 [e]	NE	NE	10	5	10	mg/kg
	JP5 (C_8-C_{18})	8008-20-6	NE	NE	10	5	10	mg/kg
	Motor Oil (C_{24}-C_{36})	-3528 [e]	NE	NE	20	10	20	mg/kg
SVOC/8270C	1,2,4-Trichlorobenzene	120-82-1	62,000	NE	330	167	330	µg/kg
	1,2-Dichlorobenzene	95-50-1	600,000	NE	330	167	330	µg/kg
	1,3-Dichlorobenzene	541-73-1	530,000	NE	330	167	330	µg/kg
	1,4-Dichlorobenzene	106-46-7	3,400	NE	330	167	330	µg/kg
	2,4,5-Trichlorophenol	95-95-4	6,100,000	NE	330	167	330	µg/kg

TABLE A.7-1

REFERENCE LIMITS FOR SOIL SAMPLES

(UFP-QAPP Worksheet #15)

Analytical Group/Method	Analyte	CAS Number	Project Screening Criteria for Soil Samples [a]	Regulatory Limit for Soil Waste Samples [b]	Project Quantitation Limit	Analytical Method MDLs [c]	Analytical Method QLs [c]	Units
	2,4,6-Trichlorophenol	88-06-2	6,900	NE	330	184	330	µg/kg
	2,4-Dichlorophenol	120-83-2	180,000	NE	330	167	330	µg/kg
	2,4-Dimethylphenol	105-67-9	1,200,000	NE	330	167	330	µg/kg
	2,4-Dinitrophenol	51-28-5	120,000	NE	670	167	670	µg/kg
	2,4-Dinitrotoluene	121-14-2	120,000	NE	330	167	330	µg/kg
	2,6-Dinitrotoluene	606-20-2	61,000	NE	330	167	330	µg/kg
	2-Chloronaphthalene	91-58-7	4,900,000	NE	330	167	330	µg/kg
	2-Chlorophenol	95-57-8	63,000	NE	330	167	330	µg/kg
	2-Methylphenol	95-48-7	3,100,000	NE	330	167	330	µg/kg
	2-Nitroaniline	88-74-4	180,000	NE	330	167	330	µg/kg
	2-Nitrophenol	88-75-5	NE	NE	330	167	330	µg/kg
	3,3-Dichlorobenzidine	91-94-1	1,100	NE	330	167	330	µg/kg
	3-Nitroaniline	99-09-2	18,000	NE	330	167	330	µg/kg
	4,6-Dinitro-2-methylphenol	534-52-1	61,000	NE	670	167	670	µg/kg
	4-Bromophenyl-phenylether	101-55-3	NE	NE	330	167	330	µg/kg
	4-Chloro-3-methylphenol	59-50-7	NE	NE	330	167	330	µg/kg
	4-Chloroaniline	106-47-8	240,000	NE	330	167	330	µg/kg
	4-Chlorophenyl-phenylether	7005-72-3	NE	NE	330	170	330	µg/kg
	4-Methylphenol	106-44-5	310,000	NE	330	167	330	µg/kg
	4-Nitroaniline	100-01-6	23,000	NE	330	167	330	µg/kg
	4-Nitrophenol	100-02-7	NE	NE	670	167	670	µg/kg
	bis(2-Chloroethoxy)methane	111-91-1	NE	NE	330	167	330	µg/kg

TABLE A.7-1

REFERENCE LIMITS FOR SOIL SAMPLES

(UFP-QAPP Worksheet #15)

Analytical Group/Method	Analyte	CAS Number	Project Screening Criteria for Soil Samples [a]	Regulatory Limit for Soil Waste Samples [b]	Project Quantitation Limit	Analytical Method MDLs [c]	Analytical Method QLs [c]	Units
	bis(2-Chloroisopropyl)ether	108-60-1	2,900	NE	330	167	330	µg/kg
	bis(2-Ethylhexyl)phthalate	117-81-7	35,000	NE	330	167	330	µg/kg
	Butylbenzylphthalate	85-68-7	12,000,000	NE	330	167	330	µg/kg
	Di-n-butylphthalate	84-74-2	6,100,000	NE	330	167	330	µg/kg
	Di-n-octylphthalate	117-84-0	2,400,000	NE	330	167	330	µg/kg
	Dibenzofuran	132-64-9	150,000	NE	330	167	330	µg/kg
	Diethylphthalate	84-66-2	49,000,000	NE	330	167	330	µg/kg
	Dimethyl phthalate	131-11-3	100,000,000	NE	330	167	330	µg/kg
	Hexachlorobutadiene	87-68-3	6,200	NE	330	190	330	µg/kg
	Hexachlorocyclopentadiene	77-47-4	370,000	NE	330	167	330	µg/kg
	Hexachloroethane	67-72-1	35,000	NE	330	167	330	µg/kg
	n-Nitrosodiphenylamine	86-30-6	99,000	NE	330	167	330	µg/kg
	Nitrobenzene	98-95-3	20,000	NE	330	167	330	µg/kg
	Pentachlorophenol	87-86-5	3,000	17,000	670	175	670	µg/kg
	Phenol	108-95-2	18,000,000	NE	670	175	670	µg/kg
	Pyridine	110-86-1	61,000	NE	330	167	330	µg/kg
	Acenaphthene	83-32-9	3,700,000	NE	670	167	670	µg/kg
	Acenaphthylene	208-96-8	NE	NE	330	167	330	µg/kg
	Anthracene	120-12-7	22,000,000	NE	330	167	330	µg/kg
	Benzo(a)anthracene	56-55-3	620	NE	330	167	330	µg/kg
	Benzo(b)fluoranthene	205-99-2	620	NE	330	167	330	µg/kg
	Benzo(g,h,i)perylene	191-24-2	NE	NE	330	167	330	µg/kg

TABLE A.7-1

REFERENCE LIMITS FOR SOIL SAMPLES

(UFP-QAPP Worksheet #15)

Analytical Group/Method	Analyte	CAS Number	Project Screening Criteria for Soil Samples [a]	Regulatory Limit for Soil Waste Samples [b]	Project Quantitation Limit	Analytical Method MDLs [c]	Analytical Method QLs [c]	Units
	Benzo(k)fluoranthene	207-08-9	380	NE	330	167	330	µg/kg
	Chrysene	218-01-9	3,800	NE	330	167	330	µg/kg
	Fluoranthene	206-44-0	2,300,000	NE	330	167	330	µg/kg
	Fluorene	86-73-7	2,700,000	NE	330	167	330	µg/kg
	Indeno(1,2,3-cd)pyrene	193-39-5	620	NE	330	167	330	µg/kg
	Naphthalene	91-20-3	1,700	NE	330	167	330	µg/kg
	Phenanthrene	85-01-8	NE	NE	330	167	330	µg/kg
	Pyrene	129-00-0	2,300,000	NE	330	167	330	µg/kg
SVOCs/8270C SIM	1,4-dioxane	123-91-1	44,000	NE	50	20	50	µg/kg
	bis(2-Chloroethyl)ether	111-44-4	220	NE	20	10	20	µg/kg
	Hexachlorobenzene	118-74-1	300	NE	20	10	20	µg/kg
	n-Nitrosodinpropylamine	621-64-7	69	NE	20	10	20	µg/kg
	Benzo(a)pyrene	50-32-8	62	NE	20	10	20	µg/kg
	Dibenz(a,h)anthracene	53-70-3	62	NE	20	10	20	µg/kg
Pesticides/8081A	4,4'-DDD	72-54-8	2,400	1,000 [f]	4	1.2	4	µg/kg
	4,4'-DDE	72-55-9	1,700	1,000 [f]	4	1.2	4	µg/kg
	4,4'-DDT	50-29-3	1,700	1,000 [f]	4	1.2	4	µg/kg
	alpha-BHC	319-84-6	90	NE	2	0.6	2	µg/kg
	Aldrin	309-00-2	29	1,400	2	0.6	2	µg/kg
	beta-BHC	319-85-7	320	NE	2	0.6	2	µg/kg
	delta-BHC	319-86-8	NE	NE	2	0.6	2	µg/kg
	Chlordane (technical)	57-74-9	1,600	2,500	50	20	50	µg/kg

TABLE A.7-1

REFERENCE LIMITS FOR SOIL SAMPLES
(UFP-QAPP Worksheet #15)

Analytical Group/Method	Analyte	CAS Number	Project Screening Criteria for Soil Samples [a]	Regulatory Limit for Soil Waste Samples [b]	Project Quantitation Limit	Analytical Method MDLs [c]	Analytical Method QLs [c]	Units
	Dieldrin	60-57-1	30	8,000	4	1.2	4	µg/kg
	Endosulfan sulfate	1031-07-8	370,000 [g]	NE	4	1.5	4	µg/kg
	Endosulfan I	959-98-8	370,000 [g]	NE	2	0.6	2	µg/kg
	Endosulfan II	33213-65-9	370,000 [g]	NE	4	1.2	4	µg/kg
	Endrin	72-20-8	18,000	200	4	1.2	4	µg/kg
	Endrin Aldehyde	7421-93-4	NE	NE	4	1.2	4	µg/kg
	Endrin Ketone	53494-70-5	NE	NE	4	1.2	4	µg/kg
	Lindane	58-89-9	440	4,000	2	0.6	2	µg/kg
	Heptachlor	76-44-8	110	4,700 [h]	2	0.6	2	µg/kg
	Heptachlor epoxide	1024-57-3	53	4,700 [h]	2	0.6	2	µg/kg
	Methoxychlor	72-43-5	310,000	100,000	20	4	20	µg/kg
	Toxaphene	8001-35-2	440	5,000	50	10	50	µg/kg
PCBs/8082	Aroclor 1016	12674-11-2	220 [i]	50,000 [i]	50	20	50	µg/kg
	Aroclor 1221	11104-28-2	220 [i]	50,000 [i]	50	20	50	µg/kg
	Aroclor 1232	11141-16-5	220 [i]	50,000 [i]	50	20	50	µg/kg
	Aroclor 1242	53469-21-9	220 [i]	50,000 [i]	50	20	50	µg/kg
	Aroclor 1248	12672-29-6	220 [i]	50,000 [i]	50	20	50	µg/kg
	Aroclor 1254	11097-69-1	220 [i]	50,000 [i]	50	20	50	µg/kg
	Aroclor 1260	11096-82-5	220 [i]	50,000 [i]	50	20	50	µg/kg

TABLE A.7-1

REFERENCE LIMITS FOR SOIL SAMPLES

(UFP-QAPP Worksheet #15)

Analytical Group/Method	Analyte	CAS Number	Project Screening Criteria for Soil Samples [a]	Regulatory Limit for Soil Waste Samples [b]	Project Quantitation Limit	Analytical Method MDLs [c]	Analytical Method QLs [c]	Units
Metals/ 6010B/6020/7000	Antimony	7440-36-0	31	500	3	0.1	3	mg/kg
	Arsenic	7440-38-2	16.55 [j]	500	0.5	0.1	0.5	mg/kg
	Barium	7440-39-3	5,400	10,000	0.5	0.1	0.5	mg/kg
	Beryllium	7440-41-7	150	75	0.5	0.1	0.5	mg/kg
	Cadmium	7440-43-9	37	100	0.5	0.1	0.5	mg/kg
	Chromium	7440-47-3	210	2,500	0.5	0.1	0.5	mg/kg
	Cobalt	7440-48-4	900	8,000	1	0.1	1	mg/kg
	Copper	7440-50-8	3,100	41,000	0.5	0.2	0.5	mg/kg
	Lead	7439-92-1	150	1,000	0.5	0.1	0.5	mg/kg
	Mercury	7439-97-6	1,800	20	0.1	0.033	0.1	mg/kg
	Molybdenum	7439-98-7	23	3,500	1	0.1	1	mg/kg
	Nickel	7440-02-0	390	2,000	1	0.1	1	mg/kg
	Selenium	7782-49-2	1,600	100	0.5	0.1	0.5	mg/kg
	Silver	7440-22-4	390	500	0.5	0.1	0.5	mg/kg
	Thallium	7440-28-0	390	700	0.5	0.1	0.5	mg/kg
	Vanadium	7440-62-2	41.78 [j]	2,400	0.5	0.1	0.5	mg/kg
	Zinc	7440-66-6	23,000	5,000	1	1	1	mg/kg
Hexavalent Chromium/7196A	Hexavalent Chromium	18540-29-9	30	N/A	0.4	0.2	0.4	mg/kg
TOC/Walkey Black	Total Organic Carbon	-28 [e]	NE	N/A	600	300	600	mg/kg

TABLE A.7-1

REFERENCE LIMITS FOR SOIL SAMPLES
(UFP-QAPP Worksheet #15)

Notes:

[a] Levels listed are based on EPA Region 9 residential PRGs. For analytes that do not have established values, the DoN and regulators will be consulted to provide guidance on acceptable levels.
[b] Levels listed are based on Total Threshold Limit Concentration (TTLC) values.
[c] Values listed are from the laboratory analytical methods.
[d] Value listed is for total 1,3-dichloropropene.
[e] Value listed is from the Navy Electronic Data Deliverable valid value list since the analyte does not have a chemical abstract service number.
[f] Value listed is for the sum of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT.
[g] Value listed is for sum of Endosulfan sulfate, Endosulfan I, and Endosulfan II.
[h] Value listed is for the sum of heptachlor and heptachlor epoxide.
[i] Value listed is for total PCBs.
[j] Value listed based on Site 16 background concentrations at 95% confidence level (Tetra Tech, 2004), as indicated.

Abbreviations and Acronyms:

µg/kg – micrograms per kilogram
CAS – Chemical Abstract Service
mg/kg – milligrams per kilogram
ng/kg – nanogram per kilogram
NE – none established
PAH – polynuclear aromatic hydrocarbons
PCB – polychlorinated biphenyl
PRG – Preliminary Remediation Goal
SIM – Selective Ion Monitoring
SVOC – semi-volatile organic compound
TPH – total petroleum hydrocarbons
TTLC – Total Threshold Limit Concentration
TOC – total organic carbon
UFP-QAPP – Uniform Federal Policy for Quality Assurance Project Plans
VOC – volatile organic compound

TABLE A.7-2

REFERENCE LIMITS FOR WATER SAMPLES
(UFP-QAPP Worksheet #15)

Analytical Group/Method	Analyte	CAS Number	Project Screening Criteria for Water Samples [a]	STLC Limit	TCLP Limit	Project Quantitation Limit	Analytical Method MDLs [b]	Analytical Method QLs [b]	Units
VOCs/8260B	1,1,1-Trichloroethane	71-55-6	200	NE	NE	2	0.2	2	µg/L
	1,1,2,2-Tetrachloroethane	79-34-5	1	NE	NE	1	0.2	1	µg/L
	1,1,2-Trichloroethane	79-00-5	5	NE	NE	5	0.2	5	µg/L
	1,1-Dichloroethane	75-34-3	5	NE	NE	5	0.2	5	µg/L
	1,1-Dichloroethene	75-35-4	6	NE	700	5	0.2	5	µg/L
	1,2-Dichloroethane	107-06-2	0.5	NE	500	0.5	0.2	0.5	µg/L
	1,2-Dichloropropane	78-87-5	5	NE	NE	5	0.2	5	µg/L
	1,2,4-Trichlorobenzene	120-82-1	5	NE	NE	1	0.2	1	µg/L
	1,4-Dichlorobenzene	106-46-7	5	NE	7,500	10	5	10	µg/L
	2-Hexanone	591-78-6	NE	NE	NE	50	5	50	µg/L
	Acetone	67-64-1	NE	NE	NE	50	5	50	µg/L
	Benzene	71-43-2	1	NE	500	1	0.2	1	µg/L
	Bromodichloromethane	75-27-4	80 [c]	NE	NE	5	0.2	5	µg/L
	Bromoform	75-25-2	80 [c]	NE	NE	5	0.3	5	µg/L
	Bromomethane	74-83-9	NE	NE	NE	5	0.2	5	µg/L
	Carbon tetrachloride	56-23-5	0.5	NE	500	0.5	0.2	0.5	µg/L
	Chlorobenzene	108-90-7	70	NE	100,000	5	0.2	5	µg/L
	Chloroethane	75-00-3	NE	NE	NE	5	0.2	5	µg/L
	Chloroform	67-66-3	80 [c]	NE	6,000	5	0.2	5	µg/L
	Chloromethane	74-87-3	NE	NE	NE	5	0.2	5	µg/L
	cis-1,2-Dichloroethene	156-59-2	6	NE	NE	5	0.2	5	µg/L

TABLE A.7-2

REFERENCE LIMITS FOR WATER SAMPLES

(UFP-QAPP Worksheet #15)

Analytical Group/Method	Analyte	CAS Number	Project Screening Criteria for Water Samples [a]	STLC Limit	TCLP Limit	Project Quantitation Limit	Analytical Method MDLs [b]	Analytical Method QLs [b]	Units
	cis-1,3-Dichloropropene	10061-01-5	0.5 [d]	NE	NE	0.5	0.2	0.5	μg/L
	Dibromochloromethane	124-48-1	80 [c]	NE	NE	5	0.2	5	μg/L
	Ethylbenzene	100-41-4	300	NE	NE	5	0.2	5	μg/L
	2-Butanone	78-93-3	NE	NE	200,000	50	5	50	μg/L
	Methyl tert-butyl ether	1634-04-4	13	NE	NE	5	0.2	5	μg/L
	Methylene chloride	75-09-2	5	NE	NE	5	0.5	5	μg/L
	Methyl isobutyl ketone	108-10-1	NE	NE	NE	50	5	50	μg/L
	Styrene	100-42-5	100	NE	NE	5	0.2	5	μg/L
	Tetrachloroethene	127-18-4	5	NE	700	5	0.2	5	μg/L
	Toluene	108-88-3	150	NE	NE	5	0.2	5	μg/L
	trans-1,2-Dichloroethene	156-60-5	10	NE	NE	5	0.2	5	μg/L
	trans-1,3-Dichloropropene	10061-02-6	0.5 [d]	NE	NE	0.5	0.2	0.5	μg/L
	Trichloroethene	79-01-6	5	204,000	500	5	0.2	5	μg/L
	Vinyl chloride	75-01-4	0.5	NE	200	0.5	0.2	0.5	μg/L
	Xylenes (Total)	1330-20-7	1,750	NE	NE	5	0.2	5	μg/L
TPH-purgeable/ 8015B	Gasoline (C_6 to C_{10})	8006-61-9	NE	NE	NE	0.1	0.02	0.1	mg/L
TPH-extractable/ 8015B	Diesel (C_{10} to C_{24})	-3527 [e]	NE	NE	NE	0.5	0.1	0.5	mg/L
	JP5 (C_8-C_{18})	8008-20-6	NE	NE	NE	0.5	0.1	0.5	mg/L
	Motor oil (C_{24} to C_{36})	-3528 [e]	NE	NE	NE	0.5	0.1	0.5	mg/L

TABLE A.7-2

REFERENCE LIMITS FOR WATER SAMPLES

(UFP-QAPP Worksheet #15)

Analytical Group/Method	Analyte	CAS Number	Project Screening Criteria for Water Samples [a]	STLC Limit	TCLP Limit	Project Quantitation Limit	Analytical Method MDLs [b]	Analytical Method QLs [b]	Units
SVOCs/8270C	1,2-Dichlorobenzene	95-50-1	600	NE	NE	10	5	10	µg/L
	1,3-Dichlorobenzene	541-73-1	NE	NE	NE	10	5	10	µg/L
	2,4,5-Trichlorophenol	95-95-4	NE	NE	400,000	10	5	10	µg/L
	2,4,6-Trichlorophenol	88-06-2	NE	NE	2,000	10	5	10	µg/L
	2,4-Dichlorophenol	120-83-2	NE	NE	NE	10	5	10	µg/L
	2,4-Dimethylphenol	105-67-9	NE	NE	NE	10	5	10	µg/L
	2,4-Dinitrophenol	51-28-5	NE	NE	NE	50	5	50	µg/L
	2,4-Dinitrotoluene	121-14-2	NE	NE	130	10	5	10	µg/L
	2,6-Dinitrotoluene	606-20-2	NE	NE	NE	10	5	10	µg/L
	2-Chloronaphthalene	91-58-7	NE	NE	NE	10	5	10	µg/L
	2-Chlorophenol	95-57-8	NE	NE	NE	10	5	10	µg/L
	2-Methylphenol	95-48-7	NE	NE	200,000 [f]	10	5	10	µg/L
	2-Nitroaniline	88-74-4	NE	NE	NE	20	5	20	µg/L
	2-Nitrophenol	88-75-5	NE	NE	NE	20	5	20	µg/L
	3,3-Dichlorobenzidine	91-94-1	NE	NE	NE	20	5	20	µg/L
	3-Nitroaniline	99-09-2	NE	NE	NE	20	5	20	µg/L
	4,6-Dinitro-2-methylphenol	534-52-1	NE	NE	NE	50	5	50	µg/L
	4-Bromophenyl-phenylether	101-55-3	NE	NE	NE	10	5	10	µg/L
	4-Chloro-3-methylphenol	59-50-7	NE	NE	NE	10	5	10	µg/L
	4-Chloroaniline	106-47-8	NE	NE	NE	10	5	10	µg/L
	4-Chlorophenyl-phenylether	7005-72-3	NE	NE	NE	10	5	10	µg/L

TABLE A.7-2

REFERENCE LIMITS FOR WATER SAMPLES

(UFP-QAPP Worksheet #15)

Analytical Group/Method	Analyte	CAS Number	Project Screening Criteria for Water Samples [a]	STLC Limit	TCLP Limit	Project Quantitation Limit	Analytical Method MDLs [b]	Analytical Method QLs [b]	Units
	4-Methylphenol	106-44-5	NE	NE	200,000 [f]	10	5	10	μg/L
	4-Nitroaniline	100-01-6	NE	NE	NE	20	5	20	μg/L
	4-Nitrophenol	100-02-7	NE	NE	NE	20	5	20	μg/L
	bis(2-Chloroethoxy)methane	111-91-1	NE	NE	NE	10	5	10	μg/L
	bis(2-Chloroisopropyl)ether	108-60-1	NE	NE	NE	10	5	10	μg/L
	Butylbenzylphthalate	85-68-7	NE	NE	NE	10	5	10	μg/L
	Di-n-butylphthalate	84-74-2	NE	NE	NE	10	5	10	μg/L
	Di-n-octylphthalate	117-84-0	NE	NE	NE	10	5	10	μg/L
	Dibenzofuran	132-64-9	NE	NE	NE	10	5	10	μg/L
	Diethylphthalate	84-66-2	NE	NE	NE	10	5	10	μg/L
	Dimethyl phthalate	131-11-3	NE	NE	NE	10	5	10	μg/L
	Hexachlorobutadiene	87-68-3	NE	NE	500	10	5	10	μg/L
	Hexachlorocyclopentadiene	77-47-4	50	NE	NE	50	5	50	μg/L
	Hexachloroethane	67-72-1	NE	NE	3,000	10	5	10	μg/L
	n-Nitrosodiphenylamine	86-30-6	NE	NE	NE	10	5	10	μg/L
	Nitrobenzene	98-95-3	NE	NE	2,000	10	5	10	μg/L
	Phenol	108-95-2	NE	NE	NE	10	5	10	μg/L
	Pyridine	110-86-2	NE	NE	5,000	10	5	10	μg/L
	Acenaphthene	83-32-9	NE	NE	NE	10	5	10	μg/L
	Acenaphthylene	208-96-8	NE	NE	NE	10	5	10	μg/L
	Anthracene	120-12-7	NE	NE	NE	10	5	10	μg/L

TABLE A.7-2

REFERENCE LIMITS FOR WATER SAMPLES

(UFP-QAPP Worksheet #15)

Analytical Group/Method	Analyte	CAS Number	Project Screening Criteria for Water Samples [a]	STLC Limit	TCLP Limit	Project Quantitation Limit	Analytical Method MDLs [b]	Analytical Method QLs [b]	Units
	Benzo(a)anthracene	56-55-3	NE	NE	NE	10	5	10	µg/L
	Benzo(b)fluoranthene	205-99-2	NE	NE	NE	10	5	10	µg/L
	Benzo(g,h,i)perylene	191-24-2	NE	NE	NE	10	5	10	µg/L
	Benzo(k)fluoranthene	207-08-9	NE	NE	NE	10	5	10	µg/L
	Chrysene	218-01-9	NE	NE	NE	10	5	10	µg/L
	Fluoranthene	206-44-0	NE	NE	NE	10	5	10	µg/L
	Fluorene	86-73-7	NE	NE	NE	10	5	10	µg/L
	Indeno(1,2,3-cd)pyrene	193-39-5	NE	NE	NE	10	5	10	µg/L
	Naphthalene	91-20-3	NE	NE	NE	10	5	10	µg/L
	Phenanthrene	85-01-8	NE	NE	NE	10	5	10	µg/L
	Pyrene	129-00-0	NE	NE	NE	10	5	10	µg/L
SVOCs/8270C SIM	1,4-dioxane	123-91-1	NE	NE	NE	1	0.6	1	µg/L
	bis(2-Chloroethyl)ether	111-44-4	NE	NE	NE	10	5	10	µg/L
	bis(2-Ethylhexyl)phthalate	117-81-7	4	NE	NE	4	2	4	µg/L
	Hexachlorobenzene	118-74-1	1	NE	130	1	0.5	1	µg/L
	n-Nitrosodinpropylamine	621-64-7	NE	NE	NE	10	5	10	µg/L
	Pentachlorophenol	87-86-5	1	1,700	100,000	1	0.5	1	µg/L
	Benzo(a)pyrene	50-32-8	0.2	NE	NE	0.2	0.1	0.2	µg/L
	Dibenz(a,h)anthracene	53-70-3	NE	NE	NE	10	5	10	µg/L

TABLE A.7-2

REFERENCE LIMITS FOR WATER SAMPLES

(UFP-QAPP Worksheet #15)

Analytical Group/Method	Analyte	CAS Number	Project Screening Criteria for Water Samples [a]	STLC Limit	TCLP Limit	Project Quantitation Limit	Analytical Method MDLs [b]	Analytical Method QLs [b]	Units
Pesticides/8081A	4,4'-DDD	72-54-8	NE	100 [g]	NE	0.2	0.02	0.2	µg/L
	4,4'-DDE	72-55-9	NE	100 [g]	NE	0.2	0.02	0.2	µg/L
	4,4'-DDT	50-29-3	NE	100 [g]	NE	0.2	0.02	0.2	µg/L
	alpha-BHC	319-84-6	NE	NE	NE	0.2	0.02	0.2	µg/L
	Aldrin	309-00-2	NE	140	NE	0.1	0.02	0.1	µg/L
	beta-BHC	319-85-7	NE	NE	NE	0.1	0.02	0.1	µg/L
	delta-BHC	319-86-8	NE	NE	NE	0.1	0.02	0.1	µg/L
	Chlordane (technical)	57-74-9	0.1	250	30	1	0.5	1	µg/L
	Dieldrin	60-57-1	NE	800	NE	0.2	0.02	0.2	µg/L
	Endosulfan sulfate	1031-07-8	NE	NE	NE	0.2	0.02	0.2	µg/L
	Endosulfan I	959-98-8	NE	NE	NE	0.1	0.02	0.1	µg/L
	Endosulfan II	33213-65-9	NE	NE	NE	0.2	0.02	0.2	µg/L
	Endrin	72-20-8	2	20	20	0.2	0.02	0.2	µg/L
	Endrin Aldehyde	7421-93-4	NE	NE	NE	0.2	0.02	0.2	µg/L
	Endrin Ketone	53494-70-5	NE	NE	NE	0.2	0.02	0.2	µg/L
	Lindane	58-89-9	0.2	400	400	0.1	0.02	0.1	µg/L
	Heptachlor	76-44-8	0.01	470 [h]	8 [h]	0.1	0.02	0.1	µg/L
	Heptachlor epoxide	1024-57-3	0.01	470 [h]	8 [h]	0.1	0.02	0.1	µg/L
	Methoxychlor	72-43-5	30	10,000	10,000	1	0.2	1	µg/L

TABLE A.7-2

REFERENCE LIMITS FOR WATER SAMPLES

(UFP-QAPP Worksheet #15)

Analytical Group/Method	Analyte	CAS Number	Project Screening Criteria for Water Samples [a]	STLC Limit	TCLP Limit	Project Quantitation Limit	Analytical Method MDLs [b]	Analytical Method QLs [b]	Units
PCBs/8082	Toxaphene	8001-35-2	3	500	500	2	1	2	µg/L
	Aroclor 1016	12674-11-2	0.5 [i]	5,000 [i]	NE	0.5	0.25	0.5	µg/L
	Aroclor 1221	11104-28-2	0.5 [i]	5,000 [i]	NE	0.5	0.25	0.5	µg/L
	Aroclor 1232	11141-16-5	0.5 [i]	5,000 [i]	NE	0.5	0.25	0.5	µg/L
	Aroclor 1242	53469-21-9	0.5 [i]	5,000 [i]	NE	0.5	0.25	0.5	µg/L
	Aroclor 1248	12672-29-6	0.5 [i]	5,000 [i]	NE	0.5	0.25	0.5	µg/L
	Aroclor 1254	11097-69-1	0.5 [i]	5,000 [i]	NE	0.5	0.25	0.5	µg/L
	Aroclor 1260	11096-82-5	0.5 [i]	5,000 [i]	NE	0.5	0.25	0.5	µg/L
Metals/ 6010B/6020/7000	Antimony	7440-36-0	6	15,000	NE	1	0.5	1	µg/L
	Arsenic	7440-38-2	10	5,000	5,000	1	0.5	1	µg/L
	Barium	7440-39-3	1,000	100,000	100,000	1	0.5	1	µg/L
	Beryllium	7440-41-7	4	750	NE	1	0.5	1	µg/L
	Cadmium	7440-43-9	5	1,000	1,000	1	0.5	1	µg/L
	Chromium	7440-47-3	50	5,000	5,000	1	0.5	1	µg/L
	Cobalt	7440-48-4	NE	80,000	NE	1	0.5	1	µg/L
	Copper	7440-50-8	1,300	25,000	NE	1	0.5	1	µg/L
	Lead	7439-92-1	15	5,000	5,000	1	0.5	1	µg/L
	Mercury	7439-97-6	2	200	200	0.5	0.1	0.5	µg/L
	Molybdenum	7439-98-7	NE	350,000	NE	2	1	2	µg/L
	Nickel	7440-02-0	100	20,000	NE	1	0.5	1	µg/L

TABLE A.7-2

REFERENCE LIMITS FOR WATER SAMPLES

(UFP-QAPP Worksheet #15)

Analytical Group/Method	Analyte	CAS Number	Project Screening Criteria for Water Samples [a]	STLC Limit	TCLP Limit	Project Quantitation Limit	Analytical Method MDLs [b]	Analytical Method QLs [b]	Units
	Selenium	7782-49-2	50	1,000	1,000	1	0.5	1	µg/L
	Silver	7440-22-4	NE	5,000	5,000	1	0.5	1	µg/L
	Thallium	7440-28-0	2	7,000	NE	1	0.5	1	µg/L
	Vanadium	7440-62-2	NE	24,000	NE	1	0.5	1	µg/L
	Zinc	7440-66-6	NE	250,000	NE	10	5	10	µg/L
Hexavalent Chromium/7196A	Hexavalent Chromium	18540-29-9	50 [j]	N/A	N/A	10	5	10	µg/L
Anions/300.0	Nitrate	14797-55-8	45,000	N/A	N/A	100	50	100	µg/L
	Phosphate	14265-44-2	NE	N/A	N/A	500	250	500	µg/L
	Sulfate	14808-79-8	NE	N/A	N/A	500	250	500	µg/L
Alkalinity/310.1	Alkalinity	-17 [e]	NE	N/A	N/A	10	1	10	mg/L
Ammonia/SM4500 -NH3 F	Ammonia as nitrogen	7664-41-7	NE	N/A	N/A	0.1	0.03	0.1	mg/L
TKN/SM4500N B	TKN	-20 [e]	NE	N/A	N/A	0.1	0.35	0.1	mg/L

Notes:

[a] Levels listed are from the California or EPA MCLs (2007), whichever is lower..
[b] Values listed are from the laboratory analytical methods.
[c] Value listed is from the California MCLs (2003) for trihalomethanes. Trihalomethanes include chloroform, bromodichloromethane, dibromochloromethane, and bromoform.
[d] Value listed is for total 1,3-dichloropropene.
[e] Value listed if from the Navy Electronic Data Deliverable valid value list since that analyte does not have a chemical abstract service number.
[f] Value listed is for the sum of 2-methylphenol and 4-methylphenol.
[g] Value listed is for the sum of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT.
[h] Value listed is for the sum of heptachlor and heptachlor epoxide.
[i] Value listed is for total PCBs.
[j] Value listed is for total chromium.

TABLE A.7-2

REFERENCE LIMITS FOR WATER SAMPLES

(UFP-QAPP Worksheet #15)

Abbreviations and Acronyms:

µg/L – micrograms per liter
BTEX – benzene, toluene, ethylbenzene, and total xylenes
CAS – Chemical Abstract Service
EPA – Environmental Protection Agency
MCL – maximum contaminant level
MDL – method detection limit
mg/L – milligrams per liter
MTBE – methyl tert-butyl ether
N/A – not applicable
NE – none established
PAH – polynuclear aromatic hydrocarbons
PCB – polychlorinated biphenyl
pg/L – picograms per liter
QL – quantitation limit
SIM – Selective Ion Monitoring
STLC – soluble threshold limit concentration
SVOC – semi-volatile organic compound
TCLP – Toxicity Characteristic Leaching Procedure
TKN – total kjedhal nitrogen
TPH – total petroleum hydrocarbons
UFP-QAPP – Uniform Federal Policy for
Quality Assurance Project Plans
VOC – volatile organic compound

This page intentionally left blank.

TABLE A.7-3

QUALITY CONTROL ACCEPTANCE CRITERIA

Method	Analyte	CAS Number	Accuracy Soil (%R) [a]	Precision Soil (RPD) [b]	Accuracy Water (%R) [a]	Precision Water (RPD) [b]
EPA Method 8260B	1,1-Dichloroethene	75-35-4	65-135	≤ 30	70-130	≤ 30
	Benzene	71-43-2	75-125	≤ 30	80-120	≤ 30
	Chlorobenzene	108-90-7	75-125	≤ 30	80-120	≤ 30
	Trichloroethene	79-01-6	75-125	≤ 30	70-125	≤ 30
	Toluene	108-88-3	70-125	≤ 30	75-120	≤ 30
	Surrogates:					
	1,2-Dichloroethane-d_4	17060-07-0	70-140	N/A	70-120	N/A
	4-Bromofluorobenzene	460-00-4	85-120	N/A	75-120	N/A
	Toluene-d_8	2037-26-5	85-115	N/A	85-120	N/A
EPA Method 8015B	Gasoline (C_6 to C_{10})	8006-61-9	60-130	30	60-130	30
	Surrogate:					
	4-Bromofluorobenzene	460-00-4	60-140	N/A	70-140	N/A
EPA Method 8015B	Diesel (C_{10} to C_{24}) JP5 (C_8 to C_{18}) Motor oil (C_{24} to C_{36})	-3527 [c] 8008-20-6 -3528 [c]	60-140	30	70-140	30
	Surrogate:					
	Octacosane/hexacosane/bromofluorobenzene	TBD	70-140	N/A	70-140	N/A
EPA Method 8270C	1,2,4-Trichlorobenzene	120-82-1	45-110	≤ 30	35-105	≤ 30
	1,4-Dichlorobenzene	106-46-7	35-105	≤ 30	30-100	≤ 30
	2,4-Dinitrotoluene	121-14-2	50-115	≤ 30	50-120	≤ 30
	Acenaphthene	83-32-9	45-110	≤ 30	45-110	≤ 30
	2-Chlorophenol	95-57-8	45-105	≤ 30	35-105	≤ 30
	4-Chloro-3-methyl phenol	59-50-7	45-115	≤ 30	45-110	≤ 30

TABLE A.7-3

QUALITY CONTROL ACCEPTANCE CRITERIA

Method	Analyte	CAS Number	Accuracy Soil (%R) [a]	Precision Soil (RPD) [b]	Accuracy Water (%R) [a]	Precision Water (RPD) [b]
	4-Nitrophenol	100-02-7	15-140	≤ 30	0-125	≤ 30
	Phenol	108-95-2	40-100	≤ 30	0-115	≤ 30
	Pyrene	129-00-0	45-125	≤ 30	50-130	≤ 30
	Surrogates:					
	2,4,6-Tribromophenol	118-79-6	35-125	N/A	40-125	N/A
	2-Fluorbiphenyl	321-60-8	45-105	N/A	50-110	N/A
	2-Fluorophenol	367-12-4	35-105	N/A	20-110	N/A
	Nitrobenzene-d_5	4165-60-0	35-100	N/A	40-110	N/A
	Phenol- d_5	4165-62-2	40-100	N/A	10-115	N/A
	Terphenyl- d_{14}	1718-51-0	30-125	N/A	50-135	N/A
EPA Method 8270C SIM	1,4-dioxane	123-91-1	30-130	≤ 30	30-130	≤ 30
	Surrogates:					
	Bromobenzene	108-86-1	30-130	N/A	30-130	N/A
EPA Method 8270C SIM	bis(2-Chloroethyl)ether	111-44-4	40-130	30	30-130	30
	bis(2-Ethylhexyl)phthalate	117-81-7	45-125	≤ 30	40-125	≤ 30
	Hexachlorobenzene	118-74-1	45-120	≤ 30	50-110	≤ 30
	n-Nitrosodinpropylamine	621-64-7	30-140	30	10-150	30
	Pentachlorophenol	87-86-5	25-120	≤ 30	40-115	≤ 30
	Benzo(a)pyrene	50-32-8	40-135	≤ 30	40-115	≤ 30
	Dibenz(a,h)anthracene	53-70-3	40-130	30	50-130	30
	Surrogate:					
	Terphenyl- d_{14}	1718-51-0	30-125	N/A	50-135	N/A

TABLE A.7-3

QUALITY CONTROL ACCEPTANCE CRITERIA

Method	Analyte	CAS Number	Accuracy Soil (%R) [a]	Precision Soil (RPD) [b]	Accuracy Water (%R) [a]	Precision Water (RPD) [b]
EPA Method 8081A	4,4'-DDT	50-29-3	45-140	≤ 30	45-140	≤ 30
	Aldrin	309-00-2	45-140	≤ 30	25-140	≤ 30
	Dieldrin	60-57-1	65-125	≤ 30	60-130	≤ 30
	Endrin	72-20-8	60-135	≤ 30	55-135	≤ 30
	gamma-BHC (Lindane)	58-89-9	60-125	≤ 30	25-135	≤ 30
	Heptachlor	76-44-8	50-140	≤ 30	40-130	≤ 30
	Surrogates:					
	Decachlorobiphenyl	2051-24-3	55-130	N/A	30-125	N/A
	Tetrachloro-m-xylene (TCMX)	877-09-8	70-125	N/A	25-140	N/A
EPA Method 8082	Aroclor 1016	12674-11-2	40-140	≤30	25-145	≤30
	Aroclor 1260	11096-82-5	60-130	≤30	30-145	≤30
	Surrogate:					
	Decachlorobiphenyl (DCBP)	2051-24-3	60-135	N/A	40-135	N/A
	Tetrachloro-m-xylene (TCMX)	877-09-8	40-130	N/A	30-130	N/A
EPA Method 6010B/6020/7000	Antimony	7440-36-0	80-120	≤ 20	80-120	≤ 20
	Arsenic	7440-38-2	80-120	≤ 20	80-120	≤ 20
	Barium	7440-39-3	80-120	≤ 20	80-120	≤ 20
	Beryllium	7440-41-7	80-120	≤ 20	80-120	≤ 20
	Cadmium	7440-43-9	80-120	≤ 20	80-120	≤ 20
	Chromium	7440-47-3	80-120	≤ 20	80-120	≤ 20
	Cobalt	7440-48-4	80-120	≤ 20	80-120	≤ 20
	Copper	7440-50-8	80-120	≤ 20	80-120	≤ 20

TABLE A.7-3

QUALITY CONTROL ACCEPTANCE CRITERIA

Method	Analyte	CAS Number	Accuracy Soil (%R) [a]	Precision Soil (RPD) [b]	Accuracy Water (%R) [a]	Precision Water (RPD) [b]
	Lead	7439-92-1	80-120	≤ 20	80-120	≤ 20
	Mercury	7439-97-6	80-120	≤ 20	80-120	≤ 20
	Molybdenum	7440-02-0	80-120	≤ 20	80-120	≤ 20
	Nickel	7782-49-2	80-120	≤ 20	80-120	≤ 20
	Selenium	7440-22-4	80-120	≤ 20	80-120	≤ 20
	Silver	7440-28-9	75-120	≤ 20	80-120	≤ 20
	Thallium	7440-62-2	80-120	≤ 20	80-120	≤ 20
	Vanadium	7440-66-6	80-120	≤ 20	80-120	≤ 20
	Zinc	7440-36-0	80-120	≤ 20	80-120	≤ 20
EPA Method 7196A	Hexavalent Chromium	18540-29-9	80-120	≤ 20	80-120	≤ 20
Walkey Black	Total organic carbon	-28 [c]	80-120	≤ 20	N/A	N/A
EPA Method 300.0	Anions	14808-79-8 (sulfate) 14265-44-2 (phosphate) 14797-55-8 (nitrate)	N/A	N/A	80-120	≤ 20
EPA Method 310.1	Alkalinity	-17 [c]	N/A	N/A	80-120	≤ 20
SM4500-NH3 F	Ammonia as nitrogen	7664-41-7	N/A	N/A	80-120	≤ 20
SM4500N B	TKN	-20 [c]	N/A	N/A	80-120	≤ 20

Notes:

[a] Percent recovery (%R) limits listed are for LCS/LCSD and MS/MSD. (LCSD is required if sufficient volume is not available for an MSD.)

[b] Relative percent difference (RPD) limits listed are for LCS/LCSD and MS/MSD. (LCSD is required if sufficient volume is not available for an MSD.)

[c] Value listed if from the Navy Electronic Data Deliverable valid value list since that analyte does not have a chemical abstract service number.

* Limit is not defined in the DoD QSM. Therefore, according to the QSM, laboratory in-house limit will be used. Limits will be added to this table once laboratory for this project has been procured.

TABLE A.7-3

QUALITY CONTROL ACCEPTANCE CRITERIA

Abbreviations and Acronyms:

%R – percent recovery
CAS –Chemical Abstract Service
DoD – Department of Defense
EPA – U.S. Environmental Protection Agency
LCS – laboratory control sample
LCSD – laboratory control sample duplicate
MS – matrix spike
MSD – matrix spike duplicate
N/A – not applicable
PAH – polynucleaer aromatic hydrocarbons
QSM – Quality Systems Manual
RPD – relative percent difference
SIM – Selective Ion Monitoring

This page intentionally left blank.

TABLE A.7-4

MEASUREMENT PERFORMANCE CRTIERIA – FIELD QC SAMPLES

(UFP-QAPP Worksheet #12)

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field duplicate	[a]	1 per 10 groundwater sampling locations	Precision	RPD <25 percent for water	S
Equipment rinsate	[a]	1 per sampling equipment per day	Accuracy	No analyte > QL	S&A
Source blank	[a]	1 per lot of water	Accuracy	No analyte > QL	S&A
Trip blank	VOC	1 per cooler with VOC groundwater samples	Accuracy	No analyte > QL	S&A

Notes:

[a] QC sample analysis will be dependent upon the analytical requirements for each site. QC samples will be analyzed for the same constituents as the samples collected from that site.

Abbreviations and Acronyms:

A – analysis
QC – quality control
QL – quantitation limit
RPD – relative percent difference
S – sampling
TPH – total petroleum hydrocarbons
UFP-QAPP – Uniform Federal Policy for Quality Assurance Project Plans
VOC – volatile organic compound

This page intentionally left blank.

TABLE A.7-5

FIELD QUALITY CONTROL SAMPLE SUMMARY

(UFP-QAPP Worksheet #20)

Matrix	Analytical Group	Analytical and Preparation SAP Reference	# of Primary Sampling Locations	# of Field Duplicates	MS/MSD	# of Field Blanks	# of Equipment Rinsates	# of Trip Blanks	Total # of Samples to Laboratory
Soil and Groundwater Samples									
Soil	VOCs	SAP Table A.6-2	227 [a]	N/A	1 per 20 samples	1 per lot	1 per day per equipment	N/A	227 [a]
Soil	TPH-purgeable	SAP Table A.6-2	113 [a]	N/A	1 per 20 samples	1 per lot	1 per day per equipment	N/A	113 [a]
Soil	TPH-extractable	SAP Table A.6-2	113 [a]	N/A	1 per 20 samples	1 per lot	1 per day per equipment	N/A	113 [a]
Soil	SVOCs	SAP Table A.6-2	181 [a]	N/A	1 per 20 samples	1 per lot	1 per day per equipment	N/A	181 [a]
Soil	SVOCs by SIM	SAP Table A.6-2	181 [a]	N/A	1 per 20 samples	1 per lot	1 per day per equipment	N/A	181 [a]
Soil	1,4-dioxane by SIM	SAP Table A.6-2	181 [a]	N/A	1 per 20 samples	1 per lot	1 per day per equipment	N/A	181 [a]
Soil	Pesticides	SAP Table A.6-2	94 [a]	N/A	1 per 20 samples	1 per lot	1 per day per equipment	N/A	94 [a]
Soil	PCBs	SAP Table A.6-2	138 [a]	N/A	1 per 20 samples	1 per lot	1 per day per equipment	N/A	138 [a]
Soil	Metals	SAP Table A.6-2	344 [a]	N/A	1 per 20 samples	1 per lot	1 per day per equipment	N/A	344 [a]
Soil	Hexavalent Chromium	SAP Table A.6-2	36 [a]	N/A	1 per 20 samples	1 per lot	1 per day per equipment	N/A	36 [a]
Soil	TOC	SAP Table A.6-2	29 [a]	N/A	1 per 20 samples	1 per lot	1 per day per equipment	N/A	29 [a]
Soil	Grain size	SAP Table A.6-2	29 [a]	N/A	N/A	N/A	N/A	N/A	29 [a]
Soil	Porosity	SAP Table A.6-2	29 [a]	N/A	N/A	N/A	N/A	N/A	29 [a]
Soil	Bulk density	SAP Table A.6-2	29 [a]	N/A	N/A	N/A	N/A	N/A	29 [a]
Soil	Microbial Parameters	SAP Table A.6-2	29 [a]	N/A	N/A	N/A	N/A	N/A	29 [a]
Water	VOCs	SAP Table A.6-2	521 [a]	1 per 10 samples	1 per 20 samples	1 per lot	1 per day per equipment	1 per cooler	521 [a]
Water	TPH-purgeable	SAP Table A.6-2	298 [a]	1 per 10 samples	1 per 20 samples	1 per lot	1 per day per equipment	1 per cooler	298 [a]
Water	TPH-extractable	SAP Table A.6-2	298 [a]	1 per 10 samples	1 per 20 samples	1 per lot	1 per day per equipment	N/A	298 [a]
Water	SVOCs	SAP Table A.6-2	89 [a]	1 per 10 samples	1 per 20 samples	1 per lot	1 per day per equipment	N/A	89 [a]
Water	SVOCs by SIM	SAP Table A.6-2	89 [a]	1 per 10 samples	1 per 20 samples	1 per lot	1 per day per equipment	N/A	89 [a]

TABLE A.7-5

FIELD QUALITY CONTROL SAMPLE SUMMARY

(UFP-QAPP Worksheet #20)

Matrix	Analytical Group	Analytical and Preparation SAP Reference	# of Primary Sampling Locations	# of Field Duplicates	MS/MSD	# of Field Blanks	# of Equipment Rinsates	# of Trip Blanks	Total # of Samples to Laboratory
Water	1,4-dioxane by SIM	SAP Table A.6-2	89 [a]	1 per 10 samples	1 per 20 samples	1 per lot	1 per day per equipment	N/A	89 [a]
Water	Pesticides	SAP Table A.6-2	18 [a]	1 per 10 samples	1 per 20 samples	1 per lot	1 per day per equipment	N/A	18 [a]
Water	PCBs	SAP Table A.6-2	18 [a]	1 per 10 samples	1 per 20 samples	1 per lot	1 per day per equipment	N/A	18 [a]
Water	Dissolved Metals	SAP Table A.6-2	521 [a]	1 per 10 samples	1 per 20 samples	1 per lot	1 per day per equipment	N/A	521 [a]
Water	Hexavalent Chromium	SAP Table A.6-2	15 [a]	1 per 10 samples	1 per 20 samples	1 per lot	1 per day per equipment	N/A	15 [a]
Water	Anions	SAP Table A.6-2	236 [a]	1 per 10 samples	1 per 20 samples	1 per lot	1 per day per equipment	N/A	236 [a]
Water	Alkalinity	SAP Table A.6-2	236 [a]	1 per 10 samples	1 per 20 samples	1 per lot	1 per day per equipment	N/A	236 [a]
Water	Ammonia	SAP Table A.6-2	236 [a]	1 per 10 samples	1 per 20 samples	1 per lot	1 per day per equipment	N/A	236 [a]
Water	TKN	SAP Table A.6-2	236 [a]	1 per 10 samples	1 per 20 samples	1 per lot	1 per day per equipment	N/A	236 [a]
Water	Microbial Parameters	SAP Table A.6-2	80 [a]	N/A	N/A	N/A	N/A	N/A	80 [a]
Soil Waste Samples									
Soil	VOC	SAP Table A.6-2	TBD [b]	N/A	N/A	N/A	N/A	N/A	TBD [b]
Soil	SVOC	SAP Table A.6-2	TBD [b]	N/A	N/A	N/A	N/A	N/A	TBD [b]
Soil	Pesticides	SAP Table A.6-2	TBD [b]	N/A	N/A	N/A	N/A	N/A	TBD [b]
Soil	PCBs	SAP Table A.6-2	TBD [b]	N/A	N/A	N/A	N/A	N/A	TBD [b]
Soil	TPH-purgeable	SAP Table A.6-2	TBD [b]	N/A	N/A	N/A	N/A	N/A	TBD [b]
Soil	TPH-extractable	SAP Table A.6-2	TBD [b]	N/A	N/A	N/A	N/A	N/A	TBD [b]
Soil	Metals	SAP Table A.6-2	TBD [b]	N/A	N/A	N/A	N/A	N/A	TBD [b]

TABLE A.7-5

FIELD QUALITY CONTROL SAMPLE SUMMARY

(UFP-QAPP Worksheet #20)

Matrix	Analytical Group	Analytical and Preparation SAP Reference	# of Primary Sampling Locations	# of Field Duplicates	MS/MSD	# of Field Blanks	# of Equipment Rinsates	# of Trip Blanks	Total # of Samples to Laboratory
Wastewater Samples									
Water	VOC	SAP Table A.6-2	TBD [b]	N/A	N/A	N/A	N/A	N/A	TBD [b]
Water	SVOC	SAP Table A.6-2	TBD [b]	N/A	N/A	N/A	N/A	N/A	TBD [b]
Water	Pesticides	SAP Table A.6-2	TBD [b]	N/A	N/A	N/A	N/A	N/A	TBD [b]
Water	PCBs	SAP Table A.6-2	TBD [b]	N/A	N/A	N/A	N/A	N/A	TBD [b]
Water	TPH-purgeable	SAP Table A.6-2	TBD [b]	N/A	N/A	N/A	N/A	N/A	TBD [b]
Water	TPH-extractable	SAP Table A.6-2	TBD [b]	N/A	N/A	N/A	N/A	N/A	TBD [b]
Water	Metals	SAP Table A.6-2	TBD [b]	N/A	N/A	N/A	N/A	N/A	TBD [b]

Notes:

[a] The number of samples for soil and groundwater listed are the minimum number of sample locations. The total number of locations may increase based on additional step-out/down sampling.

[b] The total number of soil waste and wastewater samples is to be determined based on the volume of waste generated.

Abbreviations and Acronyms:

BTEX – benzene, toluene, ethylbenzene, and total xylenes
MS – matrix spike
MSD – matrix spike duplicate
MTBE – methyl tert-butyl ether
PAH – polynuclear aromatic hydrocarbons
PCB – polychlorinated biphenyl
SAP – Sampling and Analysis Plan
SIM – Selective Ion Monitoring
SVOC – semivolatile organic compound
TBD – to be determined
TKN – total kjedhal nitrogen
TOC – total organic carbons
TPH – total petroleum hydrocarbons
UFP-QAPP – Uniform Federal Policy for Quality Assurance Project Plans
VOC – volatile organic compound

This page intentionally left blank.

8.0 DATA MANAGEMENT

This section discusses the data management procedures for samples collected for this project, tracing the path of the field and laboratory data from generation, review, and verification to storage and final use. The quality of the data collection process will be assessed through reviews of all documentation and measurements performed, and verification that information recorded is accurate and complete. Project documentation that will be generated is presented in Table A.4-1.

8.1 DATA GENERATION

Two types of data will be generated: field data and laboratory data. These types are described in the following sections.

8.1.1 Field Data

Field sampling data, including field logbooks and field forms, will be maintained. The logbooks will be numbered sequentially on the cover by the PQCM and that number will be entered into a logsheet maintained by the PQCM for the project. Field logbooks and forms will be reviewed by the PQCM, verified as described in Table A.8-1, and validated as described in Table A.8-2. A copy of all field forms containing information pertaining to sample collection (such as calibration forms) will be forwarded to the Project Chemist.

A copy of the CoCs will be faxed/emailed to the Project Chemist on a daily basis for review and communication with the laboratory. The CoCs will be reviewed by the Project Chemist for completeness daily. The manila copy of the CoC form will be mailed to the Project Chemist. The Project Chemist will maintain field documents and forward them to the main project file in San Diego, California at the completion of the project.

8.1.2 Laboratory Data

The laboratory will report data to TtEC by submitting data packages as described in Section 4.2. For this project, 80 percent of the data will be submitted in an EPA Level III-equivalent data package and 20 percent submitted in an EPA Level IV-equivalent data package as described in Section 4.2. (For waste characterization samples, 100 percent of the data will be submitted in an EPA Level III-equivalent data package.) All data reported by the laboratory will be verified as described in Table A.8-1. The original hardcopy data package will be submitted to NAVFAC SW Administrative Record.

As described in Section 7.1.2, the laboratory will verify sample receipt and document in a sample receipt form. In addition, samples will be assigned a unique number and recorded in the laboratory internal CoC.

All data reported by the analyst must be reviewed by a peer analyst who is qualified to perform the method and a supervisor prior to reporting the data to TtEC. In addition, the laboratory QA manager must review 10 percent of the data reported for each section, annually. The laboratory QA manager review may be conducted after the data have been reported to TtEC.

All data will be reported to TtEC on or before the designated turnaround time (TAT) by fax/email. The Project Chemist will review the data upon receipt prior to releasing to project personnel to verify that the sampling procedures and analytical results were obtained following the protocols in this SAP and are of sufficient quality to satisfy DQOs.

On or before 21 calendar days from sample receipt, the laboratory will submit hardcopy data with associated QC information as described in Section 4.2 along with an electronic format of the data to TtEC. The format to be used for the electronic data deliverable will be compatible with NEDD and is described in the procurement package.

8.1.3 Electronic

Field data from the CoCs (date and time collected, sample identification, etc.) will be entered into the TtEC database by the Project Chemist. Survey data will be recorded by a field surveyor and also entered into the database. All sample locations, except for waste characterization samples, will be surveyed in accordance with *Environmental Work Instruction (EWI) EVR.6, Environmental Data Management and Required Electronic Delivery Standards* (Southwest Division, Naval Facilities Engineering Command, [SWDIV] 2005). Horizontal control information will be captured in the State Plane Coordinate System (North American Datum [NAD] 83) in ft, and vertical control standards will be in mean sea level (North American Vertical Datum [NAVD] 88) in ft. All manual entries into the database will be 100 percent verified by the Project Chemist by checking the manual entry against the hardcopy information.

The EDD from the laboratory, which will be compatible with NEDD requirements, will be uploaded into the TtEC database. The data will be checked for required values and project-specific requirements by the database. Any discrepancies in the EDD will either be corrected by TtEC or the laboratory will be notified to make corrections. Ten percent of the data will be checked by the Project Chemist against the hardcopy data package. If errors are found in the electronic data, the Project Chemist will contact the laboratory for correction.

The Data Manager will conduct weekly backup of the database and maintain the backup file for 3 months.

The electronic data in NEDD format will be submitted to the DoN within 30 calendar days of receipt of validation report and as described in *EWI EVR.6, Environmental Data Management and Required Electronic Delivery Standards* (SWDIV, 2005). An e-mail confirmation received by TtEC will be forwarded to the project file.

8.2 DATA VALIDATION

The following documents will be used as guidance for validating all data, except waste characterization samples: Contract Laboratory Program *National Functional Guidelines for Organic Data Review, EPA 540/R-99-008* (EPA, 1999b); Contract Laboratory Program *National Functional Guidelines for Inorganic Data Review, EPA 540-R-04-004* (EPA, 2004); *EWI #1, 3EN2.1, Chemical Data Validation* (SWDIV), 2001a), and the QC criteria specified in this SAP.

Data validation will be performed by an independent data validation company. For this project, 80 percent of the data will require EPA Level III-equivalent data validation and 20 percent EPA Level IV-equivalent data validation. Data may be qualified as protocol or advisory. Protocol violations are when the laboratory deviates from the referenced analytical methods or the project-specific QLs, QC limits, or QC criteria.

Field QC samples will be discussed in the validation reports as follows:

- **Field Duplicates** - Field duplicate identifications will be provided on the CoC form for each SDG by TtEC. A section showing RPD values will be included to demonstrate field duplicate precision. If the results cannot be calculated, this will be noted in the report.
- **Field Blanks** - Identifications for field blanks including trip blanks, equipment rinsates, and source blanks will be provided on the CoC forms by TtEC. Any analyte detected in field blanks will be discussed in this section of the report.

Data validation reports will be submitted to TtEC as described in Section 4.3. The validator reports will be filed with the respective analytical data package. The original hardcopy data validation report will be submitted to NAVFAC SW Administrative Record.

8.3 DATA QUALITY ASSESSMENT

After data are validated, the Project Chemist will review and assess field and laboratory quality control. The PARCC parameters will be determined as described in Section 7.2. The Project Chemist will review the data validation reports for any deviations and qualify data. The following data qualifiers will be used:

J - Result is estimated
U - Analyte is not detected at or above the stated QL
R - Data are rejected
UJ - Analyte is not detected, but there is an uncertainty about the QL

Data qualifiers are used to indicate uncertainties associated with the data. The assigned qualifiers will be entered into the validation code field in the database. In addition, data will be assessed through the evaluation of the PARCC parameters.

The Project Chemist will prepare a data quality assessment (DQA) report that will summarize the findings of the data assessment and discuss usability of the data to be included in the report.

Data will be reported in tabular format to be included in the report.

TABLE A.8-1

VERIFICATION PROCESS

(UFP-QAPP Worksheet #34)

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Field logbook	Field logbooks will be reviewed weekly and verified that the information is complete in accordance with requirements in Section 4.1.1. The inspection will be documented in daily QC reports.	I	PQCM, TtEC
CoC forms	CoC forms will be reviewed daily upon their completion and verified for completeness.	I	PQCM, TtEC
Sample receipt	For samples shipped via courier or FedEx®, the Project Chemist will verify receipt of samples by the laboratory the day following shipment.	I	Project Chemist, TtEC
Sample logins	Sample login information will be reviewed for completeness in accordance with the CoC forms.	I E	Project Chemist, TtEC Laboratory Project Manager, TBD
Laboratory data prior to release	Laboratory data will be reviewed and verified for completeness against analyses requested on the CoC forms.	E	Laboratory Project Manager, TBD
Laboratory data due at turnaround time listed on CoC	Laboratory data will be verified that the analyses reported are consistent with the analyses requested on the CoC forms.	I	Project Chemist, TtEC
Laboratory data packages	All laboratory data packages will be verified by the laboratory performing the work for completeness and technical accuracy prior to submittal. Data packages will then be reviewed by the Project Chemist for accuracy against faxed/e-mailed data and for completeness in accordance with the data package requirements described in Section 4.5. Subsequently, data packages will be evaluated externally by undergoing data validation as described in Section 8.2.	E I E	Laboratory, TBD Project Chemist, TtEC Third-party data validators, TBD
Field and electronic data	One hundred percent of manual entries will be reviewed against the hardcopy information and 10 percent of electronic uploads will be checked against the hardcopy.	I	Project Chemist, TtEC

TABLE A.8-1

VERIFICATION PROCESS

(UFP-QAPP Worksheet #34)

Abbreviations and Acronyms:

CoC – chain-of-custody
E – external
I – internal
PQCM – Project Quality Control Manager
QC – quality control
TBD – to be determined
TtEC – Tetra Tech EC, Inc.
UFP-QAPP – Uniform Federal Policy for Quality Assurance Project Plans

TABLE A.8-2

VALIDATION STEPS (IIA AND IIB) PROCESS

(UFP-QAPP Worksheet #35)

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	Field logbook	Field logbooks will be reviewed weekly for accuracy associated with each sampling event. The inspection will be documented in daily QC reports.	PQCM, TtEC
IIa	COC forms	COC forms will be reviewed daily to ensure that project information, sample analyses requested, number of field QC samples collected, and percent level III or IV validation chosen is accurate and in accordance with the requirements in this SAP.	Project Chemist, TtEC
IIa	Sample receipt	The sample cooler will be checked for compliance with temperature and packaging requirements listed in Section 6.5 of this SAP.	Laboratory sample custodian, TBD
IIa	Sample logins	Sample login will be reviewed for accuracy against the COC form.	Project Chemist, TtEC Laboratory Project Manager, TBD
IIa	Laboratory data prior to release	Laboratory data will be reviewed to ensure that the data is accurate and meets the requirements in this SAP. Prior to release, data will be validated as follows: 100 percent of the data comply with the method- and project-specific requirements and that any deviations or failure to meet criteria are documented for the project file. 100 percent of manual entries are free of transcription errors and manual calculations are accurate; computer calculations are spot-checked to verify program validity; data reported are compliant with method- and project-specific QC requirements; raw data and supporting materials are complete; spectral assignments are confirmed; descriptions of deviations from method or project requirements are documented; significant figures and rounding have been appropriately used; reported values include dilution factors; and results are reasonable.	Laboratory Project Manager, TBD Laboratory Analyst, TBD Laboratory Peer Analyst, TBD

TABLE A.8-2

VALIDATION STEPS (IIA AND IIB) PROCESS

(UFP-QAPP Worksheet #35)

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
		Data reported are compliant with method- and project-specific QC requirements; the reported information is complete; the information in the report narrative is complete and accurate; and results are reasonable.	Laboratory Supervisor, TBD
		Data reported are compliant with method- and project-specific QC; analytical methods are performed in compliance with approved SOPs. This review may be conducted after release of data since they are done only on 10 percent of the data.	Laboratory Quality Assurance Manager, TBD
	Laboratory data due at turnaround time listed on CoC	Laboratory data will be reviewed to ensure that the data reported met the analyte list and limits listed in Tables A.7-1 and A.7-2.	Project Chemist, TtEC
IIa	Laboratory data packages	All laboratory data packages will be validated by the laboratory performing the work for technical accuracy prior to submittal.	Laboratory Project Manager, TBD
		Data packages will then be reviewed for accuracy against the laboratory data that was faxed/emailed data at the turnaround time listed on the COC.	Project Chemist, TtEC
		Data packages will be evaluated externally by undergoing data validation as described in Section 8.2.	Third-party data validator, TBD
IIb	Data validation reports	Data validation reports will be reviewed in conjunction with the project DQOs and data quality indicators (listed in Section 7.2).	Project Chemist, TtEC

Abbreviations and Acronyms:

COC – chain-of-custody
DQO – Data quality objective
PQCM – Project Quality Control Manager
QC – quality control
SAP – Sampling and Analysis Plan
SOP – Standard Operating Procedure
TBD – to be determined
TtEC – Tetra Tech EC, Inc.
UFP-QAPP – Uniform Federal Policy for Quality Assurance Project Plans

9.0 QUALITY ASSURANCE OVERSIGHT

QA oversight for this project will include surveillance of field activities and the laboratories performing analysis. Planned project assessments, assessment findings and corrective action responses, and QA management reports are included in Tables A.9-1, A.9-2, and A.9-3, respectively.

9.1 FIELD SURVEILLANCE

The NAVFAC SW QA Officer and TtEC QCM may schedule surveillance of field activities at any time to evaluate the execution of sample collection, identification, and control in the field. TtEC QCM will conduct surveillance of field activities at a minimum of once for a project duration less than 6 months and once every 6 months for a project duration longer than 6 months. The surveillance will also include observations of CoC procedures, field documentation, instrument calibrations, and field measurements.

Field documents and CoC records will be reviewed to ensure that all entries are printed or written in indelible black or blue ink, dated, and signed. Sampling operations will be reviewed and compared to this SAP and other applicable SOPs. Use of proper sample containers, proper handling of samples, and adequate documentation of the sampling operation will be verified.

Field measurements will be reviewed by random spot-checking to determine that the instrument is within calibration, the calibration is done at the appropriate frequency, and the sensitivity range of the instrument is appropriate for the project.

9.1.1 Corrective Action

Findings identified during the field surveillance will be recorded on a surveillance checklist. A surveillance report will be prepared and provided to the PjM. The PjM shall assign an individual to identify and implement corrective actions.

The TtEC QCM will monitor corrective action documentation, verify implementation of the corrective action, track and analyze the corrective action, and close out corrective action documentation upon completion of the corrective action.

9.2 LABORATORY ASSESSMENT

The laboratory to be used for this project will have the qualifications described in Section 7.1.1. TtEC will only conduct a laboratory assessment if warranted during the project. The scope of the laboratory assessment by TtEC will be determined based on quality issues encountered.

This page intentionally left blank.

TABLE A.9-1

PLANNED PROJECT ASSESSMENTS

(UFP-QAPP Worksheet #31)

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions (Title and Organizational Affiliation)
Operational Readiness Review	Prior to mobilization of the project and prior to initiating major phases of work	Internal	TtEC	Project Manager, TtEC	Project Manager, TtEC	Project Manager, TtEC	PQCM, TtEC
Field Sampling Surveillance	Once at the beginning, once during, and once towards the end of field sampling activities	Internal	TtEC	PQCM, TtEC	Project Manager, TtEC	Project Manager, TtEC	Project Manager and QCM, TtEC
Data Review Surveillance	Once for project duration less than 6 months	Internal	TtEC	Program Chemist, TtEC	Project Chemist, TtEC	Program Chemist, TtEC	QCM, TtEC
Management Review	Once	Internal	TtEC	QCM, TtEC	Project Manager, TtEC	Project Manager, TtEC	PQCM, TtEC

Abbreviations and Acronyms:

PQCM – Project Quality Control Manager
QCM – Quality Control Program Manager
TtEC – Tetra Tech EC, Inc.

This page intentionally left blank.

TABLE A.9-2

ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES

(UFP-QAPP Worksheet #32)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Organization)	Timeframe for Response
Field Sampling Surveillance	Surveillance Report	Project Manager, TtEC	7 days after completion of the inspection	Corrective Action Report	Project Manager and QCM, TtEC	5 days after notification
Data Review Surveillance	Surveillance Report	Project Manager, TtEC	7 days after completion of the inspection	Corrective Action Report	Project Manager and QCM, TtEC	14 days after notification
Management Review	Surveillance Report	Project Manager, TtEC	7 days after completion of the inspection	Corrective Action Report	QCM, TtEC	14 days after notification

Abbreviations and Acronyms:

QCM – Quality Control Program Manager
TtEC – Tetra Tech EC, Inc.
UFP-QAPP – Uniform Federal Policy for Quality Assurance Project Plans

This page intentionally left blank.

TABLE A.9-3

QA MANAGEMENT REPORTS

(UFP-QAPP Worksheet #33)

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Field Sampling Surveillance Report	Once at the beginning, once during, and once towards the end of field sampling activities	TBD	PQCM, TtEC	Project Manager QCM, TtEC
Data Review Surveillance Report	One after all data generated and reviewed	TBD	Program Chemist, TtEC	Project Manager, Program Chemist, QCM, TtEC
Management Review Report	One after management review is completed	TBD	QCM, TtEC	Project Manager, Program Manager, TtEC

Abbreviations and Acronyms:

PQCM – Project Quality Control Manager
QCM – Quality Control Program Manager
TBD – to be determined
TtEC – Tetra Tech EC, Inc.

This page intentionally left blank.

10.0 SAP REVISION OR AMENDMENT

Significant change in work scope affecting the original project DQOs will require this SAP to be amended. Any changes to this SAP will be documented prior to sampling and analysis activities. Minor changes will be documented by completing a FCR form. The FCR must be approved prior to field implementation. Major changes to work scope affecting the original DQOs or meeting criteria described in *EWI #2, 3EVR.2, Review, Approval, Revision, and Amendment of Sampling and Analysis Plans (SAPs)* (NAVFAC SW, 2006) will require preparation of a SAP addendum. The SAP addendum must be approved by a NAVFAC SW Quality Assurance Officer QAO prior to conducting sampling and analysis.

This page intentionally left blank.

11.0 REFERENCES

California Department of Health Services (DHS). 2003. Federal and State MCLs – Updated 09/12/03.

Department of Defense (DoD). 2006. *Quality Systems Manual for Environmental Laboratories.* January.

ERM-West. 1994. *Final Environmental Baseline Survey/Community Environmental Response Facilitation Act Report for NAS/NADEP Alameda.* October 31.

GretagMacbeth. 1994 (revised edition). *Munsell® Soil Color Charts.* GretagMacbeth: New Windsor, NY.

.K. Howard. 1986. Visual Classification of Soils, Unified Soil Classification System. Bureau of Reclamation. January.

Innovative Technical Solutions, Inc. (ITSI). 2006. *Draft Spring 2006 Alameda Basewide Annual Groundwater Monitoring Report, Alameda Point, Alameda, California.* October.

NAVFAC SW. 2006. *Environmental Work Instruction (EWI) #2, 3EVR.2, Review, Approval, Revision, and Amendment of Sampling and Analysis Plans (SAPs).* April.

Naval Facilities Engineering Service Center (NFESC). 1999. *Navy Installation Restoration Chemical Data Quality (CDQM) Manual.* October.

Southwest Division Naval Facilities Engineering Command (SWDIV). 2001. *Environmental Work Instruction (EWI) #1, 3EN2.1, Chemical Data Validation.* November.

______________. 2005. *Environmental Work Instruction (EWI) EVR.6, Environmental Data Management and Required Electronic Delivery Standards.* April.

SulTech. 2005a. *Final Remedial Investigation Study Report Operable Unit 2A (OU-2A) Sites 9, 13, 19, 22, and 23, Alameda Point, Alameda, CA. Volumes I–III.* April 1, 2005.

______________. 2005b. *Final OU-2B Remedial Investigation Study Report Sites 3, 4, 11, and 21, Alameda Point, Alameda, CA. Volumes I–IV.* August 5, 2005.

United States Army Corps of Engineers (USACE). *Safety and Health Requirements* (EM-385-1-1), and all applicable Occupational Safety and Health Administration (OSHA).

U.S. Environmental Protection Agency (EPA). 1986. *Test Methods for Evaluating Solid Waste, Physical Chemical Methods, SW-846.* Third Edition and final updates.

______________. 1992. *Specification and Guidance for Obtaining Contaminant-Free Sample Containers,* EPA 540/R-93/051 and OSWER Directive 9240.0-05A.

______________. 1999. *National Functional Guidelines for Organic Data Review, EPA 540/R-99/008.* Contract Laboratory Program. October.

______________. 2004. *National Functional Guidelines for Inorganic Data Review, EPA 540/R-04/004.* Contract Laboratory Program. October.

______________. 2005. *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP).* March.

______________. 2006a. *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5. May.

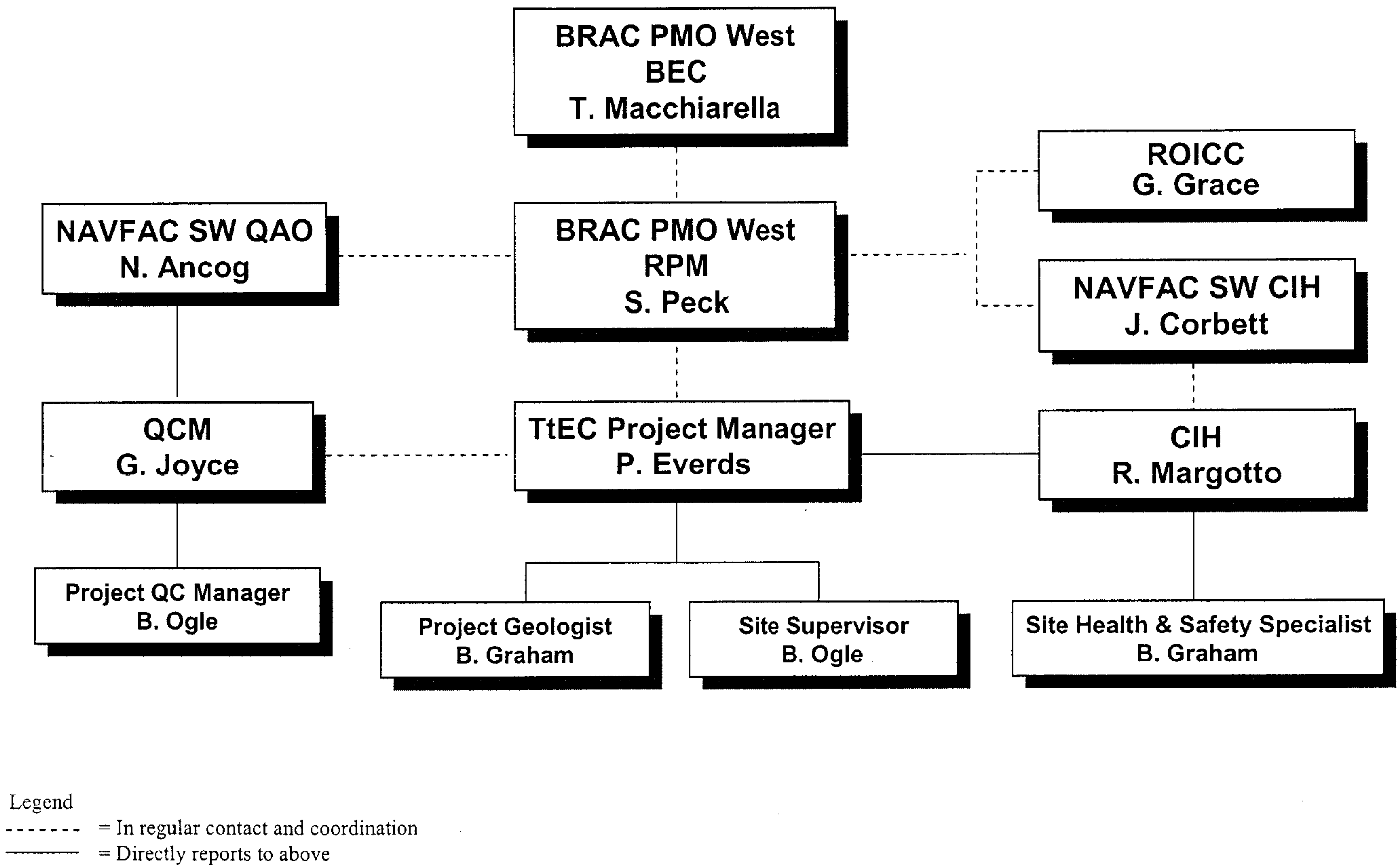
______________. 2006b. *Guidance on Systematic Planning using the Data Quality Objectives Process, EPA QA/G-4.* February.

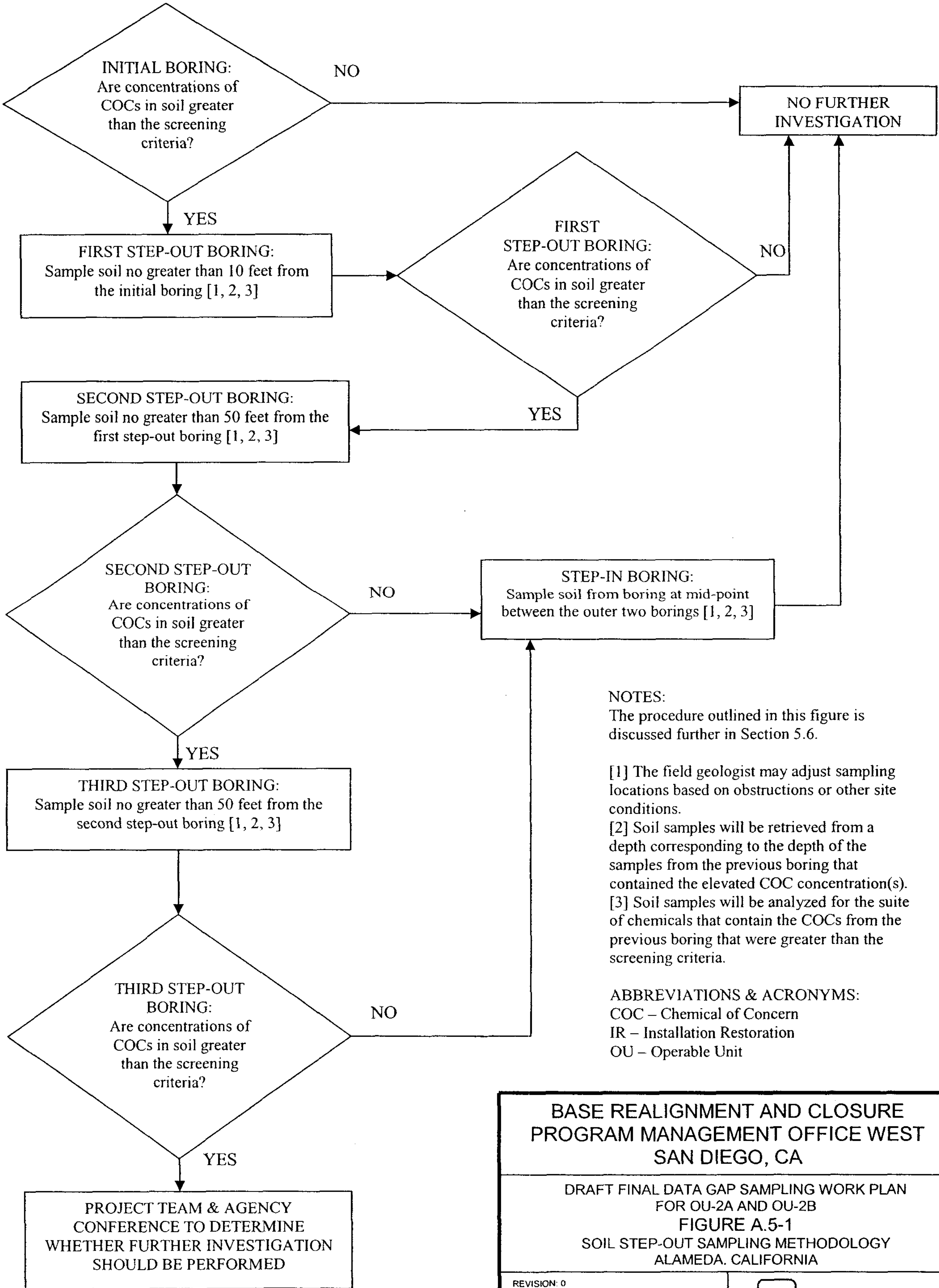
FIGURES

This page intentionally left blank.

Figure A.2-1

Project Organization Chart





NOTES:
The procedure outlined in this figure is discussed further in Section 5.6.

[1] The field geologist may adjust sampling locations based on obstructions or other site conditions.
[2] Soil samples will be retrieved from a depth corresponding to the depth of the samples from the previous boring that contained the elevated COC concentration(s).
[3] Soil samples will be analyzed for the suite of chemicals that contain the COCs from the previous boring that were greater than the screening criteria.

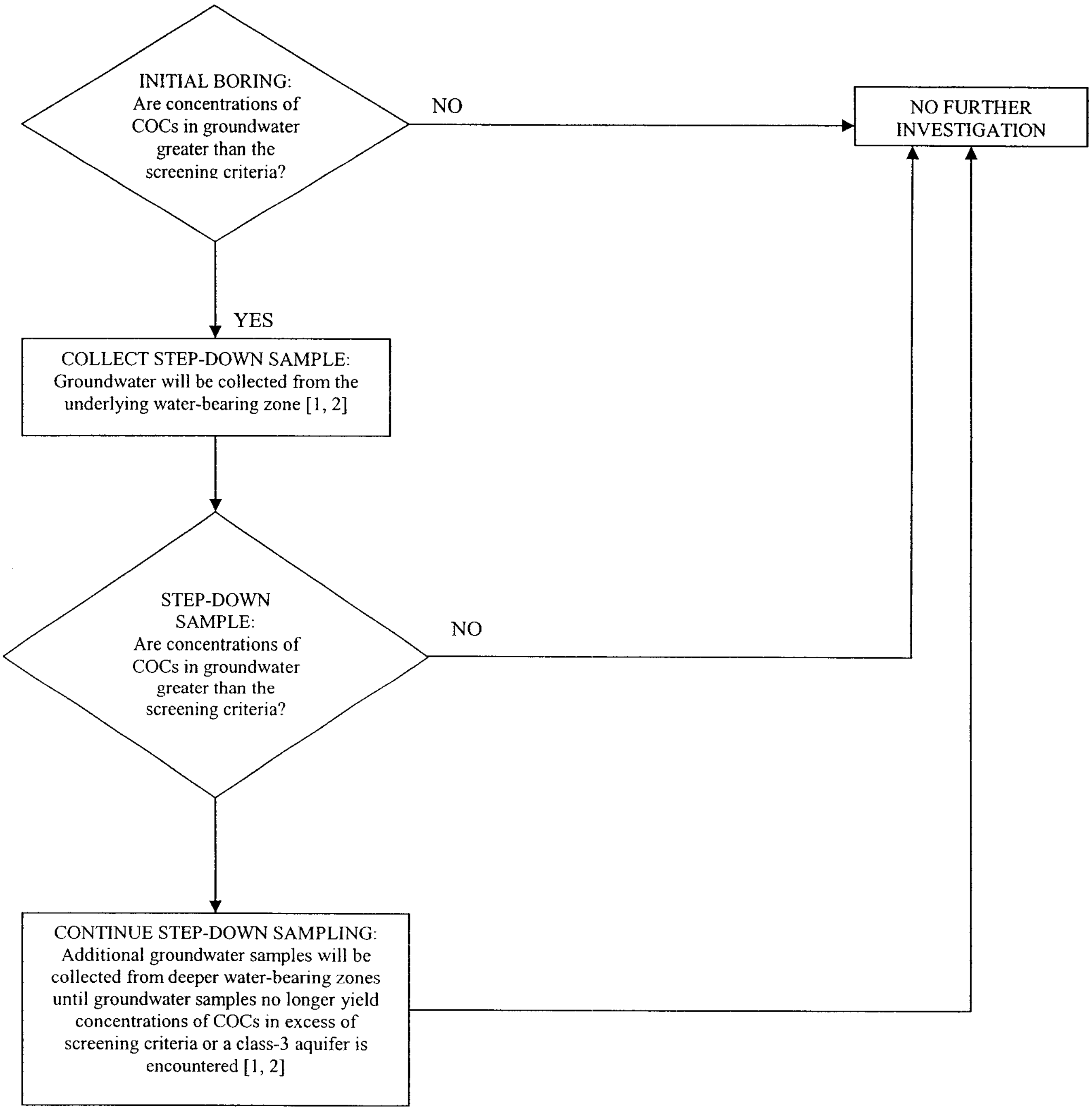
ABBREVIATIONS & ACRONYMS:
COC – Chemical of Concern
IR – Installation Restoration
OU – Operable Unit

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

DRAFT FINAL DATA GAP SAMPLING WORK PLAN
FOR OU-2A AND OU-2B
FIGURE A.5-1
SOIL STEP-OUT SAMPLING METHODOLOGY
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: SD
FILE: 0012000251.DOC

TETRA TECH



NOTES:
The procedure outlined in this figure is discussed further in Section 5.8.1.
[1] The field geologist may adjust or terminate sampling depths based on obstructions or other site conditions.
[2] Groundwater samples will be analyzed for the suite of chemicals that contain the COCs from the previous sample that were in excess of the screening criteria.

ABBREVIATIONS & ACRONYMS:
COC – Chemical of Concern
IR – Installation Restoration
OU – Operable Unit

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

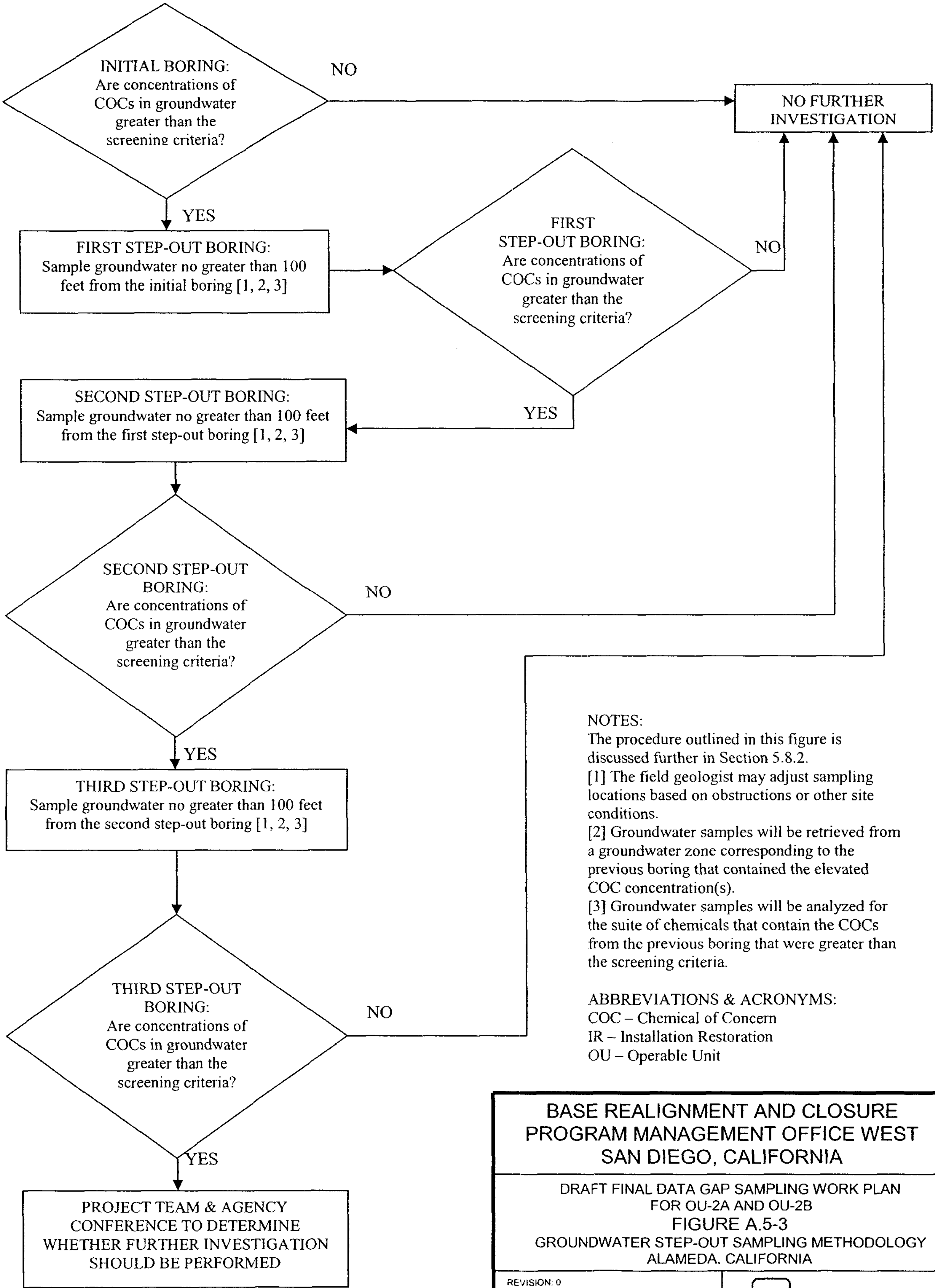
DRAFT FINAL DATA GAP SAMPLING WORK PLAN
FOR OU-2A AND OU-2B

FIGURE A.5-2

GROUNDWATER STEP-DOWN SAMPLING METHODOLOGY
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: SD
FILE: 0012000252.DOC

TETRA TECH



NOTES:
The procedure outlined in this figure is discussed further in Section 5.8.2.
[1] The field geologist may adjust sampling locations based on obstructions or other site conditions.
[2] Groundwater samples will be retrieved from a groundwater zone corresponding to the previous boring that contained the elevated COC concentration(s).
[3] Groundwater samples will be analyzed for the suite of chemicals that contain the COCs from the previous boring that were greater than the screening criteria.

ABBREVIATIONS & ACRONYMS:
COC – Chemical of Concern
IR – Installation Restoration
OU – Operable Unit

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

DRAFT FINAL DATA GAP SAMPLING WORK PLAN
FOR OU-2A AND OU-2B

FIGURE A.5-3

GROUNDWATER STEP-OUT SAMPLING METHODOLOGY
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: SD
FILE: 0012000253.DOC

TETRA TECH

ATTACHMENT 1

FIELD FORMS

Project: ____________

EQUIPMENT/INSTRUMENT CALIBRATION AND MAINTENANCE FORM

INSTRUMENT (NAME / MODEL NO. / SERIAL NO.): ______________________________

MANUFACTURER: ____________________ DATE PURCHASED *or* LEASED: ____________

CALIBRATION LOGSHEET

CALIBRATION DATE	INITIAL SETTINGS	STANDARD(S) USED	PROCEDURE	ADJUSTMENTS MADE	FINAL SETTINGS	SIGNATURE	COMMENTS

MAINTENANCE LOGSHEET

MAINTENANCE DATE	REASON FOR MAINTENANCE	MAINTENANCE PERFORMED	SIGNATURE	COMMENTS

TETRA TECH EC, INC

SUBSURFACE EXPLORATION LOG

BORING/WELL ID NUMBER: ________

CLIENT: ____________________
PROJECT NUMBER: ____________________
LOCATION: ____________________
SURFACE ELEVATION: ____________________

GEOLOGIST: ____________________
DATE DRILLED: ____________________
DRILLING COMPANY: ____________________
NORTHING: ____________________

TOTAL DEPTH: ____________________
DRILLING METHOD: ____________________
SAMPLE METHOD: ____________________
EASTING: ____________________

Depth (ft)	Sample Recovery	Blow Count	Sample Number	Time (24 hr)	FID/PID Sample	FID/PID Breathing Zone	Lithologic Contact (ft bgs)	GEOLOGIC DESCRIPTION	Well / Boring Completion
1									
2									
3									
4									
5							5		
6									
7									
8									
9									
10							10		
11									
12									
13									
14									
15							15		
16									
17									
18									
19									
20							20		

Notes:

% gravel - > 1/4 inch
% sand - visible -1/4 in.
% non-plastic fines - visible with hand lens
% plastic fines - not visible
Sand Size: Fine / Med / Coarse
Gravel Size: Fine / Med / Coarse
Angularity: A / Sa / Sr / R
Color: Use Munsell color chart
Moisture: Dry / Moist / Wet
Grading: poorly / well
Plasticity: high / med / low / non
Density (Course): v. loose loose / md. Dense / dense / v. dense
Consistency (Fines): v. soft / soft / md. stiff / v.stiff / hard
Max. Gravel Size : inches

Lithologic Name
Soil Class Symbol / See USCS flow Charts.
Describe sand and gravel grading, ie, fine to coarse grained
Additonal Modifiers: odor, staining, minerology, stucture, cementation, reaction with HCl

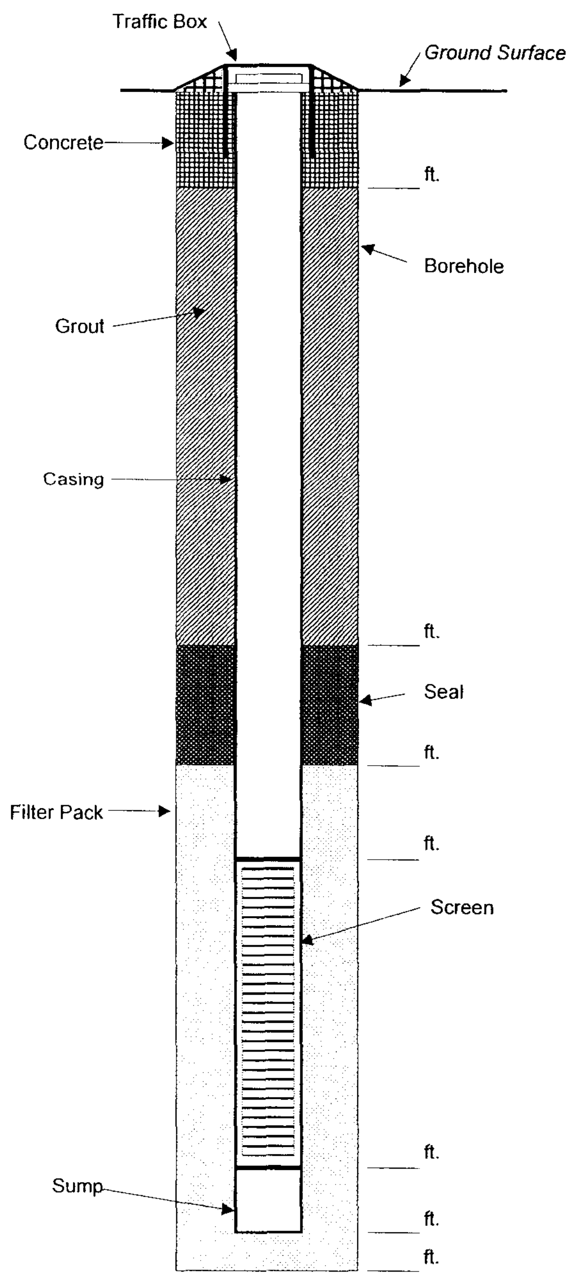
WELL CONSTRUCTION LOG (TYPICAL)

WELL NUMBER: ______________________

WELL TYPE: ______________________

SURFACE ELEV (ft. above MSL): ______________________

CASING ELEV (ft. above MSL): ______________________



DRILLING SUMMARY

DATE COMPLETED: ______________________

DRILLING COMPANY: ______________________

DRILLING RIG TYPE: ______________________

TOTAL DEPTH DRILLED: ______________________

CONSTRUCTION DETAILS

BOREHOLE DIAMETER: ______________________

TOTAL WELL DEPTH: ______________________

BLANK CASING TYPE: ______________________

BLANK CASING DIAMETER: ______________________

TOTAL BLANK CASING LENGTH: ______________________

SCREEN TYPE: ______________________

SCREEN SLOT SIZE: ______________________

SCREEN LENGTH: ______________________

SUMP LENGTH: ______________________

PROTECTIVE CASING STICKUP: ______________________

GROUT MATERIAL: ______________________

SEAL MATERIAL ______________________

FILTER MATERIAL: ______________________

COMMENTS: ______________________

____

LOW-FLOW GROUNDWATER SAMPLING DATA SHEET

Page ______ of ______

Date ______________

Well Name ______________________
Project ______________________
Project No. ______________________
Well Location ______________________
Sample Date ______________________
Sampling Personnel ______________________
____
____
Sample ID ______________________
Duplicate ID ______________________

Screen Interval ______________________
Station Elevation ______ GND ____ TOC _____
Immiscible Phases Present ☐ Yes ☐ No
Static Water Level (from TOC) / Time ______________ ______________ ______________
Average Water Level (from TOC) ______________________
Reference Point ______________________
PID Readings (background) ______________
Reference Elevation ______________________
PID Reading (TOC) ______________
Static Elevation ______________________
Notes ______________
Well Depth MEAS ________ RPTD ________
Feet of Water ______________
Depth of Bottom of Tubing ______________________
Depth to Water (w/ Tubing in Well) ______________________

PURGING

Time	Discharge Rate[1] (L/min)	Dissolved Oxygen (mg/L)	pH	Eh/ORP (mV)	Temp. (°C)	Specific Conduct. (µmhos/cm at °C)	Turbidity (NTU)	Cumulative Volume of Water Removed/Purged (Gallons)	PID/OVA Reading Location	PID/OVA Reading Value	Depth to Water[2] (ft)	Comments

Notes:
1. Purge rate = 0.2 - 0.5 L/minute
2. Drawdown shall be <0.33 foot

SAMPLE PARAMETERS

SAMPLE RATE

Notes:
1. Sample rate for VOCs analysis = 0.1 - 0.2 L/minute
2. Sample rate for non-VOCs analysis = purge rate = 0.2 - 0.5 L/minute

Condition of Well: ______________________
Remarks: ______________________

FIELD EQUIPMENT

pH Meter ______________ Serial Number ______________ Number of Bottles ______________
Temperature Meter ______________ Serial Number ______________
Turbidity Meter ______________ Serial Number ______________
Spec. Elec. Cond. Meter ______________ Serial Number ______________ Field Notebook ______________
ORP Meter ______________ Serial Number ______________
D.O. Meter ______________ Serial Number ______________ Sample Method ______________
Interface Probe ______________ Serial Number ______________
PID/OVA ______________ Serial Number ______________
Pump ______________ Serial Number ______________
Filter Apparatus ______________________ Discharge Water Containerized ☐ Yes ☐ No

ATTACHMENT 2

EXAMPLE OF SAMPLE LABEL, CHAIN-OF-CUSTODY, AND CUSTODY SEAL

SAMPLE LABEL (EXAMPLE)

SAMPLE NO.:____
PROJECT:____
DATE:____/____/____ **TIME:**_______________**HRS**__________
MEDIUM: **WATER**_____ **SOIL**_____ **SEDIMENT**_____________
OTHER__________________________________(**Specify**)
TYPE: **GRAB**_____ **COMPOSITE**_____ **OTHER**______________
PRESERVATION:____________________________________
ANALYSIS:____
SAMPLED BY:____
REMARKS:____
____

CUSTODY SEAL (EXAMPLE)

CUSTODY SEAL

Person Collecting Sample:__________________________ Sample No.:______
(Signature)
Date Collected:_____________ Time___________
____

TETRA TECH
1230 Columbia Street, Suite 500
San Diego, CA 92101 (619) 234-8696

NUMBER 21700

CHAIN-OF-CUSTODY RECORD

PROJECT NAME	PURCHASE ORDER NO.	ANALYSES REQUIRED	LABORATORY NAME
PROJECT LOCATION	PROJECT NO.		
SAMPLER NAME	AIRBILL NUMBER		LABORATORY ID (FOR LABORATORY)
PROJECT CONTACT	PROJECT CONTACT PHONE NUMBER		

SAMPLE ID	DATE COLLECTED	TIME COLLECTED	NO. OF CONTAINER	LEVEL 3	LEVEL 4	TYPE	TAT										COMMENTS

RELINQUISHED BY (Signature)	DATE	RECEIVED BY (Signature)
COMPANY	TIME	COMPANY
RELINQUISHED BY (Signature)	DATE	RECEIVED BY (Signature)
COMPANY	TIME	COMPANY
RELINQUISHED BY (Signature)	DATE	RECEIVED BY (Signature)
COMPANY	TIME	COMPANY

LABORATORY INSTRUCTIONS/COMMENTS

COMPOSITE DESCRIPTION

SAMPLE CONDITION UPON RECEIPT (FOR LABORATORY)
TEMPERATURE: ______ SAMPLE CONDITION: ☐ INTACT ☐ BROKEN
COOLER SEAL: ☐ INTACT ☐ BROKEN

Project Information Section
Do not submit to Laboratory

LOCATION	DEPTH START	DEPTH END	QC

SAMPLING COMMENT:

White - Laboratory; Pink - Laboratory; Canary - Project File; Manila - Data Management

APPENDIX B

SITE-SPECIFIC CONTRACTOR QUALITY CONTROL PLAN

This page intentionally left blank.

Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

CONTRACT NO. N62473-06-D-2201
CTO NO. 0012

APPENDIX B

FINAL

SITE-SPECIFIC
CONTRACTOR QUALITY CONTROL PLAN

October 11, 2007

**DATA GAP SAMPLING
FOR OPERABLE UNITS 2A and 2B
ALAMEDA POINT
ALAMEDA, CALIFORNIA**

DCN: ECSD-2201-0012-0002.R1

TETRA TECH EC, INC.
1230 Columbia Street, Suite 750
San Diego, CA 92101-8536

DRAFT ACCEPTED AS FINAL

Gregory D Joyce, ASQ CQM
Quality Control Program Manager

DRAFT ACCEPTED AS FINAL

Pete Everds
Project Manager

Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

CONTRACT NO. N62473-06-D-2201
CTO NO. 0012

APPENDIX B

DRAFT FINAL

SITE-SPECIFIC CONTRACTOR QUALITY CONTROL PLAN

September 7, 2007

DATA GAP SAMPLING FOR OPERABLE UNITS 2A and 2B ALAMEDA POINT ALAMEDA, CALIFORNIA

DCN: ECSD-2201-0012-0002

TETRA TECH EC, INC.
1230 Columbia Street, Suite 750
San Diego, CA 92101-8536

Gregory D Joyce

Gregory D Joyce, ASQ CQM
Quality Control Program Manager

Pete Everds
Project Manager

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

LIST OF TABLES

LIST OF FIGURES

ATTACHMENTS

This page intentionally left blank.

ABBREVIATIONS AND ACRONYMS

AHA	Activity Hazard Analysis
CQC	Contractor Quality Control
CTO	Contract Task Order
DCN	Design Change Notice
DFW	Definable Feature of Work
DoN	Department of the Navy
DPT	direct push technology
EPA	U.S. Environmental Protection Agency
FCR	Field Change Request
FWBZ	First Water-Bearing Zone
NAVFAC SW	Naval Facilities Engineering Command, Southwest
NCR	Nonconformance Report
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PjM	Project Manager
PQCM	Project Quality Control Manager
QA	Quality Assurance
QAO	Quality Assurance Officer
QC	Quality Control
QCM	Quality Control Program Manager
ROD	Record of Decision
ROICC	Residential Officer in Charge of Construction
RPM	Remedial Project Manager

ABBREVIATIONS AND ACRONYMS
(Continued)

SHSS	Site Health and Safety Specialist
SOP	Standard Operating Procedure
SS	Site Supervisor
SWMU	solid waste management unit
TtEC	Tetra Tech EC, Inc.

REVISION PAGE

Section No.	Page No.	Modification	Approval Signature	Date

This page intentionally left blank.

1.0 INTRODUCTION

The Site-Specific Contractor Quality Control (CQC) Plan identifies the specific procedures and methods to be implemented for Operable Unit (OU)-2A and (OU)-2B, data gap sampling, at Alameda Point, Alameda, California.

This CQC Plan will provide an effective quality control (QC) system that will ensure the quality of work performed by the selected contractors and its subcontractor personnel. The purpose of this CQC Plan is to establish the specific procedures and methods for field inspections to be performed.

1.1 BACKGROUND

The Data Gap Sampling Work Plan for OU-2A and OU-2B, located on Alameda Point, Alameda, California, has been developed to fill data gaps identified as a result of remedial investigations conducted for OU-2A and OU-2B.

The general location of Alameda Point is shown on Figure 1-1 of the Work Plan. Site boundaries for OU-2A and OU-2B are shown on Figure 1-2 of the Work Plan. OU-2A is composed of Sites 9, 13, 19, 22, and 23. OU-2B is composed of Sites 3, 4, 11, and 21.

The objectives of the Work Plan are to:

- Investigate soil and groundwater adjacent to individual SWMUs located at OU-2A and OU-2B identified for further action under CERCLA.
- Refine the nature and extent of soil contamination at OU-2A and OU-2B that were identified as a result of previous investigations.
- Refine the lateral and vertical extent of contaminant plumes in groundwater at each OU and determine aquifer parameters at these sites, including groundwater flow direction within the first and second water-bearing zones (FWBZ and SWBZ, respectively).

The scope of work consists of the following:

- Utility clearance
- Surface soil sampling
- Direct-push technology (DPT) soil and groundwater sampling
- Groundwater monitoring well installation and development
- Quarterly groundwater monitoring
- Location and elevation survey of all sampling locations

This CQC plan will address activities required prior to implementing the field investigation activities.

2.0 PROJECT ORGANIZATION, RESPONSIBILITY AND POINTS OF CONTACT

This section describes the organization and authority of project personnel including subcontractors. The organizational structure, functional responsibilities, levels of authority, and lines of communication have been established within the organization to ensure high-quality work. The project organization chart showing the reporting lines for each individual is provided in Figure B.2-1. The responsibilities and authorities of the key personnel are described in the following paragraph.

The Naval Facilities Engineering Command, Southwest (NAVFAC SW) Remedial Project Manager (RPM) for this project is Mr. Steve Peck. Mr. Gregory Grace, the on-site Resident Officer in Charge of Construction (ROICC), is responsible for the management, oversight of safety, and quality assurance (QA) of field activities.

2.1 REMEDIAL PROJECT MANAGER

The RPM has primary responsibility with the DoN for day-to-day management of the project activities performed under this Work Plan and for its successful completion. The RPM's duties and authority include:

- Performing project management for the DoN
- Ensuring that the project scope of work requirements are fulfilled
- Overseeing project cost and schedule
- Providing formal technical direction to the Tetra Tech EC, Inc. (TtEC) project team, as needed

2.2 QUALITY ASSURANCE OFFICER

The Quality Assurance Officer (QAO) is the DoN representative with primary responsibility for ensuring that the contract-required QA measures are in place and effective for the work performed. The QAO's duties and authority include the following:

- Review and approve Sampling and Analysis plans
- Provide DoN oversight of the TtEC QA Program
- Act as Point of Contact for matters pertaining to generation and maintenance of quality of data
- Authorize the suspension of project execution if QA requirements are not adequately followed

2.3 RESIDENT OFFICER IN CHARGE OF CONSTRUCTION

The ROICC staff has the primary responsibility for providing on-site QA and safety oversight of contractors. The ROICC staff member's duties and authority include the following:

- Verify that all work has been completed per contract and technical specifications prior to final government acceptance.
- Perform ongoing field inspection to verify that all work is in compliance with both contract and technical specifications.
- Notify the contractor of any work not in compliance.
- Notify the contractor of any work being performed in an unsafe manner.
- Interact with the contractor's Project Quality Control Manager (PQCM) on quality-related issues.
- Review and sign waste manifests as the generator's representative.
- Review Contractor Daily Reports for completeness and accuracy.
- Attend preparatory phase, initial phase, pre-final, and final acceptance inspections.
- Attend weekly QC meetings.

2.4 PROJECT MANAGER

The Project Manager (PjM) is responsible for the direction, execution, and successful completion of project tasks in order to achieve overall project goals. The PjM has responsibility for, and the authority to direct, all segments of the project including technical, construction, and administrative activities. Authorities and responsibilities include the following:

- Coordinate work activities of subcontractors and TtEC personnel and ensure that all personnel adhere to the administrative and technical requirements of the project.
- Monitor and report the progress of work and ensure that the project deliverables are completed on time and within project budget.
- Monitor the budget and schedule and notify the client and the Program Manager of any changes that may require administration actions.
- Ensure adherence to the quality requirements of the contract, project scope of work, and the QC Plans.
- Ensure that all work meets the requirements of the technical specifications and complies with applicable codes and regulations.
- Ensure that all work activities are conducted in a safe manner in accordance with the Site Health and Safety Plan, *Safety – Safety and Health Manual* (EM-385-1-1; United States Army Corps of Engineers [USACE], 2003), and all applicable Occupational Safety and Health Administration (OSHA) regulations.

- Serve as the primary contact between the DoN and TtEC for actions and information related to the work and make sure to include appropriate TtEC lead and experts in the decision-making.
- Coordinate satisfactory implementation of corrective actions and/or deposition of Nonconformance Reports (NCRs).

2.5 SITE SUPERVISOR

The Site Supervisor (SS) reports to the PjM and is responsible for coordinating, directing, implementing, and supervising site construction activities. Specific duties of the SS include the following:

- Implement construction activities in accordance with the Work Plan.
- Direct field construction leaders, labor, support personnel, and subcontractors.
- Administer site access and site security.
- Maintain work site, vehicles, and equipment.
- Coordinate and maintain logistics of all components of on-site tasks, including all personnel and equipment.
- Assist Site Health and Safety Specialist (SHSS) to ensure that all work is being conducted in a safe manner.
- Prepare daily production and weekly status reports along with a monthly summary report and estimate future scheduling needs.

2.6 PROJECT QUALITY CONTROL MANAGER

The PQCM is responsible for overall management of project QC and reports to the Quality Control Program Manager (QCM). An appointment letter and the resume of the assigned PQCM are provided in Attachments 1 and 2, respectively. The PQCM has the authority to stop work on site-related issues that affect quality of the work performed and for directing the correction of all nonconforming work. The PQCM will be on site at all times during field activities. The duties of the PQCM are the following:

- Implement the three phases of control (preparatory, initial, and follow-up) to assure that all prerequisites have been completed prior to the start of and during each applicable definable feature of work (DFW).
- Schedule and conduct QC meetings to review work status. Generate meeting minutes to document discussions and conclusions.
- Monitor work activities to ensure conformance with authorized policies, procedures, contract specifications, required standards, sound practices, and methods of quality construction.
- Be responsible for issuance and disposition of NCRs.

- Ensure that all on-site and off-site inspections, testing, and sampling are performed in accordance with the plans, specifications, and applicable codes.
- Perform inspections and conduct or supervise testing and sampling.
- Review and maintain records of approved submittals and Field Change Requests (FCRs) for construction activities.
- Inspect material delivery handling and storage in accordance with technical specifications.
- Update as-built drawings for invoice certification.
- Review and approve submittals and shop drawings and/or forward submittals as information only or for approval.
- Issue compliance notice on material, equipment, work-in-place, and workmanship.
- Direct the removal of work, material, and equipment not in compliance with plans and specifications.
- Immediately stop any segment of work that does not comply with the specifications and drawings.
- Inform the QCM of all proposed changes, concerns, problems, and any deviations from approved plans. This includes health and safety issues.
- Inform the QCM and PjM of NCRs to document any discrepant conditions and forward the NCRs to the QCM to obtain approval of recommended corrective actions.

2.7 SUBCONTRACTORS AND VENDORS

Qualified subcontractors may be selected to provide various construction services for this project. The subcontractor is required to provide labor, material, and equipment necessary to conduct construction activities as directed by the PjM. Subcontractors and vendors will be required to conform to TtEC's QA/QC Plan and the requirements of all approved procedures, technical specifications, and contract provisions.

The subcontractor is responsible for field inspection of their construction and operating activities. TtEC personnel will monitor, oversee, and make on-site observations and inspections of work in progress to determine if the subcontractor's work is proceeding in accordance with the QA/QC Plan.

Subcontractor personnel are responsible for maintaining a daily log of the project activities they perform and for providing information needed to complete the Daily CQC Report. All inspection records, including inspection reports, deficiency reports, and re-inspections of corrective actions will be documented.

2.8 POINTS OF CONTACT

The following is a list of the key project, DoN, and regulatory contacts:

Agency	Contact	Project Title
Base Realignment and Closure Program Management Office West 1455 Frazee Road, Suite 900 San Diego, CA 92108-4310	Mr. Steve Peck, P.E. (619) 532-0786	Remedial Project Manager
Base Realignment and Closure Program Management Office West 1455 Frazee Road, Suite 900 San Diego, CA 92108-4310	Mr. Thomas Macchiarella (619) 532-0923	BRAC Environmental Coordinator
Navy BRAC Detachment 410 Palm Avenue, Building 1 Treasure Island, CA 94130	Mr. Doug DeLong (415) 743-4713	Caretaker Site Office
EFA West ROICC 2450 Saratoga Street, Suite 200, Bldg. 114 Alameda Point Alameda, CA 94501	Mr. Gregory Grace (510) 749-5940	Resident Officer in Charge of Construction
Naval Facilities Engineering Command, Southwest Division 1220 Pacific Highway San Diego, CA 92132-5190	Mr. Narciso Ancog (619) 532-2540	Quality Assurance Officer
EPA Region 9 75 Hawthorne St., SDF-73 San Francisco, CA 94105	Ms. Anna Marie Cook (415) 972-3029	EPA – Remedial Project Manager
RWQCB, San Francisco Bay Region 1515 Clay Street, Suite 1400 Oakland, CA 94612	Mr. Erich Simon (510) 622-2355	RWQCB – Remedial Project Manager
Department of Toxic Substances Control 700 Heinz Avenue, Suite 100 Berkley, California 94710	Ms. Michelle Dalrymple, P.G. (510) 540-3926	DTSC – Remedial Project Manager
Tetra Tech EC, Inc. 1230 Columbia Street, Suite 750 San Diego, CA 92101-8536	Mr. Pete Everds (619) 471-3504 phone (619) 301-0433 cell	Project Manager
Tetra Tech EC, Inc. 1230 Columbia Street, Suite 750 San Diego, CA 92101-8536	Ms. Marianne Binkin, P.G. (619) 471-3564	Technical Lead
Tetra Tech EC, Inc. 19803 North Creek Parkway Bothell, WA 98011	Mr. Bryan Graham (425) 785-2685 cell	Project Geologist/Site Health and Safety

Agency	Contact	Project Title
Tetra Tech EC, Inc. 1230 Columbia Street, Suite 750 San Diego, CA 92101-8536	Mr. Roger Margotto, C.I.H, (619) 471-3503 (619) 981-4148 cell (714) 810-3742 pager	Project Environmental Safety Manager
Tetra Tech EC, Inc. Former Naval Air Station Moffett Field Building TE-45 Moffett Field, CA 94035	Mr. Bill Ogle (650) 564-9868 (650) 450-2982 cell	Project Quality Control Manager/Site Supervisor
Tetra Tech EC, Inc. 1050 NE Hostmark Street, Suite 202 Poulsbo, WA 98370	Mr. Gregory Joyce (360) 598-8117 (360) 780-0371 cell	Quality Control Program Manager
Tetra Tech EC, Inc. 1940 East Deere Avenue, Suite 200 Santa Ana, CA 92705-5718	Ms. Lisa Bienkowski (949) 756-7592	Project Chemist

Abbreviations and Acronyms:

BRAC – Base Realignment and Closure
C.I.H. – Certified Industrial Hygienist
DTSC – Department of Toxic Substances Control
EFA – Engineering Field Activities
EPA – U.S. Environmental Protection Agency
P.E. – Professional Engineer
P.G. – Professional Geologist
PQCM – Project Quality Control Manager
ROICC – Resident Officer in Charge of Construction
RWQCB – Regional Water Quality Control Board

3.0 DEFINABLE FEATURES OF WORK

A Definable Feature of Work is defined as an activity or task that is separate and distinct from other activities and that requires separate control activities. The DFW establishes the control measures required to verify both the quality of work performed and compliance with specified requirements, which include inspecting materials and workmanship before, during, and after each DFW. The following DFWs have been identified for the project and the required phases of controls are presented in Table B.3-1.

Pre-field Activities:

- Mobilization
- Geophysical survey for utility clearance

Field Activities:

- Collection of soil and groundwater samples from hand auger and DPT locations
- Groundwater monitoring well installation
- Surface work completion of well (monument, apron, bollards, etc.)
- Groundwater monitoring well development
- Collection of quarterly water level data from existing and new groundwater monitoring wells
- Collection of quarterly groundwater samples from existing and new groundwater monitoring wells
- Slug testing of newly installed monitoring wells
- Tidal study to determine tidal influence
- Equipment decontamination
- Performance of a land survey of the new groundwater monitoring well and soil boring locations

Post-Field Activities:

- Waste characterization
- Waste disposal
- Site restoration

This page intentionally left blank.

4.0 SUBMITTALS

Design drawings and specifications were developed and will be implemented by TtEC during the course of investigation activities.

4.1 SUBMITTAL LOG

All submittals are included in the submittal register (Table B.4-1). Each submittal will have a unique transmittal number according to the following format:

12 – XXX

where, 12 defines Contract Task Order (CTO) No. 0012 and XXX is the three-digit sequential transmittal number which, to the extent possible, will be pre-assigned in the submittal register.

A transmittal form will accompany each submittal. Each transmittal will be identified with:

- Contract number and CTO number
- Transmittal number
- Name and association of designer
- Description of item being submitted, including reference to specification section
- Approval of submitting organization indicating conformance to the requirements

The PQCM will update the submittal log on a regular basis and submit to the ROICC at a frequency agreed upon during the kick-off meeting.

This page intentionally left blank.

5.0 INSPECTION PLAN

This section discusses the DFWs for all field activities, including those of subcontractors and suppliers, the inspection process, and the required meetings to ensure compliance with the contract. The DFWs establish the measures required to verify both the quality of work performed and compliance with specified requirements and include inspecting materials and workmanship before, during, and after each DFW. The DFWs for this project are identified in Section 3.0 and listed in Table B.3-1.

Project CQC implements the following three control phases for all DFWs, except mobilization:

- Preparatory phase
- Initial phase
- Follow-up phase

The PQCM will conduct periodic inspections during mobilization to ensure that the appropriate equipment, materials and qualified personnel are on site prior to starting work activities.

5.1 KICK-OFF MEETING

Prior to the start of site work, the PQCM will conduct a meeting with the ROICC to discuss the QC program required by this contract. The purpose of this meeting is to develop a mutual understanding of the QC details, including forms to be used; administration of on-site and off-site work; and coordination of the Contractor's management, production, and the PQCM duties with the ROICC. As a minimum, the Contractor's personnel required to attend shall include the PjM, Project SS, SHSS, and PQCM. Minutes of the meeting shall be prepared by the PQCM and signed by both the PjM and RPM or ROICC. This meeting may be held in conjunction with other meetings (i.e., pre-construction meeting).

5.2 QC MEETINGS

After the start of field activities, the PQCM will conduct QC meetings at a frequency of once per week or as required by the ROICC. The meetings will be held at the project site and will be attended by the ROICC, PQCM, SHSS, and SS. The PQCM will notify the ROICC at least 48 hours in advance of each meeting. The following shall be accomplished at each meeting:

- Review minutes of the previous meeting.
- Review schedule.
  - Work or testing accomplished since last meeting
  - Rework items identified since last meeting
  - Rework items completed since last meeting

- Review status of submittals.
  - Submittals reviewed and approved since last meeting
  - Submittals required in the near future
- Review work to be accomplished in the following 2 weeks and documentation required. Schedule the three phases of control and testing.
  - Establish completion date for rework items
  - Required preparatory phase inspections
  - Required initial phase inspections
  - Required follow-up phase inspections
  - Required testing
  - Status of off-site work or testing
  - Required documentation
- Resolve QC and production problems.
- Review safety topics, Activity Hazard Analyses (AHAs), and safety concerns.
- Review environmental and pollution prevention topics, plans, and concerns.
- Address items that may require revisions to the Project CQC Plan.

5.3 PREPARATORY PHASE INSPECTION

The PQCM will conduct preparatory phase inspections prior to starting each construction phase and appropriate DFWs listed in Table B.3-1. These inspections shall include:

- Review of each paragraph of applicable specifications
- Review of the contract plans, drawings, and requirement
- Verification to ensure that all materials and/or equipment have been tested, submitted, and approved
- Verification to ensure that provisions have been made to provide required control inspection and testing
- Examination of the work area to verify that all required preliminary work has been completed and is in compliance with the contract
- Physical examination of required materials, equipment, and sample work to verify that they are on hand, conform to approved shop drawings or submitted data, and are properly stored
- Review of the appropriate AHAs to verify safety requirements are met
- Discussion of procedures for constructing the work, including repetitive deficiencies
- Documentation of construction tolerance and workmanship standards for that phase of work

- Verification to ensure that the portion of the Project QA/QC Plan for the work to be performed has been accepted by the DoN

The PjM, DoN RPM, and ROICC shall be notified at least two work days in advance of each preparatory phase inspection for DFWs identified in B.3-1. This phase shall include a meeting conducted by the PQCM and attended by the SS and any other personnel involved in performing the DFW. The PQCM may determine the need for a Preparatory Inspection due to changing conditions at the site. The PQCM will notify the PjM, DoN RPM, and ROICC immediately upon identifying the need for an unscheduled Preparatory Inspection.

The preparatory phase meetings will be documented by item on the Inspection Checklist and will be reported on the Daily CQC Report with the Preparatory Inspection Checklist included as an attachment. The PQCM will direct personnel performing work activities as to the acceptable level of workmanship required.

5.4 INITIAL PHASE INSPECTION

An initial inspection will be performed at the beginning of a DFW and will include:

- Check of preliminary work to ensure that it is in compliance with contract requirements
- Review of the Inspection Checklist documenting results of the preparatory meeting
- Verification of full contract compliance, including required control inspections
- Establishment of the required level of workmanship and verification to ensure that work meets minimum acceptable standards
- Resolution of all differences
- Check of safety requirements to include compliance with, and upgrading of, the Site Health and Safety Plan (SHSP) and AHAs.
- Review of the AHAs with project personnel

The PQCM will notify the PjM, DoN RPM, and ROICC of the Initial Inspection at the time they are notified of the Preparatory Inspection The PQCM will document initial inspections for each item using the Initial Inspection Checklist and attaching it to the Daily CQC Report. The exact location of the initial phase inspection will be indicated for future reference and comparison with follow-up inspections.

An initial phase inspection will be conducted each time a new crew arrives on site or any time acceptable specified quality standards are not being met.

5.5 FOLLOW-UP PHASE INSPECTION

During the completion of a particular work feature, follow-up inspections will be conducted to ensure continued compliance with contract requirements. The frequency of the follow-up inspections will depend on the extent of the work being performed on each particular feature. Each follow-up inspection will be documented on the Follow-Up Inspection Checklist, which will be attached to the Daily CQC Report. A final follow-up check will be conducted on any completed work phase prior to the commencement of a subsequent phase. Any deficiencies will be corrected prior to starting additional phases of work or will be identified on a Corrective Measures/Rework Item List of items that do not conform to the specified requirements or are incomplete.

5.5.1 Additional Preparatory and Initial Phases

The PQCM may conduct additional preparatory and initial inspections on the same DFWs under the following circumstances: 1) if the quality of ongoing work is unacceptable as determined by the ROICC, or designee, or the RPM and ROICC QA; 2) if there are changes in the staff, on-site supervision, or work crew; 3) if work on a definable feature is resumed after a substantial period of inactivity; or 4) if other problems develop.

5.6 COMPLETION INSPECTION

Completion inspections will be performed as summarized in this section.

5.6.1 Construction Quality Control Completion Inspections

The PQCM will conduct a detailed inspection prior to the pre-final inspection, when all of the work or an increment of work is deemed to be substantially complete. The ROICC and RPM and ROICC QA may also participate and will be notified in advance of the inspection date. The work will be inspected for conformance to plans, specifications, quality, workmanship, and completeness. The PQCM will prepare an itemized list of work not properly completed, inferior workmanship, or work that does not conform to plans and specifications. The list will also include outstanding administrative items, such as record (as-built) drawings. The list will be included in the QC documentation and submitted to the PjM following the inspection and will specify an estimated date for correction of each deficiency. The completion inspection will be documented on the Completion Inspection Checklist and attached to the Daily CQC Report.

5.6.2 Pre-final Inspection

The PQCM will conduct pre-final inspections. The ROICC or designee will schedule the pre-final inspection in response to notification from the PQCM prior to the planned inspection date. The PQCM is required to verify at this time that all specific items previously identified on the Corrective Measures/Rework Item List as being unacceptable, along with all remaining project work, will be complete and acceptable by the date scheduled for the pre-final inspection. At this inspection, the PQCM will develop a specific list of incomplete and/or unacceptable work performed under the contract and will provide this list to the ROICC.

5.6.3 Final Acceptance Inspection

The ROICC will schedule the final acceptance inspection based on notification from the PQCM of readiness. The inspection will include the PQCM, PjM, SS, ROICC, and RPM. Notification will be provided by the PQCM to the ROICC prior to the planned final acceptance inspection date and must include verification that all specific items previously identified as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection.

5.7 INSPECTION DOCUMENTATION

The PQCM is responsible for the maintenance of the inspection records. Inspection records will be legible and clearly provide all necessary information to verify that the items or activities inspected conform to the specified requirements, or in the case of nonconforming conditions, provide evidence that the conditions were brought into conformance or otherwise accepted by the ROICC. All inspection records will be made available to the DoN.

This page intentionally left blank.

6.0 DOCUMENTATION

Preparation, review, approval, and issuance of documents affecting quality will be controlled to the extent necessary to determine that the documents meet specified requirements. Project documents, which may be controlled, include the following:

- Meeting minutes, conference notes, and confirmation notes
- Submittal register
- Inspection documentation
- Contractor production report
- Daily CQC report
- Material inspection and shipping logs
- NCRs
- NCR log
- FCRs
- Rework items list
- Photograph log
- Field logbooks

6.1 CONTRACTOR QUALITY CONTROL REPORT

The PQCM is responsible for maintenance of current QC records of operation, activities, and tests performed, including the work of subcontractors and suppliers. The records will include factual evidence that required QC activities and tests were performed. A Daily CQC Report will be completed by the PQCM to document activities covered by the Project CQC Plan. A Contractor Production Report will also be completed daily by the Site Superintendent. These documents will include the following:

- Contractor/subcontractor(s) and their area of responsibility
- Operating equipment, with hours worked, idle, or down for repair
- Work performed on a given day, giving location, description, and by whom
- Test and/or control activities performed with results and references to Standard Operating Procedures (SOPs) plan requirements, including the control phase (preparatory, initial, follow-up) and deficiencies (along with corrective action)
- Material received, with statement as to its acceptability and storage
- Submittals reviewed, with contract reference, by whom, and action taken
- Off-site surveillance activities, including actions taken
- Job safety evaluations stating what was checked, results, and instructions or corrective actions

- A list of instructions given/received and conflicts in plans and/or SOPs
- Contractor's verification statement
- Site visitors/purpose, deviations from plans, difficulties, and resolution

The records will indicate a description of trades working on the project, the number of personnel working, weather conditions encountered, and any delays encountered. Both conforming and nonconforming features will be covered with a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original of this report shall be furnished to the ROICC on the first work day (or an acceptable schedule established by ROICC during the kick-off meeting) following the date covered by the report. Reports need not be submitted for days during which no work is performed. At a minimum, one report shall be prepared and submitted for every seven days of no work and on the last day of a no-work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work will summarize work for that day only. Reports will be signed and dated by the PQCM and other appropriate personnel, including subcontractors responsible for completion of activities. The report will include copies of test reports and copies of reports prepared by all subordinate QC personnel.

6.2 CONFERENCE NOTES AND CONFIRMATION NOTES

In addition to other required documentation, the PQCM is responsible for taking notes and preparing the reports of all conferences. Conference notes will be typed and the original report furnished to the DoN within five days after the date of the conference for concurrence and subsequent distribution to all attendees. At a minimum, this report will include the following:

- Date and place the conference was held
- List of attendees, including name, organization, and telephone number
- Comments made during the conference and decisions affecting criteria changes
- Conference notes that augment the written comments

The PjM is also responsible for providing a record of all discussions, verbal directions, telephone conversations, and so forth in which TtEC personnel or their representatives participate on matters relating to this contract and work. These records, entitled "Confirmation Notices," will be numbered sequentially and fully identify participating personnel, subject discussed, and any conclusions reached. The PjM, or his designee, will forward a reproducible copy of the confirmation notices to the DoN RPM and ROICC within five working days.

7.0 NONCONFORMANCES

The PQCM documents any work or materials not conforming to the technical specifications or project/contract requirements on an NCR. The NCR will detail the nonconforming condition, the recommended corrective action(s), and the disposition of the corrective action(s). Qualified representatives from engineering, QA, and construction will review the NCR and either accept or reject the recommended corrective action or disposition. The NCR will remain open until the nonconforming condition has been satisfactorily resolved and verified by QC inspection staff and the PQCM. Upon receipt of notification of a detected nonconformance, NCRs for each item will be completed.

7.1 IDENTIFICATION OF NONCONFORMING ITEMS

Items identified as nonconforming will be documented. Copies of completed NCRs will be sent to the ROICC.

7.1.1 Condition Requiring Stop Work

If corrective actions are insufficient, resolution cannot be reached, or results of prior work are indeterminate, work may be stopped. The PQCM will verbally notify the Superintendent or Site Supervisor to suspend work and immediately notify the PjM. If there is a disagreement between the PQCM and the PjM, the difference will be brought to the attention of the QCM until resolution is achieved.

The conditions of the stop work will be described in detail on the NCR form to allow evaluation of the problem(s) and proper corrective action(s). In addition to the NCR the stop work notification will be documented on the Rework Items List, if not resolved by the end of the work day. Work will not continue until the individual who authorized the stop work concurs with resolution of the deficient condition.

7.2 DISPOSITION

The disposition of NCRs will include the necessary actions required to bring the nonconforming condition to an acceptable condition and may include use-as-is, reworking, replacing, retesting, or reinspecting. Implementation of the disposition may be done in accordance with the original procedural requirements, a specific instruction, or a FCR.

7.2.1 Field Change Requests

Site personnel shall document changes to the approved plans in the field through the FCR form. At a minimum, the following information will be documented in the FCR form:

- Project name

- CTO number
- FCR number
- Documents to which a change is requested (including revision number if applicable)
- Description of the item or condition for which the change is requested
- Reason for the change
- Recommended disposition
- Cost and schedule implication of the change, if any
- Approval of disciplines if changes involve risk-sensitive items in that discipline
- Approval of the PjM, SS, Project Environmental Safety Manager, and QCM

7.3 CORRECTIVE ACTIONS

On detection of a nonconforming condition, the PQCM will immediately take corrective action. The procedure for identification, analysis, and implementation of corrective action is described in the QP-12 procedure, Corrective Action.

8.0 REFERENCES

Department of Navy (DoN) Base Realignment and Closure (BRAC) Program Management Office West. 2007. *Draft Final Record of Decision for Operable Unit 1 Installation Restoration Sites 6, 7, 8, and 16.*

United States Army Corps of Engineers (USACE). 2003. *Safety–Safety and Health Requirements*. EM-385-1-1. November 3.

This page intentionally left blank.

TABLES

This page intentionally left blank.

TABLE B.3-1

DEFINABLE FEATURES OF WORK

ACTIVITY	PREPARATORY	DONE	INITIAL	DONE	FOLLOW-UP	DONE
Geophysical survey for utility clearance prior to intrusive activities	• Verify that schedule and access notification has occurred with the ROICC. • Verify that Underground Service Alert has been notified. • Review available Base utility drawings for areas where drilling, hand augering, and monitoring well installation are going to take place. • Identify and demarcate survey areas. • Review the AHAs for this activity. • Verify that survey requirements have been reviewed with appropriate personnel. • Ensure that base drawings are provided to geophysical contractor.		• Verify that utility survey was performed in correct location. • Check compliance with SHSP and task AHAs.		• Verify that markings/pin-flags remain in place for the duration of work. • Verify that proper markings are on utility drawings and field locations.	

TABLE B.3-1

DEFINABLE FEATURES OF WORK

ACTIVITY	PREPARATORY	DONE	INITIAL	DONE	FOLLOW-UP	DONE
Shallow and deep soil and groundwater sampling using DPT or hand auger.	• Verify that schedule and access notifications have occurred with the ROICC. • Review applicable sections of Work Plan and SAP. • Verify that Underground Service Alert has been contacted 48 hours prior to sampling, if needed for 3 ft depth or greater. • Verify that geophysical survey has been conducted. • Review existing site utility drawings and marked utilities (by geophysical contractor). • Review the AHAs for this activity. • Verify that required equipment and materials are on hand to conduct work in accordance with Work Plan (e.g., PID, hand auger, sample containers, decontamination equipment). • Verify that the appropriate equipment has been properly calibrated. • Inspect soil sampling equipment.		• Verify that drilling and sampling of soil are being conducted in accordance with the Work Plan and SAP. • Verify that samples are collected in accordance with the Work Plan and SAP. • Verify that appropriate containers and preservatives are used after sample retrieval. • Verify proper handling, packaging of samples, and appropriate chain-of-custody completion. • Verify equipment decontamination procedure. • Verify sample locations. • Verify that borings are backfilled in accordance with the Work Plan.		• Inspect and verify that work was performed per the Work Plan. • Verify that site activities are being photographed. • Verify that appropriate containers and preservatives are used after sample retrieval. • Verify proper handling, packaging of samples, and appropriate chain-of-custody completion. • Verify backfill of each boring. • Verify equipment decontamination procedure. • Verify proper management of waste.	

TABLE B.3-1

DEFINABLE FEATURES OF WORK

ACTIVITY	PREPARATORY	DONE	INITIAL	DONE	FOLLOW-UP	DONE
Groundwater monitoring well installation	• Verify construction schedule and access notifications with Alameda ROICC. • Verify installation location with ROICC. • Verify that construction permits have been approved and are available on site. • Review applicable sections of Work Plan. • Verify that Underground Service Alert has been contacted a minimum of 72 hours prior to any intrusive activities. • Review existing site utility drawings and marked utilities (by geophysical contractor). • Verify that ACWD has been notified, forms and permits completed and submitted. • Verify that required equipment and materials are on hand to conduct work in accordance with Work Plan. • Review the AHAs for this activity.		• Check compliance with SHSP and task AHAs. • Verify that wells are being installed in accordance with the Work Plan. • Inspect field documentation.		• Inspect and verify that work was performed per the Work Plan. • Verify that contractor has provided daily logs and listed materials used. • Verify proper management of waste. • Verify that site activities are being photographed. • Verify installation of all wells. • Inspect field documentation.	
Surface work completion of well (monument, apron, bollards)	• Verify that construction schedule and access notifications have occurred with ROICC. • Review applicable sections of Work Plan. • Review AHAs for this activity. • Verify that required equipment and materials are on hand to conduct work in accordance with Work Plan.		• Verify that surface completions are being completed in accordance with the Work Plan. • Check compliance with SHSP and task AHAs. • Verify that site activities are being photographed. • Inspect field documentation.		• Verify that contractor has provided daily logs and listed materials used. • Verify surface completion of all wells. • Inspect field documentation.	

TABLE B.3-1

DEFINABLE FEATURES OF WORK

ACTIVITY	PREPARATORY	DONE	INITIAL	DONE	FOLLOW-UP	DONE
Groundwater monitoring well development	• Verify that construction schedule and access notifications have occurred with ROICC. • Review applicable sections of Work Plan and SAP. • Review the AHAs for this activity. • Verify that required equipment and materials are on hand to conduct work in accordance with Work Plan (e.g., pump and decontamination equipment). • Verify that the appropriate equipment has been properly calibrated.		• Check compliance with SHSP and task AHAs. • Verify that wells are being developed in accordance with the Work Plan. • Inspect field documentation.		• Verify that contractor has provided daily logs and listed materials used. • Verify proper management of waste. • Verify well development for each well. • Inspect field documentation.	
Collection of water level data for quarterly gauging of newly installed and existing groundwater wells	• Verify that schedule and access notifications have occurred with the ROICC. • Review applicable sections of Work Plan and SAP. • Verify that required equipment and materials are on hand to conduct work in accordance with Work Plan and SAP (e.g., transducers and decontamination equipment). • Verify that the appropriate equipment has been properly calibrated. • Verify well locations and access. • Review the AHAs for this activity.		• Verify that water levels are being measured in accordance with the Work Plan and SAP. • Verify that sampling and data collection are performed per Work Plan and SAP. • Check compliance with SHSP and with task AHAs. • Inspect field documentation.		• Verify water level data collection procedure. • Verify proper management of waste. • Inspect field documentation for completeness.	

TABLE B.3-1

DEFINABLE FEATURES OF WORK

ACTIVITY	PREPARATORY	DONE	INITIAL	DONE	FOLLOW-UP	DONE
Collection of groundwater samples from existing and newly installed groundwater wells.	• Verify that schedule and access notifications have occurred with the ROICC. • Review applicable sections of Work Plan and SAP. • Verify that required equipment and materials are on hand to conduct work in accordance with Work Plan and SAP (e.g., sample containers, pump, and decontamination equipment). • Verify that the appropriate equipment has been properly calibrated. • Review the AHAs for this activity.		• Verify that samples are collected in accordance with the Work Plan and SAP. • Verify calibration of groundwater sampling equipment. • Verify that appropriate containers and sample preservatives are used. • Verify proper handling and packaging of samples. • Verify equipment decontamination procedure. • Inspect field documentation.		• Verify that sampling has been performed in accordance with the Work Plan and SAP. • Verify that appropriate containers and sample preservatives are used. • Verify proper handling and packaging of samples. • Verify proper management of waste. • Inspect field documentation.	
Slug testing of new monitoring wells	• Verify that schedule and access notifications have occurred with the ROICC. • Review applicable sections of Work Plan and SAP. • Review the AHAs for this activity. • Verify that required equipment and materials are on hand to conduct work in accordance with Work Plan (e.g., transducers).		• Verify well locations. • Verify that the tests are conducted in accordance with the Work Plan. • Verify equipment decontamination procedure. • Inspect field documentation.		• Verify that work was performed per the Work Plan. • Verify proper management of data. • Inspect field documentation.	

TABLE B.3-1

DEFINABLE FEATURES OF WORK

ACTIVITY	PREPARATORY	DONE	INITIAL	DONE	FOLLOW-UP	DONE
Conduct tidal study	• Verify that schedule and access notifications have occurred with the ROICC. • Review applicable sections of Work Plan and SAP. • Verify that required equipment and materials are on hand to conduct work in accordance with Work Plan and Sampling and Analysis Plan (SAP) (e.g., data recorders). • Verify well locations and access. • Review the AHAs for this activity.		• Verify tidal data collection procedure. • Verify that data collection is performed per Work Plan and SAP. Check compliance with SHSP and task AHAs. Verify that water level measurements were conducted prior to installation of data-loggers. Verify that water level measurements are recorded to the nearest 0.01 ft. Verify data-loggers are installed in all appropriate wells.		• Verify tidal data collection procedure. • Verify that water level measurements are recorded to the nearest 0.01 ft. • Verify that data loggers are installed in all appropriate wells. • Verify that manual water levels are measured once per day. • Inspect field documentation for completeness.	

TABLE B.3-1

DEFINABLE FEATURES OF WORK

ACTIVITY	PREPARATORY	DONE	INITIAL	DONE	FOLLOW-UP	DONE
Performing a land survey of new groundwater monitoring wells, DPT, and hand auger sample locations	• Verify that schedule and access notifications have occurred with the ROICC. • Verify that surveyor is licensed in California. • Review Alameda GIS drawings that show pertinent survey benchmarks and monuments. Verify that survey monuments and benchmarks exist in the field. • Review the AHAs for this activity. • Verify that survey requirements are reviewed by appropriate personnel.		• Verify that survey was performed in correct locations.		• Inspect and verify that work was performed per the Work Plan.	
Post-Field Activities						
Waste Characterization	• Verify that schedule and access notifications have occurred with ROICC. • Review applicable sections of Work Plan. • Review the AHAs for this activity. • Verify that waste transporter and disposal facility have been identified. • Review disposal requirements with appropriate personnel.		• Verify that analytical requirements have been satisfied.		• Verify that each waste stream has been sampled. • Verify that sample handling and shipping procedures are being followed. • Verify that all waste streams have been properly characterized.	

TABLE B.3-1

DEFINABLE FEATURES OF WORK

ACTIVITY	PREPARATORY	DONE	INITIAL	DONE	FOLLOW-UP	DONE
Waste Disposal	• Verify that schedule and access notifications have occurred with ROICC. • Verify that copies of the profile have been submitted to the ROICC. • Verify that manifests have been properly completed and signed by the DoN. • Verify that waste transporter and disposal facility have been approved by TtEC. • Review the AHAs for this activity.		• Inspect waste documentation. • Verify efficient and safe loading of waste.		• Verify arrival of the waste stream at the disposal facility. • Verify that the ROICC has received a copy of the delivered manifest.	
Site restoration	• Verify that required materials are on hand to conduct work. • Verify that schedule and access notifications have occurred with the ROICC. • Review applicable sections of Work Plan. • Review AHAs for this activity.		• Inspect site restoration activities. • Check compliance with SHSP and task AHAs.		• Inspect and verify that site is restored as agreed upon with the DoN.	

Abbreviations and Acronyms:

ACWD – Alameda County Water District
AHA – Activity Hazard Analysis
DPT – direct push technology
DoN – Department of the Navy
ft – feet
GIS – Global Information System
PID – photoionization detector
ROICC – Resident Officer in Charge of Construction
SAP – Sampling and Analysis Plan
SHSP – Site Health and Safety Plan
TtEC – Tetra Tech EC, Inc.

TABLE B.4-1

SUBMITTAL REGISTER

TITLE AND LOCATION: Draft Final Data Gap Sampling Work Plan for OU-2A and OU-2B, Alameda Point, Alameda, CA						CONTRACTOR Tetra Tech EC, Inc.							CONTRACT NO. N62473-06-D-2201			
						CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				
ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	CLASSIFICATION GOVT OR A/E REVWR	SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(r)
		01110	SD-01, PRE-CONSTRUCTION SUBMITTAL	1.4.1												
			a. List of Contact Personnel		G											
		01310	SD-01, PRE-CONSTRUCTION SUBMITTAL	1.1.1												
			a. List of Contact Personnel		G											
		01320	SD-01, PRE-CONSTRUCTION SUBMITTALS	1.1.1												
			a. Activity Schedule		G											
		01330	SD-01, PRE-CONSTRUCTION SUBMITTAL	1.3.1												
			a. Submittal Register		G											
		01330	SD-11, CLOSEOUT SUBMITTALS	1.3.2												
			a. Submittal Register		G											
			b. Well Construction Logs		G											
			c. Special warranties		G											
			d. Posted operating instructions		G											
			e. Field Summary Report		G											
		01450	SD-01, PRE-CONSTRUCTION SUBMITTAL	1.2.1												
			a. Quality Control (QC) Plan		G											
		01500	SD-01, PRE-CONSTRUCTION SUBMITTAL	1.2												
			a. Traffic Control Plan		G											
			b. Data Gap Work Plan													
			c. Product data													
		01575	SD-01, PRE-CONSTRUCTION SUBMITTALS	1.4.1												
			b. Pre-construction Survey Report		G											
			c. Site Health and Safety Plan													

TABLE B.4-1

SUBMITTAL REGISTER

TITLE AND LOCATION: Draft Final Data Gap Sampling Work Plan for OU-2A and OU-2B, Alameda Point, Alameda, CA						CONTRACTOR Tetra Tech EC, Inc.							CONTRACT NO. N62473-06-D-2201			
						CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				
ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	CLASSIFICATION GOVT OR A/E REVIEWER	SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(r)
		01575	SD-07, CERTIFICATES	1.4.2												
			a. Solid waste disposal manifests		G											
			b. Disposal permit/manifests for hazardous waste		G											
		01720	SD-01, PRE-CONSTRUCTION SUBMITTAL	1.4												
			a. Names and proof of registration		G											
			b. Verification of accuracy (on request)													
			c. Certification by surveyor													
			d. Survey drawings													
			e. Copy of field survey notes													
		02231	SD-01, PRE-CONSTRUCTION SUBMITTAL	1.1.1												
			a. Material product data (MSDS)		G											
		02300	SD-04, SAMPLES	1.2												
			a. Goresorber													
		02300	SD-06, TEST REPORTS	1.2												
			a. Boring Logs		G											
			b. California Registered Civil Engineer or Geologist certification		G											

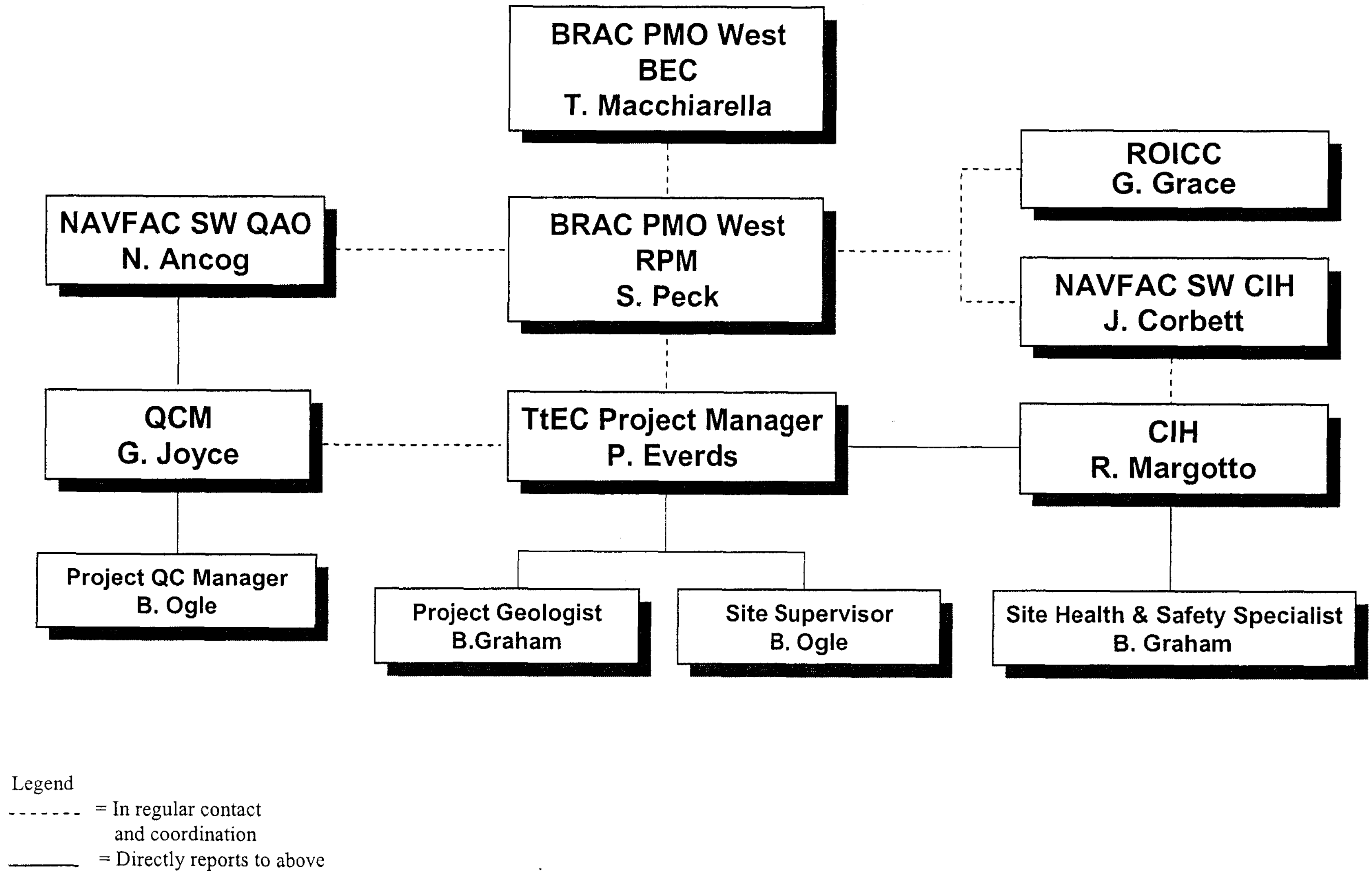
Abbreviations and Acronyms:

MSDS – Material Safety Data Sheet

FIGURES

Figure B.2-1

Project Organization Chart



ATTACHMENT 1

DELEGATION OF AUTHORITY LETTER

This page intentionally left blank.

TETRA TECH EC, INC.

August 31, 2006

Mr. Bill Ogle
Tetra Tech EC, Inc.
Cummins Ave. (North of Building 45)
Moffett Field, CA 94035

Subject: Project Quality Control Manager

Reference: Contract No. N62473-06-D-2201,
Environmental Remediation Contract, Contract Task Order (CTO) No. 0012,
Alameda Point, Alameda, California

Dear Mr. Ogle:

In accordance with the terms of Tetra Tech EC, Inc. (TtEC) Contract No. N62473-06-D-2201, this letter notifies you of your appointment as the Project Quality Control Manager for CTO No. 0012 at the Alameda Point, Alameda, California.

As the designated Project Quality Control Manager, you will be responsible for managing the site-specific quality control requirements in accordance with the approved plans. You will be responsible for conducting quality control meetings, performing the three phases of control, and performing submittal review. You will be required to be present during all field activities to ensure that any testing is conducted in accordance with approved plans. In addition, you will be required to prepare the necessary quality control certification and documentation.

You have the authority and responsibility for suspending work when conditions adverse to quality are identified and for directing the correction of all nonconforming work.

This letter is effective immediately until modified by the Quality Control Program Manager with concurrence of the TtEC Project Manager, the NAVFAC SW Remedial Project Manager, and the Resident Officer in Charge of Construction.

Sincerely,

Tetra Tech EC, Inc.
Mary Schneider

Mary Schneider
Quality Control Program Manager

cc: P. Everds, Project Manager

SGS

1230 Columbia Street, Suite 500, San Diego, CA 92101
Tel 619.234.8690 Fax 619.234.8591
www.tteci.com

ATTACHMENT 2

RESUMES

This page intentionally left blank.

Mr. George William Ogle
Supervisor, Craft Personnel

EXPERIENCE SUMMARY

Project Superintendent with well developed professional skills in facility construction, operations, repair/maintenance, mobilization, and demobilization, safety procedures, labor management, coordination and scheduling, budget formulation, logistics, customer relations, and QA/QC sampling programs. Background includes the following highlights:

- Construction and operational management of a $3MM, experimental asphalt recycling facility utilizing indirect firing in the primary dryer and in the oxidizer.
- Operations Manager of a bioremediation/land farming project designed to clean light end hydrocarbons from soil. Seven-acre facility.
- Erection and operational management of a $2MM, LTTD operation designed as semi-fixed facility. Later, was responsible for moving the plant to a remote location, re-erecting, and rewiring for operation as a mobile plant.
- Participation in soil washing and fixation operations.
- Site selection, lease negotiation, and agency permitting of a fixed facility TDU in Northern California.
- Permitting responsibility for establishing and operating the first "fixed facility" thermal desorption operation in the San Francisco Bay Area.

EDUCATION

BS, Biology/Geology/Geography, Shepherd College, 1968

REGISTRATIONS/CERTIFICATIONS

TRAINING

40-Hour Hazwoper Training – 1994
Hazardous Site Supervisor Training – 1998
Confined Space – 1998
Basic Electricity – 1998
Bearings and Drives – 1999
First Aid/CPR – 2004
8-Hour Hazwoper update – 2004
Federal Contract Basics (FAR) – 2000
ESS Training – 2001
CQC School – 2001
Waste Management Training – 2004
Caterpillar Medium Wheel Loader Training –1999
CAL/OSHA Excavation/Trenching & Shoring – 1999
Hertz Fork Lift Training – 2002

CORPORATION PROJECT EXPERIENCE

Site Superintendent, 2001 to Present
Initial responsibilities were confined to the operation and maintenance of two, pump-and-treat water systems (West Aquifer Treatment System [WATS] and EAST Aquifer Treatment System [EATS]). WATS is a state-of-the-art system that includes hydrogen peroxide and ozone injection at Moffett Field, CA. Currently, monitors and assists in overall on-site activity by Tetra Tech EC, Inc. (TtEC). Responsibilities include site safety, CQC management on site, supervision of Moffett-based TtEC personnel, operation and maintenance of the WATS and EATS treatment systems (WATS has undergone three major upgrades, one to add final step charcoal filtering to the water being treated, another to delete the air stripper from the treatment train and enclose the system so that no fugitive contaminants would

escape to the atmosphere, and one to upgrade the ozone generation system. EATS is similar to WATS but with lower output and carbon filtered only capabilities), O&M of two landfills on site, ongoing maintenance of DoN-owned wells on the facility, periodic sampling of specific DoN monitoring wells, and after-task maintenance of various locations throughout the site, daily agency compliance, and client relations. Also serves as Point of Contact and site liaison for new projects until the field team is operational and a backup to the field team.
Functioning as Site Superintendent for electrical installation and startup of NBC Filter System Installation at Onizuka AFS.

PREVIOUS EXPERIENCE

Site Superintendent, 1996–2001
Environmental Chemical Corporation
Began as a Loader Operator and progressed to Site Superintendent with first-line responsibility for overall plant operations of this IUMM, plus, protect. Responsible for site safety, personnel, production, maintenance (electrical and mechanical), agency compliance, customer relations, and budgetary management.

Plant Manager, 1995–1996
Ecopave, Inc.
Initial responsibilities were associated with the construction, erection, and assembly of an experimental asphalt recycling plant on a Greenfield Site. The plant consisted of two, indirect fired units, one for the dryer and one for the oxidizer designed to destroy any hydrocarbon vapors produced in the recycling operation. After construction, responsible for all aspects of day-to-day operations, including customer liaison and budgetary maintenance.

Operations Manager, 1993–1995
Remedial Environmental Marketing Company
Initially responsible for specification approval of a new, $2MM, Tarmac, LTTD plant. Was given the sole responsibility of erecting the plant and training personnel for operation. Then, was responsible for all aspects of the operation except sales.

Operations Manager, 1993
Nevada Hydrocarbon Inc., CA
After functioning as a consultant for several months, accepted a position responsible for the site location, permitting, construction, and operation of a fixed facility soil remediation plant in the Sacramento, CA, area. A site was located, leased (along with a service contract to the site owner), and permitted for this operation.

Operations Manager, 1989–1992
Port Costa Materials
Three sites. Initially responsible for the operation of three remote plants, Port Costa, CA, Frazier Park, CA, and Olancha, CA. Developed operational budgets for these locations. Successfully initiated Prop. 65 compliance and safety programs designed to reduce abnormally high incidence of accidents. Negotiated a trade-off with State of California in order to construct a shipping dock on the Carquinez Strait. Maintained a viable operation while developing good community relations with neighboring municipalities. Permitted and operated the first fixed-base Thermal Desorption remediation facility in Northern California.

Production Manager, 1986–1989
Hawaiian Cement Company
Responsible for all aspects of the production of Portland Cement at the HCC, Ewa Beach, HI, facility. Developed and implemented a plan to increase plant operation time from 50 percent of the year to 100 percent. Trained personnel, including supervisors to meet budget set. End result was more than twice the yearly output a cost increase of approximately 20 percent. Recommissioned two cement mills, one at a remote location, to satisfy production requirements. Supervised 5 salaried and 28 hourly (union) personnel.

Various managerial positions within the cement industry, 1964–1986
Began as a Physical Tester in the laboratory and progressed, with three different companies, to Regional Plant Manager. Responsibilities included quarrying, milling, pyroprocessing, shipping, QA/QC, safety and health, maintenance, administration, and customer relations. Budgets have been as high as $12MM per year. Involved with the construction of a new, $94MM cement plant and was responsible for start-up of that plant.

DISCIPLINE CODES

16 Construction Manager, Y

RELATED COMPANY INFORMATION

Payroll Number: 14943
Employment Status: Full
Preferred First Name: Bill
Office Location: San Diego
Hire Date: 1/22/01
Years with Other Firms: 33
Years with Current Firm: 5
Total Years Experience: 38
Supervisor:
Office Phone: (650) 564-9868
Cell Phone: (650) 450-2982
Fax: (650) 564-9870
E-mail Address: bill.ogle@tteci.com
Other E-mail Address (if any):
Resume Last Revised: 6/23/2006

ATTACHMENT 3

FORMS

This page intentionally left blank.

CONTRACTOR QUALITY CONTROL REPORT

(ATTACH ADDITIONAL SHEETS IF NECESSARY)

DATE

REPORT NO

PHASE	CONTRACT NO. N62473-06-D-2201	CONTRACT TITLE OU-1, OU-2A, and OU-2B Data Gap Sampling, Alameda Point

PREPARATORY

WAS PREPARATORY PHASE WORK PREFORMED TODAY? YES ☐ NO ☐

IF YES, FILL OUT AND ATTACH SUPPLEMENTAL PREPARATORY PHASE CHECKLIST.

Schedule Activity No.	Definable Feature of Work	Index #

INITIAL

WAS INITIAL PHASE WORK PREFORMED TODAY? YES ☐ NO ☐

IF YES, FILL OUT AND ATTACH SUPPLEMENTAL INITIAL PHASE CHECKLIST.

Schedule Activity No.	Definable Feature of Work	Index #

FOLLOW-UP

WORK COMPLIES WITH CONTRACT AS APPROVED DURING INITIAL PHASE? YES ☐ NO ☐

WORK COMPLIES WITH SAFETY REQUIREMENTS? YES ☐ NO ☐

Schedule Activity No.	Description of Work, Testing Performed & By Whom, Definable Feature of Work, Specification Section, Location and List of Personnel Present

REWORK ITEMS IDENTIFIED TODAY (NOT CORRECTED BY CLOSE OF BUSINESS)

Schedule Activity No.	Description

REWORK ITEMS CORRECTED TODAY (FROM REWORK ITEMS LIST)

Schedule Activity No.	Description

REMARKS (Also Explain Any Follow-Up Phase Checklist Item From Above That Was Answered "NO"), Manuf. Rep On-Site, etc.

Schedule Activity No.	Description

On behalf of the contractor, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge except as noted in this report.

AUTHORIZED QC MANAGER AT SITE DATE

GOVERNMENT QUALITY ASSURANCE REPORT

DATE

QUALITY ASSURANCE REPRESENTATIVE'S REMARKS AND/OR EXCEPTIONS TO THE REPORT

Schedule Activity No.	Description

GOVERNMENT QUALITY ASSURANCE MANAGER DATE

CONTRACTOR QUALITY CONTROL REPORT

(CONTINUATION SHEET)
(ATTACH ADDITIONAL SHEETS IF NECESSARY)

DATE

REPORT NO.

PHASE	CONTRACT NO. 0011	CONTRACT TITLE OU-5/IR-02 Pre-Design Investigation, Alameda Point

FOLLOW-UP

WORK COMPLIES WITH CONTRACT AS APPROVED DURING INITIAL PHASE? YES ☐ NO ☐

WORK COMPLIES WITH SAFETY REQUIREMENTS? YES ☐ NO ☐

Schedule Activity No.	Description of Work, Testing Performed & By Whom, Definable Feature of Work, Specification Section, Location and List of Personnel Present

REMARKS (Also Explain Any Checklist Item From Above That Was Answered "NO"), Manuf. Rep. On-Site, etc.

Schedule Activity No.	Description

CONTRACTOR PRODUCTION REPORT

(ATTACH ADDITIONAL SHEETS IF NECESSARY)

CONTRACT NO N62473-06-D-2201	TITLE AND LOCATION OU-1, OU-2A, and OU-2B Data Gap Sampling, Alameda Point	DATE
		REPORT NO
CONTRACTOR Tetra Tech EC, Inc.	SUPERINTENDENT/ PQCM	

AM WEATHER	PM WEATHER	MAX TEMP (F)	MIN TEMP (F)

WORK PERFORMED TODAY

WORK LOCATION AND DESCRIPTION	EMPLOYER	NUMBER	TRADE	HRS

JOB SAFETY

WAS A JOB SAFETY MEETING HELD THIS DATE? (If YES attach copy of the meeting minutes)	☐ YES	☐ NO	TOTAL WORK HOURS ON JOB SITE, THIS DATE, INCL CON'T SHEETS
WERE THERE ANY LOST TIME ACCIDENTS THIS DATE? (If YES attach copy of completed OSHA report)	☐ YES	☐ NO	CUMULATIVE TOTAL OF WORK HOURS FROM PREVIOUS REPORT
WAS CRANE/MANLIFT/TRENCHING/SCAFFOLD/HV ELEC/HIGH WORK/ HAZMAT WORK DONE? (If YES attach statement or checklist showing inspection performed.)	☐ YES	☐ NO	TOTAL WORK HOURS FROM START OF CONSTRUCTION
WAS HAZARDOUS MATERIAL/WASTE RELEASED INTO THE ENVIRONMENT? (If YES attach description of incident and proposed action.)	☐ YES	☐ NO	

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED ☐ SAFETY REQUIREMENTS HAVE BEEN MET.

EQUIPMENT/MATERIAL RECEIVED TODAY TO BE INCORPORATED IN JOB (INDICATE SCHEDULE ACTIVITY NUMBER)

Submittal #	Description of Equipment/Material Received

CONSTRUCTION AND PLANT EQUIPMENT ON JOB SITE TODAY. INDICATE HOURS USED AND SCHEDULE ACTIVITY NUMBER.

Owner	Description of Construction Equipment Used Today (incl Make and Model)	Arrival	Off Rent Date	Actual Demob Date	Hours Idle	Hours Used	Reason for Idle

REMARKS

CONTRACTOR/SUPERINTENDENT

DATE

PREPARATORY PHASE CHECKLIST

(CONTINUED ON SECOND PAGE)

CONTRACT NO N62473-06-D-2201	DEFINABLE FEATURE OF WORK	SPEC SECTION SCHEDULE ACT NO.	DATE INDEX #

PERSONNEL PRESENT

GOVERNMENT REP NOTIFIED ____ HOURS IN ADVANCE: YES ☐ NO ☐

NAME	POSITION	COMPANY/GOVERNMENT

SUBMITTALS

REVIEW SUBMITTALS AND/OR SUBMITTAL REGISTER. HAVE ALL SUBMITTALS BEEN APPROVED? YES ☐ NO ☐

IF NO, WHAT ITEMS HAVE NOT BEEN SUBMITTED? ______

ARE ALL MATERIALS ON HAND? YES ☐ NO ☐

IF NO, WHAT ITEMS ARE MISSING? ______

CHECK APPROVED SUBMITTALS AGAINST DELIVERED MATERIAL. (THIS SHOULD BE DONE AS MATERIAL ARRIVES.)

COMMENTS: ______

MATERIAL STORAGE

ARE MATERIALS STORED PROPERLY? YES ☐ NO ☐

IF NO, WHAT ACTION IS TAKEN? ______

SPECIFICATIONS

REVIEW EACH PARAGRAPH OF SPECIFICATIONS. ______

DISCUSS PROCEDURE FOR ACCOMPLISHING THE WORK. ______

CLARIFY ANY DIFFERENCES. ______

PRELIMINARY WORK & PERMITS

ENSURE PRELIMINARY WORK IS CORRECT AND PERMITS ARE ON FILE.

IF NOT, WHAT ACTION IS TAKEN? ______

TESTING	IDENTIFY TEST TO BE PERFORMED, FREQUENCY, AND BY WHOM. WHEN REQUIRED? WHERE REQUIRED? REVIEW TESTING PLAN. HAS TEST FACILITIES BEEN APPROVED?
SAFETY	ACTIVITY HAZARD ANALYSIS APPROVED? YES ☐ NO ☐ REVIEW APPLICABLE PORTION OF EM 385-1-1.
MEETING COMMENTS	NAVY/ROICC COMMENTS DURING MEETING.
OTHER ITEMS OR REMARKS	OTHER ITEMS OR REMARKS:

PQCM DATE

INITIAL PHASE CHECKLIST

INITIAL PHASE CHECKLIST		SPEC SECTION	DATE
CONTRACT NO N62473-06-D-2201	DEFINABLE FEATURE OF WORK	SCHEDULE ACT NO.	INDEX #

PERSONNEL PRESENT

GOVERNMENT REP NOTIFIED _____ HOURS IN ADVANCE: YES ☐ NO ☐

NAME	POSITION	COMPANY/GOVERNMENT

PROCEDURE COMPLIANCE

IDENTIFIY FULL COMPLIANCE WITH PROCEDURES IDENTIFIED AT PREPARATORY. COORDINATE PLANS, SPECIFICATIONS, AND SUBMITTALS.

COMMENTS: ____________________

PRELIMINARY WORK

ENSURE PRELIMINARY WORK IS COMPLETE AND CORRECT. IF NOT, WHAT ACTION IS TAKEN?

WORKMANSHIP

ESTABLISH LEVEL OF WORKMANSHIP.

WHERE IS WORK LOCATED? ____________________

IS SAMPLE PANEL REQUIRED? YES ☐ NO ☐

WILL THE INIITAL WORK BE CONSIDERED AS A SAMPLE? YES ☐ NO ☐

(IF YES, MAINTAIN IN PRESENT CONDITION AS LONG AS POSSIBLE AND DESCRIBE LOCATION OF SAMPLE) ____________________

RESOLUTION

RESOLVE ANY DIFFERENCES.

COMMENTS: ____________________

CHECK SAFETY

REVIEW JOB CONDITIONS USING EM 385-1-1 AND JOB HAZARD ANALYSIS

COMMENTS: ____________________

OTHER

OTHER ITEMS OR REMARKS

____

PQCM DATE

COMPLETION INSPECTION CHECKLIST

Date	
Report No.	
Contract No.: N62473-06-D-2201, CTO No. 0012	Contract Title: OU-1, OU-2A, and OU-2B Data Gap Sampling, Alameda Point
Contract Specifications:	
Major Definable Features of Work:	

A. Open Punchlist Items From Follow-Up Phase Checklist:

	Item	Date of Completion
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

B. New Punchlist Items Noted:

	Item	Date of Completion
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

C. ROICC NOTIFIED? ☐ Yes ☐ No

On behalf of Tetra Tech EC, Inc., I certify this activity is completely in accordance with the Contract Documents, based upon the information available to me.

Project Quality Control Manager

NONCONFORMANCE REPORT

	Report No.
Client or Project:	Drawing No./Spec. No.
Supplier, Construction QC or Contractor	P.O. No.
Description of Component, Part or System	

I. Description of Nonconformance *(Items involved, specification, code or standard to which items do not comply, submit sketch if applicable)*

Name and Signature of Person Reporting Nonconformance	Title/Company	Date

II. Recommended Disposition *(Submit sketch, if applicable)*

Name and Signature of Person Recommending Disposition	Title/Company	Date

III. Evaluation of Disposition by Tetra Tech EC, Inc., Reason for Disposition

IV. Corrective Action ☐ Required ☐ Not Required

V. ☐ Engineering	☐ QA/QC	☐ Construction	☐ Other
Name *(Signature)*	Name *(Signature)*	Name *(Signature)*	Name *(Signature)*
Date	Date	Date	Date
☐ Accepted ☐ Rejected ☐ Accepted with Comments	☐ Accepted ☐ Rejected ☐ Accepted with Comments	☐ Accepted ☐ Rejected ☐ Accepted with Comments	☐ Accepted ☐ Rejected ☐ Accepted with Comments

VI. Verification of Disposition ☐ Required ☐ Not Required

By	Signature	Title	Date

NONCONFORMANCE REPORT LOG

PROJECT TITLE: OU-1, OU-2A, and OU-2B Data Gap Sampling

PROJECT LOCATION: Alameda Point, Alameda, California

CONTRACTOR: Tetra Tech EC, Inc.

NCR NO.	HOLD TAG NO.	DESCRITION OF CONDITIONS/ ITEM AFFECTED	LOCATION	DATE					REMARKS
				VALIDATION	DISPOSITION/ APPROVAL	RE-INSPECTION	CLOSURE	HOLD TAG REMOVAL	

REWORK ITEMS LIST

Contract No. and Title: N62473-06-D-2201, CTO 0012, OU-1, OU-2A, and OU-2B Data Gap Sampling, Alameda Point

Contractor: Tetra Tech EC, Inc.

NUMBER	DATE IDENTIFIED	DESCRIPTION	CONTRACT REQUIREMENT (Spec. Section and Par. No., Drawing No. and Detail No., etc.)	ACTION TAKEN BY QC MANAGER	RESOLUTION	DATE COMPLETED

MATERIALS INSPECTION CHECKLIST

Date

Report No.

Contract No.: N62473-06-D-2201, CTO No. 0012

Contract Title: OU-1, OU-2A, and OU-2B Data Gap Sampling, Alameda Point

Contract Specifications:

Material	Qty	Condition	Testing	Comments

Storage Conditions:

Submittals:

MATERIALS INSPECTION CHECKLIST

Date	
Report No.	

Contract No.: N62473-06-D-2201, CTO No. 0012	Contract Title: OU-1, OU-2A, and OU-2B Data Gap Sampling, Alameda Point
Contract Specifications:	
Material/Equipment Certifications:	
Preparatory Site Conditions:	
Contract Variance:	
Comments:	

Attendees:	
	QC Representative Date
	PQCM Date

See instructions on reverse
No carbon paper is required to complete this form
No transmittal letter required

CATALOG CUT/SHOP DRAWING TRANSMITTAL AND APPROVAL
SOUTHWESTNAVFACENGCOM 4355 / 2 (10-89)

SUBMITTAL NO.	CQC CLAUSE ☐ IS APPLICABLE ☐ IS NOT APPLICABLE	
REFERENCES TO USE WHEN CQC CLAUSE IS APPLICABLE	**PART I – FOR CONTRACTOR USE**	REFERENCES TO USE WHEN CQC CLAUSE IS NOT APPLICABLE
(A) ROICC/REICC	FROM (*Contractor*) Tetra Tech EC, Inc. 1230 Columbia Street, Suite 750 San Diego, CA 92101-8536 / TO (A)	(A) DESIGNER
	CONTRACT NO. / CONTRACT TITLE	
(B) (*Check one*) ☐ RECORD ☐ APPROVAL	THE FOLLOWING ITEM IS SUBMITTED FOR (B) PER SPECIFICATION SECTION NUMBER	(B) APPROVAL
	CERTIFICATION (This form shall not be used to forward proposed substitutions) IT IS HEREBY CERTIFIED THAT THE ☐ EQUIPMENT ☐ MATERIAL SHOWN AND MARKED IN THIS SUBMITTAL IS THAT PROPOSED TO BE INCORPORATED INTO CONTRACT N62473-06-D-2201, CTO 0012 IS IN COMPLIANCE WITH THE CONTRACT DRAWINGS AND SPECIFICATIONS AND CAN BE INSTALLED IN THE ALLOCATED SPACES.	
(C) AUTHORIZED CONTRACTOR QUALITY CONTROL REPRESENTATIVE	CERTIFIED BY (C) / DATE	(C) PERSON DESIGNATED BY CONTRACTOR AS HAVING AUTHORITY TO SIGN CERTIFICATION
	PART II – FOR DESIGNER USE	
	FROM (*Designer*) / TO (ROICC/REICC)	
(D) CURSORY REVIEW REQUIRED ON RECORD COMES – REPLY TO ROICC ONLY IF APPROPRIATE. DETAILED REVIEW REQUIRED ON SUBMITTALS FOR GOVERNMENT APPROVAL STAMP AND MARK EACH COPY AS APPROPRIATE.	THIS SUBMITTAL HAS BEEN REVIEWED (D). THE FOLLOWING RECOMMENDATION IS MADE:	(D) DETAILED REVIEW REQUIRED. STAMP AND MARK EACH COPY AS APPROPRIATE
	SIGNATURE / DATE	
	PART III – FOR ROICC/REICC USE	
(E) DESIGNER (*Copy to ROICC*)	FROM (*ROICC/REICC*) / TO (E)	(E) CONTRACTOR (*Copy to ROICC*)
	ENCLOSURES ARE RETURNED WITH THE FOLLOWING COMMENTS:	
	SIGNATURE / DATE	

INSTRUCTIONS

Enter submittal number.
Check applicable CQC clause.

CONSTRUCTION CONTRACTOR – PART I

From: *Construction contractor's name and address.*
To: *Designer's name and address or ROICC/REICC as applicable.*

Enter contract number.

Enter title of contract and location.

Describe item being transmitted. A separate form must be used for each set of catalog cuts or shop drawings. Include name of manufacturer, catalog sheets, drawing no., name of item, and number of copies forwarded.

Check submittal for record or approval purposes.

Type date and name.

Sign original and one.

Distribution (as applicable to CQC clause):

Send to designer: *original and four transmittal forms with the seven copies of catalog cuts or shop drawings. When factory inspection is required, send eight copies.*

Send to ROICC/REICC: *one carbon copy of form.*

Send to ROICC/REICC (CQC): *Original and three copies of catalog cuts or shop design.*

Retain one copy for your files.

DESIGNER (A&E CONTRACTOR, SOUTHWESTNAVFACENGCOM) OR ROICC RESPONSIBLE FOR DESIGN – PART II

From: *Designer's name and address.*
To: *ROICC/REICC and address.*

Enter recommended action (i.e., approval recommended or disapproved, with appropriate comments).

Type date and name.

Sign original and one.

Distribution:

Send to ROICC/REICC: *original and three copies with six (or seven when factor inspection is required) copies of catalog cuts or shop drawings.*

Retain one copy of form and one copy of cuts or drawings for your files.

ROICC OR REICC – PART III

From: *ROICC or REICC and address.*
To: *Construction contractor's name and address.*

Enter action taken (i.e., approved subject to, etc.).

Type date and name.

Sign original and one.

Distribution:

Send to construction contractor: *original with three copies of cuts or drawings*

Send to ROICC one carbon copy of form with one copy of cut or drawings.

Retain two copies of form and two copies of cuts or drawings: *one for field use and one for ROICC/REICC file.*

NOTE: When factory inspection is required, forward one approved copy of cuts or drawings to the ROICC, Construction Division. Cover transmittal should state the information is forwarded for factory inspection.

TETRA TECH EC, INC.

FIELD CHANGE REQUEST FORM

Contract No.	CTO No.	Field Change Request Form No.
N62473-06-D-2201	0012	FCRF-
Location		Date

RE: Drawing No. ____________ Title ____________

Specification Section ____________ Title ____________

Other ____________

Description (items involved, submit sketch, if applicable)

Reason for Change

Recommended Disposition (submit sketch, if applicable)

TETRA TECH EC, INC.

FIELD CHANGE REQUEST FORM

Contract No.	CTO No.	Field Change Request Form No.
N62473-06-D-2201	0012	FCRF-

Additional Details

Will this change result in a contract cost or time change? ☐ Yes ☐ No

Estimate of contract cost or time charge (if any) ______________________

Preparer (signature)	Date	Preparer's Title	Site Superintendent/PQCM (Signature)	Date

Disposition

☐ Approved.

☐ Not approved (give reason). ______________________

TtEC Engineer (signature) (if engineering related) ☐ Comments (attached) ☐ No Comments	Date	TtEC Project Manager (signature) ☐ Comments (attached) ☐ No Comments	Date
TtEC PESM (signature) ☐ Comments (attached) ☐ No Comments	Date	TtEC Scientist (signature) (if science related) ☐ Comments (attached) ☐ No Comments	Date
TtEC QC Program Manager (signature) ☐ Comments (attached) ☐ No Comments	Date		

Distribution: Original to Project File, Copy to Site File, Project Manager, DON RPM, DON ROICC, PQCM, QCM

PHOTOGRAPH LOG SHEET

Date Submitted	
Roll No.	
Contract No.: N62473-06-D-2201, CTO No. 0012	Contract Title: OU-1, OU-2A, and OU-2B Data Gap Sampling, Alameda Point
Photographer:	

Frame	Date	Time	Location/Grid No.	Description/Work No.	Notes
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					
31.					
32.					
33.					
34.					

APPENDIX C

SITE HEALTH AND SAFETY PLAN

This page intentionally left blank.

Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, California 92108-4310

CONTRACT NO. N62473-06-D-2201
CTO NO. 0012

APPENDIX C

FINAL

SITE HEALTH AND SAFETY PLAN

October 11, 2007

FOR OU-1, OU-2A, AND OU-2B DATA GAP SAMPLING
ALAMEDA POINT
ALAMEDA, CALIFORNIA

DCN: ECSD-2201-0012-0002.R1

TETRA TECH EC, INC.
1230 Columbia Street, Suite 750
San Diego, CA 92101-8536

DRAFT ACCEPTED AS FINAL

Roger Margotto, CIH, CSP, CHMM
Program Health and Safety Manager

DRAFT ACCEPTED AS FINAL

Pete Everds
Project Manager

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

PAGE

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

PAGE

LIST OF TABLES

LIST OF FIGURES

ATTACHMENTS

This page intentionally left blank.

ABBREVIATIONS AND ACRONYMS

ABIH	American Board of Industrial Hygiene
ACGIH	American Conference of Governmental Industrial Hygienists, Inc.
ACO	Administrative Contracting Officer
AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
APR	air purifying respirator
ARRA	Alameda Reuse and Redevelopment Authority
bgs	below ground surface
BRAC	Base Realignment and Closure
CAA	Corrective Action Area
Cal-OSHA	California Occupational Health and Safety Administration
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CO	carbon monoxide
CP	Construction Practice
CPR	Cardiopulmonary Resuscitation
CRC	Contamination Reduction Corridor
CTO	Contract Task Order
dBA	decibels, A-scale
DoN	Department of the Navy
DTSC	Department of Toxic Substances Control
EHS	Environmental Health and Safety
EM	Engineer Manual
EPA	U.S. Environmental Protection Agency

ABBREVIATIONS AND ACRONYMS
(Continued)

ESS	Environmental Safety Supervisor
EZ	exclusion zone
FCR	Field Change Request
FEV10	forced expiratory volume, one second
FID	flame ionization detector
FOPS	Falling Object Protective System
FS	Feasibility Study
FVC	Force Vital Capacity
FWBZ	First Water-Bearing Zone
GFCI	Ground Fault Circuit Interrupter
HAZWOPER	Hazardous Waste Operations
HEPA	High-Efficiency Particulate Air
kV	kilovolt
LEL	lower explosive limit
mg/m^3	milligrams per cubic meter
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
NAS	Naval Air Station
NAVFAC SW	Naval Facilities Engineering Command, Southwest
NEC	National Electrical Code
NIOSH	National Institute for Occupational Safety and Health
O_2	oxygen
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated byphenyl
PEL	Permissible Exposure Limit

ABBREVIATIONS AND ACRONYMS
(Continued)

PESM	Project Environmental and Safety Manager
PID	photoionization detector
PjM	Project Manager
PM	Program Manager
PPE	personal protective equipment
ppm	parts per million
QA	Quality Assurance
QC	Quality Control
RAC	Remedial Action Contract
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROICC	Resident Officer in Charge of Construction
RPM	Remedial Project Manager
RQ	reportable quantity
RWQCB	Regional Water Quality Control Board
SCBA	self-contained breathing apparatus
SHSP	Site Health and Safety Plan
SHSS	Site Health and Safety Specialist
SOW	Scope of Work
SWBZ	Second Water-Bearing Zone
SWMU	Solid Waste Management Units
TLV	Threshold Limit Value
TtEC	Tetra Tech EC, Inc.
TWA	Time Weighted Average
USACE	U.S. Army Corps of Engineers
UST	Underground Storage Tanks

This page intentionally left blank.

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

Tetra Tech EC, Inc. (TtEC) has been contracted by the Department of the Navy (DoN) to conduct remedial actions for the cleanup of hazardous waste sites under Naval Facilities Engineering Command, Southwest (NAVFAC SW) Remedial Action Contract N62473-06-D-2201, Contract Task Order (CTO) 0012. This Site Health and Safety Plan (SHSP) applies to all work performed under CTO 0012 at the Alameda Point, Alameda, California. Figure C.1-1 presents the site vicinity map and Figure C.1-2 is the site location map. The TtEC Health and Safety Program for Alameda Point consists of this document, the Contract Health and Safety Program, and the TtEC Corporate Health and Safety Program Manual. The SHSP and the TtEC program manual will always be available and maintained on site.

1.2 APPLICATION

The Contract Health and Safety Program is applicable to all work conducted by TtEC and TtEC subcontractors under CTO 0012 and under NAVFAC SW Remedial Action Contract N62473-06-D-2201.

The SHSP is site specific and shall include a job hazard analysis for all field work tasks performed. The SHSP will address required activities and elements identified in the Data Gap Sampling Work Plans for OU-1, OU-2A, and OU-2B and provide for a safe and healthy environment for all personnel involved. The SHSP will be added as an appendix to the Data Gap Sampling Work Plans for OU-1, OU-2A, and OU-2B.

Essentially equivalent or additional health and safety procedures and practices may be approved by TtEC and implemented by TtEC subcontractors where necessary. All subcontractors are required to follow the TtEC Health and Safety programs and procedures unless changes are approved by the TtEC Project Environmental Safety Manager (PESM), who is a Certified Industrial Hygienist (CIH), and the DoN Contracting Officer. The TtEC PESM will review TtEC and subcontractor SHSPs prior to the initiation of fieldwork. The subcontractor SHSPs include activity hazard analysis (AHA) (Attachment 1) for the tasks performed by subcontractors. These AHAs will be reviewed and accepted by the PESM.

1.3 APPLICABLE STANDARDS, REGULATIONS, AND GUIDANCE DOCUMENTS

Adherence to applicable portions of federal, local, national consensus organization, and corporate health and safety standards, regulations, and guidance manuals is required during field activities. These include, but may not be limited to, the following:

- 29 Code of Federal Regulations (CFR), Part 1910, Occupational Safety and Health Standards, General Industry
- 29 CFR, Part 1926, Occupational Safety and Health Standards, Construction Industry 10 CFR, Part 20, Nuclear Regulatory Commission
- State Regulations including Title 8 California Code of Regulations (CCR) California-Occupational Health and Safety Administration (Cal-OSHA) and Title 24 CCR (Health and Safety Code)
- TtEC Corporate Health and Safety Program Manual
- TtEC Project Rules Handbook
- DoN Environmental Restoration Manual, August 2006
- U.S. Army Corps of Engineers Safety and Health Requirements Manual, Engineer Manual (EM) 385-1-1, 3 November 2003
- Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists (ACGIH), most current publication
- Occupational Safety and Health Guidance for Hazardous Waste Site Activities

1.4 SUMMARY OF MAJOR RISKS

The project objective is to collect supplemental information that will fill the data gaps identified in the Remedial Investigation (RI) and Feasibility Study (FS) reports for each OU, as well as collecting the necessary parameters to support design activities. The information collected during this project will facilitate the following:

- Refine the nature and extent of soil contamination related to individual solid waste management units (SWMUs) and other areas identified as a result of previous investigations.
- Determine aquifer parameters, including groundwater flow direction, within the first water-bearing zone (FWBZ) and the second water-bearing zone (SWBZ).
- Refine the lateral and vertical extent of contaminant plumes.

Potential hazards associated with sampling to delineate soil and groundwater contamination include contact with contaminants that may include petroleum hydrocarbons, volatile organic compounds, semivolatile organic compounds, polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), and metals including lead.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project organization chart (Figure C.2-1) shows the key individuals involved in the project.

2.1 PROGRAM MANAGER

The Program Manager (PM) has the overall responsibility for the health and safety of site personnel in all projects under this contract. The PM will ensure that adequate resources are provided to the field health and safety staff to carry out their responsibilities as outlined below. The PM will also ensure that fieldwork is scheduled with adequate personnel and equipment resources to complete the job safely.

2.2 PROJECT MANAGER

The Project Manager (PjM) is responsible for managing all technical and business aspects of the project. This includes the development of the best technical approach and budget for the CTO scope, managing technical, cost, schedule, and project issues as work progresses, and subcontractor oversight. The PjM will also ensure that adequate personnel and resources are available to complete the project safely. TtEC Environmental Health and Safety (EHS) Procedure 1-2 specifies that line managers (PjMs, Superintendent, site superintendents, and site supervisors) have the responsibility to integrate loss control principles into all operations and to ensure that:

- All projects are implemented in compliance with all environmental, safety, and health laws and regulations, EHS program requirements, and Environmental Management System requirements.
- EHS plans are developed, approved, and implemented in accordance with TtEC requirements.
- Personnel understand the requirements of the project EHS plan(s) and each individual understands his/her responsibility for plan implementation.
- Personnel have all required training and are capable of performing all assigned tasks.
- Facilities and equipment meet TtEC and government regulations.
- Work rules are enforced.
- Inspections and incident investigations are conducted per program requirements. The PjM or designated manager will conduct monthly health and safety inspections of the job site.
- Effective corrective actions are implemented in a timely manner following inspections, audits, incident investigations, and so forth.

- Clients are notified of TtEC incident-reporting procedures.
- Appropriate disciplinary action is implemented by line supervision when necessary.

2.3 SITE SUPERINTENDENT

The Site Superintendent coordinates activities on this CTO at Alameda Point. The superintendent is responsible for ensuring that all work is performed in accordance with the contract requirements in a safe and healthy manner. As line managers, the superintendents have the same responsibilities for health and safety program implementation as the PjM. The Site Superintendent will:

- Ensure that work crews have adequate resources to effectively conduct field activities.
- In conjunction with the Site Health and Safety Specialist (SHSS), ensure that proper protective equipment is being used by all personnel.
- Ensure that appropriate disciplinary actions are taken when health and safety requirements are not being followed or when unsafe practices occur.
- Oversee work practices to verify that they are in accordance with the SHSP.
- Understand and be familiar with the SHSP.
- Participate in the daily tailgate safety meetings.
- Observe project personnel for signs of chemical or physical trauma.
- Immediately notify the SHSS and the PESM of any illness, accident, injury or near-miss incident.
- Correct any hazards disclosed by project workers or the SHSS.

The superintendent has the authority to suspend field activities if the health and safety of personnel are in danger.

The superintendent will submit to the DoN Administrative Contracting Officer (ACO), upon request, copies of the certificates (or acceptable alternative documents) of most recent health and safety training required by 29 CFR, Part 1910.120 for all the personnel who will be working on site. Copies of the training certificates (or acceptable alternative documents) will also be kept at the work site.

2.4 PROJECT ENVIRONMENTAL SAFETY MANAGER

The PESM is responsible for implementing and overseeing the Contract Health and Safety Program and to develop, implement, and approve all SHSPs. Any changes to the established Contract Health and Safety Program or SHSP are made at the direction and approval of the PESM, with concurrence of the DoN ACO. The PESM or designee will not necessarily be on site during all remedial activities, but will be readily available for consultation when required.

The PESM or designee is a CIH certified by the American Board of Industrial Hygiene (ABIH). The PESM supervises and directs the activities of the SHSS. The PESM has the authority to stop unsafe operations, remove unqualified personnel from the work area, and approve changes to the SHSP. Duties of the PESM include:

- Oversee all aspects of the SHSP from development to implementation.
- Advise the SHSS on all related health and safety aspects.
- Review site-specific plans for completeness and compliance.
- Review other site documents as they affect health and safety (AHAs, Sampling Plans).
- Review and evaluate all monitoring results.
- Establish and monitor all related health and safety procedures through site safety inspections and audits.
- Ensure that TtEC employees receive required EHS regulatory training.
- Fulfill specific responsibilities for project EHS personnel that are identified within each EHS procedure.
- Function as a technical resource for all environmental compliance, safety, loss control, and industrial hygiene issues.

2.5 SITE HEALTH AND SAFETY SPECIALIST

The SHSS will be present on site, as required, during the conduct of field operations and is responsible for all health and safety activities and the delegation of duties to the health and safety staff in the field. The SHSS is responsible for implementation of the SHSP, ensuring that appropriate personal protective equipment (PPE) is used relative to the hazard that may be encountered, verifying that communication systems are in place, monitoring conformance with safety and emergency response procedures, giving safety briefings, seeing that safety equipment is maintained, and conducting safety drills and exercises. The SHSS or designee is responsible for the setup and execution of decontamination procedures. The SHSS has stop work authorization, which will be executed upon determination of an imminent safety hazard or potentially dangerous situation. Work cannot restart until clearance has been authorized by the SHSS, who is responsible for maintaining the site health and safety logbooks.

The SHSS possesses the knowledge and experience necessary to ensure that all elements of the approved SHSP are implemented and enforced on site. TtEC employs full-time personnel as Environmental Safety Supervisors (ESSs) and personnel who have been cross-trained as ESSs. The ESS is the equivalent of the SHSS. Each TtEC SHSS has a minimum of six months work experience with hazardous materials and has completed a minimum of 40 hours additional specialized training in personal and respiratory protective equipment, program implementation, and proper use of air-monitoring instruments, air-sampling methods, and interpretation of results. Every SHSS is certified as having completed training in first aid and cardiopulmonary resuscitation (CPR) by a recognized organization such as the American Red Cross Association. TtEC EHS Procedure 1-2 states that the SHSS has the responsibility to:

- Ensure that TtEC employees understand the requirements of TtEC EHS programs and procedures through training and communication.
- Develop or assist with the development of EHS plans in conjunction with project personnel.
- Assist management with EHS plan implementation.
- Perform specific tasks in accordance with EHS plans.
- Fulfill the specific responsibilities for project EHS personnel that are identified within each EHS procedure.

Additional responsibilities, as described in the TtEC EHS program, include but are not limited to:

- Investigating all accidents, injuries, illnesses, near-misses, and other incidents.
- Ensuring that employees are trained on the hazards of hazardous substances used on any project; maintaining Material Safety Data Sheet (MSDS) file to provide easy access to all employees; performing inspections to ensure that all containers are labeled.
- Ensuring that the SHSP is read, understood, and signed by all field personnel including subcontractors.
- Ensuring that tailgate safety meetings are conducted on days that work is performed; ensuring that documentation of all meetings and any other additional training is maintained.
- Assessing employee exposure through specified monitoring protocols and ascertaining that protective measures are appropriate.
- Verifying that project safety equipment is inspected, as required by EHS program.
- Reporting to the Resident Officer in Charge of Construction (ROICC), within 24 hours, all incidents required to be reported by EM 385-1-1; immediately reporting to the ROICC any fatal injury, one or more persons admitted to a hospital, or property damage to government property.
- Verifying that all personnel have the necessary training and medical clearance prior to entering the exclusion zone (EZ) or contamination reduction zone of any site. The SHSS will inform site superintendents of any site personnel with medical restrictions.
- Determining and posting routes to medical facilities and emergency phone numbers; arranging for emergency transportation to medical facilities.
- Maintaining training records and medical certifications for all on-site personnel including subcontractors.
- Serving as the Project Hazard Communication Coordinator.

On each project with an EHS plan, an ESS is assigned to assist line management with EHS Program implementation. The ESS may have multiple duties.

2.6 SITE PERSONNEL

The PjM or Superintendent will select, as needed, personnel to function as supervisors. Supervisors will ensure that their subordinates comply with all requirements of this plan. A list of personnel authorized to have access to the remediation or work site will be compiled and maintained on site by the SHSS. This list will include employees of TtEC, subcontractors, and representatives of governmental agencies that may require access, where possible. All authorized personnel will meet the requirements of the SHSP and be approved by the SHSS or Site Superintendent prior to entering any EZ or controlled area when potentially hazardous activities are being conducted.

Although the employer is responsible for providing a safe and healthy workplace, each employee is responsible for his/her own safety as well as the safety of those around them. Employees will use all equipment provided in a safe and responsible manner as directed by the Site Superintendent. All TtEC personnel will follow the policies set forth in this SHSP and in the TtEC Environmental Health and Safety Program Manual. Each employee is responsible for immediately reporting any injuries, incidents, and safety infractions to a project supervisor or the SHSS so treatment can be obtained and/or corrective action taken. Equipment operators are responsible for the maintenance, inspection, and safe operation of their equipment. They will report any equipment malfunctions or necessary repairs to a project supervisor.

2.7 PROJECT CONSTRUCTION QUALITY CONTROL MANAGER

The Project Quality Control (QC) Manager inspects the preparatory and initial phases of projects for compliance with health and safety requirements.

2.8 SUBCONTRACTED PERSONNEL AND THIRD PARTIES

All subcontracted personnel are responsible for compliance with this SHSP and other applicable regulations. Subcontractor personnel must receive a briefing from the SHSS prior to unescorted access to the project site. They must fulfill the requirements established by this plan. They must acknowledge receipt of the plan and the hazard communication briefing. On-site subcontractors are responsible for providing their personnel with appropriate PPE as specified by the plan.

Subcontractor and third-party personnel have the authority to request a work area hazard assessment by the SHSS prior to the commencement or continuation of work.

Subcontractors will:

- Provide updated documentation of all training (Hazardous Waste Operations [HAZWOPER] refresher training, waste management training, and so forth) and medical certification for work in the EZ and contamination reduction zone.
- Report all incidents and accidents immediately to the Superintendent, a Site Superintendent or the SHSS.
- Have a Drug-free Workplace Program in compliance with the Federal Drug-free Workplace Act.

2.9 VISITORS

All visitors to TtEC project sites will report to the main office (Building 112) and sign in on a visitor's log. TtEC employees not assigned to Alameda Point or the Remedial Action Contract (RAC) Program Management Office will contact the supervisor that requested their visit or they will contact the PjM, the superintendent or the SHSS. Subcontractor visitors will contact their manager on site. Government visitors will sign the visitor's log and the administrative assistant or other person staffing the main office will contact the appropriate site manager.

In no case will visitors be allowed onto any project site area until they have acknowledged training and understanding of the SHSP and received a specific briefing regarding the hazards of the area they intend to visit. PPE will be issued as needed to TtEC employees and government employees (as required by the contract). No PPE will be issued to subcontractor employees.

Visitors who do not meet the training requirements of 29 CFR 1910.120 (8 CCR 5192) will not be issued PPE. These visitors will not enter any active work area or EZ on site. If it is necessary for a visitor to enter active work areas or EZs, all work in these areas will be stopped. The visitors can only enter these areas when it is considered safe to do so by the SHSS or a superintendent. These visitors will be escorted at all times.

LIST OF POINTS OF CONTACT

Agency	Contact	Project Title
Base Realignment and Closure Program Management Office West 1455 Frazee Road, Suite 900 San Diego, CA 92108-4310	Mr. Steve Peck, P.E. (619) 532-0786	Remedial Project Manager
Base Realignment and Closure Program Management Office West 1455 Frazee Road, Suite 900 San Diego, CA 92108-4310	Mr. Thomas Macchiarella (619) 532-0923	BRAC Environmental Coordinator

Agency	Contact	Project Title
DoN BRAC Detachment 410 Palm Avenue, Building 1 Treasure Island, CA 94130	Mr. Doug DeLong (415) 743-4713	Caretaker Site Office
EFA West ROICC 2450 Saratoga Street, Suite 200, Bldg 114 Alameda Point Alameda, CA 94501	Mr. Gregory Grace (510) 749-5940	Resident Officer in Charge of Construction (ROICC)
Naval Facilities Engineering Command, Southwest Division 1220 Pacific Highway San Diego, CA 92132-5190	Mr. Narciso Ancog (619) 532-2540	Quality Assurance Officer
U.S. EPA Region 9 75 Hawthorne St., SDF-73 San Francisco, CA 94105	Ms. Anna Marie Cook (415) 972-3029	EPA – Remedial Project Manager
RWQCB, San Francisco Bay Region 1515 Clay Street, Suite 1400 Oakland, CA 94612	Mr. Erich Simon (510) 622-2355	RWQCB – Remedial Project Manager
DTSC 700 Heinz Avenue, Suite 100 Berkley, California 94710	Ms. Michelle Dalrymple, P.G. (510) 540-3926	DTSC – Remedial Project Manager
TtEC 1230 Columbia Street, Suite 750 San Diego, CA 92101-8536	Mr. Pete Everds (619) 471-3504 phone (619) 301-0433 cell	Project Manager
TtEC 1230 Columbia Street, Suite 750 San Diego, CA 92101-8536	Ms. Marianne Binkin, P.G. (619) 471-3564	Technical Lead
TtEC 19803 North Creek Parkway Bothell, WA 98011	Mr. Bryan Graham (425) 482-2685 cell	Project Geologist/Site Health and Safety
TtEC 1230 Columbia Street, Suite 750 San Diego, CA 92101-8536	Mr. Roger Margotto, C.I.H., C.S.P. (619) 471-3503 (619) 988-0520 cell	Project Environmental Safety Manager
TtEC Former Naval Air Station Moffett Field Building TE-45 Moffett Field, CA 94035	Mr. Bill Ogle (650) 564-9868 (650) 450-2982 cell	Project Quality Control Manager/Site Supervisor
Tetra Tech EC, Inc. 1230 Columbia Street, Suite 750 San Diego, CA 92101-8536	Mr. Gregory Joyce (360) 598-8117 (360) 780-0371 cell	Quality Control Program Manager

Agency	Contact	Project Title
TtEC 1940 East Deere Avenue, Suite 200 Santa Ana, CA 92705-5718	Ms. Lisa Bienkowski (949) 756-7592	Project Chemist

Abbreviations and Acronyms:

BRAC – Base Realignment and Closure
C.I.H. – Certified Industrial Hygienist
DTSC – Department of Toxic Substances Control
EFA – Engineering Field Activities
EPA – U.S. Environmental Protection Agency
P.E. – Professional Engineer
P.G. – Professional Geologist
PQCM – Project Quality Control Manager
ROICC – Resident Officer in Charge of Construction
RWQCB – Regional Water Quality Control Board

3.0 SITE HISTORY AND PROJECT DESCRIPTION

The following sections provide a description of Alameda Point and its history.

3.1 SITE DESCRIPTION AND BACKGROUND

Alameda Point is located on the West end of Alameda Island, which lies on the East side of San Francisco Bay adjacent to the City of Oakland. Alameda Point is relatively flat land created by filling tidelands, marshlands, and sloughs in the early 1900s. The site is rectangular in shape, approximately 2 miles long east to west, 1 mile wide north to south, and occupies 1,734 acres. Prior to 1930, at least two large industrial sites, a borax processing plant and an oil refinery, were located on the island near what is now the eastern end of Alameda Point.

3.2 ALAMEDA POINT HISTORY

Alameda Point is located on Alameda Island at the base of a gently sloping plain that extends from the Berkeley Hills on the east to the shore of the San Francisco Bay on the west. Originally a peninsula, Alameda Island was detached from the mainland in 1902 when a channel was cut linking San Leandro Bay to San Francisco Bay. A summary of the historical use of Alameda Point and the former Alameda Naval Air Station (NAS) is presented below:

- Prior to 1930 – NAS Alameda, the western tip of Alameda Island, was farmland and later became an industrial and transit center. Railroad yards and rights-of-way for the Southern Pacific, Central Pacific, South Pacific Coast, and small local railways were built to the north of the present-day NAS facility. For a short period in 1869, the western terminus of the transcontinental railroad was located at the southeastern corner of Alameda Point. A borax plant operated in the eastern end of Alameda Point from the late 1800s to 1903. Pacific Coast Oil Works operated an oil refinery on the western tip of Alameda prior to filling activities, and was active from 1864 to 1899.
- 1930 to 1931 – The U.S. Department of the Army acquired the western tip of Alameda Point from the City of Alameda and began construction activities.
- 1936 – In response to the military buildup in Europe prior to World War II, the DoN acquired title to the land from the Army and began building NAS Alameda. Construction involved filling in the tidelands, marshes, and sloughs between the Oakland Inner Harbor and the western tip of Alameda Island. According to historical photographs and records, the NAS Alameda area was filled in during two separate events:

– 1887 to 1915 – First fill event included most of the NAS Alameda.

– 1930 to 1939 – Second fill event added the material within the southeast portion of the facility. The fill material used to create Alameda Point consisted largely of dredge spoils from the surrounding San Francisco Bay and Oakland Inner Harbor.

- 1941 – After the United States entered World War II, the DoN acquired more land to the west.
- 1945 to 1997 – Following the end of the war, Alameda Point continued to provide facilities and support for fleet aviation activities. During the period that it was an active naval base, the installation provided berthing for Pacific Fleet ships and support for Naval aviation.
- 1993 – NAS Alameda was identified for closure during the 1993 round of BRAC.
- 1994 – The city and county of Alameda established the Alameda Reuse and Redevelopment Authority (ARRA). The ARRA is responsible for submitting and completing the community reuse plan for NAS Alameda, as recognized by the Department of Defense.
- 1997 – NAS Alameda closed, and the DoN began the process of property transfer to the city of Alameda.
- 1999 – NAS Alameda was placed on the National Priorities List.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites and petroleum corrective action areas (CAAs) were designated to assess contamination within specific areas of Alameda Point. In addition, an area known as the Marsh Crust was identified. The Marsh Crust layer consists of entrapped organic matter with medium- to heavy-weight petroleum hydrocarbons, situated at approximately 10 feet below ground surface (bgs) in the northern portion of the facility and 20 feet bgs in the southern portion of the facility. The Marsh Crust was formed as petroleum products were discharged into the surrounding marshlands and intertidal areas that were subsequently filled in from 1887 to 1939 to form what would become Alameda Annex and Alameda Point.

3.2.1 Site Location

The work area defined by the DoN under CTO 0012 as OU-1, OU-2A, and OU-2B data gap investigation is comprised of the following sites:

<u>OU-1</u>

- Site 6 – Building 41 (Aircraft Intermediate Maintenance Facility)
- Site 7 – Navy Exchange Service Station
- Site 8 – Building 114 (Pesticide Storage Area)
- Site 16 – Shipping Storage Container Area

<u>OU-2A</u>

- Site 9 – Building 410 (Paint Stripping Facility)
- Site 13 – Former Oil Refinery
- Site 19 – Yard D-13 (Hazardous Waste Storage)

- Site 22 – Former Service Station
- Site 23 – Missile Rework Operations

OU-2B

- Site 3 – Abandoned Fuel Storage Area
- Site 4 – Building 360 (Aircraft Engine Facility)
- Site 11 – Building 14 (Engine Test Cell)
- Site 21 – Building 162 (Ship Fitting and Engine Repair)

3.3 PROJECT DESCRIPTION

This scope of work (SOW) under this CTO for the Data Gaps Investigation for OU-1, OU-2A, and OU-2B includes the following:

- Refine the nature and extent of soil contamination related to individual SWMUs and other areas identified as a result of previous investigations.
- Determine aquifer parameters, including groundwater flow direction, within the FWBZ and the SWBZ.
- Refine the lateral and vertical extent of contaminant plumes.

Fieldwork elements include:

- Sample soil and groundwater required to support further characterization for SWMUs and other areas identified as a result of previous investigations.
- Conduct field activities necessary to install groundwater monitoring wells to evaluate groundwater contamination within the FWBZ and the SWBZ.

Project tasks include the following:

- Coordinate with the Base in the event SWMU investigation areas are occupied by commercial tenants or business employees.
- Mobilize equipment, supplies, and manpower to the site.
- Perform utility clearance.
- Conduct tidal study.
- Perform direct push technology soil and groundwater sampling.
- Conduct cone penetrometer technology soil sampling.
- Perform hand augering soil sampling.
- Direct hollow-stem auger drilling for the installation of groundwater monitoring wells.
- Perform groundwater monitoring well installation and development.

- Survey sample and well locations.
- Decontaminate equipment and demobilize.

This project poses the challenge of working in areas that may be leased to commercial tenants. Success of this project will depend on coordination with the DoN Point of Contact and the tenants to ensure that tenants understand project activities and impacts. Strict site control will reduce unauthorized access to work areas and health and safety risks to the commercial community members.

3.4 PROJECT DURATION

The project is scheduled to commence in July 2007. There will be approximately 5 months of field activities.

4.0 POTENTIAL HAZARDS

Potential chemical hazards exist throughout Alameda Point. Numerous physical hazards identified with the site include those associated with investigative sampling, use of heavy equipment, fire hazards, and electrical hazards. Also, environmental hazards are associated with the physical location of the base and weather conditions such as heat stress, noise, and flora and fauna contact.

4.1 CHEMICAL HAZARDS

OU-1, OU-2A, and OU-2B were all areas of historical chemical, oil, and lubricant usage related to ship and aircraft maintenance; bulk fuel service; and hazardous waste storage operations. Contaminants of concern include petroleum hydrocarbons, volatile organic compounds, semivolatile organic compounds, PCBs, PAHs, and metals including lead. The likelihood of significant exposure to chemical contaminants during this remedial action is low based on the detection levels documented by previous site investigations.

4.1.1 Additional Chemical Hazards

MSDSs for the contaminants and any additional chemicals found on site or brought onto the site will be acquired and reviewed with all personnel during daily safety meetings. Attachment 2 of this SHSP contains MSDSs of the anticipated contaminants. The PESM and SHSS will initially specify the levels of protection and air-monitoring requirements based on the data provided or obtained prior to characterization activities. These requirements may change as site conditions are more fully evaluated. Table C.4-1 summarizes the hazards associated with these chemicals.

A master file of MSDSs for chemicals on site and any additional chemicals brought on site for use on this project will be kept in the Alameda Point site office, (Building 112). A copy of the MSDSs will also be maintained at the work site and will be readily accessible at all times.

TtEC's protective equipment requirements, combined with the requirement to wash arms, face, and hands before eating or smoking, should prevent exposure through these routes. In addition, the SHSS and supervisors observe and warn the crew members to be aware of the initial symptoms of chemical exposure. The amount of exposure depends primarily on the specific activities undertaken and the care with which the activities are performed. A supervisor will remove any crew member from the work site and have the worker medically evaluated if the following initial symptoms persist and are unexplained by other causes (such as allergy, common cold, heat stress):

- Dizziness or stupor
- Nausea, headaches, or cramps

- Irritation of the eyes, nose, or throat
- Euphoria
- Chest pains and coughing
- Rashes or burns

4.1.2 Hazard Communication Program

The purpose of a Hazard Communication or Employee Right-To-Know program is to ensure that the hazards of all chemicals located at this field project site are communicated, according to 29 CFR, Part 1926.59 (8 CCR, Section 5194) regulations, to all TtEC personnel and subcontractors. TtEC EHS Procedure 4-2 is the written hazard communication program. This program requires:

- ***Container Labeling***—Personnel will ensure that all drums and containers are labeled according to contents. These drums and containers will include those from manufacturers and those produced on site by operations. All incoming and outgoing labels will be checked for identity, hazard warning, and name and address of responsible party.
- ***MSDSs***—An MSDS will be located on site for each hazardous chemical used or known to be on site, as well as a list of all chemicals brought on site that require an MSDS.
- ***Employee Information and Training***—Training employees on chemical hazards is accomplished through formal safety training conducted annually and informal safety meetings. Project-specific chemical hazards are communicated to employees through an initial site orientation meeting and during daily safety meetings held at field projects.

4.2 ENVIRONMENTAL HAZARDS

The SHSS or a supervisor will discuss environmental hazards associated with each site location at the orientation meeting prior to startup of remediation activities.

4.2.1 Weather and Heat Stress

With the possible combination of ambient factors such as high air temperature, a few days with high relative humidity, low air movement, high radiant heat, and protective clothing, the potential for heat stress is a concern. The potential exists for:

- Heat rash
- Heat cramps
- Heat exhaustion
- Heat stroke

The TtEC EHS Procedure 4-6, available on site, describes the heat stress management and prevention program. At 70 degrees Fahrenheit (°F) ambient temperature, the supervisor on site initiates the procedures in the program.

Heat stroke, heat cramps, and heat exhaustion are covered in detail during the 40-Hour Occupational Safety and Health Administration (OSHA) 29 CFR, Part 1910.120 (8 CCR, Section 5192) pre-employment course. In addition, this information is discussed during a safety "tailgate" meeting before each work day where heat stress may be a factor. Workers are encouraged to increase consumption of water and electrolyte-containing beverages such as Gatorade during warm weather. Water and electrolyte-containing beverages will be provided on site and will be available for consumption during work breaks.

At a minimum, workers will break every two hours for 10- to 15-minute rest periods when temperatures exceed 70°F. In addition, workers are encouraged to take rests whenever they feel any adverse effects, especially those effects that may be heat-related. The frequency of breaks may need to be increased upon worker recommendation or decision of the SHSS and a supervisor.

The EHS procedure also describes a cold stress program. However, due to the location of Alameda Point, it is unlikely that there will be a need for this program.

Workers need to protect themselves from sunburn. Workers should wear clothing that protects them from the sun or otherwise wear a sunscreen lotion with a skin protection factor of 15 or greater. TtEC will provide all workers with sunscreen lotion preferably resistant to sweating. On this project all workers will wear long-sleeve shirts in areas where there is potential exposure to contaminated dust.

4.2.2 Hearing Conservation Program

In and around heavy equipment operations, noise levels may exceed a time-weighted average (TWA) of 84 decibels, A-scale (dBA). Hearing protection will be made available to all exposed employees. Additional sound level monitoring will be conducted on site using a noise survey meter. Personnel with a standard threshold shift will be restricted from high noise exposure or will be required to wear hearing protection at all times. TtEC EHS Procedure 4-4 is a hearing conservation program in compliance with OSHA regulations (29 CFR, Part 1910.95) (8 CCR, Sections 5095 through 5100).

4.2.3 Biological Hazards

Biological hazards may be encountered on site. Workers should anticipate the increased likelihood of encountering these hazards, especially in and around buildings and in undeveloped outdoor areas. Animal bites and insect stings can cause localized swelling, itching, and minor pain that can be handled by first aid treatment. In sensitized individuals, however, effects can be more serious such as anaphylactic shock, which can lead to severe reactions in the circulatory, respiratory, and central nervous system, and in some cases, even death. The SHSS will identify personnel with a known reaction to bites and stings at the pre-job safety orientation meeting.

Personnel will not attempt to capture or feed any wild or semi-wild animals such as cats, rats or ground squirrels due to the possibility of a bite or parasitic infestation. Some biological hazards are described as follows:

- Poison oak causes discomfort, irritation, and inflammation of the skin. Personnel will be warned to prevent contact with unknown plants. Protective clothing worn by site personnel should reduce the probability of such exposure. Cleaning the skin thoroughly with soap and water after contact will also reduce the risk of severe symptoms.
- Animal and bird droppings often contain mold, fungus, or bacteria that represent a significant respiratory hazard including lung diseases and allergies. Personnel will not touch visual droppings and will wear gloves and Tyvek® protective wear, at a minimum, when going into normally limited access areas such as crawl spaces and high ceilings that may have become refuges or nesting areas.
- The hantavirus is sometimes transmitted by rodents found in the Southwestern United States and causes respiratory distress, sometimes with fatal consequences. Similarly, rats transmit the arenavirus. Transmission of the hantavirus or arenavirus occurs with exposure to rodent droppings. Good hygiene practices such as washing hands and face prior to eating and drinking will help to minimize the potential for exposure to the hantavirus. While work is in progress, use of high-efficiency particulate air (HEPA) filter cartridges and work practices that minimize generation of dust and aerosols will help protect employees. Avoiding areas with concentrations of mouse droppings (hantavirus) or rat droppings (arenavirus), for example, minimizes exposure to either virus. The virus can be inhaled in the dust from areas where mice or rats have nested or left their droppings. Minimizing dust inhalation or avoiding these areas will lessen the risks of exposure. Any work in such areas should be done only with full Level C protection including, at a minimum, a HEPA air-purifying respirator. Thorough washing of hands and face after removing the PPE will further minimize the potential for exposure.
- Personnel must use extreme caution when walking through an area, around buildings, and near objects such as drums and containers where a snake is likely to rest during the daytime. If a snake is encountered, slowly and quietly back away from the snake and inform all personnel of its location. Do not attempt to move or kill a snake as certain snakes are protected under state and federal laws. In the event of snakebite, do not try to move the affected individual. Wipe off the skin, as the venom will attack intact skin. Do not suck out the venom. Do not cut open the wound. Do not apply ice or ice packs. Do not use a tourniquet. Do not administer alcohol or medications. Call for medical assistance.

4.2.4 Storm Protection

If a warning of gale-force winds is issued, take precautions to minimize danger to persons, and protect the work and any nearby property. Precautions will include closing of all openings; removing loose materials, tools and equipment from exposed locations; and removing or securing scaffolding and other temporary work. Close all openings in the work site if storms of a lesser intensity pose a threat to property. The SHSS will ascertain predicted daily weather conditions by listening to daily weather forecasts on radio or television. If particularly ominous weather conditions are predicted, the SHSS will monitor radio broadcasts regularly or through National Weather Service reports. Workers will not enter any excavations during a rainstorm. The supervisor or SHSS will stop all work when wind speeds are 25 miles per hour or higher, and will assess what work procedures can be safely performed under this condition. This person will give consideration to fugitive dust and odor emissions, the safety of equipment in high winds, and protection of workers from flying debris and dust in windy conditions. No crane or boom work is permitted in winds at 25 miles per hour or higher. (Cranes are not anticipated for use on this project; however, rigs with high masts may be used, so there is concern for high winds.) Projects near, in, or on water will stop work, and conditions will be evaluated before allowing work to continue. The Bay can become dangerous when there are high winds or high tides. The project SHSS and Site Superintendent will make a decision as to whether work can continue, continue with modifications, or must be stopped.

4.3 PHYSICAL HAZARDS

Numerous physical hazards are associated with the project, which if not identified and addressed, may present accidents and personal injury to the workforce as well as operational problems. To minimize physical hazards, TtEC has developed standard safety protocols that will be followed at all times. Failure to follow safety protocols or continued negligence of these policies will result in discipline of the employee. The TtEC Project Rules Handbook states the health and safety project rules and guidelines. Some of these are described in this section and in Section 10.0 of this plan. All TtEC personnel will follow these requirements as specified here and in the Project Rules Handbook. Supervisors will observe the general work practices of each worker and enforce safe procedures to minimize physical hazards. Hard hats, safety glasses, and safety boots are required in all construction or investigation areas of the work site, unless specifically exempted by the PESM, SHSS, or a supervisor.

4.3.1 Tripping, Slipping, and Falling Hazards

Supervisors will remind personnel and subcontractors daily to maintain sure footing on all surfaces. The supervisor and/or the SHSS will inspect all work areas prior to the start of work to look for hazards. Where engineering controls such as guardrails cannot be installed or used, personnel working 6 feet above any surface, including man lifts, are required to wear safety harnesses and safety lanyards. These will be attached to an approved anchorage point. The SHSS will inspect these before use. To minimize tripping hazards caused by debris, job supplies, and equipment, personnel will remove this material from the work areas daily and stockpile the materials and place equipment in storage areas. The Superintendent will enforce this "housekeeping" effort throughout the day. Workers will not work near the edges (less than 6 feet) of excavations where there is a vertical drop potential greater than 6 feet without fall protection.

4.3.2 Head and Back Injuries

At a minimum, workers will don hard hats, safety boots, and safety glasses prior to performing any site construction or investigation activities. This will prevent minor injuries caused by bumping one's head while working around and under piping and other process-related structures or equipment. Personnel are instructed in proper lifting techniques and will not lift heavy items without assistance per TtEC EHS Procedure 3-1. Each worker will not lift more than 50 pounds. Objects heavier than 50 pounds and those with uneven weight distribution may require assistance from another person. Supervisors will use mechanical lifting equipment whenever possible to minimize worker exposure to lifting hazards.

4.3.3 Falling Objects

All items raised will be slowly lowered to the ground using a grapple and/or skip bucket. No personnel will work under equipment at any time. Also, the construction supervisor will ensure that an adequate area is clear of personnel while the equipment is in operation. Dump truck drivers will remain in their trucks while soil and debris is placed in their trucks, if their trucks are equipped with a Falling Object Protective System (FOPS). If their trucks are not equipped with FOPS, the drivers will get out of their trucks and stand clear of the loading operation. Workers will not work under other workers, who are on scaffolds or levels higher than these workers, unless those levels have protection to prevent objects from falling on workers below.

4.3.4 Heavy Equipment and Traffic

The use of heavy equipment for debris removal, excavation, and lifting presents the greatest potential for injury to personnel. In order to minimize these hazards, the Superintendent and supervisors will designate routes for mobilization through Alameda Point and establish specific traffic patterns. All trucks and heavy equipment will have spotters for backing maneuvers. Only qualified personnel will operate heavy equipment. Those crew members directly involved with spotting for the operator are the only personnel allowed in the vicinity of the heavy equipment. All others will remain a safe distance away from these operations. Personnel needing to approach heavy equipment while operating will observe the following protocols:

- Make eye contact with the operator (and spotter).
- Signal the operator to cease heavy equipment activity.
- Approach the equipment and inform the operator of intentions.

All TtEC personnel will follow all local traffic rules. Company vehicles will yield to all bikes and pedestrians. Personnel working in areas subject to vehicular traffic (streets, parking lots, and so forth) will wear high-visibility safety vests. Flashing light or reflectorized barricades will be used for all roads blocked because of equipment or excavation. In addition, excavations left open will require more substantial barricades such as "K" rails or other barrier. Coordinate all traffic management issues with the Remedial Project Manager (RPM).

4.3.4.1 Site Pre-Inspection of Heavy Equipment

The projects will only use heavy equipment in safe working order. To maintain this policy, the supervisor(s), the SHSS, and the equipment operator will inspect each heavy equipment piece and vehicle brought onto the project site prior to use for structural integrity, smooth operational performance, and proper functioning of all critical safety devices in accordance with the manufacturer's specifications and safety regulations. All heavy equipment brought on site will have a mechanic's certificate that equipment has been inspected and is safe to operate. There will be an operator's manual for each heavy equipment and vehicle. All equipment not conforming to the operational and safety requirements set forth during this inspection will not be put into service until all necessary repairs are made to the satisfaction of the inspection group. The Project Manager and the Site Superintendent will ensure that all equipment operations comply with Construction Practice–7 (CP-7) of the TtEC construction program.

Operator Qualifications

Only qualified operators familiar with the equipment to be used will be permitted to operate it. Subcontractors will supply proof of their operator's capability and experience to operate the equipment in a safe manner. TtEC reserves the right to remove any operator from the project site if there is a question or doubt concerning the operator's capabilities. There are specific training requirements for industrial truck (forklift) operators and crane operators. These requirements are specified in the TtEC EHS procedures and EM 385-1-1 (USACE, 2003).

4.3.5 Electrical Hazards

In order to prevent accidents caused by electric shock, the project SHSS will inspect all electrical connections on a daily basis. The SHSS will shut down and lock out any equipment found to have frayed or loose connections until a qualified electrician is contacted and repairs are made. The equipment will be de-energized and tested before any electrical work is done. All equipment will be properly grounded prior to and during all work. In addition, ground fault circuit interrupters (GFCIs) will be installed for each circuit between the power source and tool for all outdoor use. In the event that generators are used to supply power, these generators will contain GFCIs.

Requirements for electrical safety include:

- All electrical wiring and equipment will be listed by a recognized testing laboratory. In California, the usual recognized testing laboratories are Underwriters Laboratory, Canadian Standards Association, and Factory Mutual. Six other recognized laboratories are rarely ever seen in the certification of electrical equipment. Some equipment manufactured in foreign countries have other listing certifications; most foreign certifications are not recognized as meeting the standards in California.
- Live parts of wiring and equipment will be guarded to protect all persons or objects from harm. Uninsulated live wires must be placed at various heights and distances from the ground and from buildings depending on the voltage carried by those lines. (Consult the PESM if uninsulated live wires are anticipated.)
- Transformer banks and high-voltage equipment will be protected from unauthorized access.
- A qualified electrician will perform all work on electrical power supplies and lines.
- Flexible cords (extension cords) will contain the number of conductors required for service plus a ground wire. Cords will be rated for hard usage (S, SE, SEO, SO, SOO, ST, STO, STOO). (Note: This rating is not required to be listed on the cord itself, so check the wrapping or label that comes with the cord to assure that the cord meets this requirement.) Flexible cords are not allowed to pass through doors, windows, or be placed on the ground where they are subject to being run over by vehicles. If flexible cords must pass through walls, the cords will be protected by bushings or fittings.
- Flexible cords must be inspected on each day of use. No splices or fraying are allowed.
- Flexible cords will not be secured with staples, hung from nails or suspended by pare wire. (Plastic tie straps, commonly used today, are acceptable.)
- All portable lamps must have bulbs protected by a substantial guard and attached to the lamp holder handle.
- All circuit breaker panels and electrical transformers and supply equipment must be labeled as to the voltage contained therein.
- All circuit breaker panels must be labeled as to what each breaker controls.
- All breaker panels and electrical panels must have a cover protecting any live exposed wires.
- At least a 30-inch clearance must be maintained on three sides of all circuit breaker boxes, transformers, and electrical supply equipment so as to provide ready access to the equipment in the event of an emergency. A 36-inch clearance is required for higher voltages, so to assure that adequate clearance is provided, TtEC requires a 36-inch clearance of all breaker boxes, and so forth.

- Circuit breaker boxes that are locked or kept in locked rooms must have a key readily available in the event of an emergency.

4.3.5.1 Portable Generators

Portable generators are used on many construction sites. Portable generators must meet the requirements for grounding as specified in the National Electrical Code (NEC) National Fire Protection Association 70. NEC 250-6 has certain exemptions for the grounding of portable and vehicle-mounted generators. Refer to the code to EM 385-1-1, Section 11 for additional details. Portable generators will be operated in open air only where there is sufficient ventilation as to prevent accumulation of exhaust gases including carbon monoxide.

4.3.5.2 Temporary Wiring

A qualified electrician will design temporary wiring. A qualified engineer will approve the design. The system will be tested as required by EM 385-1-1, Section 11 (USACE, 2003). Temporary lighting will be protected by guards and will not be suspended by the wire. Exposed empty light sockets and broken bulbs are not permitted. Temporary lighting circuits will be separate from electrical tool circuits. Circuits will be labeled as "LIGHTS ONLY" or "TOOLS ONLY."

4.3.6 Control of Hazardous Energy (Lock-Out/Tag-Out)

TtEC EHS Procedure 6-4, Lock-Out/Tag-Out, establishes TtEC Control of Hazardous Energy Program. This program applies to all TtEC operations, except as follows:

- Work on cord and plug connected electrical equipment where the plug is under the control of the employee performing the work
- Hot tap operations
- Work involving minor changes and adjustments to equipment during routine operations (such as small tooling adjustments)

The following are the steps to be followed in preparing for, applying, and releasing a machine or piece of equipment from lock-out. These steps will be completed, in order, using the corresponding permit. While work is being performed under the lock-out, a copy of the completed permit will be posted at the equipment controls or work area as appropriate. (The steps below and this section of this plan refer to sections of the permit form.)

1. Complete the general information in Section A of the permit.
2. Identify isolation points:

   The first step required to isolate a piece of equipment is to identify the sources of hazardous energy present. To identify the sources, the authorized employee will complete the following steps:

- Survey the equipment and related schematics, blueprints, or as-builts, if available, for hazardous energy sources.
- Identify the isolation points and device positions for controlling each source of hazardous energy.
- Identify the isolation method to be used on each source.

The above information will be documented in Section B of the Lock-out/Tag-out Permit as each point is identified.

3. Provide notification.

   Prior to applying a lock-out, the authorized employee will notify affected employees of the equipment to be locked out and sign Section C of the Lock-out/Tag-out Permit on the "Notifier" line.

4. Shut down equipment.

   Shut down the equipment or place into the desired configuration using normal operating procedures. The authorized employee will sign Section C of the Lock-out/Tag-out Permit on the "Shutdown by" line.

5. Isolate equipment.

   To apply a lock-out to a piece of equipment, complete the following steps:

   - Place each energy isolation device into a position that will prevent the transmission of hazardous energy.
   - The authorized employee will lock out devices to each isolation point and control the key for each lock at all times. Only one key is permitted per lock.

   Complete Section D of the permit as each device is placed and sign the "Isolator" line in Section C.

   Notes:

   - Any lock-out device not containing an integral locking mechanism must be used in conjunction with a keyed lock.
   - Any energy isolation point not capable of being locked out must be controlled physically through such means as removal of handles and disconnecting.

6. Release stored energy.

   After the equipment has been locked and tagged as required in Section D, all remaining stored energy must be released. Methods for the release of stored energy include, but are not limited to the following:

   - Discharge and grounding of capacitors
   - Bleeding pressure from vessels and lines
   - Releasing mechanical sources of energy to engage blocks

Stored energy has the potential to reaccumulate; therefore, verification of isolation will continue until work is complete. After releasing stored energy, complete Section E of the permit.

7. Verify lock-out/tag-out.

   After completing the lock-out of the desired piece of equipment, the effectiveness of the lock-out must be verified by the authorized employee by attempting to operate the machine. After attempting to operate the machine, sign Section C of the permit on the "Verifier" line.

8. Perform work.

   After verifying and receiving the supervisor's approval signature, work may be performed on the equipment that was locked/tagged.

9. Remove lock-out/tag-out.

   After work has been completed, the following steps will be followed to release equipment from lock-out/tag-out:

   - The area affected by the lock-out will be inspected to ensure that releasing the machine does not present a hazard to people and property.
   - Lock-out devices and tags will be removed.
   - Isolation devices will be returned to their operating positions.
   - The equipment will be started.
   - Affected employees will be notified of the release.
   - Section F of the permit will be completed as the equipment is returned to service.

4.3.6.1 Tag-Out

The use of tags without locks is prohibited, except in those cases where it is physically impossible to attach a locking device to an isolation point. When it is necessary to use tags without locks, the following will be completed:

- The isolation point will be placed in the correct position to prevent the flow of energy.
- The device will be physically disconnected.
- A tag will be placed on the disconnected device.
- Employees will be warned not to tamper with the tag or isolation point.

4.3.6.2 Equipment-Specific Lock-out/Tag-out Procedures

As TtEC does not normally perform lock-outs of machinery on a repetitive basis, the lock-out/tag-out permit is designed for initial and one-of-a-kind lock-outs. Should it become necessary to repetitively lock out the same piece of equipment, specific procedures and permits for the equipment will be developed. Information contained in the equipment-specific procedure and permit should be the same as the information in the permit. The procedures will be generated by trained and knowledgeable project personnel and be reviewed and approved by the PESM. Equipment-specific procedures are not required when all of the following conditions are present:

- The machine has no potential for stored energy or the reaccumulation of energy after shutdown.
- The equipment has a single, readily identifiable, and isolated source of energy.
- Isolation and lock out of the source will completely de-energize and deactivate the equipment.
- The machine is locked-out and isolated from that energy source during servicing and maintenance.
- A single lock-out device will achieve a locked-out condition.
- The servicing or maintenance does not create a hazard to other employees.

4.3.6.3 Shift Changes

If it is necessary to maintain the status of a locked-out machine or device past the end of the shift when the lock-out was initially installed, the following procedures will be adhered to:

- The incoming authorized employee will place their lock on the lock-out point and complete a new permit.
- The outgoing employees will remove their lock(s) after the new lock(s) are applied.
- If multiple shifts are not used, the initial locks may be left in place until the following day or until the equipment is released from lock-out/tag-out.
- The new shift supervisor will sign the permit before work is begun on the new shift. The last supervisor whose name is on the lock-out/tag-out permit is responsible for all activities related to the work activity.

4.3.6.4 Failure to Clear Locks

If a person should fail to clear a lock-out and their lock remains in place, the supervisor will attempt to contact the person who applied the lock and resolve the issue.

If the person cannot be contacted, the supervisor will investigate the situation and determine if removal of the lock will create a hazard in the work zone. If there is no hazard present, the supervisor will then verify that the work zone is clear, blocking devices have been removed, and the system has been restored to the normal configuration. The supervisor will then cut the lock off and restore energy to the system.

A written incident and investigation report per TtEC EHS Procedure 1-7, Incident Reporting and Investigating, will be prepared by the supervisor stating the reason for cutting the lock, why the lock was not removed, and the procedure used to ensure the safety of personnel in the area. The individual whose lock was cut off must be notified immediately.

4.3.6.5 Subcontractors

The supervisor will be familiar with the nature of any subcontractor work on site that may involve hazardous energy and assure that they follow work practices at least as strict as this procedure. For any lock-out/tag-out requirements, the supervisor will review and approve all subcontractor work setup, apply his locks to the scheme, and sign the appropriate lock-out/tag-out procedure checklist.

4.3.6.6 Periodic Inspections

Periodic inspections pursuant to EHS 3-3, Inspections, will be completed during the monthly inspections by the SHSS, PESM or other qualified personnel to ensure that the lock-out/tag-out program is being effectively implemented. At a minimum, the following will be done:

- Existing lock-outs will be reviewed for effectiveness.
- Permits for each existing lock-out will be reviewed for adequacy.
- Incident reports and past permits will be reviewed to determine if deficiencies in the program exist.
- Corrections to the system will be made as warranted.
- Results will be logged in the health and safety logbook.

4.3.6.7 Training

Following are the training requirements for various personnel involved with, or affected by, lock-out/tag-out.

- Authorized employees will receive training in the following prior to being allowed to use lock-out/tag-out procedures:
  - Recognition of hazardous energy sources
  - Types and magnitudes of energies available at the site
  - Methods and means needed for energy isolation and control
  - The requirements of this procedure and 29 CFR 1910.147
- Affected employees will be instructed in the following:
  - Purpose of the lock-out/tag-out program
  - Use and requirements of this procedure and 29 CFR 1910.147

- Prohibitions of restarting or tampering with equipment that has been locked out
- Prohibitions of tampering with locks and tags installed on equipment

Personnel not employed by TtEC will be briefed in the requirements of this program during site-specific orientations, when applicable. Training records will be maintained in accordance with TtEC EHS Procedure 1-9, Recordkeeping.

4.3.7 Confined Space Entry

A confined space is any enclosed area having a limited means of egress where ventilation is not adequate to remove a toxic or flammable atmosphere or oxygen deficiency that may exist. Examples of confined spaces include, but are not limited to, the following: tanks, boilers, vessels, bins, manholes, tunnels, pipelines, underground utility vaults, or any open top space more than 4 feet in depth such as pits, tubes, trenches, or vessels. No confined space entry is allowed without the approval of the PESM.

TtEC EHS Procedure 6-1 outlines procedures in detail. If a confined space entry is planned, the PESM will be immediately contacted. The PESM, the SHSS, and the project supervisor(s) will identify confined spaces or confined spaces created by the nature of the work. The SHSS will identify these confined spaces and will not allow entry into these spaces. The SSHS will develop a confined space entry plan and AHA that will detail the confined space entry procedure and requirements. Prior to entry, the plan and the AHA must be reviewed by the PESM and accepted by the PESM.

4.3.8 Fire and Explosion Hazards

Atmospheric testing with a combustible gas indicator must be performed to determine the potential for a flammable atmosphere. A hot work permit must be issued to control the presence of equipment or operations producing open flames or sparks. Hot work permits and procedures are found in TtEC EHS Procedure 6-5 and are issued by the SHSS. The SHSS must establish a fire prevention and protection program by ensuring that flammable materials are properly stored and that safe work procedures and rules are followed. Smoking is not permitted anywhere on a project site, except in designated areas.

4.3.9 Drilling

The Work Plan indicates that drilling may be required. Any drilling will be performed in accordance with EM 385-1-1, 16.M (USACE, 2003). A survey of the job site to identify overhead electrical hazards, potential ground hazards, and underground utilities must be performed before placement of the drilling equipment. MSDSs for drilling fluids must be provided to the SHSS before the start of work. Supervisors will ensure that a call has been made to Underground Service Alert (Dig Alert) and that drawings and maps from public works are reviewed to verify that no underground utilities are present that will be disturbed by the drilling operation.

4.3.9.1 Housekeeping

The drilling safety supervisor will understand and fulfill the responsibility for proper maintenance and good "housekeeping" on and around the drill rig. These requirements include, but are not limited to:

- Provide suitable storage locations for tools, materials, and supplies so that tools, materials, and supplies can be conveniently and safely handled without hitting or falling on a member of the drill crew or a visitor.
- Avoid storing or transporting tools, materials or supplies within or on the mast (derrick) of the drill rig.
- Neatly stack pipe, drill rods, casing augers, and similar drilling tools on racks or sills to prevent spreading, rolling, or sliding.
- Place penetration or other driving hammers at a safe location on the ground or secure them to prevent movement when not in use.
- Keep work areas, platforms, walkways, scaffolding, and other accessways free of materials, debris, and obstructions and substances such as ice, grease, or oil that could cause a surface to become slick or otherwise hazardous.
- Keep all controls, control linkages, warning and operation lights, and lenses free of oil, grease, and/or ice.
- Do not store gasoline in any portable container other than a non-sparking, approved container with a flame arrestor in the fill spout and having the word "gasoline" easily visible. A hazard communication label will also be placed on all gasoline cans. (See TtEC EHS 4-2, Hazard Communications, and TtEC EHS 3-7, Hazardous Material Storage and Transportation.)

4.3.9.2 Maintenance

Proper maintenance will make drilling operations safer. Maintenance should be performed safely. These requirements include, but are not limited to:

- Keep drill rigs and associated equipment in <u>good</u> condition.
- Wear safety glasses when performing maintenance on a drill rig or on drilling tools.
- Shut down the drill rig engine to make repairs or adjustments to a drill rig or to lubricate fittings (except repairs or adjustments that can only be made with the engine running). Take precautions to prevent accidental starting of an engine during maintenance by locking, removing, or tagging the ignition key (see TtEC EHS 6-4 Lock-out/Tag-out Procedure).

- Always block the wheels or lower the leveling jacks or both and set handbrakes before working under a drill rig.
- When possible and appropriate, release all pressure on the hydraulic systems, the drilling fluid system, and the air pressure systems of the drill rig prior to performing maintenance. In other words, reduce the drill rig and operating systems to a "zero energy state" before performing maintenance. Use extreme caution when opening drain plugs and radiator caps and other pressurized plugs and caps.
- Do not touch an engine or the exhaust system of an engine following its operation until the engine and exhaust system have had adequate time to cool.
- Never weld or cut on or near a fuel tank.
- Do not use gasoline or other volatile or flammable liquids as a cleaning agent on or around a drill rig.
- Follow the manufacturer's recommendations for applying the proper quantity and quality of lubricants, hydraulic oils, and/or coolants.
- Replace all caps, filler plugs, protective guards or panels and high pressure hose clamps and chains or cables that have been removed for maintenance before returning the drill rig to service.
- Check each deadman (emergency shut-off) switch daily. (Every drill rig must be equipped with two kill switches – one for the operator and one for the helper). Ensure that its location is known to all drill rig crew personnel.
- The client requires the use of a cage around all rotating augers.

4.3.9.3 Hand Tools

There are almost an infinite number of hand tools that can be used on or around a drill rig and in repair shops and more than an equal number of instructions for proper use. "Use the tool for its intended purpose" is the most important rule. The following are a few specific and some general suggestions that apply to safe use of hand tools often used on and around drill rigs:

- When a tool becomes damaged, either repair it before using it again or discard it.
- When using a hammer, wear safety glasses and require all others around you to wear safety glasses.
- When using a chisel, wear safety glasses and require all others around you to wear safety glasses.
- Keep all tools cleaned and neatly stored when not in use.
- Use wrenches on nuts – do <u>not</u> use pliers on nuts.
- Use screwdrivers with blades that fit the screw slot.
- When using a wrench on a tight nut, first use some penetrating oil, use the largest wrench available that fits the nut, when possible pull on the wrench handle rather than

pushing, and apply force to the wrench with both hands when possible and with both feet firmly placed. Don't push or pull with one or both feet on the drill rig or the side of a mud pit or some other blocking-off device. Always assume that footing may be lost – check the place where a fall could occur for sharp objects.

- Keep all pipe wrenches clean and in good repair. The jaws of pipe wrenches should be wire brushed frequently to prevent an accumulation of dirt and grease that would otherwise build up and cause wrenches to slip.
- Never use pipe wrenches in place of a rod-holding device.
- Replace hook and heel jaws when they become visibly worn.
- When breaking tool joints on the ground or on a drilling platform, position hands so that fingers will not be smashed between the wrench handle and the ground or the platform, should the wrench slip or the joint suddenly let go.

4.3.9.4 Clearing the Work Area

Prior to drilling, perform adequate site clearing and leveling to accommodate the drill rig and supplies and provide a safe working area. Drilling will not be commenced when tree limbs, unstable ground or site obstructions cause unsafe tool handling conditions.

4.3.9.5 Startup

- Instruct all visitors to "stand clear" of the drill rig immediately prior to and during starting of any engine.
- Make sure all gear boxes are in neutral, all hoist levers are disengaged, all hydraulic levers are in the correct non-actuating positions, and the cathead rope is not on the cathead before starting a drill rig engine.
- Start all engines according to the manufacturer's manual.

4.3.9.6 Safety During Drilling Operations

- Safety requires the attention and cooperation of every worker and site visitor.
- Do not drive the drill rig from hole to hole with the mast (derrick) in the raised position.
- Before raising the mast (derrick), look up to check for overhead obstructions. Ensure that slide hammer is secured and that no person places their hands or any part of their body on, in, or near any moving parts.
- Maintain a minimum 15-foot clearance from all overhead electric lines. See U.S. Army Corps of Engineers, EM 385-1-1, Section 11.E for additional guidance on operations adjacent to overhead lines.
- Before raising the mast (derrick), all drill rig personnel (with the exception of the operator) and visitors will be cleared from the areas immediately to the rear and the

sides of the mast. All drill rig personnel and visitors will be informed that the mast is being raised prior to raising it.

- Before the mast (derrick) of a drill rig is raised and drilling is commenced, the drill rig must first be leveled and stabilized with leveling jacks and/or solid cribbing. The drill rig will be re-leveled if it settles after initial setup. Lower the mast (derrick) only when the leveling jacks are down, and do not raise the leveling jack pads until the mast (derrick) is lowered completely.
- Before starting drilling operations, secure and/or lock the mast (derrick) if required according to the drill manufacturer's recommendations.
- The operator of a drill rig will only operate a drill rig from the position of the controls. If the operator of the drill rig must leave the area of the controls, the operator will shift the transmission controlling the rotary drive into neutral and place the feed control lever in neutral. The operator will shut down the drill engine before leaving the vicinity of the drill rig.
- Throwing or dropping tools will not be permitted. All tools will be carefully passed by hand between personnel or a hoist line will be used.
- Do not consume alcoholic beverages or other depressants or chemical stimulants prior to starting work on a drill rig or while on the job.
- When encountering a "hot spot" during drilling operations involving volatiles, vacate the immediate area and allow the borehole to vent. Resume work after monitoring instruments indicate an atmosphere in compliance with the site-specific EHS Plan.
- If it is necessary to drill within an enclosed area, make certain that exhaust gases are vented out of the area. Exhaust gases can be toxic and some cannot be detected by smell.
- Clean mud and grease from boots before mounting a drill platform and use hand holds and railings. Watch for slippery ground when dismounting from the platform.
- During freezing weather, do not touch any metal parts of the drill rig with exposed flesh. Freezing of moist skin to metal can occur almost instantaneously.
- All air and water lines and pumps should be drained when not in use if freezing weather is expected.
- All unattended boreholes must be adequately covered or otherwise protected to prevent drill rig personnel, site visitors or animals from stepping or falling into the hole. All open boreholes will be covered, protected or backfilled adequately and according to local or state regulations upon completion of the drilling project.
- "Horsing around" within the vicinity of the drill rig and tool and supply storage areas is not allowed, even when the drill rig is shut down.

- When using a ladder on a drill rig, face the ladder and grasp either the side rails or the rungs with both hands while ascending or descending. Do not attempt to use one or both hands to carry a tool while on a ladder. Use a hoist line and a tool "bucket" or a safety hook to raise or lower hand tools.
- Use elevated derrick platforms with the following precautions:
  - When working on a derrick platform, use a safety harness and a lifeline. The safety harness will be at least 4 inches (100 millimeters) wide and will fit snugly but comfortably. The lifeline, when attached to the derrick, will be less than 6 feet (2 meters) long. The safety harness and lifeline will be strong enough to withstand the dynamic force of a 250-pound (115 kilograms) weight (contained within the belt) falling 6 feet (2 meters).
  - When climbing to a derrick platform higher than 20 feet (6 meters), use a safety-climbing device.
  - When a rig worker is on a derrick platform, fasten the lifeline to the derrick just above the derrick platform and to a structural member not attached to the platform or to other lines or cables supporting the platform.
  - When a rig worker first arrives at a derrick platform, inspect the platform for broken members, loose connections, and loose tools or other loose materials.
  - Attach tools securely to the platform with safety lines. Do not attach a tool to a line attached to the waist or any other part of the body.
  - When working on a derrick platform, do not guide drill rods or pipe into racks or other supports by taking hold of a moving hoist line or a traveling block.
  - Do not leave loose tools and similar items on the derrick platform or on structural members of the derrick.
  - A derrick platform over 4 feet (1.2 meters) above ground surface will be equipped with toe boards and safety railings in good condition.
  - Workers on the ground or the drilling floor will avoid working under rig workers on elevated platforms, whenever possible.
  - Terminate drilling operations during an electrical storm and move the entire crew away from the drill rig.
  - Do not wear loose clothing, jewelry, watches, or rings around operating drill rigs.

4.3.9.7 Safe Use of Wire Line Hoists, Wire Rope and Hoisting Hardware

- The use of wire line hoists, wire rope, and hoisting hardware will be as stipulated by 29 CFR 1910, 29 CFR 1926, and the American Iron Steel Institute *Wire Rope Users Manual* (American Iron and Steel Institute, 1993).
- Visually inspect all wire ropes and fittings during use and thoroughly inspect them at least once a week for abrasion, broken wires, wear, reduction in rope diameter, reduction in wire diameter, fatigue, corrosion, damage from heat, improper reving, jamming, crushing, bird caging, kinking, core protrusion, and damage to lifting

hardware. Replace wire ropes when inspection indicates excessive damage according to the *Wire Rope Users Manual* (American Iron and Steel Institute, 1993). Thoroughly inspect all wire ropes that have not been used for a period of a month or more before returning them to service.

- End fittings and connections consist of spliced eyes and various manufactured devices. Install all manufactured end fittings and connections according to the manufacturer's instructions and follow the manufacturer's load specifications.
- If a ball-bearing-type hoisting swivel is used to hoist drill rods, inspect and lubricate the swivel daily to assure that the swivel freely rotates under load.
- If a rod slipping device is used to hoist drill rods, do not drill through or rotate drill rods through the slipping device, do not hoist more than 1 foot (0.3 meters) of the drill rod column above the top of the mast (derrick), do not hoist a rod column with loose tool joints and do not make up, tighten or loosen tool joints while the rod column is being supported by a rod slipping device. If drill rods should slip back into the borehole, do not attempt to break the fall of the rods with the hands or by tensioning the slipping device.
- Most sheaves on exploration drill rigs are stationary with a single part line. Never increase the number of parts of line without first consulting the manufacturer of the drill rig.
- Wire ropes must be properly matched with each sheave. If the rope is too large, the sheave will pinch the wire rope; if the rope is too small, it will groove the sheave. Once the sheave is grooved, it will severely pinch and damage larger sized wire ropes.
- The following procedures and precautions must be understood and implemented for safe use of wire ropes and rigging hardware:
  - Use tool-handling hoists only for vertical lifting of tools (except when angle hole drilling). Do not use tool-handling hoists to pull objects away from the drill rig; however, drills may be moved using the main hoist if the wire rope is spooled through proper sheaves according to the manufacturer's recommendations.
  - When stuck tools or similar loads cannot be raised with a hoist, disconnect the hoist line and connect the stuck tools directly to the feed mechanism of the drill. Do not use hydraulic leveling jacks for added pull to the hoist line or the feed mechanism of the drill.
  - When attempting to pull out a mired down vehicle or drill rig carrier, only use a winch on the front or rear of the vehicle and stay as far away as possible from the wire rope. Do not attempt to use tool hoists to pull out a mired down vehicle or drill rig carrier.
  - Minimize shock loading of a wire rope: apply loads smoothly and steadily.
  - Avoid sudden loading in cold weather.
  - Never use frozen ropes.
  - Protect wire rope from sharp corners or edges.

- Replace faulty guides and rollers.
- Replace damaged safety latches on safety hooks before using.
- Know the safe working load of the equipment and tackle being used. Never exceed this limit.
- Inspect and test clutches and brakes of hoists periodically.
- Know and do not exceed the rated capacity of hooks, rings, links, swivels, shackles, and other lifting aids.
- Always wear gloves when handling wire ropes.
- Do not guide wire rope on hoist drums with your hands.
- Following the installation of a new wire rope, first lift a light load to allow the wire rope to adjust.
- Never carry out any hoisting operations when the weather conditions are such that hazards to personnel, the public, or properties are created.
- Never leave a load suspended in the air when the hoist is unattended.
- Keep your hands away from hoists, wire rope, hoisting hooks, sheaves and pinch points as slack is being taken up and when the load is being hoisted.
- Never hoist the load over the head, body or feet of any personnel.
- Never use a hoist line to "ride" up the mast (derrick) of a drill rig.
- Replacement wire ropes should conform to the drill rig manufacturer's specifications.

4.3.9.8 Safe Use of Cathead and Rope Hoists

The following safety procedures will be employed when using a cathead hoist:

- Keep the cathead clean and free of rust and oil and/or grease. Clean the cathead with a wire brush if it becomes rusty.
- Check the cathead periodically, when the engine is not running, for rope wear grooves. Replace the cathead if a rope groove forms to a depth greater than 1/8 inch (3 millimeters).
- Always use a clean, dry, sound rope. A wet or oily rope may "grab" the cathead and cause drill tools or other items to be rapidly hoisted to the top of the mast.
- Should the rope "grab" the cathead or otherwise become tangled in the drum, release the rope and sound an appropriate alarm for all personnel to rapidly back away and stay clear. The operator will also back away and stay clear. If the rope "grabs" the cathead, and tools are hoisted to the sheaves at the top of the mast, the rope will often break, releasing the tools. If the rope does not break, stay clear of the drill rig until the operator cautiously returns to turn off the drill rig engine and appropriate action is taken to release the tools. The operator will keep careful watch on the suspended tools and will quickly back away after turning off the engine.

- The rope will always be protected from contact with all chemicals. Chemicals can cause deterioration of the rope that may not be visibly detectable.
- Never wrap the rope from the cathead (or any other rope, wire rope or cable on the drill rig) around a hand, wrist, arm, foot, ankle, leg or any other part of the body.
- Always maintain a minimum of 18 inches of clearance between the operating hand and the cathead drum when driving samplers, casing or other tools with the cathead and rope methods. Be aware that the rope advances toward the cathead with each hammer blow as the sampler or other drilling tool advances into the ground.
- Never operate a cathead (or perform any other task around a drill rig) with loose unbuttoned or otherwise unfastened clothing or when wearing gloves with large cuffs or loose straps or lacings.
- Do not use a rope that is any longer than necessary. A rope that is too long can form a ground loop or otherwise become entangled with the operator's legs.
- Do not use more rope wraps than are required to hoist a load.
- Do not leave a cathead unattended with the rope wrapped on the drum.
- Position all other hoist lines to prevent contact with the operating cathead rope.
- When using the cathead and rope for driving or back-driving, make sure that all threaded connections are tight and stay as far away as possible from the hammer impact point.
- The cathead operator must be able to operate the cathead standing on a level surface with good, firm footing conditions without distraction or disturbance.

4.3.9.9 Safe Use of Augers

The following general procedures will be used when starting a boring with a continuous flight or hollow-stem augers:

- Prepare to start an auger boring with the drill rig level, the clutch or hydraulic rotation control disengaged, the transmission in low gear, and the engine running at low revolutions per minute.
- Apply an adequate amount of down pressure prior to rotation to seat the auger head below the ground surface.
- Look at the auger head while slowly engaging the clutch or rotation control and starting rotation. Stay clear of the auger.
- Slowly rotate the auger and auger head while continuing to apply down pressure. Keep one hand on the clutch or the rotation control at all times until the auger has penetrated about one foot or more below ground surface.
- If the auger head slides out of alignment, disengage the clutch or hydraulic rotation control and repeat the hole starting process.

- An auger guide can facilitate the starting of a straight hole through hard ground or pavement.
- The operator and tool handler will establish a system of responsibility for the various activities required for auger drilling, such as connecting and disconnecting auger sections, and inserting and removing the auger fork. The operator must assure that the tool handler is well away from the auger column and that the auger fork is removed before starting rotation.
- Only use the manufacturer's recommended method of securing the auger to the power coupling. Do not touch the coupling or the auger with the hands, or a wrench or any other tools during rotation.
- Whenever possible, use tool hoists to handle auger sections.
- Never place hands or fingers under the bottom of an auger section when hoisting the auger over other auger sections or other hard surfaces such as the drill rig platform.
- Never allow feet to get under the auger section being hoisted.
- When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason whatsoever. The client requires all augers to be protected by a cage.
- Use a long-handled shovel to move auger cuttings away from the auger. Never use the hands or feet to move cuttings away from the auger.
- Do not attempt to remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating.

4.3.9.10 Safety During Rotary and Core Drilling

- Rotary drilling tools will be safety checked prior to drilling:
  - Lubricate and check water swivels and hoisting plugs for "frozen" bearings before use. Use only approved lubrication fluids.
  - Check drill rod chuck jaws periodically and replace when necessary.
  - Check the capacities of hoists and sheaves against the anticipated weight to the drill rod string plus other expected hoisting loads.
- Special precautions for safe rotary or core drilling involve chucking, joint break, hoisting, and lowering of drill rods:
  - Only the operator of the drill rig will brake or set a manual chuck so that rotation of the chuck will not occur prior to removing the wrench from the chuck.
  - Do not brake drill rods during lowering into the hole with drill rod chuck jaws.
  - Do not hold or lower drill rods into the hole with pipe wrenches.
  - If a string of drill rods is accidentally or inadvertently released into the hole, do not attempt to grab the falling rods with your hands or a wrench.

- In the event of a plugged bit or other circulation blockage, relieve or bleed down the high pressure in the piping and hose between the pump and the obstruction before breaking the first tool joint.
- When drill rods are hoisted from the hole, they will be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use the hands to clean drilling fluids from drill rods.
- If work must progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit will be equipped with rough surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- Do not lean unsecured drill rods against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.

4.3.9.11 Engines and Pumps

The following engine and pump stop devices are as follows:

- For an internal-combustion engine: an ignition or grounding switch
- For a diesel engine: a quick-closing valve or equivalent device that will shut off the air to the air-intake manifold of the engine and prevent entry of gas-laden air, or a means of releasing the engine compression that will not produce an open flame or spark
- For an electric motor: a suitable switch in the motor circuit, or a switch or stop button in the control circuit approved for the location in which it is installed

Mud pumps will be equipped with a pressure-relieving device set to release within the limits of the safe working pressure of the pump. Such devices include direct spring-loaded safety valves, shear-pin safety valves, and rupture disks. There will be no valve between the pump and its pressure-relieving device. The point of discharge from a pressure-relieving device will be located where employees are not endangered by the discharge of fluids. Each pump will be equipped with bleeder valves. All personnel involved in the operation of the rig will know the exact location of each stop device.

4.3.9.12 Safety During Travel

The individual who transports a drill rig on and off a drilling site will:

- Be properly licensed and will only operate the vehicle according to federal, state, and local regulations.
- Know the traveling height (overhead clearance), width, length, and weight of the drill rig with carrier and know the highway and bridge load, width, and overhead limits,

making sure that these limits are not exceeded and allowing an adequate margin of safety.

- Never move a drill rig, unless the vehicle brakes are in sound working order.
- Allow for mast overhang when cornering or approaching other vehicles or structures.
- Be aware that the canopies of service stations and motels are often too low for a drill rig mast to clear with the mast in the travel position.
- Watch for low-hanging electrical lines, particularly at the entrances to drilling sites or restaurants, motels or other commercial sites.
- Never travel on a street, road, highway with the mast (derrick) of the drill rig in the raised or partially raised position. Never travel with the mast raised at any job site, unless the path of travel is short and there are no overhead obstructions of nearby power lines.
- Remove all ignition keys when a drill rig is left unattended.

4.3.9.13 Off-Road Movement

The following safety precautions relating to off-road movement will be followed:

- Before moving a drill rig, first walk the route of travel, inspecting for depressions, stumps, gullies, ruts, and similar obstacles.
- Always check the brakes of a drill rig carrier before traveling, particularly on rough, uneven or hilly ground.
- Check the complete drive train of a carrier at least weekly for loose or damaged bolts, nuts, studs, shafts, and mountings.
- Discharge all passengers before moving a drill rig on rough or hilly terrain.
- Engage the front axle (for 4x4 and 6x6 vehicles or carriers) when traveling off highway on hilly terrain.
- Use caution when traveling a side-hill. Conservatively evaluate side-hill capability of drill rigs, because the arbitrary addition of drilling tools may raise the center of gravity. When possible, travel directly uphill or downhill. Increase tire pressures before traveling in hilly terrain (do not exceed rated tire pressure).
- Attempt to cross obstacles such as small logs and small erosion channels or ditches squarely, not at an angle.
- Use the assistance of someone on the ground as a guide when lateral or overhead clearance is close.
- After the drill rig has been moved to a new drilling site, set all brakes and/or locks and block wheels.
- Never travel off-road with the mast (derrick) of the drill rig in the raised or partially raised position.

4.3.9.14 Tires, Batteries, and Fuel

Tires on the drill rig must be checked daily for safety and during extended travel for loss of air and they must be maintained and/or repaired in a safe manner. If tires are deflated to reduce ground pressure for movement on soft ground, the tires should be reinflated to normal pressures before movement on firm or hilly ground or on streets, roads, and highways. Under-inflated tires are not as stable on firm ground as properly inflated tires. Air pressures will be maintained for travel on streets, roads, and highways according to the manufacturer's recommendations. During air pressure checks, inspect for:

- Missing or loose wheel lugs
- Objects wedged between dual tires or embedded in the tire casing
- Damaged or poorly fitting rims or rim flanges
- Abnormal or uneven wear and cuts, breaks or tears in the casing

The repair of truck and off-highway tires will only be made with required special tools following the recommendations of a tire manufacturer's repair manual. If they are split-rim tires, repairs will be performed using an appropriate tire cage device.

Batteries contain strong acid. Use the following precautions when servicing batteries:

- Batteries will only be serviced in a ventilated area while wearing safety glasses.
- When a battery is removed from a vehicle or service unit, disconnect the battery ground clamp first.
- When installing a battery, connect the battery ground clamp last.
- When charging a battery with a battery charger, turn off the power source to the battery before either connecting or disconnecting charger leads to the battery posts. Loosen cell caps prior to charging to permit the escape of gas.
- Spilled battery acid can burn the skin and damage the eyes. Spilled battery acid will be immediately flushed off your skin with lots of water. Should battery acid get into someone's eyes, flush immediately with large amounts of water and see a physician at once.
- To avoid battery explosions, keep the cells filled with electrolyte, use a flashlight (not an open flame) to check electrolyte levels, and avoid creating sparks around the battery by shorting across a battery terminal. Keep lighted smoking materials and flames away from batteries.

The following special precautions must be taken for handling fuel and refueling the drill rig or carrier:

- Only use the type and quality of fuel recommended by the engine manufacturer.

- Refuel in a well-ventilated area.
- Do not fill fuel tanks while the engine is running. Turn off all electrical switches.
- Do not spill fuel on hot surfaces. Clean any spillage before starting an engine.
- Wipe up spilled fuel with cotton rags or cloths – do not use wool or metallic cloth.
- Keep open lights, lighted smoking materials, and flames or sparking equipment well away from the fueling area.
- Turn off heaters in carrier cabs when refueling the carrier or the drill rig.
- To allow for expansion of the fuel during temperature changes, do not fill portable fuel containers completely full.
- Keep the fuel nozzle in contact with the tank being filled to prevent static sparks from igniting the fuel.
- Do not transport portable fuel containers in the vehicle or carrier cab with personnel.
- Fuel containers and hoses will remain in contact with a metal surface during travel to prevent the buildup of static charge.

4.3.9.15 Drill Rig Utilization and Alterations

Do not attempt to exceed manufacturer's ratings of speed, force, torque, pressure, flow, and so forth. Only use the drill rig and tools for the purposes for which they are intended and designed.

Alterations to a drill rig or drilling tools will only be made by qualified personnel and only after consultation with the manufacturer.

4.3.9.16 Overhead Electrical Hazards

Overhead power lines may present a hazard to equipment and personnel. To prevent equipment contact with power lines and to prevent arcing, adequate clearance must be maintained. For lines rated 50 kilovolts (kV) or below, the minimum clearance between the lines and any part of the crane or load will be 10 feet. For lines rated more than 50 kV, the minimum clearance between the lines and any part of the crane or load will be 10 feet plus 0.4 inch for each kV more than 50 kV. TtEC requires a minimum clearance of 15 feet.

This page intentionally left blank

5.0 ACTIVITY HAZARD ANALYSES

An AHA is developed for each planned activity and operation occurring in each major phase of work. This AHA identifies the sequence of work, specific hazards anticipated, and the control measures to be implemented to minimize or eliminate each hazard. This AHA is used to augment daily safety meetings intended to heighten safety and hazard awareness on the job. This pre-task briefing will be documented and may be combined with the daily tailgate safety meeting. AHAs are the focal point for safe conduct of work on a project. Since each task is described and evaluated, workers should be better prepared to perform work safely. In summary, the AHA will be covered during the Preparatory Phase Meeting of all definable tasks in the planned work. This will be documented in the Daily CQC Report as having been covered in the preparatory inspection meeting.

The SHSS will discuss the risks and precautions associated with each task identified in the Work Plan. Daily "tailgate" safety meetings are held at the start of each shift. Prior to the day's activity, the safety meeting discusses the potential chemical, physical, and environmental hazards, and preventive safety measures. During a work day, if there are any changes or new conditions, the SHSS will ensure that the AHA is updated and that workers review the amended AHA. Attendance is mandatory for all employees involved in the specific work. Amended AHAs must be reviewed by the PESM. If a change must be implemented immediately, and the PESM cannot be contacted, the SHSS may implement the change and forward a copy of the change to the PESM as soon as possible and leave a voice mail phone message for the PESM.

If there are changes required due to changing conditions or requirements, the SHSP may be modified by using the change form attached to the SHSP and by obtaining the approval of the PjM or Site Superintendent, the SHSS, and the PESM.

This page intentionally left blank.

6.0 PERSONAL PROTECTIVE EQUIPMENT

PPE for site workers is selected and used based upon the existing and potential hazards anticipated and the requirements of 29 CFR, Part 1910.120 (8 CCR, Section 5192). Different levels of personal protection will be provided to workers depending on specific work tasks performed. The selection of PPE requires an evaluation of chemical contaminants, concentrations of these chemical contaminants, and physical hazards that may be encountered.

This SHSP complies with 29 CFR, Part 1910.132 (8 CCR, Sections 3380 through 3390), which states that all PPE for eyes, face, head, and extremities, protective clothing, respiratory protection devices, and protective shields and barriers will be provided, used, and maintained in a sanitary and reliable condition. PPE is required wherever it is necessary by reason of hazards from processes or environment, chemical hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation, or physical contact.

Respiratory protection is of primary importance in the protection of employee health since inhalation of air contaminants is a potential major route of exposure. The TtEC respiratory protection program is administered pursuant to the requirements established by 29 CFR, Part 1910.134 (8 CCR, Section 5144). The SHSS is assigned responsibility as the Respirator Program Administrator for the project. Selection, use, and maintenance of PPE at the project will be in accordance with EHS Procedure 5-1, PPE, and EHS Procedure 5-2, Respiratory Protection. The SHSS may upgrade or downgrade the level of protection based on the hazard anticipated, evaluation of site monitoring data, and established action levels by the SHSP and with the concurrence of the PESM.

The U.S. Environmental Protection Agency Level categories are as follows:

- ***Level A***: Used when the greatest level of skin, eye, and respiratory protection is needed and consists of a totally encapsulated suit with supplied breathing air.
- ***Level B***: Used when the highest level of respiratory protection is needed but a lesser level (than Level A encapsulated suit) of skin protection is required.
- ***Level C***: Used when criteria for using air-purifying respirators are met and a lesser level of skin protection is required.
- ***Level D***: Used only as a work uniform and in an area without respiratory hazards.

Level D protection is used during site reconnaissance, mobilization, geophysical survey, baseline surveying, and other activities that have no potential for exposure to chemical hazards. PPE for Level D includes:

- Coveralls, cotton and/or disposable (where coveralls are not worn, work pants with a long-sleeve shirt).
- Boots, leather or rubber, steel toe and shank, non-slip soles
- Rubber overboots or disposable booties (as required)
- Safety glasses or goggles, face shield when handling liquids
- Hard hat
- Gloves as required by task (leather work gloves)
- Hearing protection (as required)

Level C protection may be used during Resource Conservation and Recovery Act (RCRA) and non-RCRA drilling, sampling, temporary storage, loading, backfilling and compaction, decontamination of equipment, and other activities where there is a potential for chemical exposure at or above action levels. If air monitoring information or visible contamination indicates that protection is required, PPE for Level C includes:

- Full facepiece air purifying respirator (APR)
- National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA)-approved air purifying respirator cartridges (approved for use with the specific types of contaminants)
- Emergency escape respirator (optional, depending on the potential for emergency conditions)
- Coveralls (inner), cotton
- Coveralls (outer), chemical-resistant, disposable (Tyvek®)
- Gloves (outer), chemical-resistant (nitrile)
- Gloves (inner), cotton or nitrile
- Boots, chemical-resistant, rubber, with steel toe and shank, or leather, with steel toe and shank, with chemically resistant rubber overboot, non-slip soles
- Hard hat
- Hearing protection (optional or as required)

Level B protection is selected and implemented when it is determined through real-time air monitoring and/or personnel sampling that the highest level of respiratory protection is necessary for site personnel. This level of protection is also used when the atmospheric contaminant(s) identified does not meet the selection criteria permitting the use of air purifying respirators or when contaminants are unknown. If unknown containers are encountered, the removal and handling of these containers will require the use of Level B protection.

PPE for Level B includes:

- Pressure-demand, self-contained breathing apparatus (SCBA) or airline respirator (with attached 5-minute escape bottle)
- Coveralls (inner), cotton
- Coveralls (outer), chemical-resistant, disposable (Tyvek®)
- Gloves (outer), chemical-resistant (nitrile)
- Gloves (inner), nitrile
- Boots, chemical-resistant, rubber, with steel toe and shank, or leather, with steel toe and shank, with chemically resistant rubber overboot, non-slip soles
- Hard hat
- Hearing protection (optional or as required).

Subcontractors are responsible for supplying and maintaining their own PPE according to the manufacturers' procedures and guidelines and their own policies and procedures, which must be at least as protective as required by regulations and these procedures.

This project requires the use of either Level D or Level C protection. Level B protection will be required when working with unknown containers and when atmospheric contaminants are unknown. Table C.6-1 lists the required PPE for tasks proposed for this project. With each level of protection, there is a degree of variability or modification dependent on the specific tasks and the nature and concentration of contaminants. For example, different tasks on the same site may require gloves of different materials, length, or thickness. Variations of a level of protection will be indicated by a qualifier ("Modified Level D") and specify the modification required. Level C and B work will always require the implementation of a heat stress monitoring program as described in this plan and in TtEC EHS Procedure 4-6, Temperature Extremes.

For site work under this contract, TtEC or subcontractors will maintain protective equipment on site for use by government visitors as specified in the contract.

The PPE required for each task on this project is listed in Table C.6-1, Personal Protective Equipment. This table is prepared based on data provided prior to the start of the project. As additional testing, monitoring, and background information become available, the SHSS may adjust the action levels and PPE accordingly. Any changes to PPE require approval by the PESM. PPE levels were selected based on the presumption that there are low-level contaminants associated with PAHs.

This page intentionally left blank.

7.0 AIR, NOISE, AND OTHER MONITORING

The SHSS will conduct monitoring to ensure that each site worker is adequately protected. Site monitoring and sampling includes personal air sampling, real-time air monitoring, perimeter monitoring, noise monitoring, and heat stress monitoring.

The SHSS will have experience using the required monitoring or sampling equipment. The PESM will ensure that each SHSS is qualified to operate all assigned instruments. The SHSS will ensure that each piece of equipment is properly maintained and calibrated.

Personal sampling requirements are based on potential airborne hazards and OSHA requirements. At this time personal air sampling is not anticipated. However, if the CIH determines that personal sampling is required, the CIH will develop a personal monitoring strategy and protocol. Personal sampling methods will be in accordance with NIOSH methods, OSHA instructions, or good industrial hygiene practice when established methods are not available or feasible. A laboratory accredited by the American Industrial Hygiene Association will conduct all laboratory analysis of industrial hygiene samples. Results will be compared to the ACGIH TLVs or OSHA Permissible Exposure Limits (PELs), whichever is more stringent. Results will be communicated to employees in accordance with OSHA requirements. All exposure records will be kept in accordance with 29 CFR, Part 1910.20 (8 CCR, Section 3204).

Ambient air monitoring will be conducted during drilling and soil sampling operations to determine airborne contamination levels.

7.1 DIRECT READING INSTRUMENTS

7.1.1 Photoionization Detector

A photoionization detector (PID) and/or a flame ionization detector (FID) will be used to determine the presence and concentration of organic vapors. Contaminants such as the volatile petroleum hydrocarbons and benzene are detectable with PID. The FID would be required to detect some halogenated hydrocarbons.

Instrument:	PID/FID
Action Level:	10 parts per million (ppm) in breathing zone
Action:	Stop work; notify PESM. Notify project contact person.

7.1.2 Combustible Gas Meter/Oxygen/Carbon Monoxide/Hydrogen Sulfide Meter

A multi-sensor meter will be used to screen for the presence of flammable vapors, oxygen (O_2)-deficient and oxygen-enriched atmospheres, carbon monoxide (CO), and hydrogen sulfide.

If flammable vapors are at ten percent lower explosive limit (LEL) or greater, work will cease and the area allowed to vent. If O_2 levels below 20.8 percent or above 22 percent are encountered, personnel will leave the area and the area will be ventilated.

Instrument:	Multi-sensor Gas Meter
Action Level:	10 percent ≥ LEL, <20.8 percent O_2 or >22 percent O_2
Action:	Stop work, allow area to ventilate. Notify PESM.
Sensor:	Hydrogen Sulfide
Action Level:	5 ppm. At no time can level exceed 20 ppm.
Action:	Stop work, ventilate, and notify PESM.
Sensor:	Carbon Monoxide
Action Level:	10 ppm.
Action:	Stop work, ventilate, and notify PESM.

7.1.3 Particulate Monitor

A MiniRam Monitor Model PDM-3 or equivalent will be used to measure respirable airborne particulates between 0.1 to 10 micrometers in size. The MiniRam will be used as an indicator of total ambient dust in the work area and will serve to monitor when additional dust control is required. Worst case scenarios can be assessed for the purpose of establishing a total dust action level by utilizing half of the TLV as the action level.

Instrument:	MiniRam Aerosol Monitor Model PDM-3 or equivalent
Action Level:	1.5 milligrams per cubic meter (mg/m^3) for work areas 0.5 mg/m^3 in areas where soil contaminated with lead is greater than 1,000 milligrams per kilograms 0.5 mg/m^3 for perimeter of work area (level chosen to minimize overall permissible dust release from site)
Action:	Implement dust control procedures.

If dust cannot be reduced below the specified concentration, respiratory protection will be required that will consist of a full-face air purifying respirator and P-100 cartridges.

7.1.4 Noise Monitoring

A noise survey meter will be used to measure the noise levels in the work area and at the work perimeter. The results will be recorded in the logbook. Workers will adhere to procedures found in TtEC procedure EHS 4-4, Hearing Conservation Program. Employees will use hearing protective plugs or muffs whenever levels are greater than 84 dBA. Levels consistently over

85 dBA will be reported to the PESM to determine if additional monitoring with dosimetry equipment will be conducted and additional noise controls will be instituted.

7.1.5 Heat Stress

Heat stress monitoring is used in estimating work loads and establishing work/rest times, based on 1) Wet Bulb Globe Temperature instrumentation and calculations, 2) monitoring physiological conditions and adjusting work/rest periods, or 3) using personnel heat stress monitors. Attachment 3 of TtEC EHS Procedure EHS 4-6, Temperature Extremes, describes the monitoring procedures in detail. Heat stress evaluation and monitoring will be performed for all work requiring impermeable clothing (coveralls) for level C and B protection.

7.2 MONITORING STRATEGY

7.2.1 Personnel

Background levels will be measured with the PID before any work commences. Monitoring of the area will begin by taking background readings. The PID will be used wherever odors are detected and will continue to be used until odors can no longer be detected and organic vapor levels are below 5 ppm. The SHSS, in consultation with the PESM, will determine if further actions and/or measurements are warranted to prevent or minimize exposure of personnel. It is essential that odors and measurable levels of organic vapors be limited to the EZ. Similarly, assess suspected contamination by approaching from a safe area to the area of concern.

The multi-sensor gas meter will be used continuously during excavation to ensure that there are not any unexpected flammable vapors or gases or toxic gases. Personal sampling will follow an monitoring plan developed by the CIH. At least one MiniRAM will be positioned in the immediate work area during all drilling activities.

7.2.2 Perimeter

Dust levels will be monitored with the MiniRAM at the perimeter of the site, downwind of active excavation or backfilling work. All levels above background will be immediately reported to the PESM, who will evaluate the results.

7.3 QUALITY ASSURANCE/QUALITY CONTROL

Adherence to a proper quality assurance/quality control (QA/QC) plan is essential for a meaningful air sampling effort. The major concerns of a QA/QC plan are calibration of equipment and document control.

7.3.1 Calibration and Maintenance Procedures

All direct reading instruments will be calibrated daily, or before and after each use following manufacturers' directions found in the instruction manuals included with the instruments.

Calibration records will be kept detailing date, time, span gas, or other standard and the name of the person performing the calibration. The calibration gas for the PID is isobutylene. The SHSS will ensure that the instrument is kept clean and will follow manufacturer's directions for keeping the lamp clean. The SHSS will not perform any other maintenance procedures unless approved by the PESM.

The calibration gas for the multi-sensor gas meter is usually a methane/air or a hexane/air mixture. O_2 is calibrated against normal air in a clean environment. A low O_2 calibration gas can be used for calibrating the response of the O_2 sensor. Often, 100 percent nitrogen is used to "zero" the O_2 sensor. For purposes of this plan, calibration of the explosimeter means a daily field check with known calibration gases. The reading on the instrument must be within 3 percent of the stated value of the gas. If it is not, then formal calibration of the instrument must follow the manufacturer's calibration procedure.

The miniRAM requires factory calibration annually. It cannot be field calibrated. However, the zero value of the instrument must be checked daily. If the zero value exceeds the manufacturer's recommended value, the instrument must be cleaned. The instrument's zero is reset by following the manufacturer's instructions.

Specific instructions for the collection of any personal air samples will be provided by the CIH to the SHSS.

7.3.2 Documentation

Strict adherence to document and data control procedures is essential for good QA/QC. Data and calibration records must be accounted for and retrievable at all times. Types of documents that are essential include notes, logbooks, maps, data sheets, equipment calibration logs, and reports. These must be placed in the project files. Copies of all field data reports and personal sampling records will be sent to the PESM for review.

The SHSS will ensure that all data is documented in logs or logbooks including calibration, types of calibrants used, the manufacturer, model number of instruments used, the date and time of calibration and monitoring events, the area or personnel monitored, the atmospheric conditions and weather, unique site conditions, equipment operating in area, initials of individuals performing the monitoring, and any other information that affects the data or the actions taken based on the data.

8.0 SITE CONTROL

The PjM, Site Superintendent, and the SHSS will implement site control measures at each site. These measures will consist of general site control and specific work location site control.

General site control measures pertain to the overall site and may include the use of security guards, perimeter fencing, sirens, posting of warning signs, and illumination. These control measures are geared toward visitors and the general public. The Site Superintendent and the SHSS implement control measures as necessary.

Location-specific control measures are designed to control contamination and worker entrance and exit from individual work areas. Prior to the commencement of any on-site work, controlled zones of activity will be established by the SHSS. No person will be allowed on the site without a briefing regarding the site hazards. This briefing must be documented and signed by the person receiving the briefing. This will reduce the spread of contamination to off-site areas and protect the health and safety of workers. The controlled zones will be included in one of the following categories: 1) EZ—where contamination does or could occur, 2) contamination reduction zone—where decontamination will occur, and 3) support zone—clean zone outside the contamination reduction zone. Each work zone will be clearly identified and delineated by cones, rope, fences, signs, or barricades. The SHSS will maintain a site entry log for each site that documents each person entering a work zone. The logs will be kept in the project files.

8.1 EXCLUSION ZONE

The EZ may include all areas within the boundaries of a contaminated work area or merely the areas immediately surrounding the site of intrusive activity. Access points are provided to the EZ, and all personnel entering an EZ must sign in and sign out from each site. During activities where the possibility of airborne contaminants being carried outside the EZ exists, the EZ will be expanded to include areas of possible contamination. Only designated project team members and authorized government agency personnel will be allowed in the EZ. All personnel entering the EZ must wear the appropriate level of protection designated for the work area. Personnel must also meet medical surveillance requirements, training requirements, and respirator fit test requirements. All personnel exiting the EZ must be fully decontaminated in the contamination reduction zone.

8.2 CONTAMINATION REDUCTION ZONE

All personnel and equipment that may have been contaminated in the EZ will be subject to decontamination in the contamination reduction zone. Temporary or field decontamination stations for personnel and equipment will also be located in the contamination reduction zone as needed. The contamination reduction zone is intended to be a buffer between the EZ and the support zone and will be designed to prevent the transfer of contaminants from the EZ to the support zone and off site. Within this zone is usually located a Contamination Reduction Corridor (CRC). In the CRC, workers will find decontamination equipment, supplies, and stations.

8.2.1 Decontamination Procedures

Personal hygiene practices on this project are essential, as there is a possibility for exposure to biological contaminants. At a minimum, site workers will be provided with adequate restroom and hand washing facilities. Workers are required to wash exposed areas of the skin (hands, arms, and face) upon exiting potentially contaminated areas. Smoking, eating, or drinking will not be allowed in EZ or contamination reduction zone work areas. Smoking is allowed only in designated areas.

The SHSS is responsible for the functional activities of the decontamination facilities. The SHSS will train site personnel in the steps used for decontamination. The SHSS will periodically inspect for compliance with decontamination procedures and correct any deficiencies.

Separate areas will be designated for equipment decontamination and personnel decontamination. These areas will be separated to minimize contamination of the personnel in the contamination reduction zone by overspray from equipment decontamination.

8.2.2 Personnel Decontamination

Personnel departing the EZ are required to proceed through a decontamination line. The following decontamination procedure is an example and will be modified as needed for each specific excavation/backfill location:

- **Facility 1**—Segregated Equipment Drop: Drop equipment onto plastic liner or shelf.
- **Facility 2**—Boot Cover Wash/Rinse and Removal: Wash and rinse outer boot covers with detergent and water. Remove boot covers and discard into proper container for disposal.
- **Facility 3**—Boot Wash/Rinse, Outer Suit Wash/Rinse and Removal: Wash and rinse protective suits. Wash and rinse safety boots. Remove and discard outer suit and place into disposal containers.
- **Facility 4**—Outer Glove Wash/Rinse and Removal: Wash and rinse outer gloves. Remove and discard into disposal container, leaving inner gloves on.
- **Facility 5**—Respirator Removal: Decontaminate, remove, and sanitize respirator and backpack assembly. Place on the table.
- **Facility 6**—Remove Boots and Inner Gloves: Remove boots, then inner gloves and discard inner gloves.
- **Facility 7**—Field Wash: Wash hands, arms, and face with water.

In case of an emergency, gross decontamination procedures will be implemented and the person will be transported to the nearest medical facility immediately at the direction of the SHSS according to the Site Emergency Response Plan (see Section 12.0). The medical facility will be informed that the injured person is on the way and has not been fully decontaminated. The medical facilities will be notified of the potential chemicals present and of the exposure-prevention measures that can be used while treating the victim.

A commercial vendor may launder reusable protective clothing (cotton overalls). If the coveralls are contaminated with a hazardous waste, the vendor will be notified in writing of the type of waste.

8.2.3 Equipment Decontamination

Heavy equipment, PPE, monitoring equipment, and sampling equipment may require decontamination. Procedures may be modified based on actual site conditions. Depending on the nature of the contaminant, seats and flooring of equipment and vehicles entering an EZ may need to be covered with disposable plastic such as polyethylene.

Decontamination of heavy equipment (including under carriage, chassis, and cab) will be performed using a high-pressure washer sprayer, and/or steam cleaner and may include appropriate biodegradable solvents. All equipment will be decontaminated on a pre-constructed decontamination pad designed to collect and store washings. The equipment will first be sprayed and scrubbed with water (and a low-sudsing detergent as required). Secondly, the equipment will be rinsed with water. If persistent contamination exists after cleaning based on visual assessment, other cleaning methods may be necessary. Air filters on equipment used in the EZ will be removed and disposed of with the materials used for decontamination if warranted. Depending on the contaminants, a simple scraping and brushing off of the equipment may be acceptable.

Outer PPE (such as protective suits, boot covers, and outer gloves) will be washed and rinsed with trisodium phosphate and water if reuse is anticipated. These items will all be discarded at the end of the day. If they have become grossly contaminated during work operations, they will be changed as necessary during the day. Respirators will be sanitized by rinsing in a germicidal rinse followed by a clean water rinse, then air-drying in a clean area.

Each person will be responsible for the decontamination of his or her own respirators at the end of each shift.

Reasonable precautions will be taken to minimize monitoring equipment contamination. Decontamination will be accomplished using materials that will not damage the instrument(s). Delicate air-monitoring and surveying equipment will be wiped off with alcohol or soap and water and protected from contamination when in use.

Sampling equipment used for chemical tests will be cleaned following procedures specified in the Sampling Analysis Plan.

If decontamination pads are used, they will be constructed to facilitate containment and collection of all potentially contaminated water and decontamination fluids. The waste liquids will be transferred to appropriate drums, holding facilities, or waste systems. All PPE wastes generated will be bagged, labeled, and stored for off-site disposal or incorporation into other waste materials. TtEC will store waste in a manner and in an area designated by the facility. In no case will storage exceed 90 days from the start date of accumulation of the waste. Some facilities require that storage not exceed a period 45 days. Each PjM will ensure that the specific requirements of the facility are followed.

8.3 SUPPORT ZONE

The support zone will be arranged considering accessibility, utility availability, wind direction, and line-of-sight to work. Included in this area will be the main office, (Building 112), administration area, vehicle parking, security, toilets, water, electricity, and a break/lunch area. The support zone will be outside the contamination reduction zone and will be the area where support workers will provide assistance to workers inside the EZ and contamination reduction zone. The support zone normally will begin at the exit from the decontamination line. Only clean or appropriately containerized equipment, material or personnel can enter the support zone from the contamination reduction zone.

9.0 MEDICAL SURVEILLANCE PROCEDURES

TtEC requires that site workers participate in a medical surveillance program that meets the requirements of 29 CFR, Part 1910.120(f) (8 CCR, Section 5192). The medical surveillance program, managed by the TtEC medical consultant (WorkCare®, Dr. Peter Greaney, American Board of Preventive Medicine-Occupational Medicine), will be instituted for the following employees:

- All employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year
- All employees who wear a respirator for 30 days or more a year or as required by 29 CFR, Part 1910.134 (8 CCR, Section 5144)
- All employees who are injured, become ill, or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation

9.1 BASELINE PHYSICAL EXAMINATION PROTOCOL

All employees who are expected to participate in on-site activities where they are potentially exposed to health or safety hazards and/or will wear respiratory protection will be required to complete a baseline physical examination. The contents of the baseline physical examination are outlined as follows:

A. A completed medical, occupational, and smoking history questionnaire with an emphasis on the following systems: nervous, skin, lung, blood-forming, cardiovascular, gastrointestinal, reproductive, as well as ears, nose, and throat. The examinee is required to fast for 8 hours, abstain from alcohol for three days before this examination, and avoid high noise exposure for 14 hours before the examination.

B. A complete physical exam, including the following, at a minimum:

1. Height, weight, temperature, pulse, respiration, and blood pressure
2. Head, nose, and throat
3. Eyes (Snellen)
4. Ears (with audiometric testing in accordance with 29 CFR 1910.95)
5. Chest (heart and lungs)
6. Peripheral vascular system
7. Abdomen (liver, spleen, kidney)
8. Musculoskeletal system

9. Genitourinary system
10. Nervous system

C. Completed tests, including at least the following, at a minimum:

1. Complete blood counts and chemistries including the following:
   a. White blood cell, differential cell, and platelet counts
   b. Hemoglobin and/or hematocrit
   c. Albumin, globulin, total protein, and total bilirubin
   d. Serum glutamic oxalacetic transaminase and serum glutamic-pyruvic transaminase
   e. Lactic dehydrogenase
   f. Alkaline phosphatase and Gamma Glutamine Trans Peptidase
   g. Calcium
   h. Phosphorous
   i. Uric acid
   j. Creatinine
   k. Urea nitrogen
   l. Cholesterol and triglycerides
   m. Glucose

2. Urinalysis (clean catch), including the following:
   a. Color and character
   b. Specific gravity
   c. pH
   d. Protein
   e. Acetone
   f. Glucose
   g. Microscopic examination
3. Chest x-ray (14- by 17-inch post-anterior and lateral performed for the baseline exam).
4. Pulmonary function test to include, at a minimum, the following:
   a. Forced Vital Capacity (FVC)
   b. Forced Expiratory Volume, one second (FEV10)
   c. The FEV10 FVC ratio
   d. A minimum of three good tracings
5. 12-lead resting echocardiogram

9.2 MEDICAL CLEARANCE

All workers who must enter EZs or who meet the criteria listed above must provide the SHSS with a written opinion from a licensed physician attesting to the employee's fitness for duty at a hazardous waste site. A physician's written opinion of the employee's ability to wear a respirator will also be required when there is reasonable possibility that a respirator may be required for site work. The physician's written opinion must be dated within the previous 12-month period, or an alternate time period as determined by the physician, for continued work. There are no additional specific medical surveillance requirements for this project.

9.3 RECORDKEEPING

The SHSS will maintain a file for each person on site. This file will have a copy of the physician's statement of employee's fitness for duty, the employee's ability to wear a respirator, and if there are any work restrictions. The SHSS will ensure that the employee and project supervisors comply with medical work restrictions, if any. The SHSS will also ask each employee to complete a form to indicate any known allergies, prescription medications, and any other medical information that will allow the SHSS to respond to any medical emergency in an appropriate manner. Personnel will notify the SHSS regarding any medications, including over-the-counter, they are using on each day of work. The SHSS in consultation with the PESM and/or a medical consultant will determine if any medications affect a worker that would impair the ability of the worker to perform work safely. At no time will the SHSS maintain the copy of any actual medical records. These records are maintained by the TtEC medical consultant.

This page intentionally left blank.

10.0 SAFETY CONSIDERATIONS

All workers must comply with the TtEC Project Rules Handbook, Volume I and Volume II. The following are some of these rules:

The following practices will be expressly forbidden during field operations:

- Entrance onto the site or into designated restricted area(s) without formal authorization, compliance with medical monitoring and training requirements, and/or compliance with this SHSP.
- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material in any area designated as contaminated.
- Approach or entries into areas or spaces where toxic or explosive concentrations of gases, vapors, or dusts exist without prior approval of the SHSS and/or use of PPE.
- Facial hair, which interferes with the satisfactory fit of the mask-to-face seal of respirators, is prohibited for personnel required wearing respiratory protection equipment.
- The use/wearing of personal headphones. Their use may preclude reception of audible warning signals and/or hazard communication. Also, cell phones cannot be used during work hours unless an employee is on break or the cell phone is used only for job-related purposes. Cell phones will not be used at any time workers are driving or operating any equipment or using any tools or mechanical devices.

The following practices are required:

- Personnel and equipment in the contaminated area will be minimized, consistent with effective site operations.
- Equipment will be bonded and grounded, spark-proof and explosion-resistant, as appropriate to minimize or prevent the ignition or flammable materials in the work zone.
- A minimum of two employees, in constant communication (either visual or voice) with each other, will be required to perform any work within the EZ.

10.1 VEHICLE AND EQUIPMENT OPERATIONS

Prior to the use of all vehicles and equipment, operators will conduct a safety inspection and record the findings in the Safety Inspection Equipment Checklist. Dust suppressants will be used to the extent possible for controlling airborne dust generation to the extent possible. In addition, vehicular traffic speed on non-paved roads will be restricted to 15 miles per hour. Motor vehicles and material handling equipment assigned to this site will conform to the requirements of 29

CFR, Parts 1926.601, and 1926.602 (8 CCR, Sections 1590 through 1596). Crews using personnel transport vehicles to and from the work site will use the vehicle's safety belts. Drivers of vehicles will be responsible for passenger use of the safety belts. Personnel are not allowed to ride in the bed of pickup trucks, unless there is an approved restraint system installed and used. The Site Superintendent is responsible for maintaining a clean job site, free from hazards, and for providing safe access and egress from the site. Traffic cones and/or high-visibility barrier tape will be used, where appropriate, for traffic control into/out of hazardous or restricted areas. Personnel will wear reflective, high-visibility safety vests or clothing whenever working in and around vehicles and on all roads and on all job sites.

Other requirements include the following:

- Whenever the operator leaves the operator's position, the equipment will be turned off, unless the equipment must be kept running to perform required maintenance or safety inspection (in which case, the operator will ensure that the equipment cannot move by placing equipment in "park," by setting the emergency brake or another type of brake, or by placing blades or pans to the ground or any other manufacturer-recommended method to keep the vehicle from moving).
- Blades and buckets on heavy equipment will be lowered during transport. Blades and buckets will be placed on the ground whenever the operator leaves the machine.
- Construction equipment (heavy equipment) has the right-of-way in field activities.
- All heavy equipment will have a reverse signal alarm (90 dBA) that operates automatically with backward movement.
- All equipment will have brakes and brake lights. Equipment operated in hours of darkness must have operating headlights.
- Personnel will not ride on or be on any equipment while it is in motion, unless there is a seat or stand designed for a person to occupy that has restraints such as approved seatbelts.
- Seatbelts and restraints will be used at all times when any equipment is in motion.

10.2 ADDITIONAL SAFETY CONSIDERATIONS

The following is a list of precautions to minimize the possibility of injury-related accidents from occurring during field operations.

10.2.1 General Information

- Be your brother's keeper. Consider what you do in terms of the hazard it may create for others.
- Ask the SHSS if you do not know how or are in doubt as to the safe way of doing your job.

- Do not run at any time, except in extreme emergencies.
- Do not throw of any object at personnel or equipment.
- Obey minimum requirements on construction sites and in the shop which are long pants, a shirt with the shoulders covered, and good work shoes. Do not wear torn, ragged, or frayed items because they can catch on obstructions or machine parts, or otherwise cause workers to trip or fall.
- Know where emergency exits are, and how to get to them. Do not block them with material or equipment.

10.2.2 Housekeeping

- Maintain clean work areas and storage areas to encourage better incident prevention and make the work easier to do.
- Dispose of trash and scrap in proper containers. This includes lunch papers, soft drink cans, banding straps, wood, rags, paper cups, and so forth.
- Keep tools, material, and equipment stored in an orderly manner and in their proper places. This prevents unnecessary damage and helps locate them when needed.
- Keep stored material, scrap, and other tripping hazards out of roads and walkways and away from emergency equipment. If it is in a walkway and it is not moving, it does not belong there.
- Cover cords, cables, and hoses crossing roads or walkways to prevent tripping or damage, or support them overhead at least 7 feet above walkways and 14 feet above roads.

10.2.3 Fire Prevention

- Control "open flame" tools and equipment.
- Protect nearby combustible materials from heat, flames, sparks, and slag by moving or covering them.
- Keep flammables in closed containers. Use safety cans.
- Train all site workers on the use of portable fire extinguishers.
- Locate fire extinguishers at each work site (minimum 20-lb, dry chemical ABC). Make sure that each vehicle and the drill rig have a fire extinguisher (minimum 5-lb dry chemical, ABC).

10.2.4 Personal Protective Equipment

- **Head** – Hard hats are required at all times on construction sites. They are also required at other locations where overhead hazards exist. Bump hats are not permitted.
- **Eyes and Face** – Spectacle-type safety glasses are required when hitting steel on steel, grinding, drilling, sawing, or vibrating concrete, or so forth, or when working near someone else creating flying particles.
- **Boots** – At a minimum, workers will wear steel-toe boots (not shoes; boots must be at least up to ankle, with steel shank and non-slip soles). Composite material that complies with the American National Standards Institute (ANSI) standard for protective footwear can be used in lieu of steel toe and steel shank. They must be constructed of leather or other chemically resistive material. Suede and cloth are not acceptable.
- **Safety Vests** – For the protection of workers, and to make workers more visible, most safety plans require that workers wear brightly colored safety vests. Workers working near roads or other places where there is vehicular traffic must wear safety orange or lime-green vests as required by code. During hours of darkness, these vests must have reflective tape.
- **Fall Protection** – Safety harnesses and a fall restraint system such as lanyards attached to an approved support point are required when working from any support or surface where the possibility of falls exists, or where guardrails are not installed. Tie off to a solid, approved support. Tie off as short as possible allowing no more than 36 inches for fall.

10.2.5 Hand Tools

- Every tool is designed for a specific use. Do not misuse. Inspect daily for defects.
- Keep tools in proper working condition: clean, sharp, oiled, dressed, and adjusted.
- Mushroomed chisel and drills cause dangerous flying objects. Keep them dressed.
- Never hit hardened steel with hardened steel, such as hitting a hatchet with a hammer.
- Do not use "cheaters" to increase capacity. Get a bigger sized tool.
- Carry tools in proper sheath, belt bag, or box, points down.
- Do not carry pointed or sharp tools in any pockets.
- Eye protection is required for protection from flying particles.
- Do not use damaged tools; mark them and tag them as out of service. Give those tools to the Site Superintendent or SHSS.

10.2.6 Power Tools

- Know how to shut it off before turning it on. No locked "on" switches on hand-held power tools.

- Eye protection is required for protection from flying particles.
- Power-activated tools will be inspected daily before use for proper operation of their safety devices. You must be authorized by your foreman to operate this equipment.
- All power tools designed to accommodate guards will have guards installed and functioning prior to use.
- Power supply must be properly attached to tool and to source. Electric tools must be grounded (or "double insulated").
- Check area for other people before starting tool. Warn people nearby.
- Be prepared for jamming of rotating tools. Have good footing, good balance, and watch out for nearby obstructions. Check yourself for loose clothing.
- Shut off and bleed down air hose before disconnecting air tools. Never point an air hose toward another person or yourself.
- Power tools must be GFCI-protected or double-insulated.
- Avoid using power tools in wet locations (air-powered tools may be used).
- Protect all cords and plugs from damage. Ensure that the power cord is well away from the operating portion of the power tool.
- All power tools must be turned off before disconnecting from power source. If a circuit breaker is tripped or the tool stops operating, turn off the power switch before disconnecting the power source.
- Disconnect power cords from source before coiling.
- Refer to Section 4.3.5 regarding the use of extension cords.
- Unplug electric cords.
- Store in safe place when not in use. Protect from weather, dirt, and water.

10.2.7 Material Hoists

- Do not use for hoisting people.
- Secure material to prevent it from shifting.
- Use tag lines.
- Ensure that rigging is performed by a person competent in rigging techniques.
- Inspect all rigging before use.

10.2.8 Crane

- General
  - Know the crane capacity and the weight to be lifted before lifting.
  - Be sure air space and walkway are clear before moving bridge or trolley.

- Inspect all rigging before use.
- A competent person must inspect all rigging and the crane before use and certify that crane is safe and positioned properly.
- A positive acting device will be used to prevent contact between the load block or overhaul ball and the boom tip (anti-two blocking device), or a system will be used that deactivates the hoisting action before damage occurs in the event of a two-blocking situation.

- Mobile
  - Maintain solid footing. Use outriggers with rubber-tired cranes.
  - Barricade area of swing of counterweight.
  - Keep boom, lines, and loads at least 15 feet away from electric power lines. Minimum distance increases above 50,000 volts. Power lines must be de-energized to work closer than the minimum distance.
  - The operator will avoid swinging loads over workmen's heads. Have only one signalman at any one time.
  - Equipment will be inspected before each use, and all deficiencies corrected before further use.

10.2.9 Forklifts

- Supervisor authorization is required before operating this equipment.
- Keep forks spread as far apart as possible. Check stability of load before moving it.
- Look in direction of travel before moving and during moving. Watch out for overhead hazards.
- Back down grades when carrying a load.
- No riders allowed unless a passenger seat is provided.
- Forks are not to be used as an elevator or as a work platform.
- Lower forks all the way down before leaving the equipment.
- Do not drive along the edge of raised docks, platforms, or ramps.
- In California, operating rules must be posted.

10.2.10 Mechanical Material Handling

- Know the weight of the load to be moved.
- Know the capacity of the equipment to be used to move the load.
- Use tag lines to control the load. Keep tag line free of your body, and free of obstructions during movement of the load.

10.2.11 Manual Material Handling

- Leg muscles are stronger than back muscles. Lift with the legs not the back. Bend knees, keep back straight, tighten abdomen, and using legs, make a smooth controlled lift.
- Plan before you lift – consider weight, size, shape, path of travel, and set-down location. Get help if necessary.
- Protect hands and fingers from rough edges, sharp corners, and metal straps. Keep hands and fingers out of pinch points between the load and other objects.

10.2.12 Overhead Work

- No one is to be unprotected under overhead work.
- Erect barricades, signs, or other devices to warn people of the work overhead. Respect the barricades or signs put up by others.
- Covered walkways are needed where people must pass under overhead work.

10.2.13 Portable Ladders

- General - All Portable Ladders
  - Inspect for defects. When defects are found, the ladder is to be withdrawn immediately from use. Set ladder feet on solid foundation.
  - Allow only one person on a ladder at one time.
  - Use ladders for climbing – not for material skids, walkways, or work benches.
  - Face the ladder while climbing up or down and while working from it. Use safety harness or fall protection when falls are possible.
  - Use both hands to climb. Use a hand line for material.
  - Do not use metal ladders.
  - Store safely to prevent damage from vehicles, materials, and so forth.
- Straight and Extension Ladders
  - Maintain the correct slope of the ladder at 1:4.
  - Secure the ladder from slipping by having non-slip feet on the bottom, and tie off with a rope at the top.
  - Extend the ladder 3 feet above top the landing where ladder is to be used for access to the landing.
  - Extension ladders cannot exceed 30 feet.
  - Do not take extension ladders apart to get two ladders.
  - Keep hands off rungs while extending or lowering extension section. Be sure latches are in place before climbing.

- Stepladders
  - Open fully. Lock spreaders. Do not use as a straight ladder.
  - Do not stand or step on top platform.
  - Keep loose tools off steps and top platform.
  - Tie off stepladder if longer than 12 feet.
  - Stepladders cannot exceed 20 feet in height.

10.2.14 Compressed Gas Cylinders

- Always keep cylinders upright. Tie off vertically with strong wire, rope or chain, or keep chained in cylinder cart.
- Do not drop or roll the cylinders.
- Use a rack for lifting cylinders to and from upper elevations. Never lift a cylinder by the control valve or a valve cover.
- Always replace valve covers when gauges are removed. Valve covers must be placed on all cylinders before they are moved.
- Store oxygen cylinders 20 feet away from other cylinders, or separate by a solid approved divider. Do not store any cylinders inside a building.
- Keep oil and grease away from oxygen valves.
- Cylinders are to be kept at a safe distance or shielded from welding and cutting operations. They are not to be placed where they can contact an electric circuit.
- Acetylene cylinders must always be stored upright.
- Use only regulators specifically approved for the type of gas in the cylinder (read the front of the gauges for this information). Never modify regulators or use adapters.

10.2.15 Welding and Burning

- Electric
  - Keep leads out of walkways.
  - Shield arcs to protect others from direct arc rays.
  - Wear proper shade number of protective lenses (welding goggles or helmets).
  - Remove rod from electrode holder before laying it down. Put rod butts in a container, not on the floor.
  - Proper grounding from work to machine is a must.
  - Turn off machine at end of shift.

- Gas
  - Keep hoses out of walkways.
  - Wear proper shade number of protective lenses (welding goggles or helmet).
  - Check area sides and below for possible fire hazards.
  - Remove gauges at end of shift and replace cap on cylinder. Use toolboxes to store hose and ventilate gauges.
  - Separate oxygen and other gases for weekends and other times when bottles are not in regular use.
  - Use soapy water when checking for leaks.
  - Before using fuel gas cylinders:
    - Always crack cylinder valve before connecting gauges to clean dirt.
    - Open cylinder valve slowly and leave wrench in position while cylinder is in use.
    - A regulator will always be used on fuel gas cylinders.
    - The cylinder valve will always be closed before removing regulator.
    - When fuel gas cylinders connected to gauges have a leak, they will be repaired or removed from service and tray away from the work area.

10.2.16 Electricity

- Refer to Section 4.3.5 for additional details on electrical safety.
- All electrical work will be performed by qualified persons familiar with the NEC and other applicable codes.
- Temporary lighting circuits require guards over the bulbs. Metal guards must be grounded.
- Keep extension cords out of water and at least 7 feet above walkways.
- Disconnect switches must be labeled to show the equipment or service they feed. Check before operating.
- Always shut down electrical equipment before servicing, repairing, or investigating questionable function.

10.2.17 Decontamination

- Personnel
  - Do not walk through areas of obvious or known contamination.
  - Do not handle or touch contaminated materials directly.
  - Make sure PPE is free of cuts or tears prior to donning.
  - Fasten all closures on suits, covering with tape, if necessary.

- Particular care should be taken to protect from any skin injuries.
- Do not carry cigarettes or gum into contaminated areas.

- Heavy Equipment
  - Take care to limit the amount of contamination that comes into contact with heavy equipment.
  - If contaminated tools are to be placed on non-contaminated equipment for transport to the decontamination pad, use plastic to keep the equipment clean.

10.2.18 Illumination

All work on site when performed outdoors is planned to be performed during daylight hours only (½ hour after sunrise to ½ hour before sunset). If work must be performed during hours of darkness or inside buildings, the project will ensure that additional lighting is provided to meet the requirements of 29 CFR, Part 1910.120 (8 CCR, Section 5192).

10.3 ERGONOMIC CONSIDERATIONS

Routine activities at the project may involve tasks that, by their nature, may subject personnel to unexpected ergonomic stresses. Examples of ergonomic stresses include:

- Muscular sprains and strains
- Musculoskeletal trauma from impacts or vibrations
- Fatigue due to extended work schedules

Caution and workload awareness should be exercised by all site personnel during project activities. Tasks that involve manual manipulation of sampling devices, chemical storage drums, shoveling, and/or prolonged exposure to vibrating mechanical equipment should be monitored by the individuals involved with them to preclude the adverse effects of ergonomic stress. Tasks should be rotated among the workers to minimize the effects of repetitive trauma.

11.0 DISPOSAL PROCEDURES

Waste Management procedures in Work Plan Section 6.0 describe the handling of wastes from the project site and the management of all decontamination liquids and disposable clothing and supplies that have come into contact with contaminated materials. All disposable PPE will be treated as contaminated waste and disposed of properly. Contaminated clothing will be placed in a drum lined with a polyethylene bag. Wastewater generated on site will be stored until ready for testing and disposal. Temporary waste storage areas will be set up by each EZ during the work day. This waste will then be moved to a main storage area until ready for disposal, if required by environmental personnel. All waste containers will be properly labeled and stored as consistent with regulatory requirements. Contents of the containers will be sampled by trained sample technicians and sent to a laboratory to determine regulatory-permitted disposal methods. Decontamination water will be contained and captured using submersible pumps and/or vacuum units. TtEC will arrange for the proper disposal of all decontamination fluids, contaminated debris, soil, and other waste per contract requirements. In no case will accumulation be allowed to exceed 90 days from the date that the accumulation started. TtEC has policies and procedures that require that disposal is managed by firms that have been pre-approved by an internal review process and by the DoN.

11.1 SPECIAL CONSIDERATIONS FOR COMMERICAL TENANT AREAS

It is important that the work areas are isolated from the general public, primarily for their protection. Investigation areas are to barricaded at all times until the area is restored. If the work area is active and physical means do not preclude public access, do not leave the area unattended during break times.

Equipment and tools will be returned to the staging area at the end of the day. Security will provide oversight at night and weekends to reduce unauthorized access to equipment, stockpiled contaminated soils, and backfill materials.

When working adjacent to commercial businesses, keep noise levels as low as possible, adhere to work times, and remove your trash. Any contact with tenants and customers should be referred to the following project contact personnel:

- BRAC Environmental Coordinator Thomas Macchiarella at (619) 532-0923
- Remedial Project Manager Steve Peck at (619) 532-0786

This page intentionally left blank.

12.0 EMERGENCY RESPONSE PLAN

There are numerous emergency services nearby in the civilian community. This plan describes response activities as they apply to Alameda Point.

12.1 RESPONSIBILITIES

The Superintendent or PjM is the primary emergency coordinator for the project. In the absence of either or both the Superintendent and the PjM, the SHSS is the emergency coordinator. The emergency coordinator will take charge and determine, direct, and delegate personnel and resources to manage the emergency. Key responsibilities of the emergency coordinator are to:

- Initiate evacuation, if needed.
- Initiate emergency response agency notification.
- Evaluate and assess emergency situation to ensure that response activities are commensurate with the level of the emergency, and as discussed in this plan, are implemented.
- Interface and coordinate with outside agencies responding to on-site emergencies.

12.2 COMMUNICATIONS

Personnel will maintain verbal communication. The following communication systems will be available during site activities:

- Cellular telephone or access to a land phone for emergency purposes
- Hand-held radios, as needed
- Compressed air horn (signals emergency evacuation only) at the site
- Hand signals, if used, that are diagrammed and posted
- Posted location of evacuation assembly area(s)
- Posted route to the nearest hospital for the project site
- Posted emergency phone numbers

12.3 ACCIDENT/INCIDENT REPORT

After the emergency event is over or during the course of the emergency when possible, the SHSS will notify the PESM by telephone. Should an accident or incident occur, the Superintendent or PjM and the SHSS will immediately investigate the cause, notify the PESM, and promptly complete the following:

- ***TtEC Incident Report Form***. Details of the incident will be documented within 24 hours and copies of the report forwarded to the DoN RPM and the PESM. Reports of serious incidents will also be faxed to the PM by the Superintendent or PjM.
- ***Incident Investigation Report***. The Incident Investigation Report will have the same distribution as the Incident Report Form within three days of the incident.

Any recommended additional hazard-control measures must be discussed with the Superintendent, SHSS, and PESM and meet their approval, prior to implementation. Any occupational injuries and illnesses will be recorded, if applicable, on an OSHA Form No. 300. The SHSS will report immediately by telephone or telegraph to the nearest District Office of the Division of Occupational Safety and Health (Cal-OSHA) any serious injury or illness, or death, of an employee occurring in a place of employment or in connection with any employment. Immediately means as soon as practically possible but not longer than eight hours after the incident. Records of all site accidents and first-aid treatments will be maintained by the SHSS.

12.4 PRE-EMERGENCY PLANNING

Prior to performing any work, the Superintendent or PjM and the SHSS will verify all emergency action plans by ensuring that planned support facilities are available and that emergency contact numbers are valid. As work proceeds, the SHSS will continue to ensure that plans specified in this section can be implemented at all times. Furthermore, the SHSS will constantly ensure that plans are modified as necessary to accommodate changes. The SHSS will coordinate all changes with the PESM. Upon arrival at the site, the Superintendent will ensure that all personnel know the system for communication of emergency situations and how to use a radio or nearby phone to summon emergency assistance. A vehicle must be available to transport personnel to safe locations or to hospitals. All personnel on this project will know how to use a portable fire extinguisher. All personnel will know the location of all emergency equipment and supplies. The SHSS will ensure that emergency equipment is available in the work areas as specified by site-specific plans and that the equipment is inspected as required by regulations and TtEC policies:

- Fire extinguishers – monthly, annual refill and servicing, 7-year hydrotest
- First aid kits – weekly (per EM 385-1-1[USACE, 2003])
- Eyewashes – weekly, if preservative is used, eyewash water may be changed every four months; otherwise, water must be changed weekly. Only potable water may be used for eyewashes. Eyewashes must meet ANSI Specification Z358-1-2004.

The SHSS will schedule a practice emergency drill within 2 weeks of commencement of field work. After the drill, the SHSS will hold a meeting to identify weaknesses in the plan and to get other feedback that will be used to update evacuation plans.

12.5 EMERGENCY MEDICAL TREATMENT

The following procedures should be observed if an accident with injury occurs:

12.5.1 First Aid

Only qualified personnel will provide first aid and stabilize an individual needing assistance. Life-support techniques such as CPR and treatment of life-threatening problems such as airway obstruction and shock will be given top priority. At least two persons certified in first aid techniques and CPR will be on each work site at all times; TtEC EHS Procedure 4-1, Bloodborne Pathogens, will be followed when first aid/CPR are administered. All personnel who have been trained in CPR and first aid must be trained as required by the Cal-OSHA Bloodborne Pathogens regulation (8 CCR 5193). The SHSS will be current in first aid and CPR. Professional medical assistance will be obtained at the earliest possible opportunity. The nearest hospitals and clinic to Alameda Point are shown on a map (Figure C.12-1).

12.5.2 Minor Injury

The following are procedures for a minor injury:

- Contact a supervisor or "buddy."
- Have qualified first-aid personnel treat injury.
- Record injury and include name of injured person, nature of injury, and treatment given.

12.5.3 Medical Emergency

In the event of a medical emergency when actual or suspected serious injury occurs, the following procedures will be implemented:

- Survey scene and evaluate whether the area is safe for entry.
- Remove the exposed or injured person(s) from immediate danger.
- Render first aid if necessary. Decontaminate affected personnel after critical first aid is given.
- Obtain paramedic services or ambulance transport to local hospital. This procedure will be followed even if there is no visible injury.
- Call 911 from phones on Alameda Point. Calling 911 from cell phones will notify California Highway Patrol who will notify county Emergency Medical Service. The local emergency number from a cell phone should be preprogrammed into each phone. The number for the fire department is (510) 337-2100 and for the police department is (510) 337-8340.
- Identify location by number of nearest building, request medical assistance, and provide name and telephone number.

- Request assistance from Emergency Medical Service and/or additional assistance.
- Evacuate other personnel in the work area to a safe distance until the Superintendent determines that it is safe for work to resume. If there is any doubt regarding the condition of the area, work will not commence until all hazard control issues are resolved.
- Notify ROICC of incident and fill out accident reporting forms and associated documents.

12.5.4 Fatal Injury

If a fatal injury occurs, the following additional steps will be followed:

- Notify the Superintendent immediately.
- Notify the PESM who will initiate contact with Cal-OSHA and other appropriate agencies.
- Notify ROICC.
- Stop all work activities on the project for 24 hours.
- Assist Cal-OSHA as directed.

12.6 DECONTAMINATION DURING MEDICAL EMERGENCIES

Any personnel requiring emergency medical attention will be evacuated immediately from exclusion and contamination reduction zones. Personnel will not enter the area to attempt a rescue if their own lives are at risk. The decision of whether or not to decontaminate a victim prior to evacuation is based on the type and severity of the illness or injury and the nature of the contaminant.

For some emergency victims, immediate decontamination may be an essential part of life-saving first aid. For others, decontamination may aggravate the injury or delay life-saving treatment. If decontamination does not interfere with essential treatment, it should be performed.

If decontamination can be performed:

- Wash external clothing and cut it away.
- Wrap the victim in a clean blanket or towel if necessary.

If decontamination cannot be performed:

- Wrap the victim in blankets or plastic to reduce contamination of other personnel.
- Alert emergency and off-site medical personnel to potential contamination; instruct them about specific decontamination procedures.
- Send along site personnel familiar with the incident.

12.7 EMERGENCY SITE EVACUATION PROCEDURES

In the event of an emergency situation such as fire or explosion, the SHSS or a supervisor will activate an air horn for approximately 15 seconds indicating the initiation of evacuation procedures. All personnel in both the restricted and non-restricted areas will evacuate and assemble near the support zone or other safe area as identified by the SHSS. Prior to start of work at any project site the SHSS will identify and mark the location of an evacuation assembly area for that project site. The location should be upwind of the site as determined by the wind direction. For efficient and safe site evacuation and assessment of the emergency situation, the Superintendent or SHSS will have authority to initiate proper action if outside services are required. Under no circumstances will incoming personnel or visitors be allowed to proceed into the area once the emergency signal has been given. The SHSS must ensure that access for emergency equipment is provided and that all equipment that may cause combustion has been shut down once the alarm has been sounded. As soon as possible, and while the safety of all personnel is confirmed, emergency agency notification will commence. The SHSS will brief site personnel each day as to the location of the evacuation assembly area.

Prior to the start at each project work site, the SHSS will establish safe egress routes from the site to the evacuation assembly area. The SHSS will prepare a drawing or map that diagrams these safe egress routes (Figure C.12-2). The SHSS will use this same map to diagram egress from the evacuation assembly area to the facility gate to be used as an exit. From this point, the map showing the route to the nearest clinic and the nearest hospital will be used if medical services are required.

12.8 FIRE PREVENTION AND PROTECTION

Fire prevention and protection measures require pre-planning. At least one 20-pound dry chemical ABC fire extinguisher will be located at each project site. A mounted fire extinguisher is required in every vehicle including heavy equipment. Extinguishers mounted on heavy equipment will be a minimum 5-pound ABC dry chemical fire extinguisher. Fire extinguishers inside the cab of pickup trucks will be 2½ -pound dry chemical ABC. Fire extinguishers in the cabs of all vehicles must be mounted or secured. Employees will follow safe work practices to include proper storage of flammable and combustible liquids. Smoking is permitted only in those areas designated specifically by the PjM, Superintendent or SHSS. Personnel will follow hot work procedures to ensure that work is performed in a safe environment. In the event of a fire or explosion, summon the Fire Department immediately, take a head count, and implement evacuation procedures.

12.9 SPILL CONTROL AND RESPONSE

All spills, leaks, and fires involving oil or hazardous substances at Alameda Point must be reported to the RPM and the PESM. The person reporting the leak or spill is required to provide the following information:

- His/her name
- Location of spill and facility number, if known
- Number of injured personnel and nature of injuries, if known
- Substance spilled
- Amount spilled (estimate)
- Extent of spill
- Rate that substance is currently being released (estimate)
- Time spill occurred (estimate)
- Any other pertinent information

The RPM, in coordination with the PjM, will manage notifications to regulatory agencies. In addition, all spills will be reported to the TtEC Environmental Compliance Manager or the PESM. Project personnel will not report spills directly to any agency, unless specifically requested by the RPM or Contracting Officer.

A minor spill would involve no immediate threat to human health or the environment, cause minimal property damage, and does not exceed the reportable quantity (RQ) for that material. In the event of a minor spill, the appropriate response action is for the responsible person to notify the RPM and the PjM and supply the responders with as much information as possible. In the case of a spill of contaminated or hazardous materials, the following procedures will be followed:

- Notify the superintendent.
- Identify protective clothing or equipment required to respond.
- Contain the spill.
- Neutralize and/or solidify any product.
- Transfer material into 55-gallon drums.
- Document the incident.

12.9.1 Release Prevention and Minimization Measures

In addition to training, the following procedures will be implemented to prevent and minimize releases of hazardous materials:

- Do not conduct hazardous materials operation when the weather could cause significant risk to the surrounding area if a spill should occur.
- Transfer all materials in or over a bermed or "protected" area. A protected area is one covered with an impermeable material, such as polyethylene.

- Dike temporary storage tanks containing hazardous wastes or potentially hazardous wastes to contain potential releases.
- Maintain a supply of basic spill-response materials and protective equipment on site to include:
  - Absorbent sheets, pillows, booms or absorbent material
  - Open-top, 55-gallon drums or other containers with lids
  - Booms, shovels, and other tools, such as squeegees

12.10 SIGNIFICANT VAPOR RELEASE

Any project activity that releases significant amounts of vapor must be reported immediately, as described in the spill-release procedure. Every attempt to mitigate the release must be taken if it can be safely performed. For example, during excavations vapor releases may be controlled by simply replacing cover on the excavation. Downwind evacuation procedures may be required. These will be initiated through coordination with Alameda emergency coordinators.

12.11 EARTHQUAKE RESPONSE

If an earthquake should occur during the course of site activities, take the following steps:

- Stop working. Remain calm and do not panic.
- Do not use or do anything that might be a source of ignition (smoking, cutting, or welding).
- Avoid power lines, power poles, and windows.
- If in a vehicle, stay in the vehicle until the earthquake is over.
- If in a building, take cover under a heavy piece of furniture or leave the building if possible.

After the earthquake is over:

- Prepare for aftershocks. Stay out of severely damaged buildings.
- Meet for a head count at a location designated by the Superintendent.
- Check for injuries. Do not move seriously injured personnel, unless remaining where they are would create danger of further injury.
- Check vehicles, equipment, and buildings for any obvious damage. Do not enter any buildings until their structural integrity has been evaluated.
- Check utility lines for damage. Switch off power, water, and gas until a utility official has inspected the buildings and operational area and determined it is safe.
- If driving, watch carefully for hazards created by the earthquake (undermined roads, weak bridges, or overpasses, fallen power lines or poles, and so forth).

12.12 EMERGENCY EQUIPMENT

The following emergency equipment will be brought onto the site or will be stationed near each work area:

- Fire extinguisher, minimum one 20-pound dry chemical ABC type in the CRC at the edge of EZ
- Industrial first aid kit, in the CRC, at the edge of the support zone
- Portable eye wash, capable of supplying 15 minutes of water and protected from direct sunlight in the support area, at the edge of the support zone
- Air horn at the support area, at the edge of the support zone
- Spill-control material consisting of absorbent pillows or absorbent material and shovels, plastic sheeting, and 55-gallon drum(s) in the support zone by the CRC entrance

The following equipment will be available in Building 112, the main office for use in an emergency situation:

- Industrial first aid kit, inspected weekly
- Blanket

12.13 EMERGENCY INFORMATION POSTINGS

Emergency contact names and phone numbers will be posted at every project site (Table C.12-1). A map showing egress routes, evacuation assembly areas, and the route to the clinic and the hospital will also be posted. Also, the contact names, phone numbers, and maps will be placed on the dashboard of every vehicle.

13.0 TRAINING

In accordance with TtEC corporate policy and pursuant to 29 CFR, Part 1910.120 (8 CCR, Section 5192), hazardous waste site workers will, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for HAZWOPER, unless excepted by the above reference. At a minimum, the training will have consisted of instruction in the topics outlined in the above reference. Personnel who have not met the requirements for initial training will not be allowed to perform any site activities that may expose them to chemical or physical hazards.

An employee's prior experience and/or training for equivalency may be considered to meet the training described above. The PESM will make the determination if previous experience and/or training meet the initial training requirements.

In addition to the required initial training, each employee will have received three days of directly supervised on-the-job training at a hazardous waste site. This training will have addressed the duties the employees are expected to perform and be properly documented. The TtEC Superintendent has the responsibility for ensuring that personnel assigned to field sites comply with these requirements. The Superintendent will provide the DoN Contracting Officer or designee with written certification of completion of the required training and maintain copies of required training records at the work site.

13.1 MANAGER/SUPERVISOR TRAINING

In accordance with 29 CFR, Part 1910.120 (8 CCR, Section 5192), on-site managers and supervisors directly responsible for, or who supervise employees engaged in HAZWOPER, will receive training as required above and at least eight additional hours of specialized training on managing such operations by the time of job assignment.

13.2 ANNUAL 8-HOUR REFRESHER TRAINING

Annual 8-hour refresher training will be required of all hazardous waste site field personnel to maintain their qualifications for fieldwork. The following topics will be reviewed: toxicology, respiratory protection—including air purifying devices and SCBA—medical surveillance, decontamination procedures, and personal protective clothing. In addition, topics deemed necessary by the SHSS or PESM may be added to the above list.

13.3 SITE-SPECIFIC TRAINING

Prior to commencement of field activities, the SHSS will provide site-specific training to all personnel assigned to the site; this training will specifically address the activities, procedures, monitoring, and equipment for the site operations. Training will include site and facility layout, hazards, and emergency services at the site, hazard communication, and will highlight all provisions contained within the SHSP. This training will also allow field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and health for their particular activity. Additional training, if required for completion of field tasks during the site work, will be identified and provided for personnel as the work progresses.

13.4 ON-SITE SAFETY BRIEFINGS

Project personnel and visitors will be given daily on-site health and safety briefings by the SHSS, or designee, to assist site personnel in safely conducting their work activities. This training will be conducted prior to the start of new work activities using AHAs. The briefings will include information on new operations to be conducted, changes in work practices, or changes in the site's environmental conditions. The briefings will also provide a forum to facilitate conformance with safety requirements, and identify performance deficiencies related to safety during daily activities or as a result of safety inspections.

13.5 FIRST AID AND CPR

The SHSS will identify those individuals requiring first-aid and CPR training. At a minimum, the SHSS will have received first-aid and CPR training. At least two persons trained and current in certification of first-aid and CPR will be present at every work site. The training will be consistent with the requirements of the American Red Cross Association.

14.0 LOGS, REPORTS, AND RECORDKEEPING

The following is a summary of required health and safety logs, reports, and recordkeeping for this contract.

14.1 SITE HEALTH AND SAFETY PLAN CHANGE APPROVAL FORM

A Site Health and Safety Plan Change Approval Form is to be completed for all changes to the SHSP. This form requires the signatures of the PjM or Superintendent, the SHSS, and the PESM. Substantial changes to the SHSP may require a Field Change Request (FCR) according to the QC Plan in order to initiate a significant change to the SHSP. PESM approval of each FCR is required. Copies of the FCR affecting the SHSP are sent to the DoN CIH. Project forms are included as Attachment 4 of this SHSP.

14.2 MEDICAL AND TRAINING RECORDS

Full medical and training records are normally kept by the employer. Proof of the most recent training and medical qualification must be provided to the SHSS by the employee. The SHSS will keep a file containing appropriate training and medical qualifications for site workers. Medical records will be maintained in accordance with 29 CFR, Part 1910.20 (8 CCR, Section 3204). The examining physician retains custody of the complete medical record. Employee records have only the physician statement of medical qualification for duty and the employee's fitness to wear a respirator.

14.3 ON-SITE LOG

A log of personnel (including job title, level of protection, and work location) will be kept on site each day by the SHSS or designee. Originals will be kept in the project file.

14.4 EXPOSURE RECORDS

Any personal monitoring results, laboratory reports, calculations, and air sampling data sheets are part of an employee exposure record. These records will be kept in accordance with 29 CFR, Part 1910.20 (8 CCR, Section 3204) and Section 7.3.2. For TtEC employees, the originals will be sent to the medical records coordinator. For subcontractor employees, the originals will be sent to the subcontractor employer and a copy kept in the project file.

14.5 ACCIDENT AND INCIDENT REPORTS

A TtEC accident/incident report must be completed following any event involving emergency first aid, lost time, or property damage in accordance with EHS Procedure 1-7. The originals will be sent to the TtEC records coordinator for maintenance and distribution by TtEC. Copies will be distributed to the PESM, Superintendent, subcontractor employees, if appropriate, and the DoN Contracting Officer. A copy of the completed forms will be kept in the project file.

14.6 OSHA FORM 300

An OSHA Form 300 (Log of Occupational Injuries and Illnesses) will be kept at the project site. All recordable injuries or illnesses will be recorded on this form. At the end of the project, the original will be sent to the TtEC records coordinator for maintenance. Subcontractor employers must also meet the requirements of maintaining an OSHA Form 300. The TtEC accident/incident report meets the requirements of the OSHA Form 301 (Supplemental Record) and must be maintained with the OSHA Form 300 for all recordable injuries or illnesses.

14.7 HEALTH AND SAFETY FIELD LOGBOOKS

The SHSS will complete and maintain the daily logbook at the site. Logbooks will be used to document important events as they occur. Some general procedures will pertain to the use of all logbooks. The following information will be recorded on each page of all logbooks:

- Initials of persons making entry
- Date
- Time of each entry (military time)
- Location

The logbook will be signed at the end of each day or work shift. All entries will be made in black ink. No pages will be removed from the logbook and each page will be numbered. Any corrections will be made with a single line through the entry, and initialed.

The logbook will be used to record daily site conditions and activities within the EZs. The logbook will contain the following items:

- Names and job titles of all personnel in the work group
- Level of protection
- Health and safety monitoring equipment used
- Weather conditions
- Work/rest schedule (if appropriate)
- A description of the activities as they are occurring

- Any pertinent health and safety observations
- Sample number (if appropriate)

Copies of the logbooks will be submitted to the Superintendent as necessary. The original logbooks will become part of the exposure records file and will be maintained by the TtEC records coordinator.

14.8 MATERIAL SAFETY DATA SHEETS

MSDSs will be obtained and kept on file at the project site for each hazardous chemical brought to, used, or stored at the site. In addition, a list of all chemicals brought on site that require an MSDS shall be maintained. An MSDS for each contaminant will also be maintained. The MSDS will be kept on file by the SHSS at the project site.

14.9 CLOSEOUT SAFETY REPORT

A final closeout safety report will be provided to the PESM summarizing the safety performance achieved during the site work. Specific elements of the report will include the following:

- A description of significant events, exposures, accidents, illnesses, and actions taken to prevent their occurrence
- A summary of monitoring results including air, noise, and heat stress samples
- A description of any state or federal inspections involving the health and safety of site workers (accompanied by the applicable EHS 1-10 form)

14.10 REQUIRED POSTINGS

- Department of Labor
    1. Minimum Wage
    2. Polygraph Protection Act
    3. Equal Employment Opportunity
    4. Job Safety and Health
    5. Family Leave
    6. Uniformed Services Employment and Reemployment Rights Act (USERRA)
- Cal-OSHA
    1. Safety and Health Protection on the Job
    2. Discrimination in Employment
    3. California Workers Compensation (Sign begins: "If a work injury occurs...")
    4. Emergency Phone Numbers

5. Access to Medical and Exposure Records
6. Notice of Unemployment and Disability Insurance
7. Hearing Protection Standard
8. A posting of what day is payday and a multipage document regarding minimum wage (California law)
9. Operating Rules for Forklifts (if forklifts are used on project)
10. California's Accident and Injury Illness Prevention Program: a management policy on Health and Safety

- Contract Requirements

  1. Posting of HOTLINE POSTER
  2. Drug Policy Poster
  3. Posting of Prevailing Wages

- Company (TtEC) Required Postings

  1. Policy on Sexual Harassment
  2. Policy on Equal Employment Opportunity
  3. Accident/Injury Reporting
  4. Environmental Safety and Quality Poster (ISO 14001)
  5. Recycling and "Use Double-Sides" Posters
  6. TtEC ZIP Poster
  7. TtEC Work Rules

15.0 FIELD PERSONNEL REVIEW

All personnel are required to be trained in this SHSP. Upon completion of this training and review, all project personnel will acknowledge this training by signing a review form acknowledging training.

This page intentionally left blank.

16.0 REFERENCES

American Conference of Governmental Industrial Hygienists (ACGIH). Most current publication. Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices.

American Iron and Steel Institute. 1993. *Wire Rope Users Manual.*

Department of the Navy (Don) 2006. *Department of the Navy Environmental Restoration Manual.* August.

Tetra Tech EC, Inc. (TtEC) Corporate Health and Safety Program Manual (most recent).

TtEC Project Rules Handbook, Volumes I and II (most recent).

Tetra Tech EC, Inc. 2007a. *Draft Final Data Gap Sampling Work Plan for OU-1, Installation Restoration Sites 6,7, 8 and 16.* Alameda Point, Alameda, California. July.

______________. 2007b. *Draft Final Data Gap Sampling Work Plan for OU-2A, and OU-B.* Alameda Point, Alameda, California. August.

U.S. Army Corps of Engineers (USACE). 2003. *Safety – Safety and Health Requirements.* EM 385-1-1. 3 November.

U.S. Department of Health and Human Services. 1985. *Occupational Safety and Health Guidance for Hazardous Waste Site Activities.*

Notes:

Where no date is given in the references above, it is assumed that the reference used will be the most recent publication.

This page intentionally left blank.

TABLES

This page intentionally left blank.

TABLE C.4-1

CHEMICAL HAZARDS ASSESSMENT

Chemical Name	ALI/AL/PEL/TLV	Routes of Exposure	Symptoms of Exposure	Target Organs
Gasoline	PEL – 300 ppm (Cal-OSHA) TLV – 300 ppm	Skin absorption, inhalation, ingestion	Acute: nose, throat, lung irritation; headaches; blurred vision; vomiting; dizziness; fever; slurred speech; unconsciousness. Chronic: appetite loss, nausea, weight loss, insomnia, sensitivity in digits, extremities.	Skin, eye, respiratory, CNS
Diesel fuel	PEL – none established TLV – 100 mg/m^3	Skin contact, inhalation, ingestion	Acute: eye irritation; skin irritation; nose, throat, lung irritation; nausea; vomiting; diarrhea; restlessness; drowsiness; loss of coordination. Chronic: repeated contact with skin causes dermatitis.	CNS, skin, respiratory system
PAHs, coal tar pitch volatiles (chrysene, pyrene, phenanthrene) from residuals of diesel fuel or other sources	PEL – 0.2 mg/m^3 TLV – 0.2 mg/m^3	Inhalation, ingestion, contact	Acute: skin contact may cause irritation, redness, burning, itching, dermatitis, and burns. Photosensitization may occur (rash worsens with exposure to sunlight). Inhalation irritating to respiratory tract. Eye contact may cause conjunctivitis, keratitis, or corneal burns. Ingestion may result in nausea, vomiting, abdominal pain, respiratory distress, and shock. Exposure to large doses, especially by ingestion, may be fatal. Chronic: dermatitis, skin cancer, lung cancer.	Respiratory system, skin, bladder, kidneys (lung, kidney and skin cancer)
Benzene	PEL – 1 ppm TLV – 0.5 ppm STEL – 5 ppm STEL (ACGIH) – 2.5 ppm	Inhalation, ingestion, contact	Carcinogen. Acute: irritation of eyes, nose, respiratory tract, breathlessness, euphoria, nausea, drowsiness, headache, dizziness, and intoxication. Severe exposure can cause convulsions and unconsciousness. Skin contact may cause dermatitis. Chronic: blood disorders including leukemia.	Blood, CNS, bone marrow, eyes, skin, upper respiratory tract
Toluene	PEL – 50 ppm (Cal-OSHA) TLV – 20 ppm STEL – 150 ppm	Inhalation, skin contact	Acute: respiratory irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, watering eyes, nervousness, dermatitis, insomnia, parasthesis, vertigo, narcotic coma, death. Chronic: mucous membrane irritation, headache, vertigo, nausea, appetite loss, intolerance to alcohol. Encephalopathies, liver enlargement, and kidney dystrophy.	CNS, liver, kidney, skin

TABLE C.4-1

CHEMICAL HAZARDS ASSESSMENT

Chemical Name	ALI/AL/PEL/TLV	Routes of Exposure	Symptoms of Exposure	Target Organs
Ethylbenzene	PEL – 100 ppm TLV – 100 ppm STEL – 125 ppm	Inhalation, skin and eye contact	Acute: eye and nose irritation, chest constriction. High concentrations: narcosis, cramps, death. Chronic: dermatitis, fatigue, sleepiness, headache, leukopenia.	Eyes, respiratory system, CNS, skin, blood.
Xylene	PEL – 100 ppm TLV – 100 ppm STEL –150 ppm	Inhalation, skin and eye contact, Ingestion	Acute: dizziness, nausea, vomiting, abdominal pain, eye, nose, throat irritation; pulmonary edema, drowsiness, unconsciousness. Eye contact can cause conjunctivitis and corneal burns. Chronic: dermatitis, peripheral and central neuropathy, liver damage.	CNS, eyes, GI tract, liver, kidneys and skin
Polychlorinated biphenyls (PCBs)	PEL - 0.05 mg/m^3 TLV - 0.05 mg/m^3	Inhalation, ingestion, skin contact	Acute: Irritation to eyes, skin, nose, throat, and respiratory tract. Intense acute exposure may cause damage to eyes, liver, or lungs. Systemic effects include nausea, vomiting, high blood pressure, fatigue, weight loss, jaundice, edema, and abdominal pain. Neurological impairment is possible. Chronic: Chloracne, neurological symptoms, and liver enlargement. Cancer, primarily of the liver.	Skin, liver, eyes, mucous membranes, and respiratory tract.
Methyl tert-butyl ether (MTBE)	PEL – 40 ppm (Cal-OSHA) TLV - 50 ppm	Inhalation, skin and eye contact, ingestion	Acute: dizziness, nausea, vomiting, sedation, general anesthesia drowsiness, unconsciousness. Eye or skin contact can cause irritation or burning sensation. Ingestion may cause aspiration pneumonitis. Chronic: Nasal and tracheal inflammation.	CNS, upper respiratory tract

Abbreviations and Acronyms:

Cal-OSHA – California Occupational Safety and Health Administration
CNS – central nervous system
GI – gastrointestinal
mg/m^3 – milligram per cubic meter
MTBE – methyl tert-butyl ether
PAH – polynuclear aromatic hydrocarbons
PCB – polychlorinated biphenyl
PEL – permissible exposure level
ppm – parts per million
STEL – short-term exposure limit
TLV – threshold limit value

TABLE C.6-1

PERSONAL PROTECTIVE EQUIPMENT

Task	EPA Level	Respiratory Protection	Head	Hand	Clothing	Boots	Face	Eye	Hearing	Additional
Site setup, surveys (land, geophysical)	D	None required, unless dust exceeds action level	Hard hat	Leather work gloves, as needed	Work uniform or Tyvek® coveralls to keep clean	Steel-toe, leather	N/A	Safety glasses	Protection when noise levels exceed 85 dBA	Reflective safety vests
Hand auger/soil sampling	D	None required, unless probe releases vapors above action limits	Hard hat	Leather work gloves or puncture/cut-resistant gloves; Nitrile gloves when sampling	Work uniform or Tyvek® coveralls to keep clean	Steel-toe, leather	N/A	Safety glasses	Protection when noise levels exceed 85 dBA	Reflective safety vests, USCG life preservers when working near water
Clearing of vegetation	D	None required, unless dust exceeds action level	Hard hat	Leather work gloves, as needed	Work uniform or Tyvek® coveralls to keep clean	Steel-toe, leather	N/A	Safety glasses	Protection when noise levels exceed 84 dBA	Fall protection for work above 6-foot level. Reflective safety vests.
Sonic Drilling Sampling, Direct Push Sampling	D	None required, unless dust exceeds action level	Hard hat	Leather work gloves, as needed	Work Uniform or Tyvek® coveralls	Steel-toe boots	N/A	Safety glasses	Protection when noise levels exceed 84 dBA	Fall protection for work above 6-foot level. Reflective safety vests.
Well Installation	D	None required, unless dust exceeds action level	Hard hat	Leather work gloves, as needed	Work uniform or Tyvek® coveralls	Steel-toe, boots	N/A	Safety glasses	Protection when noise levels exceed 84 dBA	Fall protection for work above 6-foot level. Reflective safety vests.

TABLE C.6-1

PERSONAL PROTECTIVE EQUIPMENT

Task	EPA Level	Respiratory Protection	Head	Hand	Clothing	Boots	Face	Eye	Hearing	Additional
Decontamination	D mod	None required, unless dust exceeds action level	Hard hat	Nitrile gloves, leather gloves as needed	Tyvek® coveralls for dry materials, Polyethylene-coated Tyvek® coveralls	Steel-toe boots for dry materials, Tyvek® booties. For wet materials, use PVC, latex or rubber boot covers	N/A	Safety glasses	Protection when noise levels exceed 84 dBA	Fall protection for work above 6-foot level. Reflective safety vests.
Waste management	D mod	None required, unless dust exceeds action level	Hard hat	Nitrile gloves, leather work gloves	Tyvek® coveralls	Steel-toe boots, Tyvek® booties unless liquids are present	N/A	Safety glasses	Protection when noise levels exceed 84 dBA	Fall protection for work above 6-foot level. Reflective safety vests.

Notes:
dBA – decibels, A-scale
EPA – U.S. Environmental Protection Agency
N/A – not applicable
USCG – U.S. Coast Guard

TABLE C.12-1

EMERGENCY INFORMATION

REPORT ALL FIRES, SERIOUS INJURY, OR UNCONTROLLED SPILLS IMMEDIATELY: 911 (CALL WILL ROUTE TO CALIFORNIA HIGHWAY PATROL IN VALLEJO ON A CELL PHONE)

Hospital:	Alameda Hospital (510) 522-3700 2070 Clinton Avenue Alameda, CA			
Directions:	Starting at the front of the base, turn left on Ranger Avenue. Turn right on Lexington and left on Navy Way. Take Navy Way to Main Street and turn right. Continue to Central Avenue. Central Avenue becomes CA/61. Continue on to CA/61 to Chestnut Street and turn left onto Clinton.			
Clinic:	Concentra Medical Center (510) 465-9565 384 Embarcadero W Oakland, CA			
Directions:	From Atlantic, turn left onto SR-61 (Webster Street) for 0.6 miles. Bear right onto Posey Tube for 0.6 miles and continue north on Harrison Street for about 150 yards. Turn left onto 6th Street for about 200 yards, left onto Broadway Street for 0.3 miles, and right onto West Embarcadero for 80 yards to Concentra Medical Clinic.			
Fire/Police/EMS:	911 This number will connect you to emergency dispatch. ***911 calls from a cell phone do not go directly to base emergency services, but through the California Highway Patrol.*** **If using a cell phone, call Alameda Fire Dispatch directly at (925) 447-4257.**			
TtEC Contacts:	Project Manager Pete Everds (619) 471-3504	PESM (CIH) Roger Margotto (619) 471-3503 cell: (619) 988-0520	Project SHSS Richard Quinn, CSP Cell: (650) 450-1969	
RPM:	Steve Peck, (619) 532-0786			
ROICC:	Gregory Grace, (510) 749-5940			
National Poison Referral Center	(800) 222-1222			
Poison Control Center:	California Poison Control System, Central Office University of California, San Francisco School of Pharmacy, Box 1262 San Francisco, CA 94143 Emergency Phone: (800) 876-4766 (All of CA)			

TABLE C.12-1

EMERGENCY INFORMATION

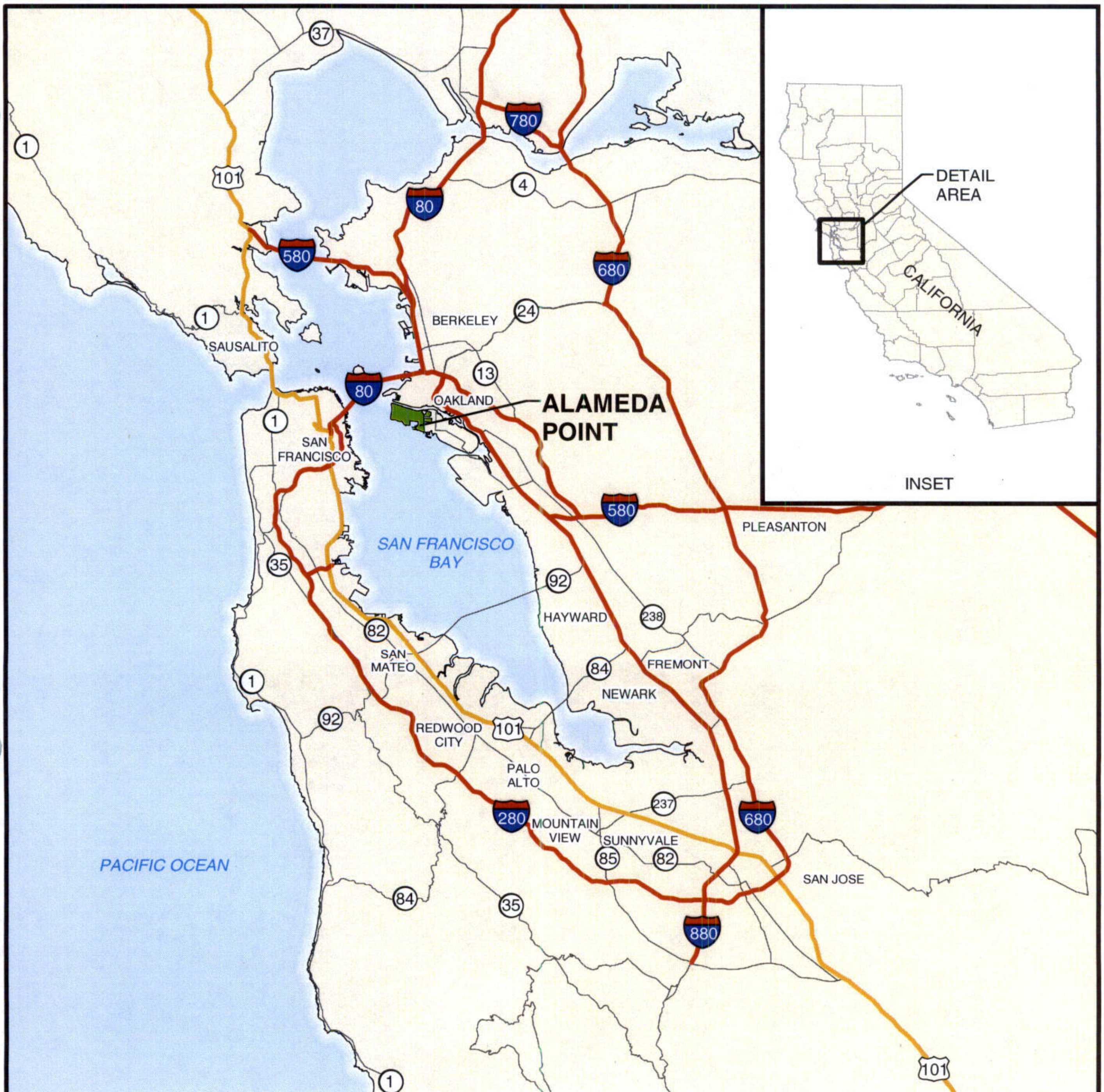
CHEMTREC:	(800) 424-9300
National Response Center:	(800) 424-8802
RCRA Hotline:	(800) 424-9346

Abbreviations and Acronyms:

CIH – Certified Industrial Hygienist
CSP – Certified Safety Professional
EMS -- Emergency Medical Services
PESM – Project Environmental Safety Manager
RCRA – Resource Conservation and Recovery Act
ROICC – Resident Officer in Charge of Construction
RPM – Remedial Project Manager
SHSS – Site Health and Safety Specialist
TtEC – Tetra Tech EC, Inc.

FIGURES

This page intentionally left blank.



LEGEND

- STATE HIGHWAY
- US HIGHWAY
- INTERSTATE HIGHWAY
- ALAMEDA POINT
- WATER

NOTE:

OU - OPERABLE UNIT

5 0 5 10 Miles

Scale: 1" = 10 Miles

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

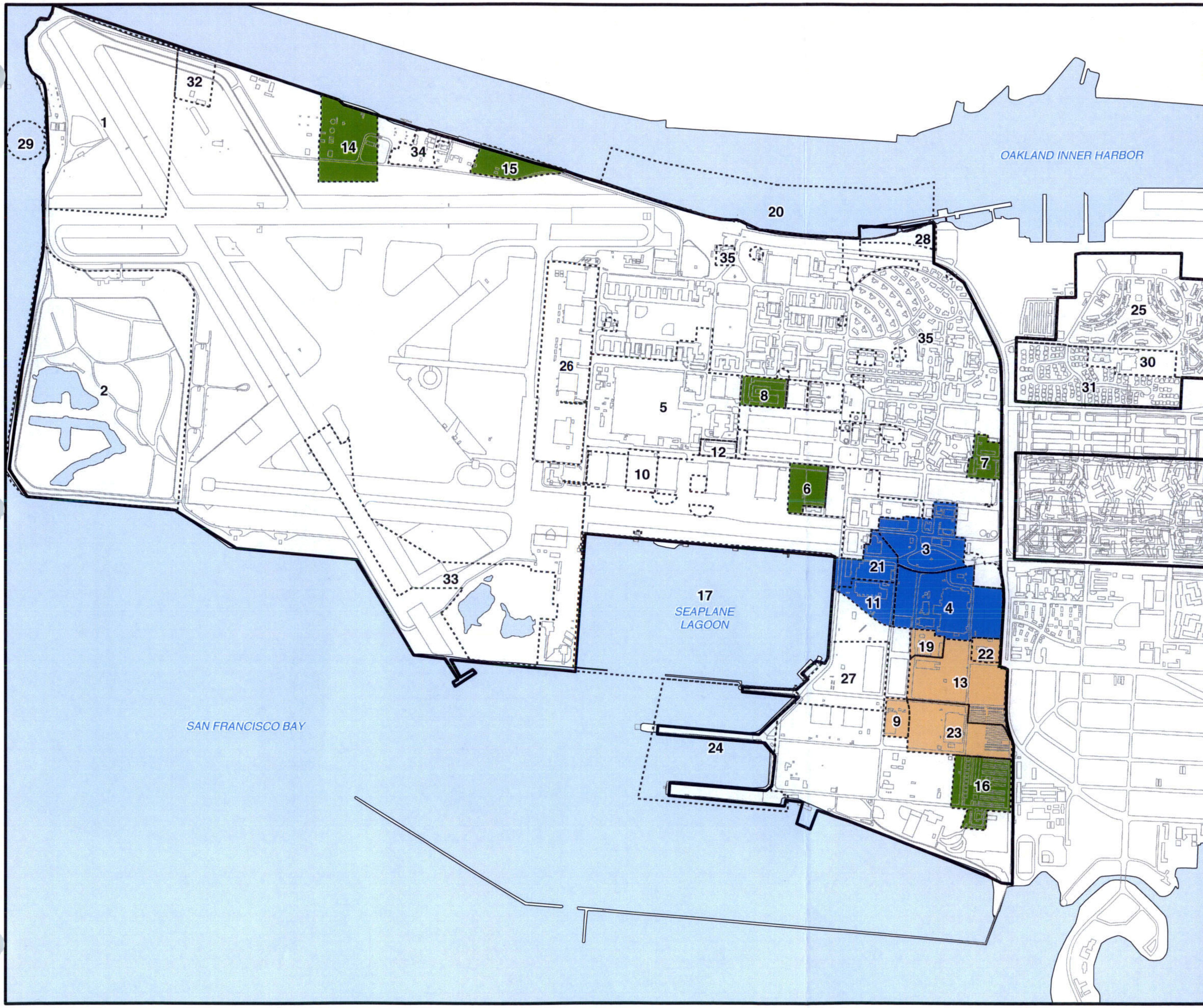
DRAFT FINAL SITE HEALTH AND SAFETY PLAN
FOR OU-1, OU-2A, AND OU-2B DATA GAP SAMPLING

FIGURE C.1-1

REGIONAL LOCATION MAP
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: GFG
DCN: ECSD-2201-0012-0002
FILE NUMBER: 071004R1964.mxd

TETRA TECH EC, INC.



LEGEND

- ROAD/RUNWAY/BUILDING
- SITE BOUNDARY AND SITE NUMBER
- OPERABLE UNIT 1
- OPERABLE UNIT 2A
- OPERABLE UNIT 2B
- ALAMEDA POINT BOUNDARY
- WATER

NOTE:

OU- OPERABLE UNIT

600 0 600 1,200 Feet

Scale: 1" = 1200'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

DRAFT FINAL SITE HEALTH AND SAFETY PLAN
FOR OU-1, OU-2A, AND OU-2B DATA GAP SAMPLING

FIGURE C.1-2

SITE LOCATION MAP

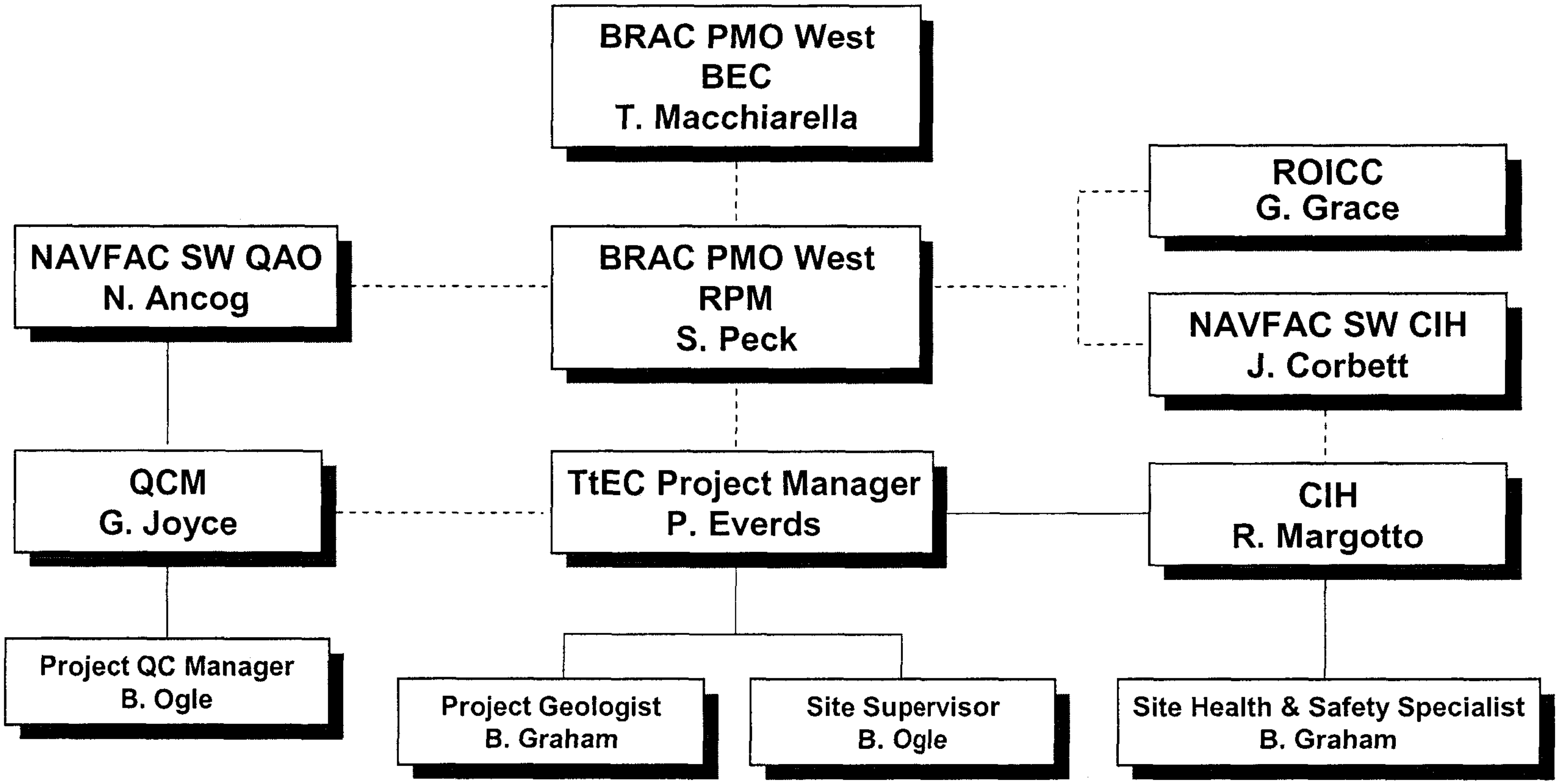
ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: GFG
DCN: ECSD-2201-0012-0002
FILE NUMBER: 071004S1965.mxd

TETRA TECH EC, INC.

Figure C.2-1

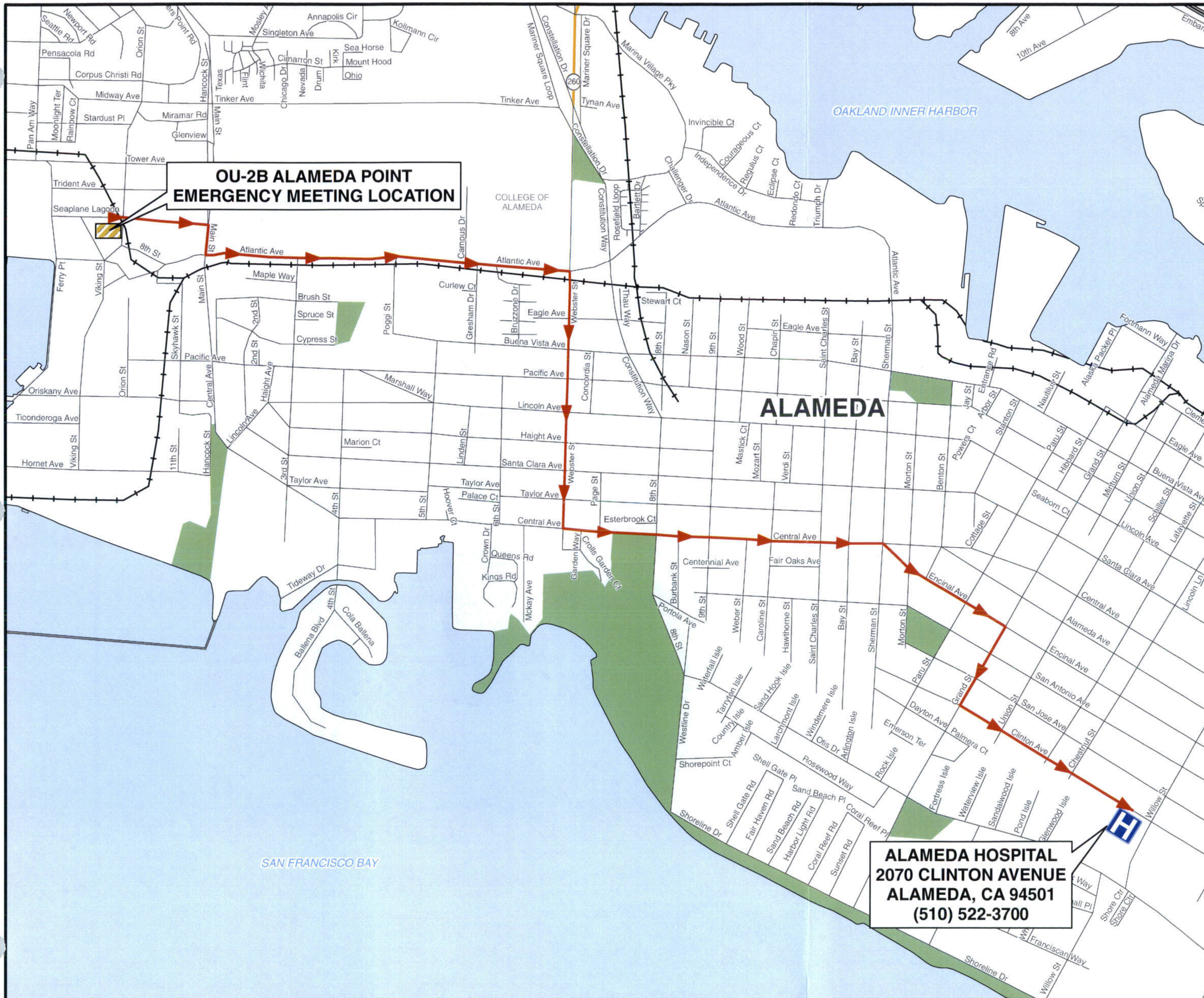
Project Organization Chart



Legend

------- = In regular contact and coordination

——— = Directly reports to above



LEGEND

- HOSPITAL ROUTE
- ROAD
- HIGHWAY
- RAILROAD
- BUILDING 112/EMERGENCY LOCATION
- PARK
- WATER

NOTE:

OU - OPERABLE UNIT

HOSPITAL DIRECTIONS:

EXIT EAST OUT OF SITE TRAVELING ON SEAPLANE LAGOON TOWARDS MAIN STREET. TURN RIGHT ON MAIN STREET HEADING SOUTH. TURN LEFT ONTO ATLANTIC AVENUE. TURN RIGHT ONTO WEBSTER STREET HEADING SOUTH TO CENTRAL AVENUE. TURN LEFT ONTO CENTRAL AVENUE HEADING EAST TO ENCINAL AVENUE. MAKE SLIGHT RIGHT ONTO ENCINAL AVENUE HEADING SOUTHEAST TO GRAND STREET. TURN RIGHT ON GRAND STREET HEADING SOUTHWEST TO CLINTON AVENUE. TURN LEFT ONTO CLINTON AVENUE HEADING SOUTHEAST TO ALAMEDA HOSPITAL (2070 CLINTON AVENUE).

600 0 600 1,200 Feet

Scale: 1" = 1200'

N

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

DRAFT FINAL SITE HEALTH AND SAFETY PLAN
FOR OU-1, OU-2A, AND OU-2B DATA GAP SAMPLING

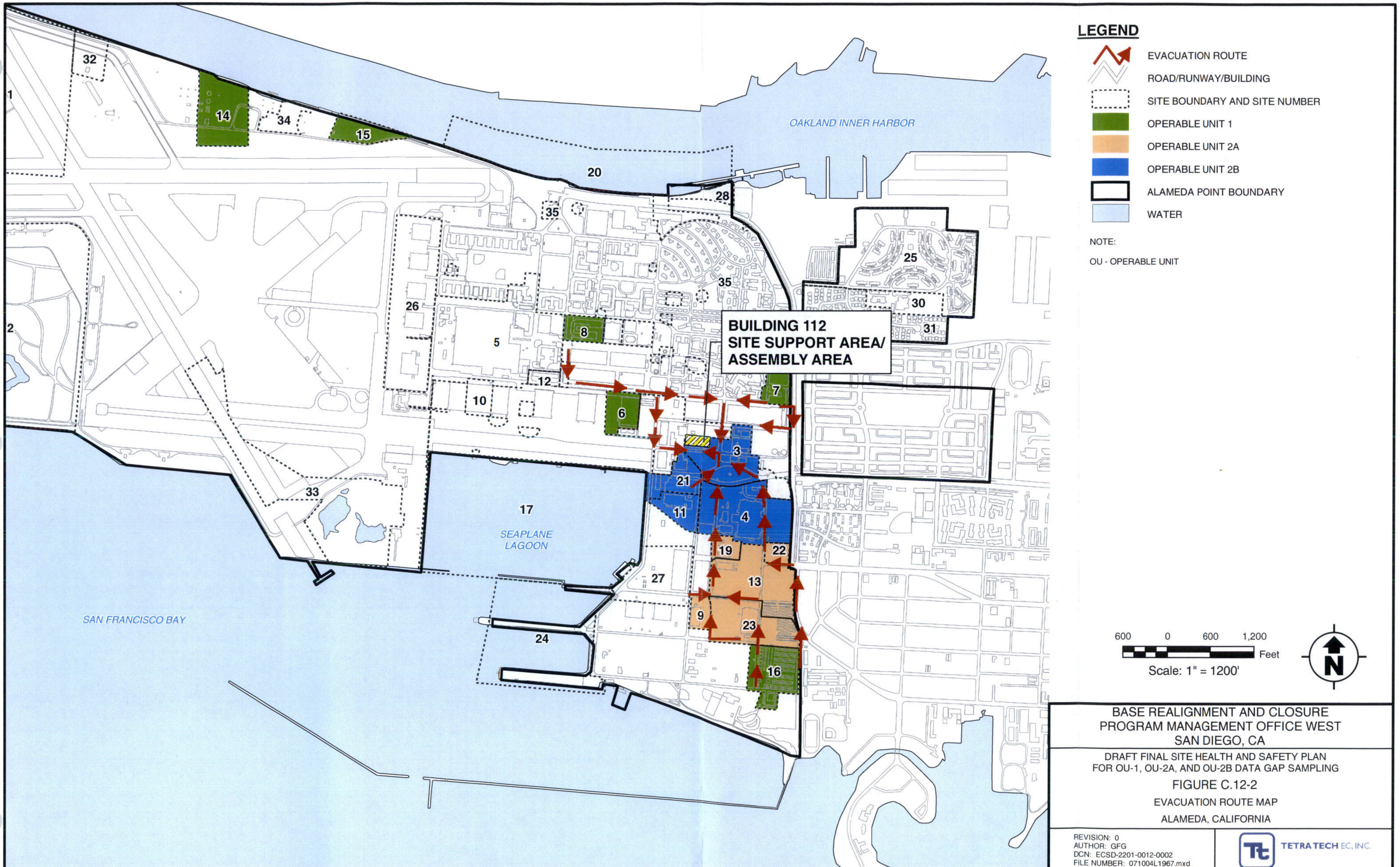
FIGURE C.12-1

HOSPITAL ROUTE MAP

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: GFG
DCN: ECSD-2201-0012-0002
FILE NUMBER: 071004L1966.mxd

TETRA TECH EC, INC.



BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

DRAFT FINAL SITE HEALTH AND SAFETY PLAN
FOR OU-1, OU-2A, AND OU-2B DATA GAP SAMPLING

FIGURE C.12-2

EVACUATION ROUTE MAP

ALAMEDA, CALIFORNIA

REVISION: 0
AUTHOR: GFG
DCN: ECSD-2201-0012-0002
FILE NUMBER: 071004L1967.mxd

TETRA TECH EC, INC.

ATTACHMENT 1

ACTIVITY HAZARD ANALYSES

This page intentionally left blank.

ACTIVITY HAZARD ANALYSIS (AHA) #1
Mobilization and Site Setup

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principle Steps	Potential Safety/ Health Hazards	Recommended Controls
1. Coordinate with Base for notification of residents and businesses.	Failure to coordinate could cause lack of access, poor community relations, potential safety encounters	Validate that coordination has been performed. Have cards printed up with contact information in case any worker is approached by a nearby resident with questions.
2. Set up work areas.	Workers could be exposed to chemical hazards.	Delineate exclusion zones and use PPE as required by type of material being used. Refer to MSDSs. Ambient air monitoring and visual observation will be used to verify selection of PPE. Identify all chemical hazards and receive training (MSDSs) regarding safe handling of chemicals. The SHSS will file copies of all MSDSs at site.
	Noise from site setup could cause hearing loss.	Hearing protection is required when sound levels exceed 85 dBA continuously. Usually this will only be for workers working in unenclosed cabs of heavy equipment or ground workers working near heavy equipment.
	Slip, trip, and fall hazards could be present.	Visually inspect work areas and work, barricade, or eliminate slip, trip, and fall hazards, if feasible. Keep work area neat and orderly. Always place supplies in areas away from normal foot traffic and equipment and tools in a safe location that does not present a trip hazard to nearby workers. Maintain proper illumination in all work areas. Work is authorized normally during daylight hours only. Refer to EHS Procedure 3-8, Fall Protection.
	Sharp objects could cause punctures.	Wear cut-resistant work gloves when sharp edges or other objects may cause the possibility of lacerations or other injury. When possible, blunt sharp edges. Workers should not stand or walk on equipment or supplies.
	Strains from manually moving materials and equipment could occur.	Direct personnel to use proper lifting techniques such as keeping the back straight, lifting with the legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Encourage the use of a hand truck. Employees will not lift more than 50 pounds. Obtain assistance from another worker or use a mechanical device. Refer to EHS Procedure 3-1, Ergonomics.
	Workers could be exposed to extreme temperatures.	Monitor for heat stress in accordance with EHS Procedure 4-6, Temperature Extremes. Provide fluids and rest breaks during warm weather and while wearing impermeable protective clothing.

ACTIVITY HAZARD ANALYSIS (AHA) #1
Mobilization and Site Setup

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principle Steps	Potential Safety/ Health Hazards	Recommended Controls
Set up work areas (continued).	Eye hazards could be present.	Safety glasses are the minimum required eye protection for all work areas.
	Electrocution could occur from generator used to power site trailer or power tools.	Only qualified electricians are allowed to hook up or disconnect electrical circuits. Follow lock-out/tag-out protocols. Inspect all extension cords daily for structural integrity, ground continuity, and damaged areas. Extension cord must be rated for hard usage or extra hard usage (Table 400-4, National Electrical Code). Inspect extension cord connection. Use GFCIs on all outdoor 115- to 120-volt, 20-ampere or less circuits. Elevate or cover electric wire or flexible cord passing through work area to protect it from damage by foot traffic, vehicles, sharp corners, projections, or pinching (cover only in accordance with National Electrical Code requirements). Keep plugs and receptacles out of water, unless they are approved, submersible types. Ground all electrical circuits in accordance with the National Electrical Code or other applicable standards and regulations. If a generator is used, be sure it is a type that does not require grounding. If it requires grounding, follow manufacturer's directions. National Electrical Code 250-6 lists the exceptions for grounding portable and vehicle-mounted generators.
	Lack of communication in widely dispersed areas could lead to delayed response in an emergency.	Ensure that each work team has a telephone or access to a telephone for communication. In addition, workers must have a 2-way radio that can contact someone who has access to a phone if they are not in line of sight of other workers. If more than one team at a time is working, ensure that there is communication between the work teams and project management. Use the buddy system.
	Workers could be struck by or against heavy equipment.	Wear high-visibility reflective vests when exposed to vehicle traffic. Make eye contact with operators before approaching equipment. Understand and review posted hand signals. Use traffic barricades, signs, flags, and backup spotters during field activities.
3. Install barricades and other support structures.	Improper use of power and hand tools could cause injury or damage tools.	Inspect all tools before each use. Train personnel in the proper use of hand tools. ground all power tools or protect by GFCI, or double-insulation.
	Material handling could cause injury.	Identify and avoid pinch points. Maintain communication with others involved in material handling. Use appropriate PPE.

ACTIVITY HAZARD ANALYSIS (AHA) #1
Mobilization and Site Setup

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principle Steps	Potential Safety/ Health Hazards	Recommended Controls
Install barricades and other support structures (continued).	Strains from handling materials could occur.	Direct personnel to use proper lifting techniques such as keeping the back straight, lifting with the legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Encourage use of hand trucks and steady pace of work. Refer to EHS Procedure 3-1, Ergonomics.

Equipment to be Used	Inspection Requirements	Training Requirements
Heavy equipment, hand tools	Daily and before use. Use form provided in plan.	Only trained equipment operators may operate heavy equipment; only Department of Motor Vehicles-licensed personnel will operate trucks. Specific training for power tools, hand tools, and electrical safety is required.

Abbreviations and Acronyms:

CIH – Certified Industrial Hygienist
CSP – Certified Safety Professional
dBA – decibels, A-scale
EHS – Environmental Health and Safety
GFCI – ground fault circuit interrupter
MSDS – Material Safety Data Sheet
PPE – personal protective equipment
SHSS – Site Health and Safety Supervisor

This page intentionally left blank.

ACTIVITY HAZARD ANALYSIS (AHA) #2
Geophysical Survey

Analyzed By/Date: R. Margotto, CIH, CSP 06/17/06

Principle Steps	Potential Safety/ Health Hazards	Recommended Controls
1. Conduct geophysical survey.	Slips, trips, and falls, could occur.	Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards, if feasible. Use care in work area; look for depressions and obstructions. Allow employees to work only on walking/working surfaces that have the strength and integrity to support employees safely. Look out for ground squirrel holes. Cover and mark openings 18 inches or more in diameter. Mark or barricade all openings less than 18 inches in diameter.
	Heat exhaustion or stroke could occur.	Implement heat stress prevention under guidelines established in EHS 4-6 Temperature Extremes.
	Workers could be struck by vehicles in traffic area.	Wear high-visibility reflective vest. Post an observer, as needed, when surveyor is using instruments. (A surveyor is often focused on the task and may not be aware of nearby traffic.) Use traffic control or barricades, if necessary, to keep traffic away from workers.
	Handling of instruments can cause strain to workers.	Carry instruments as required by the manufacturer of the instrument. Use straps when provided and adjust for comfort. Use care when walking so that there are no sudden jerks or missteps that can cause the worker to strain to maintain control of the instrument. Get assistance from other workers if several instruments must be carried.
	Use of spray paint to mark underground utilities and anomalies could expose employees to paint fumes or the paint itself.	Follow manufacturers' instructions on use of paint. Review MSDS. Never point paint toward another person.

Equipment to be Used	Inspection Requirements	Training Requirements
Vehicles, equipment, hand tools.	Daily and before use. Use the equipment safety checklist found in the Base-Wide Plan.	Only Department of Motor Vehicles-licensed personnel will operate vehicles. Specific training for power tools, hand tools, and use of survey instruments will be provided.

Abbreviations and Acronyms:

CIH – Certified Industrial Hygienist
CSP – Certified Safety Professional
EHS – Environmental Health and Safety
MSDS – Material Safety Data Sheet

This page intentionally left blank.

ACTIVITY HAZARD ANALYSIS (AHA) #3
Direct-Push Technology Soil Boring

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principle Steps	Potential Safety/ Health Hazards	Recommended Controls
1. Park contractor vehicle carrying drill rig and equipment.	Vehicle could hit someone or something.	Use spotters when positioning vehicle if needed. Ensure spotters know how to communicate with driver of vehicle.
2. Unload equipment and materials.	Load could have shifted during transport or be poorly tied down, causing load to be unstable.	If load has shifted or tie-downs are poorly installed, do not stand near truck or load. If necessary, remove each tie-down carefully and position heavy equipment on side where tie-down is being removed to prevent load from falling on that side.
	Lifting of equipment and materials from vehicle could cause strain to workers.	Use proper lifting techniques such as keeping the back straight, lifting with the legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Cuts and abrasions could occur while moving equipment and materials.	Use leather gloves when moving objects with sharp contact points.
	Slip, trip, and fall hazards could be present.	Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards. Only work on walking/working surfaces that have the strength and integrity to support employees safely. Cover and mark openings 18 inches or more in diameter. Mark or barricade all openings less than 18 inches in diameter and all holes.
3. Inspect DPT rig.	Improper inspection of rig could cause workers to be exposed to hazards associated with operating mechanical devices.	Ensure that rig and all associated equipment are inspected by a competent person and that rig is in safe operating condition. Inspect equipment, including brakes, tire pressure, cables, and hydraulic and pneumatic hoses, before use and at start of each shift. Tag and remove from service faulty or unsafe equipment. Verify that emergency shutdown system is clearly marked, and location is known by all site workers. Verify that shutdown system works properly when trip wire is pulled or pushed. Implement EHS 6-2. Operator's manual must be available and reviewed prior to operation. (Note: a DPT rig does not have a rotating auger.)
4. Ensure area has been surveyed for underground utilities and obstructions.	Since hand augering first 5 feet is not possible for soil gas surveys it is possible that an underground utility or obstruction could be hit.	Observe all markings from USA, the geophysical survey, and from use of reviewed drawings. Be prepared to respond to contact with an underground obstruction; pull back on rig immediately. Ensure that rig is grounded.
	Slip, trip, and fall hazards could be present due to boreholes.	Protect all open boreholes. All boreholes will be filled before end of day.
	Workers could be struck by site vehicles or rig when it is moved.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Barricade and mark bore hole sites for visibility.

ACTIVITY HAZARD ANALYSIS (AHA) #3
Direct-Push Technology Soil Boring

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principle Steps	Potential Safety/ Health Hazards	Recommended Controls
5. Position and set up DPT rig and associated equipment.	Failure to review site layout plan could cause exposure to potential hazards such as electrocution, damaging of underground utilities, or tipping rig over in unstable soil conditions.	Do not move DPT rig into any work area until site layout plan has been completed and route of travel to any work site has been assessed for hazards (overhead lines and stability of roads and ground). At the pre-activity safety briefing, discuss site layout plan and analysis of route of travel, along with AHAs. Do not place rig within 15 feet of any overhead electrical lines. Use a spotter for positioning as necessary.
	Rig could contact overhead lines if transported with mast raised, causing electric shock.	Never move rig when mast is extended.
	Worker could become pinned between rig and other truck components, or worker could be pinned under rig if rig is serviced from under the truck.	When any part of rig or equipment is in motion, stand far enough away from moving parts to avoid being pinned between moving parts. Do not work under rig or truck while rig is supported by lifting jacks. If work must be done under rig or truck, drill crew supervisor must contact SHSS to ascertain a safe method for lockout of equipment to ensure that adequate blocking is installed.
	High winds could destabilize rig. Mast could act as a conductor during a thunderstorm.	Check weather conditions and forecasts to determine if conditions are acceptable for use of rig. Do not operate rig if winds exceed manufacturer's recommended tolerances.
	Worker could experience strain from use of tools.	Inspect all tools for damage before use. Do not use damaged tools (mark and tag "out of service"). Maintain steady pace and follow rest periods given on job. Select hand tools to minimize following stressors: chronic muscle contraction or steady force; extreme or awkward finger/hand/arm positions; repetitive forceful motions; or excessive gripping, pinching, or pressing with hands and fingers.
	Workers could be exposed to chemical contaminants.	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Remove PPE properly and wash hands.
	Worker could be exposed to noise.	Wear earplugs whenever drill rig is in operation, if necessary.
	Worker could be exposed to pinch points.	Avoid placing hands close to moving machinery. Wear leather gloves, as appropriate. (Do not wear gloves when near moving parts as gloves or clothing may become entangled in the moving part.)

ACTIVITY HAZARD ANALYSIS (AHA) #3
Direct-Push Technology Soil Boring

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principle Steps	Potential Safety/ Health Hazards	Recommended Controls
6. Start up rig and perform borings. Insert sampling assembly.	Electrocutions, explosions, disastrous events, etc. could occur.	Obtain and examine copies of all pertinent drawings prior to performing this task. Locate and mark existing underground utilities using universal marking codes. Obtain Underground Service Alert clearance (800-642-2444) prior to work. Inspect the area of DPT activity for overhead obstructions. Contact service facility engineer before working near utilities. Ensure that weight of rig is evenly distributed on ground and is not so heavy as to damage any underground lines that may be near the surface (e.g., shallow buried PVC lines).
	Pressurized hydraulic lines could rupture, causing release of hot hydraulic fluid. Hot fluid could ignite if contact is made with engine, burn workers, and cause environmental contamination.	Ensure that personnel are trained in use of DPT equipment. Inspect all hydraulic lines before placing rig in service. Any damaged hoses or connections must be replaced before unit is used. Immediately shut down equipment if lines rupture. Ensure that first aid kit is readily available to treat injured workers. Ensure that a 20-pound dry chemical ABC fire extinguisher is readily available. Ensure that a spill control kit is available at drilling location. If rupture occurs, as quickly as possible, berm the liquid to minimize the area over which the liquid spreads. Ensure that all pressurized lines have whip checks.
	Air hoses or hydraulic hoses under pressure could suddenly release, whip, and hit workers causing severe injury.	Do not disconnect air hoses and compressors until hose line has been bled. Visually inspect all connections of any lines under pressure. Use safety clamps (whip checks) to connect each side of connection to other if connection breaks (safety clamps will keep hoses from whipping under sudden release of pressure). Tie back or attach hoses wherever possible to minimize length of hose that could whip around if there is sudden release of pressure.
	Worker could be exposed to chemical agents or contaminants.	Verify selection of PPE with ambient air/visual monitoring. Review all MSDSs. Decontaminate DPT implements after use (or cover contaminated parts when moving to the next bore hole site). Avoid exposure to dust. Use dust control as necessary and possible. Drum and label all decontamination fluids. Determine if PPE is contaminated (based on exposure to contaminants) and place contaminated PPE in a separate, properly labeled, container. Discard other PPE as approved by the Project Manager and PESM.

ACTIVITY HAZARD ANALYSIS (AHA) #3
Direct-Push Technology Soil Boring

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principle Steps	Potential Safety/ Health Hazards	Recommended Controls
Start-up rig and perform borings. Insert sampling assembly (continued).	Workers could place hands into moving parts of rig, or loose clothing could become entangled in moving machine parts, either of which could injure workers.	Guard all chains, sprockets, and moving parts. Do not wear loose clothing or any jewelry. Ensure that operator verbally alerts all workers and visually verifies that all workers are clear of dangerous parts of equipment before starting or engaging equipment.
	Workers could be exposed to noise.	Wear earplugs whenever rig is in operation, if necessary.
7. Remove boring rod and lift sampling assembly. Move to new sampling location.	Workers could be exposed to pinch points.	Avoid placing hands close to moving machinery. Wear gloves, as appropriate. Keep constantly alert.
	Lifting of sampling assembly could cause strain to workers.	Use proper lifting techniques such as keeping the back straight, lifting with the legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment.
8. Field screen bore hole with PID.	Workers could be exposed to chemical contaminants.	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Remove PPE properly and wash hands.
9. Pour bentonite into borehole to seal.	Workers could come into contact with dust.	Avoid spills. Wear designated PPE. Remove PPE properly and wash hands. Avoid generating dust. Review MSDS for bentonite. If high in silica content, wear dust mask when handling dry bentonite.
	Lifting of materials could cause strain to workers.	Use proper lifting techniques such as keeping the back straight, lifting with the legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
10. Decontaminate all reusable materials and equipment.	Workers could come into contact with contaminants.	Avoid spills. Wear designated PPE. Remove PPE properly and wash hands.
	Lifting of equipment and materials could cause strain to workers.	Use proper lifting techniques such as keeping the back straight, lifting with the legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Workers could be exposed to chemical contaminants.	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Remove PPE properly and wash hands.

ACTIVITY HAZARD ANALYSIS (AHA) #3
Direct-Push Technology Soil Boring

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principle Steps	Potential Safety/ Health Hazards	Recommended Controls
Decontaminate all reusable materials and equipment (continued).	Decontamination area may become slippery.	Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards as feasible. Maintain proper illumination in all work areas. If decontaminating on plastic sheeting, use caution since plastic sheeting is extremely slippery. Wear boots with good traction.
	Use of pressure washer could cause injury to workers.	Refer to AHA on pressure washer use. (AHA 4)

Equipment to be Used	Inspection Requirements	Training Requirements
DPT Rig	Daily or before use. Use inspection form for drilling rigs.	Only trained equipment operators may operate rig. Operator's manual to be reviewed by operators and manual maintained on site.
Vehicles	Daily and before use.	All drivers must have valid driver's license.
Hand tools – basic screwdrivers, hammers, pliers, etc.	Inspect hand tools before each use following manufacturers' requirements. Discard or tag as out-of-service any damaged tools. Do not use power tools that have frayed cords or exposed wiring. All power tools must have a grounding plug or be double insulated.	Personnel must have reviewed operators' manual and have been trained on power tools. Only qualified person will operate generator or compressor, if used.

Abbreviations and Acronyms:

CIH – Certified Industrial Hygienist
CSP – Certified Safety Professional
DPT – Direct Push Technology
MSDS – Material Safety Data Sheet
PESM – Project Environmental Safety Manager
PID – photoionization detector
PPE – Personal Protective Equipment
PVC – polyvinyl chloride
SHSP – Site Health and Safety Plan

This page intentionally left blank.

ACTIVITY HAZARD ANALYSIS (AHA) #4
Cone Penetrometer Soil Sampling

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principal Steps	Potential Safety/ Hazard Hazards	Recommended Controls
1. Pre-survey area that CPT rig will drive over.	Vehicle could run over unstable surface ground or hazards.	Mark all physical hazards. The CPT unit is mounted to truck and does not bear significant weight like a drill rig. Ensure that areas where hydraulic lifts are placed are stable.
2. Pre-survey area to ensure that underground locator services have marked utilities and that as-built drawings have been reviewed.	Underground utilities – could cause release of gas, water; electrocution if an underground power line is struck; damage to communication lines.	Verify that there are no utilities, especially PVC water lines that are often placed in some concrete pads and lead shield electrical service lines. Review drawings, nearby utility connections, and scan, locate, and mark. Underground Service Alert should have already been contacted and area marked based on previous site activities.
3. Park contractor vehicle carrying CPT and equipment.	Vehicle could hit someone or something.	Use spotters when positioning vehicle if needed. Ensure that spotters know how to communicate with driver of vehicle.
4. Unload equipment and materials.	Load could have shifted during transport or be poorly tied down, causing load to be unstable.	If load has shifted or tie-downs are poorly installed, do not stand near truck or load. If necessary, remove each tie-down carefully and position heavy equipment on side where tie-down is being removed to prevent load from falling on that side.
	Lifting of equipment and materials from vehicle could cause strain to workers.	Use proper lifting techniques such as keeping the back straight, lifting with the legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Cuts and abrasions could occur while moving equipment and materials.	Use leather gloves when moving objects with sharp contact points.
	Slip, trip, and fall hazards could be present.	Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards. Only work on walking/working surfaces that have the strength and integrity to support employees safely. Openings 18 inches or more in diameter must be covered and marked. All openings less than 18 inches in diameter and all holes must be marked or barricaded.

ACTIVITY HAZARD ANALYSIS (AHA) #4
Cone Penetrometer Soil Sampling

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principal Steps	Potential Safety/ Hazard Hazards	Recommended Controls
5. Inspect CPT unit.	Improper inspection of truck and unit could cause workers to be exposed to hazards associated with operating mechanical devices.	Ensure that CPT unit and all associated equipment are inspected by a competent person and that unit is in safe operating condition. Equipment is mounted to a truck. Inspect equipment, including brakes, tire pressure, cables, and hydraulic and pneumatic hoses, before use and at start of each shift. Tag and remove from service faulty or unsafe equipment. Verify that emergency shutdown system is clearly marked, and location is known by all site workers. Verify that shutdown system works properly when trip wire or switch is pulled or pushed and that there are two shut-off switches. Operator's manual must be available and reviewed prior to operation. (Note: a CPT unit does not have a rotating auger. In fact the unit "sits" over the hole to bored.)
6. Survey area for borehole locations that may have already been marked or cored.	Slip, trip, and fall hazards could be present due to boreholes.	Protect all open boreholes. All boreholes will be filled before end of day.
	Workers could be struck by site vehicles or CPT vehicle when it is moved.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Barricade and mark bore hole sites for visibility.
7. Position and set up CPT vehicle and associated equipment.	Failure to review site layout plan could cause exposure to potential hazards such as electrocution, damaging of underground utilities, or tipping CPT vehicle over in unstable soil conditions.	Do not move CPT vehicle into any work area until site layout plan has been completed and route of travel to any work site has been assessed for hazards (stability of roads and ground). Ensure ground under each lift is stable. Consider use of cribbing if necessary. At the pre-activity safety briefing, discuss site layout plan and analysis of route of travel, along with AHAs. Usually unit is not tall enough to come within 15 feet of any overhead electrical lines, but verify this. Use a spotter for positioning as necessary. As a precaution, never move CPT vehicle if any part can come into contact with or within 15 feet of an overhead power line.
	Workers could slip on stairs when climbing on to unit.	Watch step when climbing stairs. Do not carry anything when climbing stairs. (Put objects on platform from the ground level.) Ensure that stairs are free of anything that could make them slippery (e.g., mud).
	Workers could become pinned between unit and other truck components, or workers could be pinned under the CPT if the vehicle is serviced from under the truck.	When any part of equipment is in motion, stand far enough away from moving parts to avoid being pinned between moving parts. Do not work under unit if it is supported by lifting jacks. If work must be done under CPT vehicle, drill crew supervisor must contact SHSS to ascertain a safe method for lockout of equipment to ensure that adequate blocking is installed.

ACTIVITY HAZARD ANALYSIS (AHA) #4
Cone Penetrometer Soil Sampling

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principal Steps	Potential Safety/ Hazard Hazards	Recommended Controls
Position and set up CPT vehicle and associated equipment (continued).	Workers could experience strain from use of tools.	Inspect all tools for damage before use. Do not use damaged tools (mark and tag "out of service"). Maintain steady pace and follow rest periods given on job. Select hand tools to minimize following stressors: chronic muscle contraction or steady force; extreme or awkward finger/hand/arm positions; repetitive forceful motions; or excessive gripping, pinching, or pressing with hands and fingers.
	Workers could be exposed to chemical contaminants.	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Remove PPE properly and wash hands.
	Workers could be exposed to noise.	Wear earplugs whenever drill rig is in operation, if necessary.
	Workers could be exposed to pinch points.	Avoid placing hands close to moving machinery. Wear leather gloves, as appropriate. (Do not wear gloves when near moving parts as gloves or clothing may become entangled in the moving part.)
8. Start-up CPT unit and perform drilling.	Unqualified operators and personnel in the area could have no knowledgeable of drilling hazards.	Ensure that personnel are trained in use of drilling equipment. Ensure that the operator has current certifications to operate the equipment. Ensure that a 20-pound dry chemical ABC fire extinguisher is readily available. Ensure that a spill-control kit is available at drilling location. Ensure that there is a first-aid kit, eyewash, and an emergency air horn nearby.
	Pressurized hydraulic lines could rupture, causing release of hot hydraulic fluid. Hot fluid could ignite if contact is made with engine, burn workers, and cause environmental contamination.	Inspect all hydraulic lines before placing rig in service. Any damaged hoses or connections must be replaced before unit is used. Immediately shut down equipment if lines rupture. Ensure that a 20-pound dry chemical ABC fire extinguisher is readily available. If rupture occurs, as quickly as possible, berm the liquid to minimize the area over which the liquid spreads. Ensure that all pressurized lines have whip checks.
	Air hoses or hydraulic hoses under pressure could suddenly release, whip, and hit workers causing severe injury.	Do not disconnect air hoses and compressors until hose line has been bled. Visually inspect all connections of any lines under pressure. Use safety clamps (whip checks) to connect each side of connection to other if connection breaks (safety clamps will keep hoses from whipping under sudden release of pressure). Tie back or attach hoses wherever possible to minimize length of hose that could whip around if there is sudden release of pressure.

ACTIVITY HAZARD ANALYSIS (AHA) #4
Cone Penetrometer Soil Sampling

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principal Steps	Potential Safety/ Hazard Hazards	Recommended Controls
Start-up CPT unit and perform drilling (continued).	Workers could be exposed to chemical agents or contaminants.	Verify selection of PPE with ambient air/visual monitoring. Usually PPE consists of Level "D", hard hat steel to boots and safety glasses. Review all MSDSs. Decontaminate CPT implements after use (or cover contaminated parts when moving to the next bore hole site). Avoid exposure to dust. Use dust control as necessary and possible. Drum and label all decontamination fluids. Determine if PPE is contaminated (based on exposure to contaminants) and place contaminated PPE in a separate, properly labeled, container. Discard other PPE as approved by the Project Manager and PESM.
	Workers could place hands into moving parts of unit or loose clothing could become entangled in moving machine parts, either of which could injure workers.	Guard all chains, sprockets, and moving parts. Do not wear long hair, loose clothing or any jewelry. Ensure that operator verbally alerts all workers and visually verifies that all workers are clear of dangerous parts of equipment before starting or engaging equipment. Ensure that guards are in place.
	Workers could be exposed to noise.	Wear earplugs whenever unit is in operation, if necessary.
9. Remove boring rods and cone to collect soil sample and lift assembly.	Workers could be exposed to pinch points.	Avoid placing hands close to moving machinery. Wear gloves, as appropriate. Keep constantly alert.
	Lifting of assembly with samples could cause strain to workers.	Use proper lifting techniques such as keeping the back straight, lifting with the legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment.
	Workers could be exposed to chemical contaminants in soil (it is anticipated that there will be no contaminants).	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring (PID) will determine selection of PPE and respiratory protection. Remove PPE properly and wash hands.
10. Place soil sample into collection container.	Workers could come into contact with contaminated soil.	Wear required PPE (Level D initially). Selection of PPE beyond Level D will be determined by visual inspection and be ambient air monitoring (PID). Decontaminate exteriors of sample containers. Avoid spills. Ensure that spill cleanup supplies are available.
11. Field screen bore hole with PID.	Workers could be exposed to chemical contaminants.	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Remove PPE properly and wash hands.

ACTIVITY HAZARD ANALYSIS (AHA) #4
Cone Penetrometer Soil Sampling

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principal Steps	Potential Safety/ Hazard Hazards	Recommended Controls
12. Decontaminate all reusable materials and equipment.	Workers could come into contact with contaminants.	Avoid spills. Wear designated PPE. Remove PPE properly and wash hands.
	Lifting of equipment and materials could cause strain to workers.	Use proper lifting techniques such as keeping the back straight, lifting with the legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Workers could be exposed to chemical contaminants (it is anticipated that there will be no contaminants).	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Remove PPE properly and wash hands.
	Decontamination area may become slippery.	Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards as feasible. Maintain proper illumination in all work areas. If decontaminating on plastic sheeting, use caution since plastic sheeting is extremely slippery. Wear boots with good traction.

Equipment to be Used	Inspection Requirements	Training Requirements
Vehicles – pickup trucks	Daily and before use. Use the equipment safety checklist found in the Base-Wide Plan.	Only Department of Motor Vehicles-licensed personnel will operate vehicles.
Equipment – CPT unit, boring rods, sample containers.	Inspect equipment before each use following manufacturers' requirements. Document inspection on an inspection form or in a logbook.	Specific training for use of CPT unit will be provided or worker already has documented training.
Hand tools – basic – screwdrivers, hammers, pliers, etc.	Inspect hand tools before each use following manufacturers' requirements.	Workers will review operator manuals and be qualified to operate power tools.

Abbreviations and Acronyms:

CIH – Certified Industrial Hygienist
CPT – Cone Penetrometer Testing
CSP – Certified Safety Professional
MSDS – Material Safety Data Sheet
PESM – project environmental safety manager
PID – photoionization detector
PPE – personal protective equipment
PVC – polyvinyl chloride
SHSP – Site Health and Safety Plan
SHSS – Site Health and Safety Specialist

This page intentionally left blank.

ACTIVITY HAZARD ANALYSIS (AHA) #5
Hollow-Stem Auger (HSA) or Mud Rotary Drilling

Analyzed By/Date R. Margotto, CIH CSP, 10/05/06

Principal Steps	Potential Safety/ Health Hazards	Recommended Control
1. Pre-survey area that HSA rig will drive over.	Vehicle could run over unstable surface ground or hazards.	Mark all physical hazards. Weight of rig can be significant; verify stability of all routes of travel.
2. Pre-survey area to ensure underground locator services have marked utilities and that as-built drawings have been reviewed.	Underground utilities – could cause release of gas, water; electrocution if an underground power line is struck; damage to communication lines.	Verify that there are no utilities; especially PVC water lines that are often placed in some concrete pads and lead shield electrical service lines. Review drawings, nearby utility connections, and scan, locate, and mark. Dig Alert North (800) 644-2144 (call before you dig) should have already been contacted and area marked based on previous site activities.
3. Perform drilling operations; inspect drill rig.	Improper inspection of rig could cause workers to be exposed to hazards associated with operating mechanical devices.	Ensure that the rig and all associated equipment are inspected by a competent person and that the rig is in safe operating condition. Inspect equipment, including brakes, tire pressure, cables, and hydraulic and pneumatic hoses, before use and at start of each shift. Verify that there is a guard cage that can surround the rotating auger when the rig is in use. Tag and remove from service faulty or unsafe equipment. Verify that emergency shutdown systems (at least two) are clearly marked, and all site workers know locations. Verify that shutdown systems work properly when trip wires are pulled or pushed. Operator's manual must be available and reviewed prior to operation.
4. Perform drill operations; set up work area and move rig into position.	Failure to review site layout plan could cause exposure to potential hazards such as electrocution, damage to underground utilities, or tipping rig over in unstable soil conditions.	Do not move drill rig into any work area until site layout plan has been completed and route of travel to any work site has been assessed for hazards (overhead lines and stability of roads and ground). At the pre-activity safety briefing, discuss site layout plan and analysis of route of travel, along with AHAs. Use a spotter for positioning as necessary. Set brake and place wheel chocks under front wheels of mobile rig. Extend stabilizer jacks and ensure sound footing. Vehicle must be level to vertical and horizontal planes. Do not position wheels (loads) or rig over manholes, vaults, valve boxes, etc. Do not place rig within 15 feet of any overhead electrical lines.
	Rig could contact overhead lines, including power lines, if it is transported with rig raised, causing electric shock.	Never move the rig when the mast is extended.

ACTIVITY HAZARD ANALYSIS (AHA) #5
Hollow-Stem Auger (HSA) or Mud Rotary Drilling

Analyzed By/Date R. Margotto, CIH CSP, 10/05/06

Principal Steps	Potential Safety/ Health Hazards	Recommended Control
Perform drill operations; set up work area and move rig into position (continued).	Vehicle may move if not properly set up.	Use spotter to properly position vehicle. Set brakes and place wheel chocks under front wheels of mobile rig. Extend stabilizer jacks, and ensure sound footing. Ensure that ground can support weight of unit and any outriggers. Use cribbing of specified size and strength as required by manufacturer, if necessary. Vehicle must be level to the vertical and horizontal planes.
	When raising rig, rig may not install properly due to the condition of rig and connecting cables.	Inspect all components of rig to determine condition. Make all repairs before raising rig.
	When raising rig, mast could come into contact with, or be in close proximity to, overhead power lines causing electrocution of workers.	The mast and other equipment must be at least 15 feet from any overhead utility lines. Verify the voltage of any overhead power lines. If any lines are above 50 kV, the clearance distance must be greater. Refer to National Electrical Code for voltages above 50 kV.
	Workers may become pinned between rig and other truck components, or workers could be pinned under truck rig if rig must be serviced from under the truck.	When any part of the rig or equipment is in motion, workers will stand far enough away from the moving parts so as not to be pinned between them. Workers will not manually guide any moving part of the rig when it is raised up. Workers will not work under the rig or under the truck. If work must be done under the rig or truck, the drill crew supervisor will contact the SHSS to ascertain a safe method for lock-out of the equipment to ensure that adequate blocking is installed.
	High winds could destabilize rig. Mast could act as a conductor during a thunderstorm.	Check weather conditions and forecasts to determine if conditions are acceptable for use of rig. Do not operate the rig if winds exceed manufacturer's recommended tolerances. TtEC policy requires an evaluation anytime wind exceeds 25 miles per hour.
	Excessive noise exposure could cause hearing loss.	When necessary, earplugs will be worn.
	Workers could be exposed to pinch points.	Avoid placing hands close to moving machinery. Wear gloves, as appropriate.
	Traffic in area of drilling could injure workers because vehicles fail to see to workers or workers fail to see the vehicles.	Wear high-reflective safety vests. Barricade and mark drilling sites for visibility. Use a flagger, if necessary, to direct traffic away from drilling areas.

ACTIVITY HAZARD ANALYSIS (AHA) #5
Hollow-Stem Auger (HSA) or Mud Rotary Drilling

Analyzed By/Date R. Margotto, CIH CSP, 10/05/06

Principal Steps	Potential Safety/ Health Hazards	Recommended Control
5. Hand auger first 5 feet of intended borehole.	Workers could experience back and muscle strain from using tools.	Pre-employment back evaluations are recommended for craft workers, who may be at greater risk of developing low back pain or low back injury. This evaluation may be requested by contacting our CMC and may be performed by the local medical provider under the approval and direction of our CMC. Surveys shall be performed by persons qualified to identify and evaluate tasks that might result in injuries due to ergonomic hazards. The focus of the surveys will be operations that involve manually lifting and moving excessively heavy or asymmetric objects. Hand tools shall be selected to minimize the following stressors: chronic muscle contraction or steady force, extreme or awkward finger/hand/arm positions, repetitive forceful motions, excessive gripping, pinching, and/or pressing with hand and fingers. Avoid prolonged repetitive motion. Rotate job task with other workers.
6. Perform drilling operations; start up drill and perform drilling.	Unqualified operators and personnel in area do not have knowledge of drilling hazards.	Ensure that personnel are trained in use of drilling equipment. Ensure that the operator has current certifications to operate the equipment. Ensure that a 20-pound dry chemical ABC fire extinguisher is readily available. Ensure that a spill-control kit is available at drilling location. Ensure that there is a first-aid kit, eyewash, and an emergency air horn nearby.
	Start up of unit without guard "cage" around auger could cause workers to come into contact with auger causing injury or death.	In no case will the auger be engaged without a guard "cage" placed around it.
	Pressurized hydraulic lines could rupture, causing release of hot hydraulic fluid. Hot fluid could ignite if contact is made with an engine. Hot fluid could burn workers. Fluid could cause environmental contamination.	Inspect all hydraulic lines before placing rig in service. Any damaged hoses or connections must be replaced before unit is used. Immediately shut down equipment if lines rupture. Ensure that a 20-pound dry chemical ABC fire extinguisher is readily available. Ensure that a spill-control kit is available at drilling location. If rupture occurs, as quickly as possible, berm the liquid to minimize the area over which the liquid spreads. Ensure that all pressurized lines have whip checks.

ACTIVITY HAZARD ANALYSIS (AHA) #5
Hollow-Stem Auger (HSA) or Mud Rotary Drilling

Analyzed By/Date R. Margotto, CIH CSP, 10/05/06

Principal Steps	Potential Safety/ Health Hazards	Recommended Control
Perform drilling operations; start up drill and perform drilling (continued).	Air hoses or hydraulic hoses under pressure could suddenly release, whip, and hit workers causing severe injury.	Do not disconnect air hoses and compressors until hose line has been bled. Visually inspect all connection of any lines under pressure. Use safety clamps to connect each side of connection to the other if the connection breaks. (The safety clamps will keep the hoses from whipping under the sudden release of pressure.) Tie back or attach hoses wherever possible to minimize the length of hose that could whip around if there is a sudden release of pressure.
	Strains could result from manually moving materials, equipment, and drums.	Personnel will be directed to use proper lifting techniques such as keeping the back straight, lifting with the legs, limiting twisting, and getting help in moving bulky/heavy materials and equipment. Mechanical equipment will be used as much as possible. Use care when handling augers or drill rods. Avoid standing under any load. Do not lift more than 50 pounds without assistance.
	Workers could be exposed to atmospheric and come into contact with hazards from chemical agents.	Ambient air/visual monitoring will be used to verify selection of PPE. An MSDS for any drilling fluids will be obtained/reviewed with workers. Decontaminate drilling implements after use (or cover contaminated parts when moving to the next drilling site). Avoid exposure to dust. Use dust control as necessary and possible. PPE will be used. Drum and label all soil cuttings. Determine if PPE is contaminated (based on exposure to contaminants). Place contaminated PPE in a separate, properly labeled, container. Discard other PPE, as approved by the PESM. Do not place face or head over hole.
	Sometimes workers use plastic sheeting in the area where they are drilling to protect the surrounding ground. This sheeting becomes very slippery when drilling muds are placed on it.	Avoid using plastic sheeting, if possible. Many drillers today build a small bermed area where they place the drilling muds. It is easier to clean up the surface of the soil than to have workers slip on plastic sheeting. If plastic sheeting must be used, dig out a small depression, place the plastic on the ground, and cover it with the removed soil. This way, the plastic sheeting should not become too slippery, as it will be covered by the removed soil. (This creates a larger volume of soil to be disposed of, but it is a safer method than working on slippery plastic.)

ACTIVITY HAZARD ANALYSIS (AHA) #5
Hollow-Stem Auger (HSA) or Mud Rotary Drilling

Analyzed By/Date R. Margotto, CIH CSP, 10/05/06

Principal Steps	Potential Safety/ Health Hazards	Recommended Control
Perform drilling operations; start up drill and perform drilling (continued).	The mast could be used to lift other objects as it is being raised, causing potential failure of the mast.	Masts shall be used in a manner specified by the manufacturer and should never be loaded beyond their capacity.
	Workers could climb the drill mast and expose themselves to a fall hazard.	Climbing on the mast is not allowed.
	Workers could place hands into moving parts of the rig, or loose clothing could become entangled in moving machine parts, either of which could injure workers.	Chains, sprockets, and moving parts will be guarded. Workers will not wear loose clothing or any jewelry. Workers will not place their hands or any part of their bodies between the drill auger or rod and the drill plate. Workers should never place themselves in positions where they could come into contact with the moving drill rods or augers. There must be a guard "cage" around the auger while it is operating. The operator will verbally alert all workers and visually ensure that all workers are clear of dangerous parts of equipment before starting or engaging equipment. Workers will avoid contact with any moving auger. Means will be provided to guard against employee contact with auger. (For example, barricade the perimeter of auger or use an electronic brake activated by a presence-sensing device.)
	Workers could injure themselves by cleaning the augers while they are rotating.	Augers will be cleaned only when they are stopped and in neutral. They will not be restarted until the worker has reinstalled the auger guard "cage", given a verbal "all clear" to the operator, and the operator has visually determined that the worker is clear of the auger. Only long-handled shovels will be used to remove cuttings from the auger.
	Workers could trip or fall by the borehole.	Cap and flag open boreholes. If left unattended, protect all open boreholes as any open excavation.
	Workers could be exposed to pinch points.	Avoid placing hands close to moving machinery. Wear gloves, as appropriate. Keep constantly alert.

ACTIVITY HAZARD ANALYSIS (AHA) #5
Hollow-Stem Auger (HSA) Drilling

Analyzed By/Date R. Margotto, CIH CSP, 10/05/06

Equipment to be Used	Inspection Requirements	Training Requirements
Vehicles – pickup trucks Equipment – HSA, boring rods Hand tools – basic screwdrivers, hammers, pliers, etc.	Daily and before use. Inspect equipment before each use following manufacturers' requirements. Document inspection on an inspection form or in a logbook. Inspect hand tools before each use following manufacturers' requirements.	Only Department of Motor Vehicles-licensed personnel will operate vehicles. Specific training for use of HSA rig will be provided or worker already has documented training. Personnel must have reviewed operators' manual and have been trained on power tools. Only qualified person will operate generator or compressor, if used.

Abbreviations and Acronyms:

CIH – Certified Industrial Hygienist
CSP – Certified Safety Professional
CMC – Corporate Medical Consultant
HSA – Hollow-Stem Auger
kV – kilovolt
MSDS – Material Safety Data Sheets
PESM – Project Environmental Safety Manager
PPE – personal protective equipment
PVC – polyvinyl chloride
SHSS – Site Health and Safety Specialist
TtEC – Tetra Tech EC, Inc.

ACTIVITY HAZARD ANALYSIS (AHA) #6
Construction of Monitoring Wells

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principal Steps	Potential Safety/ Health Hazards	Recommended Controls
1. Visually survey site prior to drill rig placement.	Failure to properly survey site could cause exposure and/or damage to underground and overhead utilities, and cause slips, trips, and falls from various agents.	Ensure that ground has no hazards such as unstable soil, underground utilities (marked per utility survey), overhead utilities, or pre-existing slip, trip, and fall hazards. Mark or eliminate all hazards as feasible. Ensure that USA Alert North has been contacted. Review all existing as-built drawings. Walk site to determine if there are any indications that there may be buried utilities in the area.
2. Verify that drillers have certification of OSHA HAZWOPER training and medical release records on site.	Untrained workers or workers without annual physicals cannot work on potential hazardous waste sites.	Allow only trained personnel to operate and work on drill rig. Also, operators shall meet the physical requirements listed in EM 385-1-1 Appendix G.
3. Inspect drill rig.	Improper inspection of rig could cause workers to be exposed to hazards associated with failure of various mechanical devices including wire lines and hydraulic lines.	The rig and all associated equipment will be inspected by a competent person before use and at the beginning of each day. Ensure that an operator's manual for the drill rig is available. Verify that the emergency shutdown system is well marked to allow anyone involved in the drilling operation to perform an emergency shutdown. There must be a minimum of two kill switches. Ensure the ready availability of a first-aid kit to treat injured workers, a 20-pound, dry-chemical, ABC fire extinguisher, and a spill-control kit consisting of shovel, absorbent material, and disposal drum.
4. Place drill rig.	Unstable soil or uneven conditions could cause rig instability. Rig could hit someone or something (overhead utility, and so forth). Work in public areas and housing areas could expose children and bystanders to heavy equipment causing injury to them. Workers can be exposed to traffic hazards.	Rig must only be moved when mast has been lowered. Use spotters when positioning rig. Ensure that spotters know how to communicate with driver. Ensure that weight of rig is evenly distributed on ground, brakes are set, and wheel chocks are in place. Extend stabilizer jacks and ensure that rig is level to the vertical and horizontal planes. Rigs must have at least a 15-foot clearance from any overhead power lines 50kV or less. Ensure that workers are wearing high-visibility vests or shirts. Set up traffic control per the Traffic Control Plan. Ensure that flagmen are trained and that work area is posted. Barricade and limit access to work areas especially on site in housing areas. Always use spotters to keep people and vehicles away from rig as it is moved. All backing up requires a spotter. Keep children and visitors away from work area.

ACTIVITY HAZARD ANALYSIS (AHA) #6
Construction of Monitoring Wells

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principal Steps	Potential Safety/ Health Hazards	Recommended Controls
5. Start up drill rig.	Air hoses or hydraulic lines under pressure could suddenly release, whip and hit workers, and cause severe injury.	Only C-57 qualified operators shall operate drill rigs. Confirm that visual inspection of all pressurized hose connections was completed. Acknowledge that all personnel are ready before starting drill rig.
6. Lift drill rig mast.	Pinch points and mast could contact, or be in proximity to overhead utilities.	The mast must be at least 15 feet from overhead utility lines if voltage is less than 50 kV. Clearance must be larger if voltage is higher (refer to EM 385-1-1, Section 11, Table 11-3 for clearance requirements). When any part of the rig is in motion, workers must be far enough away to avoid being pinned. Do not manually guide any moving part and avoid placing hands close to moving machinery. The sonic rig does not use rotating external drill bits to drill; therefore, the number of moving parts is significantly less of a hazard.
7. Hand auger first 5 feet of borehole to verify that no underground utilities are present.	Hand augering could cause back and muscle strain to workers.	Select hand tools to minimize the following stressors: chronic muscle contraction or steady force, extreme or awkward finger, hand, or arm positions, repetitive forceful motions, excessive gripping, pinching, and/or pressing with hand and fingers. Avoid prolonged repetitive motion. Rotate job task with other workers.
8. Drill borehole with drill rig.	Pressurized hydraulic lines could rupture, causing a release of hot fluids. Hot fluids could cause burns to workers or ignite if they come into contact with engine.	Allow only authorized and trained personnel in the area where the drilling is performed. Ensure that the first-aid kit, fire extinguisher, and spill-control kit are readily available.
	Back and muscle strains could result from manually moving heavy materials, equipment (augers), drums, and so forth.	Do not lift more than 50 pounds without assistance. Direct personnel to use proper lifting techniques such as keeping the back straight, lifting with the legs, and limiting twisting. Use mechanical equipment, such as a drum dolly and so forth, whenever possible.
	When performing sonic drilling, workers must avoid working close to the rotating shaft even though the likelihood of entanglement is less since the shaft is smooth.	Workers will not wear any jewelry or loose clothing, or long hair (long hair must be totally under the hard hat) during operation of rig.
	Workers could injure themselves at pinch points or by slips, trips, and falls near the borehole.	Drill rig must have two kill switches. Set up barricade near rotating shaft. Avoid placing hands close to moving machinery, wear gloves as appropriate, and keep constantly alert. Cap and flag open boreholes and protect them as an open excavation.
	Workers or nearby residents could be exposed to noise above the 84 dBA limit.	Ensure that workers are using hearing protection. Monitor noise with a dosimeter, set up barriers, and potentially move residents or close windows as necessary.

ACTIVITY HAZARD ANALYSIS (AHA) #6
Construction of Monitoring Wells

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principal Steps	Potential Safety/ Health Hazards	Recommended Controls
Drill borehole with drill rig (continued).	Workers could be exposed to atmospheric and contact hazards from chemical agents released during drilling.	Monitor breathing zone for potentially harmful volatile organic vapors with field instruments and wear required PPE pursuant to SHSP.
	Without a communication system in place, workers could get injured or property could get damaged.	Ensure constant communication between the driller, his laborers, and the site geologist. Ensure that phone communications for emergency contacts are functioning.
9. Unload monitoring well casing and backfill materials and place near boring.	Well materials could have shifted during transport or are poorly tied down causing loads to fall when tie downs are removed.	Remove each tie-down carefully but have forklift, if available, positioned on the side where tie-down is being removed to prevent the load from falling on that side. No other personnel will be on the ground near the truck when the tie-downs are removed.
	Materials could be heavy and workers could be injured lifting heavy loads.	Workers will not lift more than 50 pounds without assistance. Workers can lift loads only if the loads are symmetric and balanced. Workers must avoid twisting motion at waist and use legs to do most of the lift. Wear leather work gloves.
10. Install monitoring well casing and backfill materials.	Overhead winch or cable could fail.	Inspect winch prior to operating. Never lift loads greater than the capacity of the winch.

Equipment to be Used	Inspection Requirements	Training Requirements
Vehicles – pickup trucks	Inspect vehicles daily and before use. Use the equipment safety checklist found in the Base-Wide Plan.	Only Department of Motor Vehicles-licensed personnel will operate vehicles.
Equipment – boring equipment, boring rods, drill rig	Inspect equipment before each use following the manufacturers' requirements. Document inspection on an inspection form or in a logbook.	Specific training for use of boring and sampling equipment, HSA, etc. will be provided or if training has been completed, documentation shall be provided.
Hand tools – basic screwdrivers, hammers, pliers, etc.	Inspect hand tools before each use following manufacturers' requirements.	Personnel must have reviewed operators' manual and have been trained on power tools. Only qualified person will operate generator or compressor, if used.

Abbreviations and Acronyms:

CIH – Certified Industrial Hygienist
CSP – Certified Safety Professional
dBA – decibels, A-Scale
EM – Engineering Manual
HAS – hollow stem auger
HAZWOPER – Hazardous Waste Operations and Emergency Response
kV – kilovolts
OSHA – Occupational Safety and Health Administration
PPE – personal protective equipment
SHSP – Site Health and Safety Plan

This page intentionally left blank.

ACTIVITY HAZARD ANALYSIS (AHA) #7
Gauging and Sampling Monitoring Wells

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principal Steps	Potential Safety/ Health Hazards	Recommended Controls
1. Park vehicle at well.	Vehicle could hit someone or something.	Use spotters when positioning vehicle if needed. Ensure that spotters know how to communicate with driver of vehicle.
	Location could create a traffic hazard.	Locate vehicle in an area that will not obstruct traffic.
2. Unload equipment and materials from vehicle.	Lifting of equipment and materials from vehicle could cause strain to workers.	Use proper lifting techniques such as keeping the back straight, lifting with the legs, limiting twisting, and getting help when moving bulky or heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
3. Move equipment and materials to designated monitoring well location.	Handling of equipment could cause strain to workers.	Use care when walking so that there are no sudden jerks or mis-steps that can cause the worker to strain to maintain control of the equipment. Get assistance from other workers if needed. For loads greater than 50 pounds, use two people to carry.
	Slip, trip, and fall hazards could be present.	Maintain good housekeeping in work area. Mark or remove all identified trip, slip, and fall hazards from sampling area. Maintain proper illumination in work area.
	Workers could be struck by vehicles.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Post an observer, as needed, when monitoring well is close to busy streets. Use traffic controls or barricades, if necessary, to keep traffic away from workers.
4. Remove monitoring well cover and cap.	Lifting of monitoring well cover could cause back strain.	Use proper lifting techniques such as keeping the back straight, lifting with the legs, limiting twisting, and getting help if cover is too heavy or it is too difficult to handle because cover is wedged or impaired.
	Workers could experience strain from use of tools.	Inspect all tools for damage before use. Do not use damaged tools (mark and tag "out of service"). Select hand tools to minimize following stressors: chronic muscle contraction or steady force; extreme or awkward finger, hand, or arm positions; repetitive forceful motions; or excessive gripping, pinching, or pressing with hands and fingers.
	Monitoring well covers and openings to ground may have insects, such as black widow, brown recluse, and hobo spiders.	Wear leather gloves when opening well cover. Inspect opening for insects. If insects are present, avoid them or remove them while wearing gloves. Have first-aid kit available to treat insect stings. (If allergic to any insect bites, notify SHSS. If possible, a person not allergic to insect bites should open covers.)

ACTIVITY HAZARD ANALYSIS (AHA) #7
Gauging and Sampling Monitoring Wells

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principal Steps	Potential Safety/ Health Hazards	Recommended Controls
Remove monitoring well cover and cap (continued).	Monitoring well could have atmospheric hazards if well has off-gassed, thus exposing workers to vapors.	If well has historically contained high vapor contaminant concentrations, before lifting cover, place probe through small opening in or around cover and measure air inside using a PID or FID. If reading is less than 10 ppm, open well cover and proceed with work activities. If reading is greater than 10 ppm, open well cover slowly, stand back to allow to ventilate. Measure air inside again after 5 minutes, and if readings are still above 10 ppm, contact the SHSS.
5. Measure depth to groundwater.	Workers could be exposed to chemical contaminants.	Wear required PPE. The intent of PPE is to prevent contact with groundwater that may have low levels of contaminants (although these contaminants are low in concentration, they still can be absorbed by skin or cause irritation to skin). Use care in handling gauging tape to avoid contaminating the work area.
6. Set up sampling equipment.	Polyethylene sheeting can be slippery.	Wear boots with traction. Use caution when maneuvering on or around polyethylene sheeting, especially if sheeting is wet.
	Workers could be exposed to pinch points.	Use care when setting up equipment. Wear leather gloves if necessary.
7. Purge monitoring well.	Workers could be exposed to chemical contaminants.	Wear required PPE. The intent of PPE is to prevent contact with groundwater that may have low levels of contaminants (although these contaminants are low in concentration, they still can be absorbed by skin or cause irritation to skin). Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Decontaminate exteriors of sample containers. Avoid spills. Ensure that spill cleanup supplies are available.
8. Collect groundwater samples.	Collecting samples over long periods of time could cause muscle strain.	Maintain steady pace and follow rest periods given on job. Select a position during sampling to minimize following stressors: chronic muscle contraction or steady force; extreme or awkward positions; repetitive forceful motions; or excessive gripping, pinching, or pressing.
	Workers could be exposed to chemical contaminants.	Wear required PPE. The intent of PPE is to prevent contact with groundwater that may have low levels of contaminants (although these contaminants are low in concentration, they still can be absorbed by skin or cause irritation to skin). Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Decontaminate exteriors of sample containers. Avoid spills. Ensure that spill cleanup supplies are available.

ACTIVITY HAZARD ANALYSIS (AHA) #7
Gauging and Sampling Monitoring Wells

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principal Steps	Potential Safety/ Health Hazards	Recommended Controls
9. Replace monitoring well cap.	Workers could experience strain from use of tools.	Inspect all tools for damage before use. Do not use damaged tools. Mark and tag as "out of service." Select hand tools to minimize the following stressors: chronic muscle contraction or steady force; extreme or awkward finger, hand, or arm positions; repetitive forceful motions; or excessive gripping, pinching, or pressing with hands and fingers.
	Workers could get hand caught between cover and top when replacing cover.	Use care when replacing monitoring well cover. Wear leather gloves when handling covers.
10. Decontaminate all reusable materials and equipment.	Lifting of equipment and materials could cause strain to workers.	Use proper lifting techniques such as keeping the back straight, lifting with the legs, limiting twisting, and getting help when moving bulky or heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Workers could be exposed to chemical contaminants.	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Remove PPE properly and wash hands.
	Decontamination area may become slippery.	Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards as feasible. Maintain proper illumination in all work areas. If decontaminating on plastic sheeting, use caution since plastic sheeting is extremely slippery. Wear boots with good traction.
11. Pack samples for shipment.	Manually moving materials and equipment could cause strains.	Use proper lifting techniques such as keeping the back straight, lifting with the legs, limiting twisting, and getting help when moving bulky or heavy materials and equipment. Use hand truck when handling more than one box at a time. Try to pack shipping boxes so that each box does not exceed 50 pounds. For loads greater than 50 pounds, use two people to carry.
	Contents of sample containers could leak, possibly exposing workers and people handling shipping box.	Ensure that each container top is securely tightened. Pack each container in a manner to prevent damage to container during handling of shipping box and during transportation. Ensure that boxes meet required packaging standards based on mode of transportation used for shipping.

ACTIVITY HAZARD ANALYSIS (AHA) #7
Gauging and Sampling Monitoring Wells

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Equipment to be Used	Inspection Requirements	Training Requirements
Vehicles – pickup trucks	Daily and before use. Use the equipment safety checklist found in the Base-Wide Plan	Only Department of Motor Vehicles-licensed personnel will operate vehicles
Equipment – pumps	Inspect pump according to manufacturers' directions.	Use pump as directed in operator's manual.
Hoses	Inspect hose for connections and integrity.	Training on hoses and connection of hoses.
Gauging tape	Inspect tape before use; avoid sharp edges. Repair or replace tape that has sharp edges.	General training on proper use of tape.
Sample jars	Inspect jars for cracks or breaks. Discard defective jars or containers	Use of sampling supplies.
hand tools – pry bar, hammers, pliers, etc.	Inspect each tool before use. Discard damaged tools.	.Specific training for use of tools especially tools used to open well covers.

Abbreviations and Acronyms:

CIH – Certified Industrial Hygienist
CSP – Certified Safety Professional
FID – flame-ionization detector
PID – photoionization detector
PPE – personal protective equipment
ppm – parts per million
SHSP – Site Health and Safety Plan
SHSS – Site Health and Safety Specialist

ACTIVITY HAZARD ANALYSIS (AHA) #8
Demobilization and Site Restoration

Analyzed By/Date: R. Margotto, CIH, CSP 08/06

Principle Steps	Potential Safety/ Health Hazards	Recommended Controls
1. Demobilize and restore site.	Workers could be struck by or against heavy equipment.	Wear high-visibility reflective vests when exposed to vehicle traffic. Make eye contact with operators before approaching equipment. Understand and review posted hand signals. Use traffic barricades, signs, flags, and backup spotters during demobilization.
	Workers doube be at risk of electrocution.	Allow only qualified electricians to disconnect electrical circuits. Follow lock-out, tag-out protocols. Inspect all extension cords daily for structural integrity, ground continuity, and damaged areas. Document extension cord inspection. Use GFCIs on all outdoor 115- to 120-volt, 20 ampere or less, circuits. Cover or elevate electric wire or flexible cord passing through work area to protect it from damage by foot traffic, vehicles, sharp corners, projections, or pinching. Keep plugs and receptacles out of water unless they are approved- submersible types. Ground all electrical circuits in accordance with the National Electrical Code or other applicable regulations or standards. Temporary wiring is not allowed to pass through walls, doors, or windows (extension cords are one type of temporary wiring). If a generator is used, be sure it is a type that does not require grounding. If it requires grounding, follow manufacturer's directions. NEC 250-6 lists the exceptions for grounding portable and vehicle mounted generators.
	Workers could be struck by or against heavy equipment.	Wear high-visibility reflective vests when exposed to vehicle traffic. Make eye contact with operators before approaching equipment. Understand and review posted hand signals. Use traffic barricades, signs, flags, and backup spotters during demobilization.
	Workers could experience strains from manually moving materials and equipment.	Use proper lifting techniques such as keeping the back straight, lifting with the legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use lifting devices whenever possible. Surveys shall be performed by qualified persons to identify and evaluate tasks that might result in injuries due to ergonomic hazards. The focus of the surveys will be operations that involve the manual lifting and moving of objects of excessive weight or asymmetric size. Hand tools shall be selected to minimize the following stressors: chronic muscle contraction or steady force, extreme or awkward finger/hand/arm positions, repetitive forceful motions, excessive gripping, pinching, pressing with hand and fingers. Do not lift more than 50 pounds without assistance.

ACTIVITY HAZARD ANALYSIS (AHA) #8

Demobilization and Site Restoration

Analyzed By/Date: R. Margotto, CSP 08/06

Equipment to be Used	Inspection Requirements	Training Requirements
Heavy equipment, hand tools, power tools	Daily or before use. Equipment must be inspected and certified as operational by a competent person.	Only trained equipment operators may operate heavy equipment; only Department of Motor Vehicles-licensed personnel will operate trucks. Specific training for power tools, hand tools, and electrical safety.

Abbreviations and Acronyms:

CIH – Certified Industrial Hygienist
CSP – Certified Safety Professional
GFCI – ground fault circuit interrupter
NEC – National Electrical Code

ATTACHMENT 2

MATERIAL SAFETY DATA SHEETS

This page intentionally left blank.

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 296
Arsenic and Compounds

Issued: 4/90

Section 1. Material Identification 31

Arsenic Description: Obtained from flue dust of copper and lead smelters as white arsenic (arsenic trioxide). Reduction with charcoal and sublimation in an N_2 current yields pure arsenic. Metallic arsenic is used for hardening copper, lead, and alloys; as a doping agent in germanium and silicon solid-state products, special solders, and medicine; and to make gallium arsenide for dipoles and other electronic devices. Arsenic compounds are used in manufacturing certain types of glass; in textile printing, tanning, taxidermy, pharmaceuticals, insecticides and fungicides, pigment production, and antifouling paints; and to control sludge formation in lubricating oils. Arsenic trioxide is the source for 97% of all arsenic products.
Other Designations: CAS No. 7440-38-2; arsen; arsenic black; As; gray arsenic; metallic arsenic.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

R 1
I 4
S 2
K 0

Genium
3
3 2
-

HMIS
H 3
F 2
R 2
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Arsenic and soluble compounds, as As

OSHA PEL
8-hr TWA: 0.5 mg/m^3,* 0.01 mg/m^3†

ACGIH TLV, 1989-90
TLV-TWA: 0.2 mg/m^3

NIOSH REL, 1987
Ceiling: 0.002 mg/m^3

Toxicity Data‡
Man, oral, TD_{Lo}: 76 mg/kg administered intermittently over a 12-year period affects the liver (tumors) and blood (hemorrhage)
Man, oral: 7857 mg/kg administered over 55 years produces gastrointestinal (in the structure or function of the esophagus), blood (hemorrhage), and skin and appendage (dermatitis) changes
Rat, oral, TC_{Lo}: 605 µg/kg administered to a 35-week pregnant rat affects fertility (pre- and post-implantation mortality)

* Organic compounds.
† Inorganic compounds.
‡ See NIOSH, *RTECS* (CG0525000), for additional mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: sublimes at 1134 °F/612 °C
Melting Point: 1497 °F/814 °C
Vapor Pressure: 1 mm at 702 °F/372 °C (sublimes)
Atomic Weight: 74.92
Density: 5.724 at 57 °F/14 °C
Water Solubility: Insoluble†

Appearance and Odor: A brittle, crystalline, silvery to black metalloid. Odorless.

* This data pertains to arsenic only.
† Arsenic is soluble in nitric acid (HNO_3).

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: Use dry chemical, CO_2, water spray, or foam to fight fires.
Unusual Fire or Explosion Hazards: Flammable and slightly explosive in the form of dust when exposed to heat or flame.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Arsenic is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Arsenic can react vigorously on contact with powerful oxidizers such as bromates, peroxides, chlorates, iodates, lithium, silver nitrate, potassium nitrate, potassium permanganate, and chromium (VI) oxide. This material is also incompatible with halogens, bromine azide, palladium, dirubidium acetylide, zinc, and platinum.
Hazardous Products of Decomposition: Thermal oxidative decomposition of arsenic and its compounds produces irritating or poisonous gases.

Section 6. Health Hazard Data

Carcinogenicity: The IARC, NTP, and OSHA list arsenic as a human carcinogen (Group 1). This evaluation applies to arsenic and arsenic compounds as a whole, and not necessarily to all individual chemicals within the group. Studies report that both the trivalent and pentavalent compounds are strongly implicated as causes of skin, lung, and lymphatic cancers. Experimental studies have shown that arsenic has tumorigenic and teratogenic effects in laboratory animals.
Summary of Risks: Arsenic compounds are irritants of the skin, mucous membranes, and eyes. The moist mucous membranes are most sensitive to irritation. Prolonged contact results in local hyperemia (blood congestion) and later vesicular or pustular eruption. Epidermal carcinoma is a reported risk of exposure. Peripheral neuropathy (degenerative state of the nervous system) is common after acute or chronic arsenic poisoning. Symptoms include decreased sensation to touch, pinprick, and temperature; loss of vibration sense; and profound muscle weakness and wasting. Other complications of acute and chronic arsenic poisoning are encephalopathy (alterations of brain structure) and toxic delirium.
Medical Conditions Aggravated by Long-Term Exposure: Damage to the liver, nervous, and hematopoietic (responsible for the formation of blood or blood cells in the body) system may be permanent. Pulmonary and lymphatic cancer may also occur.
Target Organs: Liver, kidneys, skin, lungs, lymphatic system.
Primary Entry Routes: Inhalation, ingestion of dust and fumes, via skin absorption.
Acute Effects: Acute industrial intoxication is more likely to arise from inhalation of arsine. However, with corrosive arsenical vapors, conjunctivitis, eyelid edema, and even corneal erosion may result. Inhalation may result in nasal irritation with perforation of the septum, cough, chest pain, hoarseness, pharyngitis, and inflammation of the mouth. If ingested, metallic or garlic taste, intense thirst, nausea, vomiting, abdominal pain, diarrhea, and cardiovascular arrhythmias (heartbeat irregularities) may occur. Symptoms generally occur within 30 minutes, but may be delayed for several hours if ingested with food. Acute poisoning may result in acute hemolysis (breakdown of red blood cells).
Chronic Effects: Chronic symptoms include weight loss, hair loss, nausea, and diarrhea alternating with constipation, palmar and plantar hyperkeratoses (thickening of the corneous layer of skin on palms and soles of feet), and skin eruptions, and peripheral neuritis (inflammation of the nerves). Leukemia, bone marrow depression, or aplastic anemia (dysfunctioning of blood-forming organs) may occur after chronic exposure.
FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have a *conscious* person drink 1 to 2 glasses of water, then induce repeated vomiting until vomit is clear.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: If emesis is unsuccessful after two doses of Ipecac, consider gastric lavage. Monitor urine arsenic level. Alkalinization of urine may help prevent disposition of red cell breakdown products in renal tubular cells. If acute exposure is significant, maintain high urine output and monitor volume status, preferably with central venous pressure line. Abdominal X-rays should be done routinely for all ingestions. Chelation therapy with BAL, followed by n-penicillamine is recommended, but specific dosing guidelines are not clearly established.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of spill, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against dust inhalation and contact with skin and eyes. Use nonsparking tools. With a clean shovel, scoop material into a clean, dry container and cover. Absorb liquid material with sand or noncombustible inert material and place in disposal containers. Do not release to sewers, drains, or waterways. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations*
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance† (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [† per Clean Water Act, Sec. 307(a); per Clean Air Act, Sec. 112]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations‡
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

* Designations for arsenic only.
‡ Listed as arsenic organic compounds (as As).

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.
Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PELs, ACGIH TLVs, and NIOSH REL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed, properly labeled, containers in a cool, well-ventilated area away from all incompatible materials (Sec. 5) and heat and ignition sources. Protect containers from physical damage.

Engineering Controls: Avoid inhalation or ingestion of dust and fumes, and skin or eye contact. Practice good personal hygiene and housekeeping procedures. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program with training, maintenance, inspection, and evaluation. All engineering systems should be of maximum explosion-proof design and electrically grounded and bonded. Provide preplacement and annual physical examination with emphasis on the skin, respiratory system, and blood.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Arsenic, solid
DOT Hazard Class: Poison B
ID No.: UN1558
DOT Label: Poison
DOT Packaging Requirements: 173.366
DOT Packaging Exceptions: 173.364

IMO Shipping Name: Arsenic, metallic
IMO Hazard Class: 6.1
IMO Label: Poison
IMDG Packaging Group: II
ID No.: UN1558

MSDS Collection **References:** 7, 26, 38, 53, 73, 85, 87, 88, 89, 100, 103, 109, 123, 124, 126, 127, 130, 136, 138
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD M4

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 312
Trichloroethylene

Issued: 7/79 Revision: F, 9/92

Section 1. Material Identification

39

Trichloroethylene (C_2HCl_3) Description: Derived by treating tetrachloroethane with lime or other alkali in the presence of water, or by thermal decomposition of tetrachloroethane followed by steam distillation. Stabilizers such as epichlorohydrin, isobutanol, carbon tetrachloride, chloroform, benzene, or pentanol-2-triethanolamine are then added. Used as a degreasing solvent in electronics and dry cleaning, a chemical intermediate, a refrigerant and heat-exchange liquid, and a diluent in paint and adhesives; in oil, fat, and wax extraction and in aerospace operations (flushing liquid oxygen). Formerly used as a fumigant (food) and anesthetic (replaced due to its hazardous decomposition in closed-circuit apparatus).

Other Designations: CAS No. 79-01-6; acetylene trichloride; Algylen; Anamenth; Benzinol; Cecolene; Chlorylen; Dow-Tri; ethylene trichloride; Germalgene; Narcogen; Triasol; trichloroethene; TCE; 1,1,3-trichloroethylene.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

R 1
I 2
S 2*
K 3
* Skin absorption

NFPA
2
2 0
-

HMIS
H 2†
F 2
R 0
PPE‡
† Chronic Effects
‡ Sec. 8

Cautions: TCE is irritating and toxic to the central nervous system (CNS). Inhalation of high concentrations have lead to death due to ventricular fibrillation. Chronic exposure may lead to heart, liver, and kidney damage. The liquid is absorbed through the skin. Although it has a relatively low flash point, TCE burns with difficulty.

Section 2. Ingredients and Occupational Exposure Limits

Trichloroethylene, < 100% [contains stabilizers (Sec. 1)].

1991 OSHA PELs
8-hr TWA: 50 ppm (270 mg/m^3)
15-min STEL: 200 ppm (1080 mg/m^3)

1990 IDLH Level
1000 ppm

1990 NIOSH REL
10-hr TWA: 25 ppm (~135 mg/m^3)

1992-93 ACGIH TLVs
TWA: 50 ppm (269 mg/m^3)
STEL: 200 ppm (1070 mg/m^3)

1990 DFG (Germany) MAK
Ceiling: 50 ppm (270 mg/m^3)
Category II: Substances with systemic effects
Half-life: 2 hr to shift length
Peak Exposure Limit: 250 ppm, 30 min average value; 2 peaks/shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 160 ppm/83 min caused hallucinations and distorted perceptions.
Human, lymphocyte: 5 mL/L caused DNA inhibition.
Rabbit, skin: 500 mg/24 hr caused severe irritation.
Rabbit, eye: 20 mg/24 hr caused moderate irritation.
Mouse, oral, TD_{Lo}: 455 mg/kg administered intermittently for 78 weeks produced liver tumors.

* See NIOSH, *RTECS* (KX4550000), for additional irritation, mutation, reproductive, tumorigenic and toxicity data.

Section 3. Physical Data

Boiling Point: 189 °F (87 °C)
Freezing Point: -121 °F (-85 °C)
Viscosity: 0.0055 Poise at 77 °F (25 °C)
Molecular Weight: 131.38
Density: 1.4649 at 20/4 °C
Refraction Index: 1.477 at 68 °F (20 °C/D)
Odor Threshold: 82 to 108 ppm (*not an effective warning*)

Vapor Pressure: 58 mm Hg at 68 °F (20 °C); 100 mm Hg at 32 °F (0 °C)
Saturated Vapor Density (Air = 0.075 lbs/ft^3; 1.2 kg/m^3): 0.0956 lbs/ft^3; 1.53 kg/m^3
Water Solubility: Very slightly soluble; 0.1% at 77 °F (25 °C)
Other Solubilities: Highly soluble in organic solvents (alcohol, acetone, ether, carbon tetrachloride, & chloroform) and lipids.
Surface Tension: 29.3 dyne/cm

Appearance and Odor: Clear, colorless (sometimes dyed blue), mobile liquid with a sweet chloroform odor.

Section 4. Fire and Explosion Data

Flash Point	Autoignition Temperature	LEL	UEL
90 °F (32 °C) CC	788 °F (420 °C)	8% (25 °C); 12.5% (100 °C)	10% (25 °C); 90% (100 °C)

Extinguishing Media: A Class 1C Flammable Liquid. Although it has a flash point of 90 °F, TCE burns with difficulty. For small fires, use dry chemical, carbon dioxide, water spray, or regular foam. For large fires, use water spray, fog, or regular foam. **Unusual Fire or Explosion Hazards:** Vapor/air mixtures may explode when ignited. Container may explode in heat of fire. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides only limited protection against TCE. Apply cooling water to sides of container until well after fire is out. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: TCE slowly decomposes in the presence of light and moisture to form corrosive hydrochloric acid. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Include alkalis (sodium hydroxide), chemically active metals (aluminum, beryllium, lithium, magnesium, sodium, potassium, and titanium), epoxides, and oxidants (nitrogen tetraoxide, perchloric acid). Contact with 1-chloro-2,3-epoxy propane or the mono and di 2,3-epoxypropyl ethers of 1,4-butanediol + 2,2-bis-4(2',3'-epoxypropoxy)-phenylpropane can, in the presence of catalytic quantities of halide ions, cause dehydrochlorination of TCE to explosive dichloroacetylene. **Conditions to Avoid:** Exposure to light, moisture, ignition sources, and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of TCE (above 300 °C) or exposure to ultraviolet light can produce carbon dioxide (CO_2) and toxic dichloro acetylene (explosive), chlorine, hydrogen chloride, and phosgene gas.

Section 6. Health Hazard Data

Carcinogenicity: The following agencies have rated TCE's carcinogenicity: IARC (Class 3, limited animal evidence & insufficient human data), Germany MAK (Class B, justifiably suspected of having carcinogenic potential), & NIOSH (Class X, carcinogen defined with no further categorization). **Summary of Risks**: TCE vapor is irritating to the eyes, nose, and respiratory tract and inhalation of high concentrations can lead to severe CNS effects such as unconsciousness, ventricular arrythmias, and death due to cardiac arrest. Mild liver dysfunction was also seen at levels high enough to produce CNS effects. Contact with the liquid is irritating to the skin and can lead to dermatitis by defatting the skin. Chronic toxicity is observed in the victims increasing intolerance to alcohol characterized by 'degreasers flush', a transient redness of the face, trunk, and arms. The euphoric effect of TCE has led to craving, and habitual sniffing of its vapors.

Continue on next page

Section 6. Health Hazard Data, *Continued*

TCE crosses the placental barrier and thus exposes the fetus (any effects are yet unknown). There are increased reports of menstrual disorders in women workers and decreased libido in males at exposures high enough to cause CNS effects. TCE is eliminated unchanged in expired air and as metabolites (trichloroacetic acid & trichloroethanol) in blood and urine. **Medical Conditions Aggravated by Long-Term Exposure:** Disorders of the nervous system, skin, heart, liver, and kidney. **Target Organs:** Respiratory, central & peripheral nervous, and cardiovascular (heart) systems, liver, kidney, and skin. **Primary Entry Routes:** Inhalation, skin and eye contact, and ingestion (rarely). **Acute Effects:** Vapor inhalation can cause eye, nose, and throat irritation, nausea, blurred vision, overexcitement, headache, drunkenness, memory loss, irregular heartbeat (resulting in sudden death), unconsciousness, and death due to cardiac failure. Skin contact with the liquid can cause dryness and cracking and prolonged exposure (generally if the victim is unconscious) can cause blistering. Eye contact can cause irritation and watering, with corneal epithelium injury in some cases. Ingestion of the liquid can cause lip, mouth, and gastrointestinal irritation, irregular heartbeat, nausea and vomiting, diarrhea (possibly blood-stained), drowsiness, and risk of pulmonary edema (fluid in lungs). **Chronic Effects:** Effects may persist for several weeks or months after repeated exposure. Symptoms include giddiness, irritability, headache, digestive disturbances, mental confusion, intolerance to alcohol (degreasers flush), altered color perception, loss or impairment of sense of smell, double vision, and peripheral nervous system function impairment including persistent neuritis, temporary loss of sense of touch, and paralysis of the fingers from direct contact with TCE liquid.

FIRST AID **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. Do not give milk, as its fat content (TCE is lipid soluble) may inhance gastrointestinal absorption of TCE. **Note to Physicians:** TCE elimination seems to be triphasic with half lives at 20 min, 3 hr, and 30 hr. Some success is seen in treating patients with propranolol, atropine, and disulfiram. Monitor urine and blood (lethal level = 3 to 110 μg/mL) metabolites. BEI = 100 mg/g creatinine (trichloroacetic acid) in urine, *sample at end of workweek.* BEI = 4 mg/L (trichloroethanol) in blood, *sample at end of shift at end of the workweek.* These tests are not 100% accurate indicators of exposure; monitor TCE in expired air as a confirmatory test.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off all ignition sources. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable container for later disposal. For large spills, flush to containment area where density stratification will form a bottom TCE layer which can be pumped and containerized. Report any release in excess of 1000 lbs. Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Bluegill sunfish, LC_{50} = 44,700 μg/L/96 hr; fathead minnow (*Pimephales promelas*), LC_{50} = 40.7 mg/L/96 hr. **Environmental Degradation:** In air, TCE is photooxidized with a half-life of 5 days and reported to form phosgene, dichloroacetyl chloride, and formyl chloride. In water it evaporates rapidly in minutes to hours. TCE rapidly evaporates and may leach since it does not absorb to sediment. **Soil Absorption/Mobility:** TCE has a Log K_{oc} of 2, indicating high soil mobility. **Disposal:** Waste TCE can be poured on dry sand and allowed to vaporize in isolated location, purified by distillation, or returned to supplier. A potential candidate for rotary kiln incineration at 1508 to 2912 °F (820 to 1600 °C) with an acid scrubber to remove halo acids. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a RCRA Hazardous Waste (40 CFR 261.33 & 261.31): No. U228 & F002 (*spent solvent*)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 100 lb (45.4 kg) [* per RCRA, Sec. 3001, CWA Sec. 311 (b)(4), & CWA Sec. 307 (a)]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear chemical safety goggles (cup-type or rubber framed, equipped with impact-resistant glass), per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. At any detectable concentration, wear a SCBA with a full facepiece operated in pressure demand or other positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made from Viton or Neoprene to prevent skin contact. *Do not* use natural rubber or polyvinyl chloride (PVC). **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in steel drums, in a cool, dry, well-ventilated area away from sunlight, heat, ignition sources, and incompatibles (Sec. 5). Store large quantities in galvanized iron, black iron, or steel containers; small amounts in dark (amber) colored glass bottles. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Design processes so that the operator is not directly exposed to the solvent or its vapor. Do not use open electric heaters, high-temperature processes, arc-welding or open flames in TCE atmospheres. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers with emphasis on skin, respiratory, cardiac, central and peripheral nervous systems, and liver and kidney function. Employ air and biological monitoring (BEIs). Instruct employees on safe handling of TCE.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Trichloroethylene
DOT Hazard Class: 6.1
ID No.: UN1710
DOT Packing Group: III
DOT Label: Keep Away From Food
DOT Special Provisions (172.102): N36, T1

Packaging Authorizations
a) Exceptions: 173.153
b) Non-bulk Packaging: 173.203
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger Aircraft or Railcar: 60L
b) Cargo Aircraft Only: 220L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 40

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 153, 159, 163, 164, 167, 168, 171, 174, 175, 176, 180.
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** AC Darlington, MD

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:
Sheet No. 316
Benzene

Issued: 11/78 Revision: E, 8/90

Section 1. Material Identification

32

Benzene (C_6H_6) Description: Derived by fractional distillation of coal tar, hydrodealkylation of toluene or pyrolysis of gasoline, catalytic reforming of petroleum, and transalkylation of toluene by disproportionation reaction. Used as a fuel; a chemical reagent; a solvent for a large number of materials such as paints, plastics, rubber, inks, oils, and fats; in manufacturing phenol, ethylbenzene (for styrene monomer), nitrobenzene (for aniline), dodecylbenzene (for detergents), cyclohexane (for nylon), chlorobenzene, diphenyl, benzene hexachloride, maleic anhydride, benzene-sulfonic acid, artificial leather, linoleum, oil cloth, varnishes, and lacquers; for printing and lithography; in dry cleaning; in adhesives and coatings; for extraction and rectification; as a degreasing agent; in the tire industry; and in shoe factories. Benzene has been banned as an ingredient in products intended for household use and is no longer used in pesticides.
Other Designations: CAS No. 0071-43-2, benzol, carbon oil, coal naphtha, cyclohexatriene, mineral naphtha, nitration benzene, phene, phenyl hydride, pyrobenzol.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

R 1
I 4
S 2*
K 4
*Skin absorption

NFPA
3 (health: 2, flammability: 3, reactivity: 0)

HMIS
H 3
F 3
R 0
PPG†
† Sec. 8

Cautions: Benzene is a confirmed *human carcinogen* by the IARC. *Chronic low-level exposure may cause cancer (leukemia) and bone marrow damage, with injury to blood-forming tissue.* It is also a dangerous fire hazard when exposed to heat or flame.

Section 2. Ingredients and Occupational Exposure Limits

Benzene, ca 100%*

1989 OSHA PELs
(29 CFR 1910.1000, Table Z-1-A)
8-hr TWA: 1 ppm, 3 mg/m³
15-min STEL: 5 ppm, 15 mg/m³

(29 CFR 1910.1000, Table Z-2)
8-hr TWA: 10 ppm
Acceptable Ceiling Concentration: 25 ppm
Acceptable Maximum Peak: 50 ppm (10 min)†

1989-90 ACGIH
TLV-TWA: 10 ppm, 32 mg/m³

1988 NIOSH RELs
TWA: 0.1 ppm, 0.3 mg/m³
Ceiling: 1 ppm, 3 mg/m³

1985-86 Toxicity Data‡
Man, oral, LD_{Lo}: 50 mg/kg; no toxic effect noted
Man, inhalation, TC_{Lo}: 150 ppm inhaled intermittently over 1 yr in a number of discrete, separate doses affects the blood (other changes) and nutritional and gross metabolism (body temperature increase)
Rabbit, eye: 2 mg administered over 24 hr produces severe irritation

* OSHA 29 CFR 1910.1000, Subpart Z, states that the final benzene standard in 29 CFR 1910.1028 applies to all occupational exposures to benzene except in some subsegments of industry where exposures are consistently under the action level (i.e., distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the excepted subsegments, the benzene limits in Table Z-2 apply.
† Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift.
‡ See NIOSH, *RTECS* (CY1400000), for additional irritative, mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 176 °F (80 °C)
Melting Point: 42 °F (5.5 °C)
Vapor Pressure: 100 mm Hg at 79 °F (26.1 °C)
Vapor Density (Air = 1): 2.7
Evaporation Rate (Ether = 1): 2.8
Molecular Weight: 78.11
Specific Gravity (15 °C/4 °C): 0.8787
Water Solubility: Slightly (0.180 g/100 g of H_2O at 25 °C)
%Volatile by Volume: 100
Viscosity: 0.6468 mPa at 20 °C

Appearance and Odor: A colorless liquid with a characteristic sweet, aromatic odor. The odor recognition threshold (100% of panel) is approximately 5 ppm (unfatigued) in air. Odor *is not* an adequate warning of hazard.

Section 4. Fire and Explosion Data

Flash Point: 12 °F (-11.1 °C), CC	Autoignition Temperature: 928 °F (498 °C)	LEL: 1.3% v/v	UEL: 7.1% v/v

Extinguishing Media: Use dry chemical, foam, or carbon dioxide to extinguish benzene fires. Water may be ineffective as an extinguishing agent since it can scatter and spread the fire. Use water spray to cool fire-exposed containers, flush spills away from exposures, disperse benzene vapor, and protect personnel attempting to stop an unignited benzene leak.
Unusual Fire or Explosion Hazards: Benzene is a Class 1B flammable liquid. A concentration exceeding 3250 ppm is considered a potential fire explosion hazard. Benzene vapor is heavier than air and can collect in low lying areas or travel to an ignition source and flash back. Explosive and flammable benzene vapor-air mixtures can easily form at room temperature. Eliminate all ignition sources where benzene is used, handled, or stored.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Structural firefighter's protective clothing provides limited protection. Stay out of low areas. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Runoff to sewer can create pollution, fire, and explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Benzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Benzene explodes on contact with diborane, permanganic acid, bromine pentafluoride, peroxodisulfuric acid, and peroxomonosulfuric acid. It ignites on contact with dioxygen difluoride, dioxygenyl tetrafluoroborate, iodine heptafluoride, and sodium peroxide + water. Benzene forms sensitive, explosive mixture with iodine pentafluoride, ozone, liquid oxygen, silver perchlorate, nitryl perchlorate, nitric acid, and arsenic pentafluoride + potassium methoxide (explodes above 30 °C). A vigorous or incandescent reaction occurs with bromine trifluoride, uranium hexafluoride, and hydrogen + Raney nickel [above 410 °F (210 °C)]. Benzene is incompatible with oxidizing materials.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of benzene can produce toxic gases and vapors such as carbon monoxide.

Section 6. Health Hazard Data

Carcinogenicity: The ACGIH, OSHA, and IARC list benzene as, respectively, a supected human carcinogen, a cancer hazard, and, based on sufficient human and animal evidence, a human carcinogen (Group 1).
Summary of Risks: Prolonged skin contact or excessive inhalation of benzene vapor may cause headache, weakness, appetite loss, and fatigue. The most important health hazards are cancer (leukemia) and bone marrow damage with injury to blood-forming tissue from chronic low-level exposure. Higher level exposures may irritate the respiratory tract and cause central nervous system (CNS) depression.
Medical Conditions Aggravated by Long-Term Exposure: Exposure may worsen ailments of the heart, lungs, liver, kidneys, blood, and CNS.
Target Organs: Blood, central nervous system, bone marrow, eyes, upper respiratory tract, and skin.
Primary Entry Routes: Inhalation, skin contact.
Acute Effects: Symptoms of acute overexposure include irritation of the eyes, nose, and respiratory tract, breathlessness, euphoria, nausea, drowsiness, headache, dizziness, and intoxication. Severe exposure may lead to convulsions and unconsciousness. Skin contact may cause a drying rash (dermatitis).
Chronic Effects: Long-term chronic exposure may result in many blood disorders ranging from aplastic anemia (an inability to form blood cells) to leukemia.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Immediately rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air. Emergency personnel should protect against inhalation exposure. Provide CPR to support breathing or circulation as necessary. Keep awake and transport to a medical facility.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* since aspiration may be fatal. Call a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Evaluate chronic exposure with a CBC, peripheral smear, and reticulocyte count for signs of myelotoxicity. Follow up any early indicators of leukemia with a bone marrow biopsy. Urinary phenol conjugates may be used for biological monitoring of recent exposure. Acute management is primarily supportive for CNS depression.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a benzene spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel, eliminate all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against vapor inhalation, eye contact, and skin absorption. Absorb as much benzene as possible with an inert, noncombustible material. For large spills, dike far ahead of spill and contain liquid. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of confined spaces such as sewers, watersheds, and waterways because of explosion danger. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Waste No. U019
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 307 (a), 311 (b)(4), 112; and per RCRA, Sec. 3001]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Tables Z-1-A and Z-2)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations at least below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all heat and ignition sources and incompatible materials. *Caution! Benzene vapor may form explosive mixtures in air.* To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas. When opening or closing benzene containers, use nonsparking tools. Keep fire extinguishers readily available.
Engineering Controls: Because OSHA specifically regulates benzene (29 CFR 1910.1028), educate workers about its potential hazards and dangers. Minimize all possible exposures to carcinogens. If possible, substitute less toxic solvents for benzene; use this material with extreme caution and only if absolutely essential. Avoid vapor inhalation and skin and eye contact. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Designate regulated areas of benzene use (see legend in the box below) and label benzene containers with "DANGER, CONTAINS BENZENE, CANCER HAZARD."
Other Precautions: Provide preplacement and periodic medical examinations with emphasis on a history of blood disease or previous exposure.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Benzene (*benzol*)
DOT Hazard Class: Flammable liquid
ID No.: UN1114
DOT Label: Flammable liquid
DOT Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Benzene
IMO Hazard Class: 3.2
ID No.: UN1114
IMO Label: Flammable liquid
IMDG Packaging Group: II

DANGER
BENZENE
CANCER HAZARD
FLAMMABLE–NO SMOKING
AUTHORIZED PERSONNEL ONLY
RESPIRATOR REQUIRED

MSDS Collection **References:** 1, 2, 12, 26, 73, 84-94, 100, 101, 103, 109, 124, 126, 127, 132, 134, 136, 138, 139, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Section 1. Material Identification

43

Toluene ($C_6H_5CH_3$) Description: Derived from petroleum i.e., dehydrogenation of cycloparaffin fractions followed by the aromatization of saturated aromatic hydrocarbons or by fractional distillation of coal-tar light oil and purified by rectification. Used widely as a solvent (replacing benzene in many cases) for oils, resins, adhesives, natural rubber, coal tar, asphalt, pitch, acetyl celluloses, cellulose paints and varnishes; a diluent for photogravure inks, raw material for organic synthesis (benzoyl & benzilidene chlorides, saccharine, TNT, toluene diisocyanate, and many dyestuffs), in aviation and high octane automobile gasoline, as a nonclinical thermometer liquid and suspension solution for navigational instruments.

Other Designations: CAS No. 108-88-3, Methacide, methylbenzene, methylbenzol, phenylmethane, toluol, Tolu-sol.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

Cautions: Toluene is an eye, skin, and respiratory tract irritant becoming narcotic at high centrations. Liver and kidney damage has occurred. Pregnant women chronically exposed to toluene have shown teratogenic effects. Toluene is highly flammable.

R 1
I 3
S 2*
K 3
* Skin absorption

NFPA
3
2 0
-

HMIS
H 2- Chronic effects
F 3
R 0
PPE-Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Toluene, < 100%; may contain a small amount of benzene (~ 1%), xylene, and nonaromatic hydrocarbons.

1991 OSHA PELs
8-hr TWA: 100 ppm (375 mg/m^3)
15-min STEL: 150 ppm (560 mg/m^3)

1990 IDLH Level
2000 ppm

1990 NIOSH RELs
TWA: 100 ppm (375 mg/m^3)
STEL: 150 ppm (560 mg/m^3)

1992-93 ACGIH TLV (Skin)
TWA: 50 ppm (188 mg/m^3)

1990 DFG (Germany) MAK*
TWA: 100 ppm (380 mg/m^3)
Half-life: 2 hr to end of shift
Category II: Substances with systemic effects
Peak Exposure Limit: 500 ppm, 30 min average value, 2/shift

1985-86 Toxicity Data†
Man, inhalation, TC_{Lo}: 100 ppm caused hallucinations, and changes in motor activity and changes in psychophysiological tests.
Human, oral, LD_{Lo}: 50 mg/kg; toxic effects not yet reviewed
Human, eye: 300 ppm caused irritation.
Rat, oral, LD_{50}: 5000 mg/kg
Rat, liver: 30 µmol/L caused DNA damage.

* Available information suggests damage to the developing fetus is probable.
†See NIOSH, *RTECS* (XS5250000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 232 °F (110.6 °C)
Melting Point: -139 °F (-95 °C)
Molecular Weight: 92.15
Density: 0.866 at 68 °F (20/4 °C)
Surface Tension: 29 dyne/cm at 68 °F (20 °C)
Viscosity: 0.59 cP at 68 °F (20 °C)
Refraction Index: 1.4967 at 20 °C/D
Water Solubility: Very slightly soluble, 0.6 mg/L at 68 °F (20 °C)
Other Solubilities: Soluble in acetone, alcohol, ether, benzene, chloroform, glacial acetic acid, petroleum ether, and carbon disulfide.
Vapor Pressure: 22 mm Hg at 68 °F (20 °C); 36.7 mm Hg at 86 °F (30 °C)
Saturated Vapor Density (Air = 0.075 lb/ft^3 or 1.2 kg/m^3): 0.0797 lb/ft^3 or 1.2755 kg/m^3
Odor Threshold (range of all referenced values): 0.021 to 69 ppm

Appearance and Odor: Colorless liquid with a sickly sweet odor.

Section 4. Fire and Explosion Data

Flash Point: 40 °F (4.4 °C) CC	**Autoignition Temperature:** 896 °F (480 °C)	**LEL:** 1.27% v/v	**UEL:** 7.0% v/v

Extinguishing Media: Toluene is a Class 1B flammable liquid. To fight fire, use dry chemical carbon dioxide, or 'alcohol-resistant' foam. Water spray may be ineffective as toluene floats on water and may actually spread fire. **Unusual Fire or Explosion Hazards:** Concentrated vapors are heavier than air and may travel to an ignition source and flash back. Container may explode in heat of fire. Toluenes' burning rate = 5.7 mm/min and its flame speed = 37 cm/sec. Vapor poses an explosion hazard indoors, outdoors, and in sewers. May accumulate static electricity. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing provides only limited protection. Apply cooling water to sides of tanks until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from fire and let burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire because a BLEVE (boiling liquid expanding vapor explosion) may be imminent. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Toluene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization can't occur. **Chemical Incompatibilities:** Strong oxidizers, concentrated nitric acid, nitric acid + sulfuric acid, dinitrogen tetroxide, silver perchlorate, bromine trifluoride, tetranitromethane, and 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione. **Conditions to Avoid:** Contact with heat, ignition sources, or incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of toluene can produce carbon dioxide, and acrid, irritating smoke.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] NTP,[169] and OSHA[164] do not list toluene as a carcinogen. **Summary of Risks:** Toluene is irritating to the eyes, nose, and respiratory tract. Inhalation of high concentrations produces a narcotic effect sometimes leading to coma as well as liver and kidney damage. 93% of inhaled toluene is retained in the body of which 80% is metabolized to benzoic acid, then to hippuric acid and excreted in urine. The remainder is metabolized to *o*-cresol and excreted or exhaled unchanged. Toluene metabolism is inhibited by alcohol ingestion and is synergistic with benzene, asphalt fumes, or chlorinated hydrocarbons (i.e. perchloroethylene). Toluene is readily absorbed through the skin at 14 to 23 mg/cm^2/hr. Toluene is absorbed quicker during exercise than at rest and appears to be retained longer in obese versus thin victims; presumably due to its lipid solubility. There is inconsistent data on toluene's ability to damage bone marrow; chronic poisoning has resulted in anemia and leucopenia with biopsy showing bone marrow hypo-plasia. These reports are few and some authorities argue that the effects may have been due to benzene contaminants. Chronic inhalation during pregnancy has been associated with teratogenic effects on the fetus including microcephaly, CNS dysfunction, attentional deficits, developmental delay + language impairment, growth retardation, and physical defects including a small midface, short palpebral fissures, with deep-set eyes, low-set ears, flat nasal bridge with a small nose, micrognathia, and blunt fingertips. There is some evidence that toluene causes an autoimmune illness in which the body produces antibodies that cause inflammation of its own kidney.

Continue on next page

Section 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Alcoholism and CNS, kidney, skin, or liver disease. **Target Organs:** CNS, liver, kidney, skin. **Primary Entry Routes:** Inhalation, skin contact/absorption. **Acute Effects:** Vapor inhalation causes respiratory tract irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, watering eyes, nervousness, insomnia, parasthesis, and vertigo progressing to narcotic coma. Death may result from cardiac arrest due to ventricular fibrillation with catecholamines loss. Liquid splashed in the eye causes conjunctival irritation, transient corneal damage and possible burns. Prolonged skin contact leads to drying and fissured dermatitis. Ingestion causes GI tract irritation and symptoms associated with inhalation. **Chronic Effects:** Symptoms include mucous membrane irritation, headache, vertigo, nausea, appetite loss and alcohol intolerance. Repeated heavy exposure may result in encephalopathies (cerebellar ataxia and cognitive dysfunction), liver enlargement, and kidney dystrophy (wasting away). Symptoms usually appear at workdays end, worsen at weeks end and decrease or disappear over the weekend.
FIRST AID **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult an ophthalmologist immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting because of danger of aspiration into the lungs. Gastric lavage may be indicated if large amounts are swallowed; potential toxicity needs to be weighed against aspiration risk when deciding for or against gastric lavage. **Note to Physicians:** Monitor cardiac function. If indicated, use epinephrine and other catecholamines carefully, because of the possibility of a lowered myocardial threshold to the arrhythmogenic effects of such substances. Obtain CBC, electrolytes, and urinalysis. Monitor arterial blood gases. If toluene has > 0.02% (200 ppm) benzene, evaluate for potential benzene toxicity. BEI: hippuric acid in urine, sample at shift end (2.5 g/g creatinine); Toluene in venous blood, sample at shift end (1.0 mg/L).

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel protect against inhalation and skin/eye contact. Use water spray to cool and disperse vapors but it may not prevent ignition in closed spaces. Cellosolve, hycar absorbent materials, and fluorocarbon water can also be used for vapor suppression/containment. Take up small spill with earth, sand, vermiculite, or other absorbent, noncombustible material. Dike far ahead of large spills for later reclamation or disposal. For water spills, (10 ppm or greater) apply activated carbon at 10X the spilled amount and remove trapped material with suction hoses or use mechanical dredges/lifts to remove immobilized masses of pollutants and precipitates. Toluene can undergo fluidized bed incineration at 842 to 1796 °F (450 to 980 °C), rotary kiln incineration at 1508 to 2912 °F (820 to 1600 °C), or liquid injection incineration at 1202 to 2912 °F (650 to 1600 °C). Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Blue gill, LC_{50} = 17 mg/L/24 hr; shrimp (*Crangonfracis coron*), LC_{50} = 4.3 ppm/96 hr; fathead minnow (*Pimephales promelas*), LC_{50} = 36.2 mg/L/96 hr. **Environmental Degradation:** If released to land, toluene evaporates and undergoes microbial degradation. In water, toluene volatilizes and biodegrades with a half-life of days to several weeks. In air, toluene degrades by reaction with photochemically produced hydroxyl radicals.
Disposal: Treat contaminated water by gravity separation of solids, followed by skimming of surface. Pass through dual media filtration and carbon absorption units (carbon ratio 1 kg to 10 kg soluble material). Return waste water from backwash to gravity separator. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U220
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg)
[* per RCRA, Sec. 3001; CWA, Sec. 311 (b)(4); CWA, Sec. 307 (a)]
Listed as a SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses with shatter-resistant glass and side-shields or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use any chemical cartridge respirator with appropriate organic vapor cartridges, any supplied-air respirator (SAR), or SCBA. For < 2000 ppm, use any SAR operated in continuous-flow mode, any SAR or SCBA with a full facepiece, or any air-purifying respirator with a full facepiece having a chin-style, front or back mounted organic vapor canister. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl alcohol with a breakthrough time of > 8 hr, Teflon and Viton are recommended as suitable materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove toluene from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from ignition sources and incompatibles. Outside or detached storage is preferred. If stored inside, use a standard flammable liquids warehouse, room, or cabinet. To prevent static sparks, electrically ground and bond all equipment used with toluene. Do not use open lights in toluene areas. Install Class 1, Group D electrical equipment. Check that toluene is free of or contains < 1% benzene before use. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Adopt controls for confined spaces (29 CFR 1910.146) if entering areas of unknown toluene levels (holes, wells, storage tanks). Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, liver, kidney, and skin. Include hemocytometric and thrombocyte count in cases where benzene is a contaminant of toluene. Monitor air at regular intervals to ensure effective ventilation.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Toluene
DOT Hazard Class: 3
ID No.: UN1294
DOT Packing Group: II
DOT Label: Flammable Liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 150
b) Non-bulk Packaging: 202
c) Bulk Packaging: 242

Quantity Limitations
a) Passenger Aircraft or Railcar: 5L
b) Cargo Aircraft Only: 60L

Vessel Stowage Requirements
Vessel Stowage: B
Other: --

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 140, 148, 153, 159, 163, 164, 167, 169, 171, 174, 175, 176, 180.
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, CIH, MPH; **Medical Review:** AC Darlington, MD, MPH

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 318
Xylene *(Mixed Isomers)*

Issued: 11/80 Revision: E, 9/92 Errata: 12/94

Section 1. Material Identification

Xylene (Mixed Isomers) (C_8H_{10}) Description: The commercial product is a blend of the three isomers [*ortho*-(*o*-), *meta*-(*m*-), *para*-(*p*-)] with the largest proportion being *m*- xylene. Xylene is obtained from coal tar, toluene by transalkylation, and pseudocumene. Used in the manufacture of dyes, resins, paints, varnishes, and other organics; as a general solvent for adhesives, a cleaning agent in microscope technique; as a solvent for Canada balsam microscopy; as a fuel component; in aviation gasoline, protective coatings, sterilizing catgut, hydrogen peroxide, perfumes, insect repellants, pharmaceuticals, and the leather industry; in the production of phthalic anhydride, isophthalic, and terephthalic acids and their dimethyl esters which are used in the manufacture of polyester fibers; and as an indirect food additive as a component of adhesives. Around the home, xylene is found as vehicles in paints, paint removers, degreasing cleaners, lacquers, glues and cements and as solvent/vehicles for pesticides.

Other Designations: CAS No. 1330-20-7 [95-47-6; 108-38-3; 106-42-3 (*o*-, *m*-, *p*-isomers)], dimethylbenzene, methyltoluene, NCI-C55232, Violet 3, xylol.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

Cautions: Xylene is an eye, skin, and mucous membrane irritant and may be narcotic in high concentrations. It is a dangerous fire hazard.

R	1
I	2
S	2
K	3

NFPA: 3 (top), 2 (left), 0 (right), – (bottom)

HMIS
H 2†
F 3
R 0
PPE ‡
† Chronic Effects
‡ Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Xylene (mixed isomers): the commercial product generally contains ~ 40% *m*-xylene; 20% each of *o*-xylene, *p*-xylene, and ethylbenzene; and small quantities of toluene. Unpurified xylene may contain pseudocumene.

1991 OSHA PELs
8-hr TWA: 100 ppm (435 mg/m³)
15-min STEL: 150 ppm (655 mg/m³)

1990 IDLH Level
1000 ppm

1990 NIOSH RELs
TWA: 100 ppm (435 mg/m³)
STEL: 150 ppm (655 mg/m³)

1992-93 ACGIH TLVs
TWA: 100 ppm (434 mg/m³)
STEL: 150 ppm (651 mg/m³)
BEI (Biological Exposure Index): Methylhippuric acids in urine at end of shift: 1.5 g/g creatinine

1990 DFG (Germany) MAK
TWA: 100 ppm (440 mg/m³)
Category II: Substances with systemic effects
Half-life: < 2 hr
Peak Exposure: 200 ppm, 30 min, average value, 4 peaks per shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 200 ppm produced olfaction effects, conjunctiva irritation, and other changes involving the lungs, thorax, or respiration.
Man, inhalation, LC_{Lo}: 10000 ppm/6 hr; toxic effects not yet reviewed.
Human, oral, LD_{Lo}: 50 mg/kg; no toxic effect noted.
Rat, oral, LD_{50}: 4300 mg/kg; toxic effect not yet reviewed.
Rat, inhalation, LC_{50}: 5000 ppm/4 hr; toxic effects not yet reviewed.

* See NIOSH, *RTECS* (XE2100000), for additional toxicity data.

Section 3. Physical Data

Boiling Point Range: 279 to 284 °F (137 to 140 °C)*
Boiling Point: *ortho:* 291 °F (144 °C); *meta:* 281.8 °F (138.8 °C); *para:* 281.3 °F (138.5 °C)
Freezing Point/Melting Point: *ortho:* -13 °F (-25 °C); *meta:* -53.3 °F (- 47.4 °C); *para:* 55 to 57 °F (13 to 14 °C)
Vapor Pressure: 6.72 mm Hg at 70 °F (21 °C)
Saturated Vapor Density (Air = 1.2 kg/m³): 1.23 kg/m³, 0.077 lbs/ft³
Appearance and Odor: Clear, sweet-smelling liquid.

* Materials with wider and narrower boiling ranges are commercially available.

Molecular Weight: 106.16
Specific Gravity: 0.864 at 20 °C/4 °C
Water Solubility: Practically insoluble
Other Solubilities: Miscible with absolute alcohol, ether, and many other organic liquids.
Octanol/Water Partition Coefficient: logKow = 3.12-3.20
Odor Threshold: 1 ppm
Viscosity: <32.6 SUS

Section 4. Fire and Explosion Data

Flash Point: 63 to 77 °F (17 to 25 °C) CC	**Autoignition Temperature:** 982 °F (527 °C) (*m*-)	**LEL:** 1.1 (*m*-, *p*-); 0.9 (*o*-)	**UEL:** 7.0 (*m*-, *p*-); 6.7 (*o*-)

Extinguishing Media: For small fires, use dry chemical, carbon dioxide (CO_2), water spray or regular foam. For large fires, use water spray, fog or regular foam. Water may be ineffective. Use water spray to cool fire-exposed containers. **Unusual Fire or Explosion Hazards:** Xylene vapors or liquid (which floats on water) may travel to an ignition source and flash back. The heat of fire may cause containers to explode and/or produce irritating or poisonous decomposition products. Xylene may present a vapor explosion hazard indoors, outdoors, or in sewers. Accumulated static electricity may occur from vapor or liquid flow sufficient to cause ignition. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing will provide limited protection. If feasible and without risk, move containers from fire area. Otherwise, cool fire-exposed containers until well after fire is extinguished. Stay clear of tank ends. Use unmanned hose holder or monitor nozzles for massive cargo fires. If impossible, withdraw from area and let fire burn. Withdraw immediately in case of any tank discoloration or rising sound from venting safety device. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Xylene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Xylene is easily chlorinated, sulfonated, or nitrated. **Chemical Incompatibilities:** Incompatibilities include strong acids and oxidizers and 1,3-dichloro-5,5-dimethyl-2,4-imidazolidindione (dichlorohydrantoin). Xylene attacks some forms of plastics, rubber, and coatings. **Conditions to Avoid:** Avoid heat and ignition sources and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of xylene can produce carbon dioxide, carbon monoxide, and various hydrocarbon products.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] NTP,[169] and OSHA[164] do not list xylene as a carcinogen. **Summary of Risks:** Xylene is an eye, mucous membrane, and respiratory tract irritant. Irritation starts at 200 ppm; severe breathing difficulties which may be delayed in onset can occur at high concentrations. It is a central nervous system (CNS) depressant and at high concentrations can cause coma. Kidney and liver damage can occur with xylene exposure. With prolonged or repeated cutaneous exposure, xylene produces a defatting dermatitis. Chronic toxicity is not well defined, but it is less toxic than benzene. Prior to the 1950s, benzene was often found as a contaminant of xylene and the effects attributed to xylene such as blood dyscrasias are questionable. Since the late 1950s, xylenes have been virtually benzene-free and blood dyscrasias have not been associated with xylenes. Chronic exposure to high concentrations of xylene in animal studies have demonstrated mild reversible decrease in red and white cell counts as well as increases in platelet counts.

Continue on next page

Section 6. Health Hazard Data, *continued*

Menstrual irregularity was reported in association with workplace exposure to xylene perhaps due to effects on liver metabolism. Xylene crosses the human placenta, but does not appear to be teratogenic under conditions tested to date. **Medical Conditions Aggravated by Long-Term Exposure:** CNS, respiratory, eye, skin, gastrointestinal (GI), liver and kidney disorders. **Target Organs:** CNS, eyes, GI tract, liver, kidneys, and skin. **Primary Entry Routes:** Inhalation, skin absorption (slight), eye contact, ingestion. **Acute Effects:** Inhalation of high xylene concentrations may cause dizziness; nausea, vomiting, and abdominal pain; eye, nose, and throat irritation; respiratory tract irritation leading to pulmonary edema (fluid in lung); drowsiness; and unconsciousness. Direct eye contact can result in conjunctivitis and corneal burns. Ingestion may cause a burning sensation in the oropharynx and stomach and transient CNS depression. **Chronic Effects:** Repeated or prolonged skin contact may cause drying and defatting of the skin leading to dermatitis. Repeated eye exposure to high vapor concentrations may cause reversible eye damage, peripheral and central neuropathy, and liver damage. Other symptoms of chronic exposure include headache, fatigue, irritability, chronic bronchitis, and GI disturbances such as nausea, loss of appetite, and gas.

FIRST AID *Emergency personnel should protect against exposure.* **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. Carefully dispose of contaminated clothing as it may pose a fire hazard. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. Monitor exposed person for respiratory distress. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, *do not induce vomiting!* If spontaneous vomiting should occur, keep exposed person's head below the hips to prevent aspiration (breathing liquid xylene into the lungs). *Aspiration of a few millimeters of xylene can cause chemical pneumonitis, pulmonary edema, and hemorrhage.* **Note to Physicians:** Hippuric acid or the ether glucuronide of *ortho*-toluic acid may be useful in diagnosis of *meta-*, *para-* and *ortho*-xylene exposure, respectively. Consider gastric lavage if a large quantity of xylene was ingested. Proceed gastric lavage with protection of the airway from aspiration; consider endotracheal intubation with inflated cuff.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove all heat and ignition sources, and ventilate spill area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. If feasible and without undue risk, stop leak. Use appropriate foam to blanket release and suppress vapors. Water spray may reduce vapor, but does not prevent ignition in closed spaces. For small spills, absorb on paper and evaporate in appropriate exhaust hood or absorb with sand or some non-combustible absorbent and place in containers for later disposal. For large spills dike far ahead of liquid to contain. Do not allow xylene to enter a confined space such as sewers or drains. On land, dike to contain or divert to impermeable holding area. Apply water spray to control flammable vapor and remove material with pumps or vacuum equipment. On water, contain material with natural barriers, booms, or weirs; apply universal gelling agent; and use suction hoses to remove spilled material. Report any release in excess of 1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** Little bioconcentration is expected. Biological oxygen demand 5 (after 5 days at 20 °C): 0.64 (no stated isomer). **Ecotoxicity values:** LD_{50}, Goldfish, 13 mg/L/24 hr, conditions of bioassay not specified, no specific isomer. **Environmental Degradation:** In the atmosphere, xylenes degrade by reacting with photochemically produced hydroxyl radicals with a half-life ranging from 1-1.7 hr. in the summer to 10-18 hr in winter or a typical loss of 67-86% per day. Xylenes are resistant to hydrolysis. **Soil Absorption/Mobility:** Xylenes have low to moderate adsorption to soil and when spilled on land, will volatilize and leach into groundwater. **Disposal:** As a hydrocarbon, xylene is a good candidate for controlled incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U239, F003 (spent solvent)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per Clean Water Act, Sec. 311(b)(4); per RCRA, Sec. 3001]

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For concentrations >1000 ppm, use any chemical cartridge respirator with organic vapor cartridges; any powered, air-purifying respirator with organic vapor cartridges; any supplied-air respirator; or any self-contained breathing apparatus. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. With breakthrough times > 8 hr, consider polyvinyl alcohol and fluorocarbon rubber (Viton) as materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in clearly labelled, tightly closed, containers in a cool, well-ventilated place, away from strong oxidizing materials and heat and ignition sources. During transferring operations, electrically ground and bond metal containers. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Use hermetically sealed equipment, transfer xylene in enclosed systems, avoid processes associated with open evaporating surfaces, and provide sources of gas release with enclosures and local exhaust ventilation. Use Class I, Group D electrical equipment. **Administrative Controls:** Establish air and biological monitoring programs and evaluate regularly. Consider preplacement and periodic medical examinations including a complete blood count, a routine urinalysis, and liver function tests. Consider hematologic studies if there is any significant contamination of the solvent with benzene. If feasible, consider the replacement of xylene by less toxic solvents such as petrol (motor fuel) or white spirit. Before carrying out maintenance and repair work, steam and flush all equipment to remove any xylene residues.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Xylenes
DOT Hazard Class: 3
ID No.: UN1307
DOT Packing Group: II
DOT Label: Flammable Liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 173.150
b) Nonbulk Packaging : 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 5L
b) Cargo Aircraft Only: 60L

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: –

MSDS Collection **References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 153, 159, 163, 164, 167, 171, 174, 176, 180.
Prepared by: MJ Wurth, BS; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** W Silverman, MD

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:
Sheet No. 382
Vinyl Chloride
Issued: 7/78 Revision: C, 9/92

Section 1. Material Identification

Vinyl Chloride (C_2H_3Cl) Description: Derived from ethylene dichloride and alcoholic potassium, by reaction of acetylene and hydrogen chloride (as gas or liquids), or by oxychlorination where ethylene reacts with hydrochloric acid and oxygen. Inhibitors such as butyl catechol, hydroquinone, or phenol are added to prevent polymerization. Used in the plastics industry for the production of polyvinyl chloride resins, in organic synthesis and formerly as a refrigerant, extraction solvent, and propellant (banned in 1974 because of its carcinogenic activity).
Other Designations: CAS No. 75-01-4, chloroethylene, chloroethene, ethylene monochloride, Trovidur, VC, VCM.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

Cautions: Vinyl chloride is a confirmed human carcinogen. Vapor inhalation leads to central nervous system (CNS) depression. The liquid can cause frostbite. It is a flammable gas at room temperature and polymerizes on exposure to air or sunlight. Avoid exposure to VC through engineering controls and wearing PPE

R 2
I 4
S 4
K 4

NFPA
4
2 2
–

HMIS
H 3*
F 4
R 2
PPE - Sec. 8
* Chronic effects

Section 2. Ingredients and Occupational Exposure Limits

Vinyl Chloride, ca 98 to 99%. Impurities include water, acetaldehyde, hydrogen chloride, hydrogen peroxide, methyl chloride, butane, 1,3-butadiene, chlorophene, diacetylene, vinyl acetylene, and propine.

1991 OSHA PELs
8-hr TWA: 1 ppm
Ceiling: 5 ppm; OSHA-X

1990 NIOSH REL
NIOSH-X

1992-93 ACGIH TLV
TWA: 5 ppm (13 mg/m^3)
TLV-A1

1990 DFG (Germany) TRK*
Existing Installations: 3 ppm
MAK-A1

1985-86 Toxicity Data†
Man, inhalation, TC_{Lo}: Intermittent exposure to 200 ppm for 14 yr caused liver tumors.
Man, inhalation, TC_{Lo}: 30 mg/m^3/5 yr caused spermatogenesis.
Human, inhalation, TC: Continuous exposure to 300 mg/m^3 for an undetermined number of weeks caused blood tumors.
Rat, oral, LD_{50}: 500 mg/kg; toxic effects not yet reviewed

* TRK (technical exposure limit) is used in place of MAK when a material is a carcinogen. Unlike an MAK below which no adverse effects are expected, the TRK is a limit set below which adverse effects may still occur. This is based on the theory that 1 molecule of a carcinogenic substance may still produce a tumor. The TRK is set to allow for an acceptable risk (for example, 1 tumor in 1 million persons may be an acceptable risk).
† See NIOSH, *RTECS* (KU9625000), for additional mutation, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 7 °F (-13.9 °C)
Freezing Point: -245 °F (-159.7 °C)
Molecular Weight: 62.5
Specific Gravity: 0.9106 at 68 °F (20 °C)
Ionization Potential: 9.99 eV
Refraction Index: 1.370 at 20 °C/D
Surface Tension: 23.1 dyne/cm at -4 °F (-20 °C)
Odor Threshold: 2000 to 5000 ppm*
Vapor Density (Air = 1): 2.155
Water Solubility: Slightly soluble, 0.1% at 77 °F (25 °C)
Other Solubilities: alcohol, benzene, carbon tetrachloride, ether, hydrocarbon and oils.
Vapor Pressure: 2530 mm Hg at 68 °F (20 °C), 400 mm Hg at -18.4 °F (-28 °C)
Critical Temperature: 304.7 °F (151.5 °C)
Critical Pressure: 56.8 atm
Viscosity: 0.01072 cP at 68 °F (20 °C), *gas*; 0.28 cP at -4 °F (-20 °C), *liquid*
Appearance and Odor: A gas at room temperature. Usually found as a compressed/cooled liquid. The colorless liquid forms a vapor with a pleasant ethereal odor.

*The actual vapor concentration that can be detected by humans has not been adequately determined and varies from one individual to another, from impurities, and probably from exposure duration. The odor threshold is not an accurate warning of exposure.

Section 4. Fire and Explosion Data

Flash Point: -108.4 °F (-78 °C) OC	**Autoignition Temperature:** 882 °F (472 °C)	**LEL:** 3.6% v/v	**UEL:** 33% v/v

Extinguishing Media: For small fires, use dry chemical or carbon dioxide. For large fires, use water spray, fog, or regular foam. **Unusual Fire or Explosion Hazards:** Large fires can be practically inextinguishable. Vapors may travel to an ignition source and flash back. VC may polymerize in cylinders or tank cars and explode in heat of fire. Vapors pose an explosion hazard indoors, outdoors, and in sewers. VC decomposes in fire to hydrogen chloride, carbon monoxide, carbon dioxide, and phosgene. Burning rate = 4.3 mm/min. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Stop gas leak if possible. Let tank, tank car, or tank truck burn unless leak can be stopped. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if this is impossible, withdraw from area and let fire burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. *Do not* release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Long term exposure to air may result in formation of peroxides which initiates explosive polymerization of the chloride. VC can polymerize on exposure to light or in presence of a catalyst. **Chemical Incompatibilities:** VC can explode on contact with oxide of nitrogen, may liberate hydrogen chloride on exposure to strong alkalies, and is incompatible with copper, oxidizers, aluminum, and peroxides. In the presence of moisture, VC attacks iron and steel. **Conditions to Avoid:** Exposure to sunlight, air, heat, and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of vinyl chloride can produce carbon oxides, and chloride gas.

Section 6. Health Hazard Data

Carcinogenicity: Vinyl chloride is listed as a carcinogen by the IARC (Class 1, *sufficient human evidence*),[164] NTP (Class 1, *sufficient human* evidence),[169] NIOSH (Class X, *carcinogen defined without further categorization*),[163] ACGIH (TLV-A1, *confirmed human carcinogen*),[163] DFG (MAK-A1, *capable of inducing malignant tumors in humans*),[163] and OSHA (Class X, *carcinogen defined without further categorization*).[164] Liver tumors (angiosarcomas) are confirmed from VC exposure. Other tumors of the CNS, respiratory system, blood, and lymphatic system have occurred from exposure to the polyvinyl chloride manufacture process but VC itself may not be the causative agent. **Summary of Risks**: Vapor inhalation causes varying degrees of CNS depression with noticeable anesthetic effects at levels of 1% (10,000 ppm). Studies have shown loss of libido and sperm in men exposed to VC and in Russian studies, 77% of exposed women experienced ovarian dysfunction, benign uterine growths, and prolapsed genital organs. However, no teratogenic effects have been seen in offspring of exposed workers.

Continue on next page

Section 6. Health Hazard Data, *continued*

It appears that metabolism is necessary before many of VC's toxic effects occur. Some vinyl chloride is exhaled unchanged but most is metabolized to chloroacetaldehyde. Skin absorption may occur if liquid is confined on skin but absorbed amount would be small. It is possible that the phenol inhibitor may be absorbed as well. The compressed liquid can cause frostbite. Vapors are severely irritating to the eyes. Chronic exposure can cause cancer and a triad of syndromes known as *vinyl chloride disease.* **Medical Conditions Aggravated by Long-Term Exposure:** Liver, cardiac, pulmonary, and connective tissue disorders. **Target Organs:** Liver, CNS, respiratory and lymphatic systems, bone, and connective tissue of the skin. **Primary Entry Routes:** Inhalation, skin/eye contact. **Acute Effects:** CNS effects include fatigue, headache, vertigo, ataxia, euphoria, visual disturbances, dulling of auditory cues, numbness and tingling in the extremities, narcosis, unconsciousness, and death due to respiratory failure. Respiratory problems include dyspnea, asthma, and pneumonoconiosis. **Chronic Effects:** Repeated exposure has lead to liver cancer; confirmed because of the otherwise rarity of its type (angiosarcoma). Tumors in other organs have occurred in the polyvinyl chloride industry but agents other than VC may be responsible; authorities are still debating this issue. A triad of other effects are associated with VC exposure. Acro-osteolysis is associated with hand cleaning of polymerization vessels and characterized by dissolution of bone in the hands, especially when associated with resorption. Raynaud's Phenomenon is a vascular disorder marked by recurrent spasm of the capillaries and especially those of the fingers and toes on exposure to cold. This is usually accompanied by pain and in severe cases may progress to local gangrene. Sclerodermatous skin changes (affecting the dorsal hands and distal forearms) are seen and described as a slowly progressive disease marked by deposition of fibrous connective tissue in the skin. The skin becomes thickened and raised nodules appear. Arthralgias (pain in one or more joints) and blood changes with decreased platelet number and capillary abnormalities may also occur.

FIRST AID Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. For frostbite, immerse affected area in 107.6 °F (42 °C) water until completely rewarmed. *Do not* use dry heat. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Unlikely! VC is a gas above 7 °F (-14°C). **Note to Physicians:** Endotracheal intubation may be required if significant CNS or respiratory depression occur. Diagnostic test: thiodiglycolic acid in urine (normally < 2 mg/g creatinine).

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. If possible without risk, stop gas flow. Shut off ignition sources. Report any release > 1 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** VC reacts with hydroxyl radicals in the trophosphere with a half-life of 1.2 days. The half-life = a few hr in photochemical smog. Reaction products in the air include chloroacetaldehyde, hydrogen chloride, chloroethylene, epoxide, formaldehyde, formyl chloride, formic acid, and carbon monoxide. In soil, VC rapidly volatilizes. What does not evaporate will be highly mobile and may leach into groundwater. In water, VC is not expected to hydrolyze, bioconcentrate, or absorb to sediment. It will rapidly volatilize with an estimated half-life of 0.805 hr for evaporation from a river 1 meter deep with a current of 3 meter/sec and a wind velocity of 3 meter/sec. In waters containing photosensitizers such as humic acid, photodegradation will be rapid. **Soil Absorption/Mobility:** From an estimated solubility of 2,700 ppm, a Koc of 56 is established for VC which indicates high soil mobility and potential to leach into groundwater.

Disposal: Dilute any waste compressed liquid to a 1% solution and remove phenol inhibitor as sodium. Pour onto vermiculite, sodium bicarbonate, or a sand & soda ash mixture (90/10). Add slaked lime if fluoride is present. Mix in paper boxes, place in incinerator, cover with scrap wood and paper, and ignite with excelsior train. Another method is to dissolve waste in a flammable solvent and spray in incinerator firebox equipped with an afterburner and alkali scrubber. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U043
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1 lb (0.454 kg) [* per CWA, Sec. 307 (a); CAA, Sec. 112, & RCRA, Sec. 3001]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. According to NIOSH[148], for any detectable concentration use a SCBA or supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode. See 29 CFR 1910.1017 for detailed OSHA respirator recommendations. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made of Viton or chlorinated polyethylene to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL's (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate work clothes from street clothes, launder before reuse and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a cool, dry, well-ventilated area in clearly labeled containers. Outside or detached storage is preferred. Large amounts should be stored in steel containers under pressure. Keep separate from incompatibles (Sec. 5). Venting, under pressure should be safety relief. At atm, venting should be pressure vacuum. Regularly monitor inhibitor levels. To avoid static sparks, electrically ground and bond all equipment used with VC. Avoid open flames, spark formation and electric discharges around VC. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Install Class 1, Group D electrical equipment. **Administrative Controls:** Inform VC exposed personnel of hazards associated with its use. Preplacement and periodic medical exams of workers exposed above the action level is mandatory under OSHA 29 CFR (1910.1017). Monitor for liver cancer, scleroderma, pneumonitis, clotting abnormalities, and acro-osteolysis.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Vinyl Chloride
DOT Hazard Class: 2.1
ID No.: UN1086
DOT Packing Group: --
DOT Label: Flammable Gas
Special Provisions (172.102): B44

Packaging Authorizations
a) Exceptions: 173.306
b) Non-bulk Packaging: 173.304
c) Bulk Packaging: 173.314 & 173.315

Quantity Limitations
a) Passenger Aircraft or Railcar: Forbidden
b) Cargo Aircraft Only: 150 kg

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: 40

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 140, 148, 149, 153, 159, 162, 163, 164, 167, 168, 171, 174, 175

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** AC Darlington, MPH, MD

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 385
Ethylbenzene

Issued: 8/78 Revision: B, 9/92

Section 1. Material Identification

39

Ethylbenzene ($C_6H_5C_2H_5$) Description: Derived by heating benzene and ethylene in presence of aluminum chloride with subsequent distillation, by fractionation directly from the mixed xylene stream in petroleum refining, or dehydrogenation of naphthenes. Used as a solvent, an antiknock agent in gasoline; and as an intermediate in production of synthetic rubber, styrene, cellulose acetate, diethylbenzene, acetophenone, ethyl anthraquinone, propyl oxide, and α-methylbenzol alcohol.
Other Designations: CAS No. 100-41-4, ethylbenzol, EB, phenylethane, NCI-C56393.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

R 1
I 3
S 2*
K 4
* Skin absorption

NFPA
3
2 0
-

HMIS
H 2†
F 3
R 0
PPE - Sec. 8
† Chronic effects

Cautions: Ethylbenzene is a skin and mucous membrane irritant considered the most irritating of the benzene series. Inhalation causes acute and chronic central nervous system (CNS) effects. It is highly flammable and forms explosive mixtures with air.

Section 2. Ingredients and Occupational Exposure Limits

Ethylbenzene, ca >99.0%. Impurities include ~ 0.1% *meta* & *para* xylene, ~ 0.1% cumene, and ~ 0.1% toluene.

1991 OSHA PELs
8-hr TWA: 100 ppm (435 mg/m^3)
15-min STEL: 125 ppm (545 mg/m^3)
Action Level: 50 ppm (217 mg/m^3)

1990 IDLH Level
2000 ppm

1990 NIOSH REL
TWA: 100 ppm (435 mg/m^3)
STEL: 125 ppm (545 mg/m^3)

1992-93 ACGIH TLVs
TWA: 100 ppm (434 mg/m^3)
STEL: 125 ppm (545 mg/m^3)

1990 DFG (Germany) MAK
TWA: 100 ppm (440 mg/m^3)
Category 1: local irritants
Peak Exposure Limit: 200 ppm, 5 min momentary value, max of 8/shift
Danger of cutaneous absorption

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 100 ppm/8 hr caused eye effects, sleep, and respiratory changes.
Human, lymphocyte: 1 mmol/L induced sister chromatid exchange.
Rat, oral, LD_{50}: 3500 mg/kg; toxic effects not yet reviewed
Rat (female), inhalation, TC_{Lo}: 1000 ppm/7 hr/day, 5 days/wk, for 3 wk prior to mating and daily for 19 days of gestation produced pups with high incidence of extra ribs.[179]

* See NIOSH, *RTECS* (DA0700000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 277 °F (136 °C)
Melting Point: -139 °F (-95 °C)
Surface Tension: 31.5 dyne/cm
Ionization Potential: 8.76 eV
Viscosity: 0.64 cP at 77 °F (25 °C)
Refraction Index: 1.4959 at 68 °F (20 °C)
Relative Evaporation Rate (ether = 1): 0.0106
Bulk Density: 7.21 lb/Gal at 77 °F (25 °C)
Critical Temperature: 651 °F (343.9 °C)
Critical Pressure: 35.6 atm
Molecular Weight: 106.16
Density: 0.863 at 77 °F (25 °C)
Water Solubility: Slightly, 14 mg/100 mL at 59 °F (15 °C)
Other Solubilities: Miscible in alcohol, ether; soluble in carbon tetrachloride, benzene, sulfur dioxide, and many organic solvents; insoluble in ammonia
Odor Threshold: 2.3 ppm
Vapor Pressure: 7.1 mm Hg at 68 °F (20 °C); 10 mmHg at 78.62 °F (25.9 °C); 100 mm Hg 165.38 °F (74.1 °C)
Saturated Vapor Density (Air = 0.075 lb/ft^3 or 1.2 kg/m^3): 0.0768 lb/ft^3 or 1.2298 kg/m^3

Appearance and Odor: Colorless, flammable liquid with a pungent odor.

Section 4. Fire and Explosion Data

Flash Point: 64 °F (18 °C) CC	**Autoignition Temperature:** 810 °F (432 °C)	**LEL:** 1.0% v/v	**UEL:** 6.7% v/v

Extinguishing Media: Class 1B Flammable liquid. For small fires, use dry chemical, carbon dioxide, or 'alcohol-resistant' foam. For large fires, use fog or 'alcohol-resistant' foam. Use water only if other agents are unavailable; EB floats on water and may travel to an ignition source and spread fire. **Unusual Fire or Explosion Hazards:** Burning rate = 5.8 mm/min. Vapors may travel to an ignition source and flash back. Container may explode in heat of fire. EB poses a vapor explosion hazard indoors, outdoors, and in sewers. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Cool container sides with water until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Withdraw immediately if you hear rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Ethylbenzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Reacts vigorously with oxidizers.
Conditions to Avoid: Exposure to heat and oxidizers.
Hazardous Products of Decomposition: Thermal oxidative decomposition of EB can produce acrid smoke and irritating fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] NTP,[169] and OSHA[164] do not list EB as a carcinogen. **Summary of Risks:** Occupational exposure to EB alone is rare since it is usually present together with other solvents. EB is irritating to the eyes, skin, and respiratory tract. Vapor inhalation produces varying degrees of CNS effects depending on concentration. The liquid is absorbed through the skin but vapors are not. 56 to 64% of inhaled ethylbenzene is retained and metabolized. Urinary metabolites following exposure to 23 to 85 ppm for 8 hr are mandelic acid (64%), phenylglyoxylic acid (25%), and methylphenylcarbinol/1-phenyl ethanol (5%). Concurrent exposure to xylene and ethylbenzene causes slower excretion of EB metabolites. Based on the rat LD_{50}, one manufacturer gives 3 to 4 oz. as the lethal dose for a 100 lb person.

Continue on next page

Section 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Skin and CNS diseases and impaired pulmonary function (especially obstructive airway disease). **Target Organs:** Eyes, respiratory system, skin, CNS, blood. **Primary Entry Routes:** Inhalation, skin and eye contact. **Acute Effects:** Vapor inhalation of 200 ppm caused transient eye irritation; 1000 ppm caused eye irritation with profuse watering (tolerance developed rapidly); 2000 ppm caused severe and immediate eye irritation and watering, nasal irritation, chest constriction, and vertigo; 5000 ppm was intolerable and caused eye and nose irritation. Inhalation of high concentrations may cause narcosis, cramps, and death due to respiratory paralysis. Skin exposed to pure ethylbenzene for 10 to 15 min absorbed 22 to 33 mg/cm^2/hr. Immersion of hand in solutions of 112 & 156 mg/L for 1 hr absorbed 118 & 215.7 μg/cm^2/hr, respectively. **Chronic Effects:** Repeated skin contact may cause dryness, scaling, and fissuring. Workers chronically exposed to > 100 ppm complained of fatigue, sleepiness, headache, and mild irritation of the eyes and respiratory tract. Repeated vapor inhalation may result in blood disorders, particularly leukopenia (abnormally low level of white blood cells) and lymphocytosis.

FIRST AID

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting! Aspiration of even a small amount of EB in vomitus can cause severe damage since its low viscosity and surface tension will cause it to spread over a large area of the lung tissue.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: BEI = mandelic acid in urine (1.5 g/g of creatinine), sample at end of shift at workweeks end. Since this test is not specific, test for EB in expired air for confirmation.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel. Isolate and ventilate area, deny entry and stay upwind. Shut off all ignition sources. Cleanup personnel should protect against vapor inhalation and skin/eye contact. Take up small spills with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable container. Dike far ahead of large spill for later reclamation or disposal. Report any release >1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** If released to soil, EB partially evaporates into the atmosphere, with a half-life of hrs to wks, and some leaches into groundwater, especially in soil with low organic carbon content. Biodegradation occurs with a half-life of 2 days. Some EB may absorb to sediment or bioconcentrate in fish. Evidence points to slow biodegradation in groundwater. In air, it reacts with photochemically produced hydroxyl radicals with a half-life of hrs to 2 days. Additional amounts may be removed by rain. **Ecotoxicity Values:** Shrimp (*Mysidopsis bahia*), LC_{50} = 87.6 mg/L/96 hr; sheepshead minnow (*Cyprinodon variegatus*) LC_{50} = 275 mg/L/96 hr; fathead minnow (*Pimephales promelas*) LC_{50} = 42.3 mg/L/96 hr in hard water & 48.5 mg/L/96 hr in softwater. **Disposal:** A candidate for rotary kiln incineration at 1508 to 2912°F (820 to 1600°C), liquid injection incineration at 1202 to 2912°F (650 to 1600°C), and fluidized bed incineration at 842 to 1796°F (450 to 980°C). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.21): No. D001
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per CWA, Sec. 311 (b)(4) & CWA, Sec. 307 (a)]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use a powered air-purifying respirator with an appropriate organic vapor cartridge, a supplied-air respirator (SAR), SCBA, or chemical cartridge respirator with appropriate organic vapor cartridge. For < 2000 ppm, use a SAR or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made of Viton or polyvinylchloride to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a cool, dry, well-ventilated area away from ignition sources and oxidizers. Outside or detatched storage is preferred. If inside, store in a standard flammable liquids cabinet. Containers should have flame-arrester or pressure-vacuum venting. To prevent static sparks, electrically ground and bond all equipment used with ethylbenzene. Install Class 1, Group D electrical equipment. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain levels as low as possible. Purge and ventilate reaction vessels before workers are allowed to enter for maintenance or cleanup. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, skin, blood, and respiratory system.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Ethylbenzene
DOT Hazard Class: 3
ID No.: UN1175
DOT Packing Group: II
DOT Label: Flammable liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 173.150
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger Aircraft or Railcar: 5L
b) Cargo Aircraft Only: 60 L

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: —

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 153, 159, 162, 163, 164, 167, 168, 171, 176, 179

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** W Silverman, MD

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 467
Automotive Gasoline, Lead-free

Issued: 10/81 Revision: A, 9/91

Section 1. Material Identification

35

Automotive Gasoline, Lead-free, Description: A mixture of volatile hydrocarbons composed mainly of branched-chain paraffins, cycloparaffins, olefins, naphthenes, and aromatics. In general, gasoline is produced from petroleum, shale oil, Athabasca tar sands, and coal. Motor gasolines are made chiefly by cracking processes, which convert heavier petroleum fractions into more volatile fractions by thermal or catalytic decomposition. Widely used as fuel in internal combustion engines of the spark-ignited, reciprocating type. Automotive gasoline has an octane number of approximately 90. A high content of aromatic hydrocarbons and a consequent high toxicity are also associated with a high octane rating. Some gasolines sold in the US contain a minor proportion of tetraethyllead, which is added in concentrations not exceeding 3 ml per gallon to prevent engine "knock." However, methyl-tert-butyl ether (MTBE) has almost completely replaced tetraethyllead.
Other Designations: CAS No. 8006-61-9, benzin, gasoline, gasolene, motor spirits, natural gasoline, petrol.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

R 1
I 2
S 2*
K 4
* Skin absorption

NFPA
3
1 0
-

HMIS
H 2
F 3
R 1
PPG†
† Sec. 8

Cautions: Inhalation of automotive gasoline vapors can cause intense burning in throat and lungs, central nervous system (CNS) depression, and possible fatal pulmonary edema. Gasoline is a dangerous fire and explosion hazard when exposed to heat and flames.

Section 2. Ingredients and Occupational Exposure Limits

Automotive gasoline, lead-free*

1990 OSHA PELs
8-hr TWA: 300 ppm, 900 mg/m^3
15-min STEL: 500 ppm, 1500 mg/m^3

1990-91 ACGIH TLVs
TWA: 300 ppm, 890 mg/m^3
STEL: 500 ppm, 1480 mg/m^3

1990 NIOSH REL
None established

1985-86 Toxicity Data*
Man, inhalation, TC_{Lo}: 900 ppm/1 hr; toxic effects include sense organs and special senses (conjunctiva irritation), behavioral (hallucinations, distorted perceptions), lungs, thorax, or respiration (cough)
Human, eye: 140 ppm/8 hr; toxic effects include mild irritation
Rat, inhalation, LC_{50}: 300 g/m^3/5 min

* A typical modern gasoline composition is 80% paraffins, 14% aromatics, and 6% olefins. The mean benzene content is approximately 1%. Other additives include sulfur, phosphorus, and MTBE.
† See NIOSH, *RTECS* (LX3300000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: Initially, 102 °F (39 °C); after 10% distilled, 140 °F (60 °C); after 50% distilled, 230 °F (110 °C); after 90% distilled, 338 °F (170 °C); final boiling point, 399 °F (204 °C)
Vapor Density (air = 1): 3.0 to 4.0
Density/Specific Gravity: 0.72 to 0.76 at 60 °F (15.6 °C)
Water Solubility: Insoluble

Appearance and Odor: A clear (gasoline may be colored with dye), mobile liquid with a characteristic odor recognizable at about 10 ppm in air.

Section 4. Fire and Explosion Data

Flash Point: -45 °F (-43 °C)	**Autoignition Temperature:** 536 to 853 °F (280 to 456 °C)	**LEL:** 1.3% v/v	**UEL:** 6.0% v/v

Extinguishing Media: Use dry chemical, carbon dioxide, or alcohol foam as extinguishing media. Use of water may be ineffective to extinguish fire, but use water spray to knock down vapors and to cool fire-exposed drums and tanks to prevent pressure rupture. Do not use a solid stream of water since it may spread the fuel.
Unusual Fire or Explosion Hazards: Automobile gasoline is an OSHA Class IB flammable liquid and a dangerous fire and explosion hazard when exposed to heat and flames. Vapors can flow to an ignition source and flash back. Automobile gasoline can also react violently with oxidizing agents.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode, and full protective clothing. When the fire is extinguished, use nonsparking tools for cleanup. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Automotive gasoline is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Automotive gasoline can react with oxidizing materials such as peroxides, nitric acid, and perchlorates.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of automotive gasoline can produce oxides of carbon and partially oxidized hydrocarbons.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC list gasoline as a possible human carcinogen (Group 2B). Although the IARC has assigned an overall evaluation to gasoline, it has not assigned an overall evaluation to specific substances within this group (inadequate human evidence).
Summary of Risks: Gasoline vapors are considered moderately poisonous. Vapor inhalation can cause central nervous system (CNS) depression and mucous membrane and respiratory tract irritation. Brief inhalations of high concentrations can cause a fatal pulmonary edema. Reported responses to gasoline vapor concentrations are: 160 to 270 ppm causes eye and throat irritation in several hours; 500 to 900 ppm causes eye, nose, and throat irritation, and dizziness in 1 hr; and 2000 ppm produces mild anesthesia in 30 min. Higher concentrations are intoxicating in 4 to 10 minutes. If large areas of skin are exposed to gasoline, toxic amounts may be absorbed. Repeated or prolonged skin exposure causes dermatitis. Certain individuals may develop hypersensitivity. Ingestion can cause CNS depression. Pulmonary aspiration after ingestion can cause severe pneumonitis. In adults, ingestion of 20 to 50 g gasoline may produce severe symptoms of poisoning.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Skin, eye, respiratory and central nervous systems.
Primary Entry Routes: Inhalation, ingestion, skin contact.
Acute Effects: Acute inhalation produces intense nose, throat, and lung irritation; headaches; blurred vision; conjunctivitis; flushing of the face; mental confusion; staggering gait; slurred speech; and unconsciousness, sometimes with convulsions. Ingestion causes inebriation (drunkenness), vomiting, dizziness, fever, drowsiness, confusion, and cyanosis (a blue to dark purplish coloration of skin and mucous membrane caused by lack of oxygen). Aspiration causes choking, cough, shortness of breath, increased rate of respiration, excessively rapid heartbeat, fever, bronchitis, and pneumonitis. Other symptoms following acute exposure include acute hemorrhage of the pancreas, fatty degeneration of the liver and kidneys, and passive congestion of spleen.
Chronic Effects: Chronic inhalation results in appetite loss, nausea, weight loss, insomnia, and unusual sensitivity (hyperesthesia) of the distal extremities followed by motor weakness, muscular degeneration, and diminished tendon reflexes and coordination. Repeated skin exposure can cause blistering, drying, and lesions.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard. Give conscious victim a mixture of 2 tablespoons of activated charcoal mixed in 8 oz of water to drink. Consult a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Use nonsparking tools. Take up small spills with sand or other noncombustible adsorbent. Dike storage areas to control leaks and spills. Follow applicable OSHA regulations (29 CFR 1910.120).
Aquatic Toxicity: Bluegill, freshwater, LC_{50}, 8 ppm/96 hr.
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.21): Characteristic of ignitability
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. There are no specific NIOSH recommendations. However, for vapor concentrations not immediately dangerous to life or health, use chemical cartridge respirator equipped with organic vapor cartridge(s), or a supplied-air respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Materials such as neoprene or polyvinyl alcohol provide excellent/good resistance for protective clothing. **Note:** Resistance of specific materials can vary from product to product.
Ventilation: Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed containers in a cool, dry, well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. Avoid direct sunlight. Storage must meet requirements of OSHA Class IB liquid. Outside or detached storage preferred.
Engineering Controls: Avoid vapor inhalation and skin or eye contact. Consider a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Indoor use of this material requires explosion-proof exhaust ventilation to remove vapors. Only use gasoline as a fuel source due to its volatility and flammable/explosive nature. Practice good personal hygiene and housekeeping procedures. Wear clean work clothing daily.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Gasoline (*including casing-head and natural*)
DOT Hazard Class: Flammable liquid
ID No.: UN1203
DOT Label: Flammable liquid
DOT Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Gasoline
IMO Hazard Class: 3.1
ID No.: UN1203
IMO Label: Flammable liquid
IMDG Packaging Group: II

MSDS Collection **References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 140, 143, 146, 153, 159
Prepared by: M Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Stuart, MS

Genium Publishing Corporation

One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 470
Diesel Fuel Oil No. 2-D

Issued: 10/81 Revision: A, 11/90

Section 1. Material Identification

Diesel Fuel Oil No. 2-D Description: Diesel fuel is obtained from the middle distillate in petroleum separation; a distillate oil of low sulfur content. It is composed chiefly of unbranched paraffins. Diesel fuel is available in various grades, one of which is synonymous with fuel oil No. 2-D. This diesel fuel oil requires a minimum Cetane No. (efficiency rating for diesel fuel comparable to octane number ratings for gasoline) of 40 (ASTM D613). Used as a fuel for trucks, ships, and other automotive engines; as mosquito control (coating on breeding waters); and for drilling muds.

Other Designations: CAS No. 68334-30-5, diesel fuel.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

Cautions: Diesel fuel oil No. 2-D is a skin irritant and central nervous depressant with high mist concentrations. It is an environmental hazard and moderate fire risk.

RISK	
R	1
I	-
S	2
K	2

NFPA: 2 (top), 0 (left), 0 (right), - (bottom)

HMIS	
H	0
F	2
R	0
PPG*	

* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Diesel fuel oil No. 2-D*

1989 OSHA PEL	1990-91 ACGIH TLV	1988 NIOSH REL	1985-86 Toxicity Data‡
None established	Mineral Oil Mist TWA: 5 mg/m³† STEL: 10 mg/m³	None established	Rat, oral, LD_{50}: 9 g/kg produces gastrointestinal (hypermotility, diarrhea) effects

* Diesel fuel No. 2-D tends to be low in aromatics and high in paraffinics. This fuel oil is complex mixture of: 1) >95% paraffinic, olefinic, naphthenic, and aromatic hydrocarbons, 2) sulfur (<0.5%), and 3) benzene (<100 ppm). [A low benzene level reduces carcinogenic risk. Fuel oils can be exempted under the benzene standard (29 CFR 1910.1028)]. Although low in the fuel itself, benzene concentrations are likely to be much higher in processing areas.

† As sampled by nonvapor-collecting method.

‡ Monitor NIOSH, *RTECS* (HZ1800000), for future toxicity data.

Section 3. Physical Data

Boiling Point Range: 340 to 675 °F (171 to 358 °C)
Viscosity: 1.9 to 4.1 centistoke at 104 °F (40 °C)
Specific Gravity: <0.86
Water Solubility: Insoluble

Appearance and Odor: Brown, slightly viscous liquid.

Section 4. Fire and Explosion Data

Flash Point: 125 °F (52 °C) min.	Autoignition Temperature: >500 °F (932 °C)	LEL: 0.6% v/v	UEL: 7.5% v/v

Extinguishing Media: Use dry chemical, carbon dioxide, or foam to fight fire. Use a water spray to cool fire exposed containers. Do not use a forced water spray directly on burning oil since this will scatter the fire. Use a smothering technique for extinguishing fire.

Unusual Fire or Explosion Hazards: Diesel fuel oil No. 2-D is a OSHA Class II combustible liquid. Its volatility is similar to that of gas oil. Vapors may travel to a source of ignition and flash back.

Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective clothing. If feasible, remove containers from fire. Be aware of runoff from fire control methods. Do not release to sewers or waterways due to pollution and fire or explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Diesel fuel oil No. 2-D is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: It is incompatible with strong oxidizing agents; heating greatly increases the fire hazard.

Conditions to Avoid: Avoid heat and ignition sources.

Hazardous Products of Decomposition: Thermal oxidative decomposition of diesel fuel oil No. 2-D can produce various hydrocarbons and hydrocarbon derivatives, and other partial oxidation products such as carbon dioxide, carbon monoxide, and sulfur dioxide.

Section 6. Health Hazard Data

Carcinogenicity: Although the IARC has not assigned an overall evaluation to diesel fuels as a group, it has evaluated occupational exposures in petroleum refining as an IARC probable human carcinogen (Group 2A). It has evaluated distillate (light) diesel oils as not classifiable as human carcinogens (Group 3).
Summary of Risks: Although diesel fuel's toxicologic effects should resemble kerosine's, they are somewhat more pronounced due to additives such as sulfurized esters. Excessive inhalation of aerosol or mist can cause respiratory tract irritation, headache, dizziness, nausea, vomiting, and loss of coordination, depending on concentration and exposure time. When removed from exposure area, affected persons usually recover completely. If vomiting occurs after ingestion and if oil is aspirated into the lungs, hemorrhaging and pulmonary edema, progressing to renal involvement and chemical pneumonitis, may result. A comparative ratio of oral to aspirated lethal doses may be 1 pt vs. 5 ml. Aspiration may also result in transient CNS depression or excitement. Secondary effects may include hypoxia (insufficient oxygen in body cells), infection, pneumatocele formation, and chronic lung dysfunction. Inhalation may result in euphoria, cardiac dysrhythmias, respiratory arrest, and CNS toxicity. Prolonged or repeated skin contact may irritate hair follicles and block sebaceous glands, producing a rash of acne pimples and spots, usually on arms and legs.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Central nervous system, skin, and mucous membranes.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: Systemic effects from ingestion include gastrointestinal irritation, vomiting, diarrhea, and in severe cases central nervous system depression, progressing to coma or death. Inhalation of aerosols or mists may result in increased rate of respiration, tachycardia (excessively rapid heart beat), and cyanosis (dark purplish discoloration of the skin and mucous membranes caused by deficient blood oxygenation).
Chronic Effects: Repeated contact with the skin causes dermatitis.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. If large areas of the body have been exposed or if irritation persists, get medical help immediately. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard. Contact a physician immediately. Position to avoid aspiration.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Gastric lavage is contraindicated due to aspiration hazard. Preferred antidotes are charcoal and milk. In cases of severe aspiration pneumonitis, consider monitoring arterial blood gases to ensure adequate ventilation. Observe the patient for 6 hr. If vital signs become abnormal or symptoms develop, obtain a chest x-ray.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate area for large spills, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Clean up spills promptly to reduce fire or vapor hazards. Use a noncombustible absorbent material to pick up small spills or residues. For large spills, dike far ahead to contain. Pick up liquid for reclamation or disposal. Do not release to sewers or waterways due to health and fire and/or explosion hazard. Follow applicable OSHA regulations (29 CFR 1910.120). Diesel fuel oil No. 2-D spills may be environmental hazards. Report large spills.
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.21): Ignitable waste
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
OSHA Designations
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, use a NIOSH-approved respirator with a mist filter and organic vapor cartridge. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety and productivity. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Use and storage conditions should be suitable for a OSHA Class II combustible liquid. Store in closed containers in a well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Use nonsparking tools and explosion-proof electrical equipment. No smoking in storage or use areas.
Engineering Controls: Avoid vapor or mist inhalation and prolonged skin contact. Wear protective rubber gloves and chemical safety glasses where contact with liquid or high mist concentration may occur. Additional suitable protective clothing may be required depending on working conditions. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures. Do not wear oil contaminated clothing. At least weekly laundering of work clothes is recommended. Do not put oily rags in pockets. When working with this material, wear gloves or use barrier cream.
Transportation Data (49 CFR 172.101)
DOT Shipping Name: Fuel oil
DOT Hazard Class: Combustible liquid
ID No.: NA1993
DOT Label: None
DOT Packaging Exceptions: 173.118a
DOT Packaging Requirements: None

MSDS Collection **References:** 1, 6, 7, 12, 73, 84, 101, 103, 126, 127, 132, 133, 136, 143, 146
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MD; **Edited by:** JR Stuart, MS

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 683
Polychlorinated Biphenyls (PCBs)

Issued: 11/88 Revision: A, 9/92

Section 1. Material Identification

39

Polychlorinated Biphenyls [$C_{12}H_{10-n}Cl_n$ (n=3, 4, 5)] Description: A class of nonpolar chlorinated hydrocarbons with a biphenyl nucleus (two benzene nuclei connected by a single C-C bond) in which any or all of the hydrogen atoms have been replaced by chlorine. Commercial PCBs are mixtures of chlorinated biphenyl isomers with varying degrees of chlorination. Prepared industrially by the chlorination of biphenyl with anhydrous chlorine in the presence of a catalyst such as ferric chloride or iron filings. Except for limited research and development applications, PCBs have not been produced in the US since 1977. When large quantities of PCBs were manufactured in the US, they were marketed under the tradename Aroclor (Monsanto) and were characterized by four digit numbers. The first two digits indicating biphenyls (12), triphenyls (54), or both (25, 44); the last two digits indicating the weight percent of chlorine. PCBs' thermal stability, nonflammability, and high dielectric capability made them very useful in electrical equipment. Formerly used as additives in hydraulic fluids, heat transfer systems, lubricants, cutting oils, printer's ink, fire retardants, asphalt, brake linings, automobile body sealants, plasticizers, adhesives, synthetic rubber, floor tile, wax extenders, dedusting agents, pesticide extenders, and carbonless reproducing paper. PCBs are still used in certain existing electrical capacitors and transformers that require enhanced electrical protection to avoid heating from sustained electric faults.

R 1
I 4
S 3*
K 1
* Skin absorption

NFPA
1
2 0
—

HMIS
H 2‡
F 1
R 0
PPE†
† Sec. 8
‡ Chronic Effects

Other Designations: CAS No. 1336-36-3, Aroclor, Clophen, Chlorextol, chlorinated biphenyls, chlorinated diphenyl, chlorinated diphenylene, chloro biphenyl, chloro-1,1-biphenyl, Dykanol, Fenclor, Inerteen, Kaneclor, Montar, Noflamol, Phenoclor, Pyralene, Pyranol, Santotherm, Sovol, Therminol FR-1

Cautions: PCBs are potent liver toxins that may be absorbed through skin. Potentially, chronic or delayed toxicity is significant because PCBs accumulate in fatty tissue and may reasonably be anticipated to be carcinogens. PCBs are a bioaccumulative environmental hazard. When burned, decomposition products may be more hazardous than the PCBs.

Section 2. Ingredients and Occupational Exposure Limits

PCBs, contain various levels of polychlorinated dibenzofurans and chlorinated naphthalenes as contaminants

1991 OSHA PELs, Skin
8-hr TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m^3
8-hr TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m^3

1990 DFG (Germany) MAK, Danger of Cutaneous Absorption
TWA (Chlorodiphenyl, 42% chlorine): 0.1 ppm (1 mg/m^3)
Category III: Substances with systemic effects, onset of effect > 2 hr., half-life > shift length (strongly cumulative)
Short-term Level: 1 ppm, 30 min., average value, 1 per shift

TWA (Chlorodiphenyl, 54% chlorine): 0.05 ppm (0.5 mg/m^3)
Category III: (see above)
Short-term Level: 0.5 ppm, 30 min., average value, 1 per shift

1985-86 Toxicity Data*
Rat, oral, TD: 1250 mg/kg administered intermittently for 25 weeks produced liver tumors.
Mammal, oral, TD_{Lo}: 325 mg/kg administered to female for 30 days prior to mating and from the 1st to the 36th day of gestation produced effects on newborn (stillbirth; live birth index; viability index).

1990 NIOSH REL
TWA (Chlorodiphenyl, 42% chlorine): 0.001 mg/m^3
TWA (Chlorodiphenyl, 54% chlorine): 0.001 mg/m^3

1992-93 ACGIH TLVs, Skin *
TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m^3
TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m^3

* These guidelines offer reasonably good protection against systemic intoxication, but may not guarantee that chloroacne won't occur.
† See NIOSH, *RTECS* (TQ1350000), for additional reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: 644-707 °F (340-375 °C)
Melting Point: 42%: -2.2 °F (-19°C); 54%: 14 °F (-10 °C)
Vapor Pressure: 1 mm Hg at 100 °F (38 °C); 10^{-6} to 10^{-3} mm at 20 °C
Molecular Weight: 188.7 to 398.5
Specific Gravity: 1.3 to 1.8 at 20 °C
Water Solubility: Low solubility (0.007 to 5.9 mg/L)
Other Solubilities: Most common organic solvents, oils, and fats; slightly soluble in glycerol and glycols.

Appearance and Odor: PCBs vary from mobile oily liquids to white crystalline solids and hard non-crystalline resins, depending upon chlorine content.

* Physical and chemical properties vary widely according to degree and to the position of chlorination.

Section 4. Fire and Explosion Data

Flash Point: 286-385 °F (141-196 °C) OC*	**Autoignition Temperature:** 464 °F (240 °C)	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Use extinguishing media suitable to the surrounding fire. Use dry chemical, foam, carbon dioxide (CO_2), or water spray. Water spray may be ineffective. Use water spray to cool fire-exposed containers or transformers. Do not scatter PCBs with high-pressure water streams. **Unusual Fire or Explosion Hazards:** Combustion products (hydrogen chloride, phosgene, polychlorinated dibenzofurans, and furans) are more hazardous than the PCBs themselves. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Approach fire from upwind to avoid highly toxic decomposition products. Structural firefighter's protective clothing will provide *limited* protection. Do not release runoff from fire control methods to sewers or waterways. Dike for later disposal.

* Flash points shown are a range for various PCBs. Some forms do not have flash points.

Section 5. Reactivity Data

Stability/Polymerization: PCBs are very stable materials but are subject to photodechlorination when exposed to sunlight or UV (spectral region above 290 nanometers). Hazardous polymerization cannot occur. **Chemical Incompatibilities:** PCBs are chemically inert and resistant to oxidation, acids, and bases. **Conditions to Avoid:** Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition [1112-1202 °F (600-650 °C)] of PCBs can produce highly toxic derivatives, including polychlorinated dibenzo-para-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), hydrogen chloride, phosgene and other irritants.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] and NTP[169] list PCBs as an IARC probable carcinogen (overall evaluation is 2A; limited human data; sufficient animal data) and NTP anticipated carcinogen, respectively. **Summary of Risks:** PCBs are potent liver toxins that can be absorbed through unbroken skin in toxic amounts without immediate pain or irritation. PCBs have low acute toxicity, but can accumulate in fatty tissue and severe health effects may develop later. Generally, toxicity increases with a higher chlorine content; PCB-oxides are more toxic. The toxic action on the liver also increases with simultaneous exposure to other liver toxins, e.g. chlorinated solvents, alcohol, and certain drugs. Pathological pregnancies (abnormal pigmentations, abortions, stillbirths, and underweight births) have been associated with increased PCB serum levels in mothers; PCBs can be passed in breast milk. PCBs can affect the reproductive system of adults. **Medical Conditions Aggravated by Long-Term Exposure:** Skin, liver, and respiratory disease. **Target Organs:** Skin, liver, eyes, mucous membranes, and respiratory tract. **Primary Entry Routes:** Inhalation, dermal contact, ingestion. **Acute Effects:** Exposure to PCB vapor or mist is severely irritating to the skin, eyes, nose, throat, and upper respiratory tract. Intense acute exposure to high concentrations may result in eye, lung, and liver injury. Systemic effects include nausea, vomiting, increased blood pressure, fatigue, weight loss, jaundice, edema and abdominal pain. Cognitive, neurobehavior and psychomotor impairment and memory loss have also been seen after acute exposure. **Chronic Effects:** Repeated exposure to PCBs can cause chloroacne; redness, swelling, dryness, thickening and darkening of the skin and nails; swelling and burning of the eyes, and excessive eye discharge; distinctive hair follicles; gastrointestinal disturbances; neurological symptoms including headache, dizziness, depression, nervousness, numbness of the extremities, and joint and muscle pain; liver enlargement; menstrual changes in women; and chronic bronchitis. Cancer, primarily liver, is also a possible result of exposure, but data is inconclusive.

FIRST AID Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Rinsing eyes with medical oil (olive, mineral) initially may remove PCB and halt irritation better than water rinsing alone. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. *Multiple soap and water washings are necessary.* Avoid the use of organic solvents to clean the skin. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** In most cases, accidental PCB ingestion will not be recognized until long after vomiting would be of any value. Never give anything by mouth to an unconscious or convulsing person. Vomiting of the pure substance may cause aspiration. Consult a physician.
Note to Physicians: Monitor patients for increased hepatic enzymes, chloroacne, and eye, gastrointestinal, and neurologic symptoms listed above. Diagnostic tests include blood levels of PCBs and altered liver enzymes.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, provide adequate ventilation, and isolate hazard area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. For small spills, take up with sand or other noncombustible material and place into containers for later disposal. For larger spills, dike far ahead of spill to contain for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** PCBs have been shown to bio-concentrate significantly in aquatic organisms. **Ecotoxicity:** Bluegill, TLm: 0.278 ppm/96 hr. Mallard Duck, LD_{50}: 2000 ppm. **Environmental Degradation:** In general, the persistence of PCBs increases with an increase degree of chlorination. **Soil Absorption/Mobility:** PCBs are tightly absorbed in soil and generally do not leach significantly in most aqueous soil systems. However, in the presence of organic solvents, PCBs may leach rapidly through the soil. Volatilization of PCBs from soil may be slow, but over time may be significant. **Disposal:** Approved PCB disposal methods include: incineration with scrubbing, high-efficiency boilers, landfills, and EPA-approved alternative disposal methods. Each disposal method has various criteria. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1 lb (0.454 kg) [* per CWA, Sec. 311(b)(4) and 307(a)]

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. Minimum respiratory protection should include a combination dust-fume-mist and organic vapor cartridge or canister or air-supplied, depending upon the situation. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. Butyl rubber, neoprene, Teflon, and fluorocarbon rubber have break through times greater than 8 hrs. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Segregate contaminated clothing in such a manner so that there is no direct contact by laundry personnel. Implement quality assurance to ascertain the completeness of the cleaning procedures. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a closed, labelled, container in a ventilated area with appropriate air pollution control equipment. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Inform employees of the adverse health effects associated with PCBs. Limit access to PCB work areas to authorized personnel. Consider preplacement and periodic medical examinations with emphasis on the skin, liver, lung, and reproductive system. Monitor PCB blood levels. Consider possible effects on the fetus. Keep medical records for the entire length of employment and for the following 30 yrs.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Polychlorinated biphenyls
DOT Hazard Class: 9
ID No.: UN2315
DOT Packing Group: II
DOT Label: CLASS 9
Special Provisions (172.102): 9, N81

Packaging Authorizations
a) Exceptions: 173.155
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger Aircraft or Railcar: 100 L
b) Cargo Aircraft Only: 220 L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 34

MSDS Collection **References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 163, 164, 168, 169, 174, 175, 180
Prepared by: MJ Wurth, BS; **Industrial Hygiene Review:** PA Roy MPH, CIH; **Medical Review:** AC Darlington, MD

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 703
1,2-Dichloroethylene

Issued: 4/90

Section 1. Material Identification 31

1,2-Dichloroethylene Description: An industrial solvent composed of 60% cis- and 40% trans-isomers. Both isomers, cis and trans, are made by partial chlorination of acetylene. Used as a general solvent for organic materials, lacquers, dye extraction, thermoplastics, organic synthesis, and perfumes. The trans-isomer is more widely used in industry than either the cis-isomer or the mixture. Toxicity also varies between the two isomers.
Other Designations: CAS No. 0540-59-0; $C_2H_2Cl_2$; acetylene dichloride; *cis*-1,2-dichloroethylene; *sym*-dichloroethylene; *trans*-1,2-dichloroethylene, dioform.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

R 1
I 2
S 2
K 1

NFPA
3
2 2
-

HMIS
H 2
F 3
R 1
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

1,2-Dichloroethylene, ca 100%

OSHA PEL
8-hr TWA: 790 mg/m³, 200 ppm

ACGIH TLV, 1989-90
TLV-TWA: 790 mg/m³, 200 ppm

NIOSH REL, 1987
790 mg/m³, 200 ppm

Toxicity Data*
Rat, oral, LD_{50}: 770 mg/kg; toxic effects not yet reviewed
Frog, inhalation, TC_{Lo}: 117 mg/m³ inhaled for 1 hr affects the peripheral nerve and sensation (flaccid paralysis without anesthesia); behavior (excitement); lungs, thorax, or respiration (respiratory depression)

* See NIOSH, *RTECS* (KV9360000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: 119 °F/48 °C
Melting Point: -56 to -115 °F/-49 to -82 °C/
Vapor Pressure: 180 to 264 torr at 68 °F/20 °C
Vapor Density (Air = 1): 3.4
Molecular Weight: 96.95 g/mol
Specific Gravity (H_2O = 1 at 39 °F/4 °C): 1.27 at 77 °F/25 °C
Water Solubility: Insoluble

Appearance and Odor: A colorless, low-boiling liquid with a pleasant odor.

Section 4. Fire and Explosion Data

Flash Point: 37 °F/2.8 °C, CC	**Autoignition Temperature:** 860 °F/460 °C	**LEL:** 5.6% v/v	**UEL:** 12.8% v/v

Extinguishing Media: Use dry chemical, CO_2, halon, water spray, or standard foam. Water may be ineffective unless used to blanket the fire.
Unusual Fire or Explosion Hazards: This material's vapors are a dangerous fire hazard and moderate explosion hazard when exposed to any heat or ignition source or oxidizer.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and a fully encapsulating suit. Vapors may travel to heat or ignition sources and flash back. Stay upwind and out of low areas. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: This material is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: This material is incompatible with alkalies, nitrogen tetraoxide, difluoromethylene, strong oxidizers, and dihypofluorite. When in contact with copper or copper alloys or by reaction with potassium hydroxide, explosive chloroacetylene may be released.
Conditions to Avoid: Addition of hot liquid to cold 1,2-dichloroethylene may cause sudden emission of vapor that could flash back to an ignition source.
Hazardous Products of Decomposition: Thermal oxidative decomposition of 1,2-dichloroethylene can produce highly toxic fumes of chlorine (Cl^-).

Section 6. Health Hazard Data

Carcinogenicity: Neither the NTP, IARC, nor OSHA lists 1,2-dichloroethylene as a carcinogen.
Summary of Risks: 1,2-Dichloroethylene's most important effect is its irritation of the central nervous system (CNS) and narcosis. This material is toxic by inhalation, ingestion, and skin contact. It is also irritating to the eyes. The trans-isomer at 2200 ppm causes nausea, vertigo, and burning of the eyes. The trans-isomer is twice as potent as the cis-isomer. If renal effects occur, they are transient.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Central nervous system, eyes, respiratory system.
Primary Entry Routes: Inhalation, ingestion, skin and eye contact.
Acute Effects: Inhalation of 1,2-dichloroethylene causes narcosis, respiratory tract irritation, nausea, vomiting, tremor, weakness, central nervous depression, and epigastric (the abdomen's upper midregion) cramps. Contact with the liquid causes eye and skin (on prolonged contact) irritation. Ingestion causes slight depression to deep narcosis.
Chronic Effects: None reported.
FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed. Have trained personnel administer 100% oxygen, preferably with humidification.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have a *conscious* person drink 1 to 2 glasses of water, then induce repeated vomiting until vomit is clear.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Intravenous injections of calcium gluconate may relieve cramps and vomiting. Treat central nervous system effects symptomatically.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a 1,2-dichloroethylene spill control and countermeasure plan (SCCP).* Notify safety personnel, remove all heat and ignition sources, evacuate hazard area, and provide adequate ventilation. Cleanup personnel should protect against vapor inhalation and skin or eye contact. Absorb small spills on paper towels. After evaporating the 1,2-dichloroethylene from these paper towels in a fume hood, burn the paper in a suitable location away from combustible material. Collect and atomize large quantities in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 100 lb (45.4 kg) [* per RCRA, Sec. 3001, per Clean Water Act, Sec. 307(a)]†
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1)
† Listed as 1,2-*trans*-dichloroethylene.

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.
Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. 1,2-dichloroethylene attacks some forms of plastics, rubber, and coatings.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL and ACGIH TLV (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, well-ventilated area away from all incompatible materials (Sec. 5) and oxidizing materials. Outside or detached storage is preferred. If stored inside, place containers in a standard flammable liquids storage cabinet or room. Protect containers from physical damage.
Engineering Controls: Avoid vapor inhalation and skin and eye contact. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. 1,2-dichloroethylene is a dangerous fire hazard. All engineering systems should be of maximum explosion-proof design and electrically grounded and bonded. Provide preplacement questionnaires which emphasize detecting a history of chronic respiratory disease.
Transportation Data (49 CFR 172.101, .102): Not listed

MSDS Collection **References:** 7, 26, 38, 73, 84, 85, 87, 88, 100, 101, 103, 109, 126, 127, 136, 137
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 708
Vinylidene Chloride

Issued: 4/90

Section 1. Material Identification

31

Vinylidene Chloride Description: Prepared from ethylene chloride. Also prepared from vinyl chloride by successive chlorination and dehydrochlorination steps. Used primarily as a co-monomer in producing vinylidene copolymers (Saran®, Velon®) for films and coatings. Also used in producing methyl chloroform, vinyl chloride resins, plastics, chloracetyl chloride; in adhesives; as a component of synthetic fibers; a chemical intermediate in vinylidene fluoride synthesis; and for 1,1,1-trichloroethane. A common constituent in our environment, measurable quantities of vinylidene chloride are found in poorly ventilated areas with a high concentration of plastics. It is a notable contaminant in recycled air environments such as nuclear submarines and spacecraft.
Other Designations: CAS No. 0075-35-4; $C_2H_2Cl_2$; 1,1-DCE; 1,1-dichloroethene; *asym*-dichloroethylene; VDC; vinylidene dichloride.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.
Comment: At temperatures above 32 °F/0 °C and especially in the presence of oxygen or other suitable catalysts, vinylidene chloride polymerizes to a plastic. Therefore, commercial products may contain small proportions of inhibitors to preserve the monomer.

R 3
I 4
S 2
K 4

NFPA
4
2 2
-

HMIS
H 2
F 4
R 2
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Vinylidene chloride, ca 100%

OSHA PEL
8-hr TWA: 1 ppm, 4 mg/m^3

ACGIH TLVs, 1989-90
TLV-TWA: 5 ppm, 20 mg/m^3
TLV-STEL: 20 ppm, 79 mg/m^3

NIOSH REL, 1987
None established

Toxicity Data*
Mouse, skin, TD_{Lo}: 4840 mg/kg has tumorigenic effects on skin, appendages, lungs, thorax, and respiration
Rat, inhalation, LC_{50}: 6350 ppm/4 hr
Human, inhalation, TC_{Lo}: 25 ppm produces changes in behavior (general anesthetic), the liver, kidney, ureter, and bladder

* See NIOSH, *RTECS* (YZ8061000), for additional mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 89.1 °F/31.7 °C at 760 mm Hg
Melting Point: -188.5 °F/-122.5 °C
Vapor Pressure: 591 mm Hg at 77 °F/25 °C
Vapor Density (Air = 1): 3.4
Molecular Weight: 96.94 g/mol
Specific Gravity (H_2O = 1 at 39 °F/4 °C): 1.2129 at 68 °F/20 °C
Water Solubility: Sparingly soluble (0.04 % wt/vol in water at 68 °F/20 °C)

Appearance and Odor: Colorless, volatile liquid with a mild, sweet odor that resembles chloroform. Most persons can detect vinylidene chloride at 1000 ppm, but others can detect it at less than 500 ppm. Neither odor is adequate to warn of excessive exposure.

Section 4. Fire and Explosion Data

Flash Point: -19 °F/-28 °C	**Autoignition Temperature:** 1058 °F/570 °C	**LEL:** 5.6% v/v	**UEL:** 11.4% v/v

Extinguishing Media: Use dry chemical, alcohol foam, or carbon dioxide. Use water to cool fire-exposed containers.
Unusual Fire or Explosion Hazards: Vinylidene chloride is a very flammable and volatile liquid with a burning rate of 2.7 mm/min. This material is a very dangerous fire hazard and moderately explosive when exposed to heat or flame. It may explode spontaneously since the vapor forms explosive mixtures with air. At elevated temperatures, polymerization may take place and containers may rupture.
Special Fire-fighting Procedures: Since vinylidene chloride may be poisonous if inhaled or absorbed through the skin, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode with a fully encapsulating suit. Keep unnecessary people away from the hazard area. Vapors may travel to an ignition source and flash back. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Vinylidene chloride is self-reactive. If stored between -40 °F/-40 °C and 77 °F/25 °C in air without an inhibitor, this material rapidly absorbs oxygen and forms a violently explosive peroxide. The heat of polymerization is -185 cal/g (inhibited). When unstable, vinylidene chloride decomposes into chlorine, hydrogen chloride, phosgene, and formaldehyde. Hazardous polymerization can occur if exposed to sunlight, air, copper, aluminum, or heat.
Chemical Incompatibilities: This material reacts violently with chlorosulfonic acid, nitric acid, and oleum; and vigorously with oxidizing materials.
Hazardous Products of Decomposition: Thermal oxidative decomposition of vinylidene chloride can produce highly toxic fumes of chlorine (Cl_2) and hydrogen chloride (HCl).

Section 6. Health Hazard Data

Carcinogenicity: Neither the NTP, IARC, nor OSHA lists vinylidene chloride as a carcinogen, although the ACGIH suggests it is a suspected carcinogen. Various animal studies suggest a high rate of cancer in species-specific testing; application to humans does not appear valid.
Summary of Risks: Vinylidene chloride is an irritant to the skin, eyes, and mucous membranes, although any inhibitor in vinylidene chloride may partly cause the irritation. VDC is narcotic at concentrations greater than 4000 ppm, and has caused liver and kidney injury in experimental animals. Solutions containing the inhibitor MEHQ (monomethyl ether of hydroquinone) may cause leucoderma (white skin) and serious eye injury.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Skin, eyes, central nervous system, liver, and kidneys.
Primary Entry Routes: Inhalation.
Acute Effects: Inhalation of VDC causes narcosis and respiratory irritation. Concentrations of 4000 ppm lead to symptoms of drunkenness and eventually unconsciousness if the exposure continues. In monkey studies, exposure to 200 ppm caused acute liver injury with a mechanism similar to carbon tetrachloride. Animal studies indicate acute kidney changes in high-level exposures. Eye contact may cause conjunctivitis, transient corneal injury, and iritis. VDC also causes skin and mucous membrane irritation.
Chronic Effects: With chronic inhalation, vinylidene chloride may cause hepatic and renal dysfunction. In monkey studies, long-term inhalation at a 48-ppm level caused liver and kidney damage and death.
FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have a *conscious* person drink 1 to 2 glasses of water, then induce repeated vomiting until vomit is clear.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Solutions containing increased MEHQ concentrations are caustic and should not be removed by emesis. There is no specific treatment for VDC intoxication, but if significant amounts have been ingested, monitor the patient for liver and kidney failure.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a vinylidene chloride spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel from hazard area, remove all heat and ignition sources, and ventilate area. Cleanup personnel should protect against inhalation and skin and eye contact. For lab spills, absorb the spill with paper towels and place in a hood to allow liquid to evaporate. For large spills, absorb bulk spill with cement powder, fly ash, sawdust, or commercial sorbents. Place waste in appropriate disposal containers. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 5000 lb (2270 kg) [* per Clean Water Act, Sec. 31 (b)(4), Sec. 307(a); per RCRA, Sec. 3001]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Respiratory canisters containing alkaline materials should not be used because dichloro acetylene can be formed. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.
Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. Rubber gloves are recommended.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL and ACGIH TLVs (Sec. 2). Local explosion-proof exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store vinylidene chloride in tanks with nickel, glass, or baked phenolic linings at 14 °F/-10 °C in the absence of light, air, water, and other polymerization initiators under a nitrogen blanket (at 10-psi pressure and an oxygen content less than 100 ppm). Outside or detached storage is preferable. If stored inside, store in a standard flammable liquids storage cabinet separate from oxidizing materials and incompatible materials (Sec. 5).
Engineering Controls: VDC requires special handling, precautions, and employee training. Do not handle VDC without adequate ventilation and personal protective gear. Limit exposures to vinylidene chloride by improving housekeeping procedures. Keep VDC away from all heat and ignition sources. All engineering systems should be of maximum explosion-proof design, electrically grounded, and bonded.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Vinylidene chloride, inhibited
DOT Hazard Class: Flammable liquid
ID No.: UN1303
DOT Label: Flammable liquid
DOT Packaging Requirements: 173.119
DOT Packaging Exceptions: 173.118

IMO Shipping Name: Vinylidene chloride, inhibited
IMO Hazard Class: 3.1
IMO Label: Flammable liquid
IMDG Packaging Group: I
ID No.: UN1303

MSDS Collection **References:** 7, 26, 38, 53, 73, 84, 85, 87, 89, 100, 103, 124, 126, 127, 129, 134, 136
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD M8

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 713
Lead (Inorganic)

Issued: 8/90

Section 1. Material Identification

32

Lead (Inorganic) (Pb) Description: Exists widely throughout the world in a number of ores. Its main commercial source is galena (lead sulphide). Lead mineral is separated from crude ores by blast-furnace smelting, drossing, or electrolytic refining. Lead is used mostly in manufacturing storage batteries. Other uses are in manufacturing tetraethyllead and both organic and inorganic lead compounds in ceramics, plastics, and electronic devices; in producing ammunition, solder, cable covering, sheet lead, and other metal products (brass, pipes, caulking); in metallurgy; in weights and as ballast; as a chemical intermediate for lead alkyls and pigments; as a constuction material for the tank linings, piping, and equipment used to handle the corrosive gases and liquids used in sulfuric acid manufacturing, petroleum refining, halogenation, sulfonation, extraction, and condensation; and for x-ray and atomic radiation protection.
Other Designations: CAS No. 7439-92-1, lead oxide; lead salts, inorganic; metallic lead; plumbum.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

R	0
I	4
S	-
K	0

Genium: 1 (top), 3 (left), 0 (right), - (bottom)

HMIS
H 3
F 1
R 0
PPG*
* Sec. 8

Cautions: *Inorganic lead is a potent systemic poison.* Organic lead (for example, tetraethyl lead) has severe, but different, health effects. Occupational lead poisoning is due to inhalation of dust and fumes. Major affected organ systems are the nervous, blood, and reproductive systems, and kidneys. Health impairment or disease may result from a severe acute short- or long-term exposure.

Section 2. Ingredients and Occupational Exposure Limits

Lead (inorganic) fumes and dusts, as Pb, ca 100%

1989 OSHA PELs (Lead, inorganic compounds)
8-hr TWA: 50 μg/m³
Action Level TWA*: 30 μg/m³

29 CFR 1910.1025 Lead Standard
Blood Lead Level: 40 μg/100 g

1989-90 ACGIH TLV (Lead, inorganic, fumes and dusts)
TLV-TWA: 150 μg/m³

1988 NIOSH REL
10-hr TWA: <100 μg/m³

1985-86 Toxicity Data†
Human, inhalation, TC_{Lo}: 10 μg/m³ affects gastrointestinal tract and liver
Human, oral, TD_{Lo}: 450 mg/kg ingested over 6 yr affects peripheral and central nervous systems
Rat, oral, TD_{Lo}: 790 mg/kg affects multigeneration reproduction

* Action level applies to employee exposure without regard to respirator use.
† See NIOSH, *RTECS* (OF7525000), for additional mutative, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 3164 °F (1740 °C)
Melting Point: 621.3 °F (327.4 °C)
Vapor Pressure: 1.77 mm Hg at 1832 °F (1000 °C)
Viscosity: 3.2 cp at 621.3 °F (327.4 °C)
Molecular Weight: 207.20
Specific Gravity (20 °C/4 °C): 11.34
Water Solubility: Relatively insoluble in hot or cold water*
Appearance and Odor: Bluish-white, silvery, gray, very soft metal.

* Lead dissolves more easily at a low pH.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: Use dry chemical, carbon dioxide, water spray, or foam to extinguish fire.
Unusual Fire or Explosion Hazards: Flammable and moderately explosive in the form of dust when exposed to heat or flame.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Lead is stable at room temperature in closed containers under normal storage and handling conditions. It tarnishes on exposure to air. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Mixtures of hydrogen peroxide + trioxane explode on contact with lead. Lead is incompatible with sodium azide, zirconium, disodium acetylide, and oxidants. A violent reaction on ignition may occur with concentrated hydrogen peroxide, chlorine trifluoride, sodium acetylide (with powdered lead), ammonium nitrate (below 200 °C with powdered lead). Lead is attacked by pure water and weak organic acids in the presence of oxygen. Lead is resistant to tap water, hydrofluoric acid, brine, and solvents.
Conditions to Avoid: Rubber gloves containing lead may ignite in nitric acid.
Hazardous Products of Decomposition: Thermal oxidative decomposition of lead can produce highly toxic fumes of lead.

Section 6. Health Hazard Data

Carcinogenicity: Although the NTP and OSHA do not list lead as a carcinogen, the IARC lists it as probably carcinogenic to humans, but having (usually) no human evidence. However, the literature reports instances of lead-induced neoplasms, both benign and malignant, of the kidney and other organs in laboratory rodents. Excessive exposure to lead has resulted in neurologic disorders in infants. Experimental studies show lead has reproductive and teratogenic effects in laboratory animals. Human male and female reproductive effects are also documented.
Summary of Risks: Lead is a potent, systemic poison that affect a variety of organ systems, including the nervous system, kidneys, reproductive system, blood formation, and gastrointestinal (GI) system. The most important way lead enters the body is through inhalation, but it can also be ingested when lead dust or unwashed hands contaminate food, drink, or cigarettes. Much of ingested lead passes through feces without absorption into the body. Adults may absorb only 5 to 15% of ingested lead; children may absorb a much larger fraction. Once in the body, lead enters the bloodstream and circulates to various organs. Lead concentrates and remains in bone for many years. The amount of lead the body stores increases as exposure continues, with possibly cumulative effects. Depending on the dose entering the body, lead can be deadly within several days or affect health after many years. Very high doses can cause brain damage (encephalopathy).
Medical Conditions Aggravated by Exposure: Lead may aggravate nervous system disorders (e.g., epilepsy, neuropathies), kidney diseases, high blood pressure (hypertension), infertility, and anemia. Lead-induced anemia and its effect on blood presssure can aggravate cardiovascular disease.

Continue on next page

Section 6. Health Hazard Data, *continued*

Target Organs: Blood, central and peripheral nervous systems, kidneys, and gastrointestinal (GI) tract.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: An acute, short-term dose of lead could cause acute encephalopathy with seizures, coma, and death. However, short-term exposures of this magnitude are rare. Reversible kidney damage can occur from acute exposure, as well as anemia.
Chronic Effects: Symptoms of chronic long-term overexposure include appetite loss, nausea, metallic taste in the mouth, lead line on gingival (gum) tissue, constipation, anxiety, anemia, pallor of the face and the eye grounds, excessive tiredness, weakness, insomnia, headache, nervous irritability, fine tremors, numbness, muscle and joint pain, and colic accompanied by severe abdominal pain. Paralysis of wrist and, less often, ankle extensor muscles may occur after years of increased lead absorption. Kidney disease may also result from chronic overexposure, but few, if any, symptoms appear until severe kidney damage has occurred. Reproductive damage is characterized by decreased sex drive, impotence, and sterility in men; and decreased fertility, abnormal menstrual cycles, and miscarriages in women. Unborn children may suffer neurologic damage or developmental problems due to excessive lead exposure in pregnant women. Lead poisoning's severest result is encephalopathy manifested by severe headache, convulsions, coma, delirium, and possibly death.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Consult a physician if any health complaints develop.
Inhalation: Remove exposed person to fresh air and support breathing as needed. Consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If large amounts of lead were ingested, induce vomiting with Ipecac syrup. Consult a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: For diagnosis, obtain blood pressure, blood lead level (PbB), zinc protoporphyrin (ZPP), complete blood count for microcytic anemia and basophilic stippling, urinalysis, and blood urea nitrogen (BUN) of creatinine. Examine peripheral motor neuropathy, pallor, and gingival lead line. Use Ca-EDTA to treat poison, but *never* chelate prophylactically. Consult an occupational physician or toxicologist.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and evacuate all unnecessary personnel immediately. Cleanup personnel should protect against inhalation of dusts or fume and contact with skin or eyes. Avoid creating dusty conditions. Water sprays may be used in large quantities to prevent the formation of dust. Cleanup methods such as vacuuming (with an appropriate filter) or wet mopping minimizes dust dispersion. Scoop the spilled material into closed containers for disposal or reclamation. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33, Appendix II—EP Toxicity Test Procedures)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per Clean Water Act, Sec. 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. Protective clothing made of man-made fibers and lacking turn-ups, pleats, or pockets retain less dust from lead.
Ventilation: Provide general and local ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially washing hands before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all incompatible materials, direct sunlight, and heat and ignition sources.
Engineering Controls: Educate worker about lead's hazards. Follow and inform employees of the lead standard (29 CFR 1910.1025). Avoid inhalation of lead dust and fumes and ingestion of lead. Use only with appropriate personal protective gear and adequate ventilation. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Avoid creating dusty conditions. Segregate and launder contaminated clothing. Take precautions to protect laundry personnel. Practice good personal hygiene and housekeeping procedures. For a variety of reasons, the lead concentration in workroom air may not correlate with the blood lead levels in individuals.
Other Precautions: Provide preplacement and periodic medical examinations which emphasize blood, nervous system, gastrointestinal tract, and kidneys, including a complete blood count and urinalysis. Receive a complete history including previous surgeries and hospitalization, allergies, smoking history, alcohol consumption, proprietary drug intake, and occupational and nonoccupational lead exposure. Maintain records for medical surveillance, airborne exposure monitoring, employee complaints, and physician's written opinions for at least 40 years or duration of employment plus 20 years. Measurement of blood lead level (PbB) and zinc protoporphyrin (ZPP) are useful indicators of your body's lead absorption level. Maintain worker PbBs at or below 40 μg/100 g of whole blood. To minimize adverse reproductive health effects to parents and developing fetus, maintain the PbBs of workers intending to have children below 30 μg/100 g. Elevated PbBs increase your risk of disease, and the longer you have elevated PbBs, the greater your chance of substantial permanent damage.

Transportation Data (49 CFR 172.102)
IMO Shipping Name: Lead compounds, soluble, n.o.s.
IMO Hazard Class: 6.1
ID No.: UN2291
IMO Label: St. Andrews Cross (X, Stow away from foodstuffs)
IMDG Packaging Group: III

MSDS Collection **References:** 26, 38, 73, 84, 85, 88, 89, 90, 100, 101, 103, 109, 124, 126, 132, 133, 134, 136, 138, 139, 142, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 735
Methyl Tertiary Butyl Ether

Issued: 11/90

Section 1. Material Identification — 33

Methyl Tertiary Butyl Ether [$(CH_3)_4CO$] Description: Prepared by reacting isobutylene with a small amount of methanol. Used as an octane booster in gasoline (in concentrations of up to 11% by volume); as a chromatographic eluent, especially in HPLC; and medically to dissolve cholesterol gallstones. MTBE improves combustion efficacy by oxygenation and is primarily used in unleaded premium brands. MTBE is one of the top 50 chemicals produced in the US, and is currently used in about 10% of the nation's gasoline. As leaded gasoline is phased out, this percentage is expected to increase.

Other Designations: CAS No. 1634-04-4, MBE, methyl 1,1-dimethylethyl ether, (2,-methyl-2-propyl) methyl ether, 2-methoxy-2-methyl propane, 2-methyl-2-methoxy propane, MTBE, tert-butyl methyl ether.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

Cautions: *Extremely flammable*, MTBE is a mild skin and eye irritant that may cause dizziness and/or suffocation if inhaled.

R 1
I -
S 2
K 4

Genium

4
2 0
-

HMIS
H 2
F 4
R 0
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Methyl tertiary butyl ether, ca 100%

1989 OSHA PEL	1990-91 ACGIH TLV	1988 NIOSH REL	1985-86 Toxicity Data*
None established	None established	None established	Rat, oral, LD_{50}: 4 g/kg Rat, inhalation, LC_{50}: 23,576 ppm/4 hr

* See NIOSH, *RTECS* (KN5250000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: 131 °F (55 °C)
Melting Point: -166 °F (-110 °C)
Vapor Pressure: 245 mm Hg at 77 °F (25 °C)
Molecular Weight: 88.15
Specific Gravity (20 °C/4 °C): 0.7405
Water Solubility: 4.8 g/100 g

Appearance and Odor: A clear, colorless liquid with a slight hydrocarbon odor with a mild mint or terpene-like odor.

Section 4. Fire and Explosion Data

Flash Point: -18.4 °F (-28 °C)	Autoignition Temperature: 815 °F (435 °C)	LEL: 1.6% v/v	UEL: 8.4% v/v

Extinguishing Media: Use dry chemical, carbon dioxide, halon, water spray, or alcohol foam as extinguishing media.

Unusual Fire or Explosion Hazards: MTBE is extremely flammable. Its vapors may explode if ignited in an enclosed area or travel to a source of ignition and flash back. At temperatures at or above flashpoint, MTBE can release vapors that form flammable mixtures.

Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and appropriate, required chemical protective clothing (including goggles, rubber over-clothing, gloves, and boots). If feasible, remove containers from fire-risk area. Otherwise, use water spray to cool fire-exposed containers. Be aware of runoff from fire control methods. Do not release to enclosed areas, sewers, or waterways due to the potential explosion and health hazard MTBE presents.

Section 5. Reactivity Data

Stability/Polymerization: MTBE is stable at room temperature in closed containers under normal storage and handling conditions. MTBE is unstable in acid solutions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: MTBE does not react with water or common materials. It is incompatible and unstable with strong oxidizing agents, strong acids, caustics, amines, aldehydes, ammonia, and chlorinated compounds.

Conditions to Avoid: Avoid all heat and ignition sources.

Hazardous Products of Decomposition: Thermal oxidative decomposition of MTBE can produce carbon dioxide (CO_2) and water vapor. Incomplete combustion can produce carbon monoxide, t-butyl formate, acetone, formic acid, and methyl radicals. If present in sufficient concentrations, these products of partial oxidation can pose serious health hazards.

Section 6. Health Hazard Data

Carcinogenicity: The NTP and IARC do not list MTBE as a carcinogen.
Summary of Risks: Data on MTBE ingestion and inhalation toxicity are based on animal studies. Human exposures are reported primarily with exposure to gasoline-MTBE mixtures and with use of MTBE in dissolving gall bladder stones by direct infusion. These reports reveal MTBE's primary anesthetic effect on the central nervous system (CNS). A progression of nausea, vomiting, and sedation followed by general anesthesia is noted with increasing exposure. A warm or burning sensation is reported with gall bladder instillation. Elevated liver function studies, duodenal inflammation, kidney failure, blood cell hemolysis, and foul breath odor are also noted with this procedure. Animal studies note primary irritation to the mucous membranes of the nose, throat, skin, and cornea. Aspiration of gasoline-MTBE mixtures may cause lung pneumonitis.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Upper respiratory tract, central nervous system.
Primary Entry Routes: Inhalation, ingestion (gasoline-MTBE mixtures).
Acute Effects: Contact with the eyes or skin may cause irritaton or burning at high concentrations. Inhalation may result in nausea, vomiting, sedation and general anesthia (central nervous system and respiratory depression). Ingestion of MTBE may result in aspiration pneumonitis.
Chronic Effects: Chronic inhalation causes nasal and tracheal inflammation.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, consult a physician immediately. *Do not induce vomiting* due to the risk of aspiration pneumonitis. If individual is coughing or choking, aspiration may have already occurred; transport to an emergency medical facility.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Activated charcoal is not recommended for MTBE ingestion because of MTBE's poor absorbing qualities. Carefully observe patients for any development of systemic signs. If large quantities of MTBE were ingested, Syrup of Ipecac is preferable to lavage in an alert patient requiring emesis. If aspiration has occurred, obtain baseline chest x-ray and vital signs. Liver function studies may be indicated following substantial MTBE exposure. PFTs, chest x-rays, and supportive care may be necessary after aspiration exposures.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and skin or eye contact. Take up spilled material with noncombustible absorbent material and place in appropriate containers for disposal. For large spills, dike far ahead of spill to contain. Do not allow MTBE to enter enclosed areas (explosion) or waterways. MTBE is more water soluble than other gasoline components, so there may be a higher MBTE concentration in groundwater when there is a spill of gasoline-MTBE mixtures. It also has a moderate to high mobility in soil. MTBE is poorly biodegraded by microorganisms in activated sludge. Cleanup of groundwater contamination is difficult. When high air-to-water ratios are used, air stripping systems can remove MTBE. Products of atmospheric degradation include t-butyl formate, acetone, and methyl radicals. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations at levels that promote worker safety and productivity. A TWA of up to 3 ppm in air produced no adverse effects in workers at ARCO's MTBE manufacturing and transport facilities. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool well-ventilated area away from all heat and ignition sources. Outside or detached storage may be preferred. Protect containers against physical damage. To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas.
Engineering Controls: Avoid inhalation of vapors and contact with skin or eyes. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Avoid heat and ignition sources. Practice good personal hygiene and housekeeping procedures.

Transportation Data (49 CFR 172.102)
IMO Shipping Name: Methyl-tert-butyl ether
IMO Hazard Class: 3.2
ID No.: UN2398
IMO Label: Flammable liquid
IMDG Packaging Group: II

MSDS Collection **References:** 73, 103, 124, 136, 150, 151
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Stuart, MS 150

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 757
Coal Tar Creosote

Issued: 7/91

Section 1. Material Identification

34

Coal Tar Creosote (molecular formula varies with purity) Description: Three main derivations: by distillation of coal tar produced by high-temperature carbonization of bituminous coal; by mixing strained naphthalene oil, wash oil, and strained or light anthracene oil; as a by-product of conventional coal coking. It typically contains up to 160 chemicals, mainly aromatic compounds such as phenol, pyrol and pyridine. Used mainly as a wood preservative for railroad ties, poles, fence posts, marine pilings, and other lumber for outdoor use; as a water-proofing agent, fuel oil constituent, frothing agent for mineral separation, hop defoliant, and lubricant for die molds; in manufacturing chemicals; and in medicine as an antiseptic, disinfectant, antipyretic, astringent, germicide, and styptic.
Other Designations: CAS No. 8001-58-9, Awpa,® brick oil, Caswell No. 225,® coal tar oil, creosote, creosote oil, creosotum, cresylic creosote, heavy oil, liquid pitch oil, naphthalene oil, Preserv-o-sote,® Sakresote,® tar oil, wash oil.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.
Cautions: Flammable, liquid coal tar creosote is toxic by inhalation, ingestion, and skin contact. The IARC and NTP classify it as *a human carcinogen.*

R 1
I 4
S 4*
K 2
* Skin absorption

NFPA
2
2 0
-

HMIS
H 2
F 2
R 0
PPG†
† Sec. 8

* Skin absorption can occur with phenol, a major component of coal tar creosote.

Section 2. Ingredients and Occupational Exposure Limits

Coal tar creosote, ca 100%

1990 OSHA PEL
8-hr TWA: 0.2 mg/m³*

1987 IDLH Level
700 mg/m³

1990-91 ACGIH TLV
TWA: 0.2 mg/m³*

1990 NIOSH REL
0.1 mg/m³ (cyclohexane extractable portion)

1985-86 Toxicity Data†
Rat, oral, LD_{50}: 725 mg/kg; toxic effects not yet reviewed
Dog, oral, LD_{Lo}: 600 mg/kg; toxic effects not yet reviewed
Rat, TD_{Lo}: 52,416 mg/kg administered during 91 days prior to mating produces reproductive effects on fallopian tubes and ovaries
Mouse, skin, TD_{Lo}: 99 g/kg produces tumors in skin and appendages

* As coal tar pitch volatiles.
† See NIOSH, *RTECS* (GF8615000), for additional mutation, reproductive, tumorigenic, and other toxicity data.

Section 3. Physical Data

Boiling Point: 381 to 752 °F (194 to 400 °C)
Distillation Range: 446 to 554 °F (230 to 290 °C)
Heat of Combustion: -12,500 Btu/lb
Heat of Vaporization: 107 Btu/lb
Molecular Weight: Varies with purity
Density/Specific Gravity: 1.07 to 1.08 at 68 °F (20 °C)
Water Solubility: Slightly soluble

Appearance and Odor: Pure coal tar creosote is colorless, but the industrial product is a yellow to black oily liquid with an aromatic smoky smell and a burning caustic taste.

Section 4. Fire and Explosion Data

Flash Point: 165.2 °F (74 °C), CC	**Autoignition Temperature:** 637 °F (336 °C)	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: For small fires, use dry chemical, carbon dioxide (CO_2), or regular foam. For large fires, use fog or regular foam. Since water is least effective, use it as an extinguishing agent only when the preferred measures are unavailable. However, use water spray to cool fire-exposed containers.
Unusual Fire or Explosion Hazards: Vapors may travel to an ignition source and flash back. Containers may explode in heat of fire. Coal tar creosote presents a vapor explosion hazard indoors, outdoors, and in sewers.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Also, wear full protective clothing. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Immediately leave area if you hear a rising sound from venting safety device or notice any fire-caused tank discoloration. Isolate area for 1/2 mile in all directions if fire involves tank, rail car or tank truck. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Fully decontaminate or properly dispose of personal protective clothing.

Section 5. Reactivity Data

Stability/Polymerization: Coal tar creosote is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Creosote oil mixed with chlorosulfonic acid in a closed container causes an increase in temperature and pressure.
Conditions to Avoid: Avoid excessive heat and contact with chlorosulfonic acid.
Hazardous Products of Decomposition: Thermal oxidative decomposition of coal tar creosote can produce oxides of carbon and thick, black, acrid smoke.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA list coal tar creosote as a carcinogen.
Summary of Risks: Coal tar creosote is toxic by inhalation, ingestion, and skin contact. It contains a variety of hydrocarbons such as phenol and polycyclic aromatic hydrocarbons such as benzo[a]pyrene, benzanthracene, and phenol derivatives. The range of toxicity depends on the exposure concentration, amount, and duration. Effects may include irritation, burns, and several forms of cancer.
Medical Conditions Aggravated by Long-Term Exposure: Chronic respiratory or skin diseases.
Target Organs: Eyes, skin, bladder, kidneys, and respiratory system.
Primary Entry Routes: Inhalation, ingestion, and skin contact.
Acute Effects: Skin contact may cause irritation, burning, itching, redness, pigment changes, dermatitis (a rash of redness and small bumps), or burns. Photosensitization (worsening of rash with exposure to sunlight) may occur. Inhalation may be irritating to the respiratory tract. Eye contact may cause conjunctivitis (inflammation of the eye's lining), keratitis (corneal inflammation), or corneal burns with scarring. Ingestion may result in nausea, vomiting, abdominal pain, rapid pulse, respiratory distress, and shock. Systemic absorption by any route (including skin absorption) may cause trouble breathing, thready (continuous or drawn out) pulse, dizziness, headache, nausea, vomiting, salivation, and convulsions. Exposure to large doses (particularly by ingestion) may be fatal.
Chronic Effects: Dermatitis, skin cancer, and lung cancer.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. *Do not* let victim rub eyes or keep them tightly closed. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Wash affected area with soap and flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of milk or water. *Do not induce vomiting!*
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Cresol may be detected in urine.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel. Isolate hazard area, deny entry, and stay upwind of spills. Shut off all ignition sources–no flares, smoking, or flames in hazard area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. If possible with no risk, stop leak. Water spray may be used to reduce vapor but it may not prevent ignition in closed spaces. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers for later disposal. For large spills, dike far ahead of liquid spill for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120).
Environmental Degradation: Coal tar creosote is fouling to shoreline. Ecotoxicity values are: TL_{50}, goldfish (*Carassius auratus*), 3.51 ppm/24 hr (60:40) mixture of creosote and coal tar; LD_{50}, bob white quail (*Colinus virginianus*), 1,260 ppm/8 days (60:40) mixture of creosote and coal tar.
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Material No. U051
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per RCRA, Sec. 3001]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed (as coal tar pitch volatiles) as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent all skin contact. Applying a layer of petroleum jelly or lanolin castor oil ointment to the face reduces vapor contact and penetration through skin. Frequent change of protective garments is an additional protective measure.
Ventilation: Provide general and local exhaust ventilation systems equipped with high-efficiency particulate filters to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Take particular care to avoid any contamination of drains or ventilation ducts. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Avoid physical damage to containers. Store in a cool, dry, well-ventilated area. Store coal tar creosote as close to area of use as possible to minimize transporting distance.
Engineering Controls: Use engineering controls to keep airborne concentrations below the OSHA PEL. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Always perform synthesis and purification procedures under a vertical ventilation hood and make regular operational safety checks. Label doors to rooms where coal tar creosote is produced, used, or stored as containing a carcinogen. Locate emergency equipment at well-marked and clearly identified stations in case emergency escape is necessary.
Other Precautions: Preplacement and periodic medical examinations of exposed workers emphasizing respiratory, skin, liver, and kidney disorders, including comprehensive work and medical history, physical examination, CXR, PFTs, urinalysis, LFT, and sputum cytology as the attending physician considers appropriate. Educate workers about coal tar creosote's carcinogenicity and proper handling procedures to avoid exposure.
Other Comments: Caution is in order when handling or sawing old creosote-treated lumber since it retains a considerable portion of creosote for up to 25 to 30 years.

Transportation Data (49 CFR 172.101)
DOT Shipping Name: Creosote
DOT Hazard Class: Flammable liquid
ID No.: UN1136
DOT Label: Flammable liquid

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 139, 140, 142, 143, 146, 148, 153, 159
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** Mark Upfal, MD, MPH; **Edited by:** JR Stuart, MS

Material Safety Data Sheet

Catalog Number: 224531
Revision date: 25-Apr-2006

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY INFORMATION

Catalog Number: 224531

Product name: 1,2-DICHLOROETHANE

Supplier:
MP Biomedicals, LLC
29525 Fountain Parkway
Solon, OH 44139
tel: 440-337-1200

Emergency telephone number: CHEMTREC: 1-800-424-9300 (1-703-527-3887)

2. COMPOSITION/INFORMATION ON INGREDIENTS

Components	CAS Number	Weight %	ACGIH Exposure Limits:	OSHA Exposure Limits:
1,2-DICHLOROETHANE	107-06-2	90 - 100%	10 ppm TWA	50 ppm TWA

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Flammable, Toxic: danger of very serious irreversible effects if swallowed. May also have serious irreversible effects through skin contact or inhalation. , Harmful to flora, fauna, soil organisms and aquatic organisms.

Category of Danger:
Flammable , Toxic , Carc. cat. 2 , Lachrymator, Dangerous for the environment

Principle routes of exposure: Skin
Inhalation: Harmful: possible risk of irreversible effects through inhalation.
Ingestion: Toxic: danger of very serious irreversible effects if swallowed.
Skin contact: Harmful: danger of serious damage to health by prolonged skin contact.
Eye contact: Risk of serious damage to eyes
Vapors extremely irritating to eyes an respiratory tract

ANSI Classification Irritant - eye, severe
Statements of hazard Flammable
Toxic if swallowed
CAUSES EYE IRRITATION.
Statement of Spill or Leak - ANSI Label Eliminate all ignition sources. Absorb and/or contain spill with inert materials (e.g., sand, vermiculite). Then place in appropriate container. For large spills, use water spray to disperse vapors, flush spill area. Prevent runoff from entering waterways or sewers.
Statement of First Aid If swallowed, do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Call a physician. In case of contact, flush eyes with running water for at least 15 minutes. Consult a physician for irritation or any other symptom.
Precautions - ANSI Label Do not taste or swallow. Wash thoroughly after handling. Keep away from heat, sparks and flame. Keep containers closed. Use only with adequate ventilation. Do not breathe vapors or spray mist Do not get in eyes, on skin, or on clothing. Wash thoroughly after handling.

4. FIRST AID MEASURES

General advice: In the case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
Inhalation: Move to fresh air. Call a physician immediately.
Skin contact: Rinse immediately with plenty of water for at least 15 minutes
Ingestion: Do not induce vomiting without medical advice. Never give anything by mouth to an unconscious person. Consult a physician Drink 1 or 2 glasses of water. Induce vomiting, but only if victim is fully conscious. Induce vomiting if person is conscious.
Eye contact: Flush eye(s) immediately with plenty of water. Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.
Protection of first-aiders: No information available
Medical conditions aggravated by exposure: None known

5. FIRE FIGHTING MEASURES

Suitable extinguishing media:	Use water spray (fog), foam, dry chemical or CO2., Use dry chemical, CO2, water spray or `alcohol` foam.
Extinguishing media which must not be used for safety reasons:	Do not use a solid water stream as it may scatter and spread fire.
Specific hazards:	Flammable liquid. Vapors are heavier than air and may travel to a source of ignition and flash back. Combustion by-products include hydrogen chloride and phosgene. Forms dense soot. Extremely flammable
Unusual hazards:	None known
Special protective equipment for firefighters:	Wear self contained breathing apparatus for fire fighting if necessary. In the event of fire and/or explosion do not breathe fumes.
Specific methods:	Water mist may be used to cool closed containers.
Flash point:	13 °C (closed cup)
Autoignition temperature:	413 °C at 1013 hPa

NFPA rating:

NFPA Health:	2
NFPA Flammability:	3
NFPA Reactivity:	0

6. ACCIDENTAL RELEASE MEASURES

Personal precautions:	Remove all sources of ignition. Use personal protective equipment.
Environmental precautions:	Do not flush into surface water or sanitary sewer system.
Methods for cleaning up:	Soak up with inert absorbent material. Ground and bond containers when transferring material

7. HANDLING AND STORAGE

Storage:
ROOM TEMPERATURE

Handling:	Use only in area provided with appropriate exhaust ventilation.
Safe handling advice:	Wear personal protective equipment. Remove and wash contaminated clothing before reuse.

Technical measures/storage conditions: Keep containers tightly closed in a cool, well-ventilated place. Keep away from heat and sources of ignition Keep container tightly closed in a dry and well-ventilated place. Keep away from open flames, hot surfaces and sources of ignition

Incompatible products: Oxidising and spontaneously flammable products

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering measures: Ensure adequate ventilation, especially in confined areas.
PERSONAL PROTECTIVE EQUIPMENT
Respiratory protection: In case of mist, spray or aerosol exposure wear suitable personal respiratory protection and protective suit.
Hand protection: Pvc or other plastic material gloves
Skin and body protection: Impervious clothing Long sleeved clothing
Eye protection: If splashes are likely to occur, wear: Safety glasses with side-shields
Hygiene measures: Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance and Odor	Colorless, oily; chloroform-like odor
Physical state:	Liquid
Formula:	C2H4Cl2
Molecular weight:	98.96
Melting point/range:	-36 °C
Boiling point/range:	83.5 °C at 1013 hPa
Density:	1.25 g/cm3 at 20 °C
Vapor pressure:	86 hPa at 20 °C
Evaporation rate:	No data available
Vapor density:	3.4 (air = 1)
Solubility (in water):	Moderately soluble
Flash point:	13 °C (closed cup)
Autoignition temperature:	413 °C at 1013 hPa

10. STABILITY AND REACTIVITY

Stability: Stable under recommended storage conditions.
Polymerization: None under normal processing.
Hazardous decomposition products: Chloride/Hydrochloric acid
Materials to avoid: -
Strong oxidizers and caustics, chemically active metals, such as aluminum or magnesium powder, sodium, potassium
Conditions to avoid: Exposure to air or moisture over prolonged periods.

11. TOXICOLOGICAL INFORMATION

Product Information
Acute toxicity

Components	**RTECS Number:**	**Selected LD50s and LC50s**
1,2-DICHLOROETHANE	KI0525000	Inhalation LC50 Rat : 1000 ppm/7H Oral LD50 Rat : 670 mg/kg Oral LD50 Mouse : 413 mg/kg Dermal LD50 Rabbit : 2800 mg/kg

Chronic toxicity:	Chronic exposure may cause nausea and vomiting, higher exposure causes unconsciousness.
Local effects:	Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting.
Specific effects:	May include moderate to severe erythema (redness) and moderate edema (raised skin), nausea, vomiting, headache.
Primary irritation:	No data is available on the product itself.
Carcinogenic effects:	Possible carcinogen
Mutagenic effects:	No data is available on the product itself.
Reproductive toxicity:	No data is available on the product itself.

Components	NIOSH - Health Effects	NIOSH - Target Organs
1,2-DICHLOROETHANE	nervous system, respiratory, cardiovascular, and liver effects	kidneys, liver, eyes, skin, CNS, CVS (in animals: forestomach, mammary gland and circulatory system cancer)

12. ECOLOGICAL INFORMATION

Mobility:	No data available
Bioaccumulation:	No data available
Ecotoxicity effects:	No data available
Aquatic toxicity:	May cause long-term adverse effects in the aquatic environment.

Components	U.S. DOT - Appendix B - Marine Pollutan	U.S. DOT - Appendix B - Severe Marine Pollutants	United Kingdom - The Red List:
1,2-DICHLOROETHANE	Not Listed	Not Listed	Original entry

Components	Germany VCI (WGK)	World Health Organization (WHO) - Drinking Water	Ecotoxicity - Fish Species Data
1,2-DICHLOROETHANE	3	30 ug/L	LC50 (96 hr) fathead minnow (0.12 g) 118 mg/L. Cond:Flow-through, pH 7.5, 42.2-45.5 mg/L CaCO3.:;LC50 (96 hr) rainbow trout (1.8 g):225 mg/L. Cond:Static, 13 °C.;LC50 (96 hr) bluegill (0.12 g):430-550

Components	Ecotoxicity - Freshwater Algae Data	Ecotoxicity - Microtox Data	Ecotoxicity - Water Flea Data
1,2-DICHLOROETHANE	Not Listed	EC50 (5,10,15,30 min) Photobacterium phosphoreum:153-2063 mg/L Microtox test. Cond:15 °C.	EC50 (48 hr) water flea (less than 24 hours old):137-188 mg/L. Cond:Static, 19-21 °C.

Components	EPA - ATSDR Priority List	EPA - HPV Challenge Program Chemical List	California - Priority Toxic Pollutants
1,2-DICHLOROETHANE	Rank (of 275): 080	indicator 4; Fully and ICCA sponsored	Not Listed

Components	California - Priority Toxic Pollutants	California - Priority Toxic Pollutants
1,2-DICHLOROETHANE	Water and organisms = 0.38 ug/L; organisms only = 99 ug/L	Not Listed

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products:	Waste disposal must be in accordance with appropriate Federal, State, and local regulations. This product, if unaltered by use, may be disposed of by treatment at a permitted facility or as advised by your local hazardous waste regulatory authority. Residue from fires extinguished with this material may be hazardous.
Contaminated packaging:	Do not re-use empty containers
Methods for cleaning up:	Soak up with inert absorbent material. Ground and bond containers when transferring material

14. TRANSPORT INFORMATION

UN/Id No: 1184

DOT:

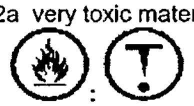
Proper shipping name:	Ethylene dichloride
IATA Hazard Label(s):	Flammable Liquid & Toxic
Hazard Class	3 - Flammable liquid
Subsidiary risk:	6.1 - Toxic
Packing group:	II

Emergency Response Guide Number (ERG): 129

Components	U.S. DOT - Appendix A Table 1 - Reportable Quantities
1,2-DICHLOROETHANE	RQ = 100 pounds (45.4 kg); also listed as Ethane, 1,2-dichloro-; also listed as Ethylene dichloride

TDG (Canada):

WHMIS hazard class: B2 flammable liquids
D2a very toxic materials

:  :

IMDG/IMO

Proper shipping name:	Ethylene dichloride
IMDG - Hazard Classifications	IMDG class or division = 3, 6.1
IMDG - Regulated Substances	UN1184

Components	U.S. DOT - Appendix B - Marine Pollutan	U.S. DOT - Appendix B - Severe Marine Pollutants
1,2-DICHLOROETHANE	Not Listed	Not Listed

IMO-labels:

15. REGULATORY INFORMATION

International Inventories

Components
1,2-DICHLOROETHANE

Inventory - United States TSCA - Sect. 8(b)	Present
Canada DSL Inventory List -	Present
Australia (AICS):	Present
Inventory - China:	Present
EU EINECS List -	203-458-1; C2H4Cl2
Inventory - Japan:	2-54
Korean KECL:	KE-10121
Philippines PICCS:	Present

U.S. regulations:

Components	**California Proposition 65 -**	**Massachusetts Right to Know List:**	**New Jersey Right to Know List:**	**Pennsylvania Right to Know List:**
1,2-DICHLOROETHANE	carcinogen; initial date 10/1/87	carcinogen; extraordinarily hazardous	sn 0652	environmental hazard; special hazardous substance

Components	**Florida substance List:**	**Rhode Island Right to Know List:**	**Illinois - Toxic Air Contaminants**	**Connecticut - Hazardous Air Pollutants**
1,2-DICHLOROETHANE	[present]	Toxic, Flammable	B2 Carcinogen, Present on HAP and Great Waters or Great Lakes list	20 ug/m³ HLV; 5 ppbv HLV; also listed as Ethylene dichloride

Components	**SARA 313 Emission reporting/Toxic Release of Chemicals**	**CERCLA/SARA - Section 302 Extremely Haz**	**NTP:**	**IARC:**
1,2-DICHLOROETHANE	form R reporting required for 0.1% de minimis concentration	Not Listed	Suspect Carcinogen	Monograph 71, 1999; Supplement 7, 1987; Monograph 20, 1979

SARA 313 Notification: The above is your notification as to the SARA 313 listing for this product(s) pursuant to Section 313 of Title III of the Superfund Ammendments and Reauthorization Act of 1986 and 40 CFR Part 372.

If you are unsure if you are subject to the reporting requirements of Section 313, or need more information, please call the EPA Emergency Planning and Community Right-To-Know Information Hotline: (800) 535-0202 or (202) 479-2499 (in Washington, DC or Alaska).

State Notification: The above information is your notice as to the Right-to-Know listings of the stated product(s). Individual states will list chemicals for a variety of reasons including, but not limited to, the compounds toxicity; carcinogenic, tumorigenic and/or reproductive hazards; and the compounds environmental impact if accidentally released.

16. OTHER INFORMATION

Prepared by: Health & Safety
Disclaimer: The information and recommendations contained herein are based upon tests believed to be reliable. However, MP Biomedicals does not guarantee the accuracy or completeness NOR SHALL ANY OF THIS INFORMATION CONSTITUTE A WARRANTY, WHETHER EXPRESSED OR IMPLIED, AS TO THE SAFETY OF THE GOODS, THE MERCHANTABILITY OF THE GOODS, OR THE FITNESS OF THE GOODS FOR A PARTICULAR PURPOSE. Adjustment to conform to actual conditions of usage maybe required. MP Biomedicals assumes no responsibility for results obtained or for incidental or consequential damages, including lost profits arising from the use of these data. No warranty against infringement of any patent, copyright or trademark is made or implied.

End of Safety Data Sheet

SIGMA-ALDRICH

MATERIAL SAFETY DATA SHEET

Date Printed: 07/11/2006
Date Updated: 01/23/2006
Version 1.8

Section 1 - Product and Company Information

Product Name	1,1,1-TRICHLOROETHANE, REAGENTPLUS, 99%
Product Number	235571
Brand	ALDRICH
Company	Sigma-Aldrich
Address	3050 Spruce Street SAINT LOUIS MO 63103 US
Technical Phone:	800-325-5832
Fax:	800-325-5052
Emergency Phone:	314-776-6555

Section 2 - Composition/Information on Ingredient

Substance Name	CAS #	SARA 313
1,1,1-TRICHLOROETHANE	71-55-6	Yes

Formula: C2H3Cl3

Synonyms: Aerothene TT * CF 2 * Chloroform, methyl- * Chlorothene * Chloroethene (inhibited) * Chlorothene NU * Chlorothene SM * Chlorothene VG * Chlorten * Ethana NU * F 140a * HCC 140a * ICI-CF 2 * Inhibisol * Methylchloroform * Methyl chloroform (ACGIH:OSHA) * Methyltrichloromethane * NCI-C04626 * RCRA waste number U226 * Solvent 111 * alpha-T * Tafclean * 1,1,1-Trichloorethaan (Dutch) * 1,1,1-Trichloraethan (German) * Trichloro-1,1,1-ethane (French) * 1,1,1-Trichloroethane (DOT:OSHA) * 1,1,1-Tricloroetano (Italian) * Trichloromethylmethane

RTECS Number: KJ2975000

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Harmful. Dangerous for the environment.
Harmful by inhalation. Irritating to eyes, respiratory system and skin. Dangerous for the ozone layer.
Target organ(s): Liver. Kidneys.

HMIS RATING

HEALTH: 3*
FLAMMABILITY: 0
REACTIVITY: 0

NFPA RATING

HEALTH: 3
FLAMMABILITY: 0
REACTIVITY: 0

*additional chronic hazards present.

For additional information on toxicity, please refer to Section 11.

Section 4 - First Aid Measures

ORAL EXPOSURE
If swallowed, wash out mouth with water provided person is conscious. Call a physician.

INHALATION EXPOSURE
If inhaled, remove to fresh air. If breathing becomes difficult, call a physician.

DERMAL EXPOSURE
In case of contact, immediately wash skin with soap and copious amounts of water.

EYE EXPOSURE
In case of contact with eyes, flush with copious amounts of water for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers. Call a physician.

Section 5 - Fire Fighting Measures

FLASH POINT
N/A

EXPLOSION LIMITS
Lower: 7.5 %   Upper: 15 %

AUTOIGNITION TEMP
537 °C

FLAMMABILITY
N/A

EXTINGUISHING MEDIA
Suitable: Water spray. Carbon dioxide, dry chemical powder, or appropriate foam.

FIREFIGHTING
Protective Equipment: Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.
Specific Hazard(s): Emits toxic fumes under fire conditions.

Section 6 - Accidental Release Measures

PROCEDURE TO BE FOLLOWED IN CASE OF LEAK OR SPILL
Evacuate area.

PROCEDURE(S) OF PERSONAL PRECAUTION(S)
Wear self-contained breathing apparatus, rubber boots, and heavy rubber gloves.

METHODS FOR CLEANING UP
Absorb on sand or vermiculite and place in closed containers for disposal. Ventilate area and wash spill site after material pickup is complete.

Section 7 - Handling and Storage

HANDLING

User Exposure: Do not breathe vapor. Avoid contact with eyes, skin, and clothing. Avoid prolonged or repeated exposure.

STORAGE

Suitable: Keep tightly closed.

Section 8 - Exposure Controls / PPE

ENGINEERING CONTROLS

Safety shower and eye bath. Mechanical exhaust required.

PERSONAL PROTECTIVE EQUIPMENT

Respiratory: Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU). Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator.
Hand: Compatible chemical-resistant gloves.
Eye: Chemical safety goggles.

GENERAL HYGIENE MEASURES

Wash thoroughly after handling.

EXPOSURE LIMITS, RTECS

Country	Source	Type	Value
USA	ACGIH	STEL	450 PPM
USA	ACGIH	TWA	350 PPM
USA	MSHA Standard-air	TWA	350 PPM (1900 MG/M3)
USA	OSHA.	PEL	8H TWA 350 PPM (1900 MG/M3)
New Zealand	OEL		
Remarks: check ACGIH TLV			
USA	NIOSH	Ceiling co350 PPM/15M	

EXPOSURE LIMITS

Country	Source	Type	Value
Poland		NDS	300 MG/M3
Poland		NDSCh	600 MG/M3
Poland		NDSP	-

Section 9 - Physical/Chemical Properties

Appearance — Physical State: Clear liquid
Color: Colorless

Property	Value	At Temperature or Pressure
Molecular Weight	133.41 AMU	
pH	N/A	
BP/BP Range	72.0 - 75.0 °C	
MP/MP Range	- 35.0 °C	
Freezing Point	N/A	
Vapor Pressure	100 mmHg	20 °C
Vapor Density	4.6 g/l	
Saturated Vapor Conc.	N/A	
SG/Density	1.336 g/cm3	
Bulk Density	N/A	
Odor Threshold	N/A	
Volatile%	N/A	
VOC Content	N/A	
Water Content	N/A	

Solvent Content	N/A
Evaporation Rate	N/A
Viscosity	N/A
Surface Tension	N/A
Partition Coefficient	N/A
Decomposition Temp.	N/A
Flash Point	N/A
Explosion Limits	Lower: 7.5 % Upper: 15 %
Flammability	N/A
Autoignition Temp	537 °C
Refractive Index	1.438
Optical Rotation	N/A
Miscellaneous Data	N/A
Solubility	N/A

N/A = not available

Section 10 - Stability and Reactivity

STABILITY
Reactions to Avoid: Reacts violently with:
Materials to Avoid: Potassium, Strong oxidizing agents, Sodium, Magnesium, Zinc, Strong bases.

HAZARDOUS DECOMPOSITION PRODUCTS
Hazardous Decomposition Products: Carbon monoxide, Carbon dioxide, Hydrogen chloride gas.

HAZARDOUS POLYMERIZATION
Hazardous Polymerization: Will not occur

Section 11 - Toxicological Information

ROUTE OF EXPOSURE
Skin Contact: Causes skin irritation.
Skin Absorption: May be harmful if absorbed through the skin.
Eye Contact: Causes eye irritation.
Inhalation: Harmful if inhaled. Material is irritating to mucous membranes and upper respiratory tract.
Ingestion: May be harmful if swallowed.

TARGET ORGAN(S) OR SYSTEM(S)
Central nervous system. Kidneys. Liver. Cardiovascular system.

SIGNS AND SYMPTOMS OF EXPOSURE
Damage to the kidneys. Damage to the liver. Narcotic effect. Symptoms of exposure may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. Exposure to and/or consumption of alcohol may increase toxic effects. Prolonged exposure can cause:

TOXICITY DATA

Oral
Rat
9600 mg/kg
LD50
Remarks: Cardiac:Pulse rate. Nutritional and Gross Metabolic:Weight loss or decreased weight gain.

Inhalation

Rat
18,000 ppm
LC50

Intraperitoneal
Rat
3593 MG/KG
LD50

Oral
Mouse
6000 mg/kg
LD50
Remarks: Nutritional and Gross Metabolic:Weight loss or decreased weight gain. Cardiac:Pulse rate.

Inhalation
Mouse
3,911 ppm
LC50
Remarks: Behavioral:Excitement.

Intraperitoneal
Mouse
2568 MG/KG
LD50

Subcutaneous
Mouse
16 GM/KG
LD50
Remarks: Behavioral:Sleep. Behavioral:Ataxia.

Oral
Dog
750 mg/kg
LD50

Intraperitoneal
Dog
3100 MG/KG
LD50
Remarks: Liver:Liver function tests impaired.

Inhalation
Cat
24,400 mg/m3
LC50

Oral
Rabbit
5660 mg/kg
LD50

Oral
Guinea pig
9470 mg/kg
LD50

IRRITATION DATA

Eyes

Man
450 ppm
8H

Skin
Rabbit
5,000 mg
12D
I
Remarks: Mild irritation effect

Skin
Rabbit
20 mg
24H
Remarks: Moderate irritation effect

Eyes
Rabbit
100 mg
Remarks: Mild irritation effect

Eyes
Rabbit
2 mg
24H
Remarks: Severe irritation effect

CHRONIC EXPOSURE - CARCINOGEN
Result: This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC CARCINOGEN LIST

Rating: Group 3

NTP CARCINOGEN LIST

Rating: Inadequate studies
Species: Mouse/rat
Route: Gavage

ACGIH CARCINOGEN LIST

Rating: A4

CHRONIC EXPOSURE - TERATOGEN
Result: Laboratory experiments have shown teratogenic effects.

Species: Rat
Dose: 43 MG/KG
Route of Application: Oral
Exposure Time: (1-22D PREG/21D POST)
Result: Specific Developmental Abnormalities: Cardiovascular (circulatory) system.

Species: Rat
Dose: 2100 PPM/6H
Route of Application: Inhalation
Exposure Time: (1-20D PREG)
Result: Effects on Embryo or Fetus: Fetotoxicity (except death,

e.g., stunted fetus).

CHRONIC EXPOSURE - MUTAGEN
Result: Laboratory experiments have shown mutagenic effects.

Species: Rat
Dose: 99 UMOL/L
Cell Type: Embryo
Mutation test: Morphological transformation.

Species: Mouse
Dose: 31300 UG/L (+S9)
Cell Type: lymphocyte
Mutation test: Mutation in microorganisms

Species: Mouse
Dose: 20 MG/L
Cell Type: Embryo
Mutation test: Morphological transformation.

Species: Hamster
Dose: 562 MG/L
Cell Type: kidney
Mutation test: Morphological transformation.

Species: Hamster
Dose: 100 UL/PLATE
Cell Type: Embryo
Mutation test: Morphological transformation.

Species: Hamster
Dose: 160 MG/L
Cell Type: ovary
Mutation test: Cytogenetic analysis

CHRONIC EXPOSURE - REPRODUCTIVE HAZARD
Result: Overexposure may cause reproductive disorder(s) based on tests with laboratory animals.

Species: Rat
Dose: 7000 PPM/3H
Route of Application: Inhalation
Exposure Time: (13-19D PREG)
Result: Effects on Newborn: Behavioral. Effects on Newborn: Live birth index (# fetuses per litter; measured after birth). Maternal Effects: Other effects.

Section 12 - Ecological Information

ACUTE ECOTOXICITY TESTS

Test Type: LC50 Fish
Species: Pimephales promelas (Fathead minnow)
Time: 96 h
Value: 53 mg/l

ODC (OZONE DEPLETING CHEMICAL) - CAA602
Ozone Depletion Class: I
Ozone Depletion Group: V

Section 13 - Disposal Considerations

APPROPRIATE METHOD OF DISPOSAL OF SUBSTANCE OR PREPARATION
Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. Observe all federal, state, and local environmental regulations.

Section 14 - Transport Information

DOT
Proper Shipping Name: 1,1,1-Trichloroethane
UN#: 2831
Class: 6.1
Packing Group: Packing Group III
Hazard Label: Toxic Substance
PIH: Not PIH

IATA
Proper Shipping Name: 1,1,1-Trichloroethane
IATA UN Number: 2831
Hazard Class: 6.1
Packing Group: III

Section 15 - Regulatory Information

EU DIRECTIVES CLASSIFICATION
Symbol of Danger: Xn-N
Indication of Danger: Harmful. Dangerous for the environment.
R: 20-59
Risk Statements: Harmful by inhalation. Dangerous for the ozone layer.
S: 24/25-59-61
Safety Statements: Avoid contact with skin and eyes. Refer to manufacturer/supplier for information on recovery/recycling. Avoid release to the environment. Refer to special instructions/safety data sheets.

US CLASSIFICATION AND LABEL TEXT
Indication of Danger: Harmful. Dangerous for the environment.
Risk Statements: Irritating to eyes, respiratory system and skin. Harmful by inhalation. Dangerous for the ozone layer.
Safety Statements: In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. Wear suitable protective clothing, gloves, and eye/face protection. Refer to manufacturer/supplier for information on recovery/recycling. Avoid release to the environment. Refer to special instructions/safety data sheets.
US Statements: Target organ(s): Liver. Kidneys.

UNITED STATES REGULATORY INFORMATION
SARA LISTED: Yes
DEMINIMIS: 1 %
NOTES: This product is subject to SARA section 313 reporting requirements.
TSCA INVENTORY ITEM: Yes

CANADA REGULATORY INFORMATION
WHMIS Classification: This product has been classified in accordance with the hazard criteria of the CPR, and the MSDS contains all the information required by the CPR.

DSL: Yes
NDSL: No

Section 16 - Other Information

DISCLAIMER

For R&D use only. Not for drug, household or other uses.

WARRANTY

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Inc., shall not be held liable for any damage resulting from handling or from contact with the above product. See reverse side of invoice or packing slip for additional terms and conditions of sale.

ATTACHMENT 3

EHS PROGRAM 4-6, TEMPERATURE EXTREMES

This page intentionally left blank.

EHS 4-6: Temperature Extremes (Previously HS 4-6)

Version Date:	10/13/2005 - Revised	Approved by:	Donald Rogers
Original Issue Date:	02/01/95		
Category:	Company Procedures	Sections:	ESQ - Environmental Health & Safety Programs
Sub Category:	Departmental/Discipline	Document Type:	Procedure
Keyword Index:	EHS Compliance/Waste Management, Monitoring, Operational Control, Training	Document Owner:	Philip Bartley

Purpose
The purpose of this program is to prevent heat and cold stress related injuries and illnesses at field operations.

1.0 PURPOSE

The purpose of this program is to prevent heat and cold stress related injuries and illnesses at field operations.

2.0 SCOPE

This program applies to all Tetra Tech EC, Inc. ("the Company") and subcontractor field personnel that may be exposed to heat or cold stress during the performance of their field work assignments.

3.0 MINIMUM REQUIREMENTS

3.1 Responsibilities

3.1.1 Line Management

Site Supervisors have the responsibility to:

a. Provide resources and facilities necessary to prevent health effects from temperature extremes

b. Enforce work rules related to such prevention

c. Ensure implementation of the requirements of this program as specified in the Site Environmental, Safety and Health (EHS) plans.

3.1.2 Environmental, Health and Safety Personnel

The Project Environmental and Safety Manager (PESM) will make the initial determination of heat and cold stress prevention requirements as part of the site EHS Plan (see EHS 3-2, EHS Plans) and oversee the implementation of this program on a project basis for all Company field programs.

The Environmental Safety Supervisor (ESS) will assist with implementation of heat and cold stress prevention programs. The ESS will, in most cases, be the person responsible for monitoring heat and cold stress on the job, determining work/rest and work/warm-up schedules where used, and will implement emergency response or corrective action, if needed. The ESS will train site personnel on the effects of temperature extremes and the site prevention program, and will maintain records related to this program.

The ESS will implement the appropriate heat stress or cold stress requirements when temperatures indicate a potential heat or cold stress condition. The ESS will work with the line management to implement work rest regimens or other administrative controls such as ceasing certain activities, changing PPE, or engineering controls such as warming areas, cooling areas or shifting work schedules.

3.2 General Program Requirements

Adverse weather conditions must be considered when planning site operations. Excessively hot or cold working environments can produce a number of different injuries. Critical to the ability to care for those injuries is a basic understanding of the way in which the body maintains its temperature and how it physiologically adjusts to extremes of heat and cold. Attachment 1 provides information on the body's physiological responses to heat and cold stress.

Proper care of victims who are suffering from the effects of heat or cold exposure will help to minimize injuries and speed recovery. On the other hand, improper treatment of these emergencies can result in serious injury, disability, or death.

The most effective first aid for any injury is prevention. When acceptable monitoring and prevention programs are followed, there should be no victims.

3.3 Heat Stress

A heat stress prevention program will be implemented when ambient temperatures exceed 70°F (21° C) for personnel wearing impermeable clothing and for other personnel when the WBGT index exceeds the ACGIH Threshold Limit Values. When a WBGT is not available or applicable (enclosed work areas, work over asphalt or reflective materials etc.) physiological (pulse, temperature) monitoring may be used in its place.

WBGT devices located away from the project (up to several miles) maybe used for monitoring the project if the general weather and measured work surfaces are similar.

3.3.1 Selection of Chemical Protective Clothing

The PESM will review site data and working conditions and select the personal protective equipment ensemble that best protects the employees from site hazards. The risk of heat related illness will be fully considered in balancing the risks and benefits of the PPE.

Where contact with a waste material is unlikely; contact is not expected to result in a serious dermal hazard; and significant absorption of the contaminants is not likely to occur, then impermeable clothing should not be required. In this case, the risk of heat related illness may grossly outweigh the benefits provided by such equipment. Even when chemical protective clothing is needed, the PESM should consider the probable exposure scenarios and select protective equipment accordingly. For example, if dermal exposure is likely to be localized, strong consideration should be given to using gloves, boots, gauntlets, leggings, aprons, bibs, face shields, etc., in lieu of full body coveralls and respirators.

3.3.2 Hydration

The Company will supply cool (50°–59°F) potable water or other suitable drinks (e.g., sport electrolyte replacements) for fluid replacement. Employees involved in the heat stress prevention program will be trained and encouraged to drink at a rate of approximately 8 oz. every 20 minutes. Individual cups will be used and kept in closed containers or dispensers.

3.3.3 Cool Rest Areas

Shaded rest areas will be provided. On large remediation projects, air conditioned rest areas should be provided for workers exposed to heat stress conditions. In low humidity locations, evaporative coolers or misting devices and fans can be used to provide cool down locations. On smaller projects, personnel can use air-conditioned vehicles as cool down areas.

3.3.4 Other Prevention Elements

The PESM, ESS and the Project Manager will incorporate other elements into the heat stress prevention program as necessary. The selected elements will be described in the EHS plans. Engineering controls are preferred. Where their use is not feasible, the program must incorporate administrative/work practice controls, personal protective equipment, or a combination. Examples of prevention program elements include:

a. Engineering Controls

Air conditioned cabs for heavy equipment and vehicles (Such controls may eliminate the need for other program elements)

Fans or blowers

Cold water for drenching personnel in impermeable clothing. This can be provided through a garden hose, a garden sprayer filled with ice water, a clean drum full of water for "hard hat dipping" or containers of ice water and clean towels in the rest area to hasten cool down

b. Administrative and Work Practice Controls

Adjusting work schedules to do the bulk of the work during the cooler parts of the day

Acclimatizing workers

Implementing work/rest regimens (See Attachment 2 for Work/Rest Regimen Procedures)

c. Personal Protective Equipment

Ice vests

Circulating water vests

Vortex tubes and air circulating vests

Where ice vests and circulating water vests are used, rest periods of approximately 15 minutes should be taken when ice packs or batteries need to be changed. Continuous work over long periods of time with these devices may present an increased musculoskeletal injury risk due to the extra weight. Since the duration of the cooling effectiveness of these devices will vary with heat and work loads, users must be instructed to leave the area to replenish ice or batteries at the first sign of loss of cooling.

d. Monitoring

A program of environmental and physiological monitoring must be established in order to use work/rest regimens to verify the effectiveness of the regimens. The monitoring procedures are described in Attachment 2.

3.3.5 Training

All site personnel must receive training on the following topics:

a. Health effects of hot environments and symptoms of heat related illness

b. Personal risk factors; work loads

c. Effect of personal protective equipment on heat stress conditions

d. Preventive measures

Physiological monitoring methods and thresholds

Acclimatization

e. Fluid replacement; including taking frequent breaks for fluid replacement on an as-needed basis

f. Elements of the site Heat Stress Prevention Program

g. First aid and emergency response

Records shall be maintained in accordance with EHS 1-9, Recordkeeping

3.4 Cold Stress

At certain times of the year, workers may be exposed to the hazards of working in cold environments. Potential hazards in cold environments include frostbite, trenchfoot or immersion foot, and hypothermia as well as slippery surfaces, brittle equipment, poor judgment and taking short cuts. The current ACGIH threshold limit values (TLVs) for cold stress will be used as a guideline. The Company will implement the following cold stress prevention program elements when there is a potential for cold related injuries.

3.4.1 Personnel Protective Equipment

The following personal protective equipment will be provided as necessary to Company employees when conditions indicate a potential for cold-related injury. Subcontractors will be expected to supply appropriate equipment to their employees.

a. Hard hat liners

b. Gloves or glove liners

c. Rain gear or water impermeable coveralls and gloves for potentially wet operations

d. Fleeced boot liners where rubber steel-toe boots are used

e. Winter coveralls

3.4.2 Engineering Controls

A variety of engineering controls shall be evaluated to minimize cold stress. These include:

a. General or spot heating should be used to increase temperature at the workplace.

b. If fine work is to be performed with bare hands in a cold environment, special provisions should be made to keep the workers' hands warm. Warm air jets, radiant heaters, or contact warm plates can be used

c. The work area should be shielded from winds and drafts that may affect the wind chill factor

d. The air velocity in refrigerated rooms should be minimized as much as possible, and should not exceed 1m/sec in the work zone

e. At temperatures below freezing, metal handles of tools and control bars should be covered with thermal insulating material

f. Unprotected metal chair sets should not be used as they conduct heat away from the body

g. When necessary, equipment and processes should be substituted, isolated, relocated, or redesigned to reduce cold stress at the worksite

h. Power tools, hoists, cranes, or lifting aids should be used to reduce metabolic workload

i. Heated warming shelters such as tents and cabins should be made available if work is performed continuously in an equivalent chill temperature of 20^{O}F or below

j. The ESS may implement a work-rest schedule to reduce exposure to cold stress

k. Scheduled rest breaks should be enforced

l. Personnel exposed to the cold should be provided the opportunity for frequent intake of warm, sweet, caffeine-free, nonalcoholic liquids or soup

m. Work should be moved to warmer areas whenever possible

n. Extra workers should be assigned to highly demanding tasks

o. Workers should be allowed to pace themselves, taking breaks when needed

p. Workers shall be trained in the prevention, symptoms, and emergency response to cold stress

q. Utilize the "buddy system" to monitor cold stress symptoms among the workers

r. Allow new employees time to adjust or "acclimate" to cold conditions

s. Minimize the need to sit or stand in one place for long periods of time

t. Minimize the amount of work time spent in a cold environment

u. Allow for the weight and bulkiness of protective clothing when estimating work performance goals and tasks

3.4.3 Warm Rest Areas

The Company will make warm rest areas, e.g., heated trailers, available for rest breaks in cold weather. Employees will be permitted and encouraged to use the heated trailers whenever they experience symptoms of cold stress.

3.4.4 Work/Warm-Up Schedules

The work/warm-up schedule found in the ACGIH TLVs for cold stress will be followed. In addition, the Company will make warm-up periods available to employees who need to change into dry clothing to prevent immersion foot or hypothermia.

3.4.5 Training

All Company employees and subcontractors will be trained in:

a. The effects of cold stress, including frostbite, immersion foot and hypothermia

b. Personal risk factors

c. Recognition of the symptoms

d. Methods employees can use to protect themselves

e. First aid procedures and recognition of medical emergencies

Records shall be maintained in accordance with EHS 1-9, Recordkeeping

4.0 GUIDELINES

This section shall contain optional guidance information to successfully execute the procedure or guideline.

4.1 Definitions

4.1.1 Adjusted Temperature

The dry bulb temperature adjusted to account for solar radiation, to be used as a heat stress indicator for personnel in impermeable protective clothing.

4.1.2 Deep Frostbite

The tissue beneath the skin is solid to the touch; it may involve a full thickness freeze to the bone. This is an extreme emergency and can result in permanent tissue loss.

4.1.3 Frostbite

Freezing of body tissue.

4.1.4 Frostnip or Incipient Frostbite

A cold related injury that progresses slowly and is painless while developing. The victim is usually unaware that he/she has frost nip. The skin first becomes reddened, then changes to white; no freezing of tissue occurs.

4.1.5 Heat Cramp

Painful muscle spasms usually occurring on the arms, legs, and abdomen; caused by excessive loss of body electrolytes from profuse sweating.

4.1.6 Heat Exhaustion/Fatigue

Heat Exhaustion is a form of shock that occurs when the body loses large amounts of water and electrolytes from excessive perspiration after exposure to heat and physical activity; also called heat prostration. Symptoms include profuse sweating, pale, cool, sweaty skin and other symptoms identified in Attachment 1, Section 1.3.

Heat fatigue refers to the temporary state of discomfort and mental or psychologic strain arising from prolonged heat exposure. Works unaccustomed to the heat are particularly susceptible and can suffer, to varying degrees, a decline in task performance, coordination, alertness, and vigilance.

4.1.7 Heat Rash

Profuse tiny raised red vesicles (blister-like) on affected areas of the skin which cause a prickling sensation during heat exposure.

4.1.8 Heat Stroke

A life-threatening condition caused by rapidly rising body core temperature that occurs when the body's temperature regulating mechanisms are overwhelmed. Sweating stops and the skin is dry and hot.

4.1.9 Hyperthermia

A rise in body core temperature above 99.6 F.

4.1.10 Hypothermia

Decreased body core temperature from prolonged exposure to freezing or near-freezing temperatures. This is the most life-threatening cold injury and affects the entire body with possible localized severe cooling.

4.1.11 Superficial Frostbite

Frostbite which affects the skin and tissue just beneath the skin. The skin is firm and waxy, tissue beneath is soft and numb. The skin turns purple and may tingle and burn during warming.

4.1.12 Wet-Bulb Globe Temperature (WBGT)

Method used to measure the environmental factors (e.g., temperature, relative humidity) which impacts the body's physiological responses to heat.

4.1.13 Wind-Chill Factor or Equivalent Chill Temperature (ECT)

An index describing the effect of the cooling power of moving air on exposed flesh. The effect of wind velocity at a certain temperature is expressed as the equivalent cooling effect of a lower temperature with still air.

4.1.14 Work/Rest Regimen

The ratio of time spent working to time spent resting in an area designed to relieve heat related conditions. This ratio is expressed in one hour periods. Example: A work/rest regimen of 75% work, 25% rest corresponds to 45 minutes work, 15 minutes rest each hour.

5.0 REFERENCES

1. ACGIH (American Conference of Government Industrial Hygienists) Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, 2005
2. Fundamentals of Industrial Hygiene. Third Edition, 1988
3. National Safety Council
4. NIOSH (National Institute for Occupational Safety and Health)
5. NIOSH/OSHA/EPA/USCG/EPA
6. Occupational Exposure to Hot Environments, Revised Criteria 1986
7. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities - October 1985
8. EHS 1-9, Recordkeeping
9. EHS 3-2, Environmental, Health & Safety Plan(s)

6.0 ATTACHMENTS

1. Heat and Cold Stress Information
2. Work/Rest Regimens and Monitoring

ATTACHMENT 1

HEAT AND COLD STRESS INFORMATION

1.0 HEAT STRESS

Hot weather can cause physical discomfort, loss of efficiency, and personal injury. The human body strives to maintain a constant core temperature of 98.6 F (37° C). If this temperature is to be maintained, heat loss must equal heat production. This balance is maintained by variations in the blood flow to the outer part of the body. When the core temperature rises, blood vessels beneath the skin dilate, and the blood brings increased heat to the skin, where it is dissipated by radiation and convection. This works only as long as the skin temperature is higher than the temperature of the outside environment. Heat loss by radiation convection is impossible when the temperature of the outside air approaches or exceeds the temperature of the skin. The body will now rely on dissipation through evaporation of sweat. But the sweat mechanism also has limits. The normal adult can sweat only about one liter per hour and can sweat at that rate for only a few hours at a time. In addition, sweating is effective only if the relative air humidity is low. Sweat evaporation ceases entirely when the relative humidity reaches 75 percent.

Of particular concern in heat stress monitoring is the use of personal protective clothing which decreases natural body ventilation and greatly increases the temperature and humidity to the skin. If precautions are not taken, heat stress will progress into a heat-related injury. Heat-related injuries fall into three major categories: heat cramps/fatigue, heat exhaustion, and heat stroke.

1.1 Heat Cramps

Heat cramps are the least common and least severe of heat injuries. Heat cramps occur when the electrolytic balance in the blood between water, calcium, and sodium (salt) is altered. Low blood salt level, from profuse sweating and inadequate salt consumption, is the usual cause.

1.1.1 Symptoms

a. Severe muscle cramps and pain, especially of the upper legs, calves, and abdomen, and occasionally in the arms

b. Faintness and dizziness

c. Possible nausea and vomiting

1.1.2 Treatment

Emergency care will include:

a. Remove victim from the hot environment

b. Dilute one teaspoon of salt in one quart of water or use a commercial product with a low glucose content; allow victim to sip this solution at the rate of one-half glassful every 15 minutes

c. To relieve pain, gently stretch the involved muscle group; gently message cramps as long as it does not increase the pain or discomfort

The victim should avoid exertion of any kind for 12 hours. A victim of heat cramps is prone to recurrence.

1.2 Heat Fatigue

Heat Fatigue is most likely to affect new, or un-acclimatized workers.

1.2.1 Symptoms

a. Loss of energy, extreme tiredness

b. Stumbling, staggering, or loss of balance. The loss of balance is a particular risk to workers on elevated surfaces or climbing.

c. Excessive skin redness as body moves blood to surface

d. Lack of judgment recognizing the onset of heat fatigue and taking action to remove themselves from the environment for cool down and hydration

1.2.2 Treatment

a. Remove from the hot work environment for cool down

b. Extend cool-down period or cessation of work for the day with extra hydration and rest

c. Enhance observations by other workers and physiological monitoring

d. Provide individual work/rest regimens until acclimatized

1.3 Heat Exhaustion

1.3.1 Symptoms

Heat exhaustion is the most common heat injury and usually occurs in an individual who is involved with heavy physical exertion in a hot, humid environment, and is wearing protective clothing. Heat exhaustion is a mild state of physical shock caused by the pooling of blood in the vessels just below the skin, causing blood to flow away from the major organs of the body. Due to prolonged and profuse sweating, the body also loses large amounts of salt and water.

The symptoms of heat exhaustion include:

a. Profuse sweating

b. Pale, cool, sweaty skin

c. Headache and extreme weakness, fatigue

d. Nausea and possible vomiting

e. Dizziness and faintness

f. Collapse and possible brief unconsciousness

g. Body core temperature normal, may even be slightly below normal

1.3.2 Treatment

Emergency care will include:

a. Remove victim from the hot environment and out of the exclusion zone

b. Lie victim down with feet slightly raised

c. Remove as much clothing as reasonable (especially personal protective clothing); loosen what cannot be removed

d. Apply cold, wet compresses to the skin; fanning will also aid in cooling

e. If the victim is fully alert, allow him/her to drink water or the same solution, at the same rate, that was used for the emergency care of heat cramps

f. If the victim vomits, do not give fluids by mouth, transport him/her to a hospital immediately (dehydration is the most critical problem in heat exhaustion victim; intravenous fluids will have to be given)

g. Take oral temperature every 10 minutes, if the victim's temperature is above 101°F (38.3 C) or shows a steady increase, transport to a hospital immediately and start sponging him/her off with cool water

1.4 Heat Stroke

Heat stroke is a true life-threatening emergency having a mortality rate of 20 to 70 percent. This condition results when the heat regulating mechanisms of the body breaks down and fail to cool the body sufficiently. The body temperature rises to between 105° F and 110° F (40.6 – 43.3° C); no sweating occurs in about 50 percent of the victims. Because no cooling takes place, the body stores increasingly more heat, and eventually brain cells are damaged, causing permanent disability or death. About 4,000 Americans die of heat stroke annually.

There are two basic kinds of heat stroke: classic heat stroke and exertional heat stroke. Classic heat stroke, in which people lose the ability to sweat, generally effects the elderly or chronically ill. Exertional heat stroke, in which victims retain the ability to sweat, is accompanied by physical exertion and muscle stress. Exertional heat stroke is the type that will be most commonly encountered on a field operation requiring strenuous physical activity.

1.4.1 Symptoms

a. Oral temperature of 105 F (40.6 C) or higher

b. Hot, reddish skin, skin is usually dry

c. Headache

d. Dry mouth

e. Shortness of breath

f. Nausea or vomiting

g. Increasing dizziness and weakness

h. Mental confusion and anxiety; victims may show unusual irritability, aggression, combative agitation, or hysterical behavior

i. Convulsions, sudden collapse and possible unconsciousness; all heat stroke victims having varying levels of consciousness, ranging from disorientation to coma

1.4.2 Treatment

Emergency care will include:

a. Remove the victim from the hot environment and from the exclusion zone

b. Call for trained emergency medical personnel **immediately**

c. Remove as much clothing as reasonable (especially personal protective clothing); cut clothing with bandage scissors, if necessary, being careful not to injure victim

d. Pour cool water over the victim, avoiding his nose and mouth

e. Fan the victim

f. Place cold packs under the arms and against neck and ankles

g. Wrap victim in a wet blanket

h. Continue a combination of these methods until the oral temperature falls below 103 F (39.4 C) (take measures to prevent chilling, if necessary, i.e., use slower cooling if the victim starts shivering

i. Elevate the head and shoulders slightly during cooling

j. Never give the victim anything to drink unless fully conscious and vomiting is unlikely

Because heat stroke involves the entire body, a number of complications may result:

Brain swelling, convulsions, coma, kidney failure, liver failure, high blood pressure and heart failure.

Therefore, always transport the victim to a hospital even if the body core temperature has lowered to near normal.

1.5 Heat Stroke Verses Heat Exhaustion

The two most reliable and distinct differences between heat stroke and heat exhaustion are:

1.5.1 Heat Stroke

a. Skin flushed (red); may be dry; hot to touch

b. Oral temperature above 105°F (40.6 C)

1.5.2 Heat Exhaustion

a. Skin pale; wet or clammy; cool to touch

b. Oral temperature usually normal

2.0 COLD STRESS

Hypothermia is a drop in the core body temperature below 98.6 F (37 C). The first symptoms of hypothermia are uncontrollable shivering and the sensation of cold; this is followed by a slowed and sometimes irregular heart beat, a weakened pulse and a drop in blood pressure. Vague or slow slurred speech, memory lapses, apathy, incoherence and drowsiness can occur. Other symptoms may include cool skin, slow, irregular breathing, apparent exhaustion, and fatigue after rest.

2.1 Prevention

Hypothermia is caused by prolonged exposure to a cold environment, whether air, water, or snow and ice. Adequate dry clothing with appropriate insulating capacity must be provided to workers to prevent hypothermia, especially if work is performed in air temperatures below 40 F (4.4 C). Wind chill is a critical factor. Work at a slow but steady pace. The job should be a "no sweat" operation.

Unless there are unusual or extenuating circumstances, cold injury to other than the extremities (hands, feet, and head) is not likely to occur without the development of the initial signs of hypothermia. Older workers or workers with circulatory problems require special precautionary protection against hypothermia. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are special precautions that should be considered for these workers. The precautionary actions to be taken will depend upon the physical condition of the worker and should be determined with the advice of a physician with knowledge of the cold stress factors and the medical condition of the worker.

2.2 Treatment

First aid for mild hypothermia will be performed as follows:

a. End the exposure - get the victim out of the cold and wet

b. Replace wet clothing with dry or add insulation to clothing

c. Offer warm, non-alcoholic fluids

d. Increase exercise

e. Seek shelter from wind, wet and cold

CAUTION: If the victim remains cold for a number of hours, chemical changes may have taken place which, on rewarming, may cause major medical problems for the victim and which could result in death. Severely hypothermic victims are best warmed in the hospital under controlled conditions. If a severely hypothermic victim cannot be transported to a hospital within a few hours, re-warming should begin in the field.

2.3 Frostbite

2.3.1 Prevention

Frostbite can be prevented by wearing sufficient protection to prevent skin from coming into prolonged contact with a freezing environment. The following steps can be taken.

a. Wear sufficient clothing. Mittens are better than gloves. Face masks and wool stocking caps are better than hats. Wind and waterproof hoods protect the face and neck.

b. Clothing should be loose enough to prevent constriction of blood vessels. Boots must be roomy enough to permit movement of the toes with no feeling of tightness.

c. Do not contact conductive metals or contact gasoline or other solvents with bare skin as rapid evaporation of solvents may quickly lead to frozen tissues in a cold environment.

d. Exercise the toes and fingers to maintain circulation.

e. Observe the condition of your partners' face, hands and ears frequently for signs of frostbite.

f. Avoid smoking and drinking alcoholic beverages.

2.3.2 Symptoms

Frostbite can occur either before or after the onset of hypothermia when body tissue (usually an extremity) is exposed to freezing temperatures. Frostbite occurs when the fluids surrounding tissue cells freezes. The danger of frostbite increases with increased wind chill and/or reduced temperatures below 32 F (0 C). Frostbite can also occur if tissues are in prolonged contact with a frozen material or object. Skin contact with frozen metal, for example, can result in frostbite in a short period of time, even in a warm environment.

There are three degrees of frostbite:

a. First degree - freezing without blistering or peeling, "frostnip"

b. Second degree - freezing with blistering and/or peeling, and

c. Third degree - freezing resulting in the death of skin tissue and possibly the death of underlying tissues as well

Symptoms of frostbite include the following:

a. The skin changes color to white or grayish-yellow, progresses to reddish-violet, and finally turns black as the tissue dies

b. Pain may be felt at first, but subsides

c. Blisters may appear, and

d. The affected area is cold and numb

2.3.3 Treatment

First aid for superficial (first degree) frostbite is as follows:

a. Place a warm body part next to the frozen area, applying firm, steady pressure.

b. DO NOT RUB THE AREA. Rubbing may cause further damage to already injured skin.

c. Protect the area from further freezing.

First aid for deep frostbite (second and third degree) is as follows:

a. KEEP THE FROZEN PART FROZEN!

b. Prevent further injury: avoid rubbing and further freezing of unaffected tissue.

c. If the part has thawed, the part should NOT be allowed to refreeze or bear weight. A victim with thawed feet should be carried out.

d. Give the victim plenty of fluids and evacuate to medical assistance as soon as possible.

2.4 Trench Foot

2.4.1 Symptoms

This condition may be caused by long, continuous exposure to cold without freezing, combined with persistent dampness or actual immersion in water. Edema (swelling), tingling, itching, and severe pain occur, and may be followed by blistering, death of skin tissue, and ulceration. When other areas of the body are affected besides the feet, the condition is known as chilblains.

2.4.2 Prevention

Trench foot and chilblains can be prevented by keeping the body as dry as possible at all times. Waterproof boots should be worn when required, but provisions must be made for preventing excessive perspiration to accumulate inside the boots. Socks should be changed at least twice daily and the boots wiped dry inside with each change of socks. The feet should also be wiped dry and foot powder applied.

2.4.3 Treatment

Affected body parts should not be rubbed or massaged, but bathed in water using plain white soap. Dry thoroughly and elevate the body part, allowing the body part to be exposed at room temperatures. If the feet are affected, do not walk during treatment.

ATTACHMENT 2

WORK/REST REGIMEN AND MONITORING

1.0 INTRODUCTION

Establishing a work/rest regimen that allows work to be completed in a timely manner while providing adequate rest time to prevent heat stress requires involvement of the ESS, FOL, and individuals involved. In many cases, particularly when wearing normal field type clothing (i.e., level D), awareness and communication are the key elements to a successful program. Allowing and encouraging rest periods on an "as needed" basis while ensuring vigilance for initial symptoms of heat stress, encourages this success.

There are times when this approach is not appropriate. When heat stress contributing protective clothing (e.g., respirators, impermeable coveralls) are worn for extended periods, or when "as needed" work/rest regimens adversely impact either the individuals exposed to the heat source or work completion, a more formal work/rest regimen will be established.

Formal work/rest regimens are based either on 1) monitoring ambient conditions (e.g., with a Wet Bulb Globe Temperature (WBGT), estimating work loads and establishing work/rest times, 2) monitoring physiological conditions and adjusting work/rest periods, or 3) using personnel heat stress monitors.

The WBGT, physiological monitors, and personnel heat stress monitors will be used in accordance with manufacturer's instructions. Personnel heat stress monitors will be approved for use by the PESM.

This attachment includes guidance for monitoring and preventing heat stress and heat strain in accordance with the 2005 ACGIH.

2.0 WBGT-BASED WORK/REST REGIMENS

2.1 Work/Rest Regimens

When required, the WBGT will be used in conjunction with the work load to determine the appropriate work/rest regimen for personnel wearing regular work clothing or semi permeable disposal coveralls (uncoated Tyvek). Light work examples include sitting or standing or performing light hand or arm work. Moderate work includes walking about with moderate lifting and pushing. Heavy work corresponds to pick and shovel-type work.

The work/rest regimen using the WBGT procedure will be used as a guideline, as the WBGT is only an index of the environment. Table 2-A and 2-B outlines the work/rest regimen guidelines based upon WBGT temperature and workload for un-acclimatized and acclimatized workers respectively. Table 2-C identifies the correction factors. The WBGT temperature will be determined in accordance with Section 2.3 of this attachment. Table 2-D provides examples of work activity categories. Rest areas should be near the work areas, shaded, and with adequate supplies of cool water. Aids to assist in evaporative cooling such as fans or blowers should be considered.

2.2 Acclimatization

Acclimatization is a gradual physiological adaptation that improves an individual's ability to tolerate heat stress. Full heat acclimatization requires up to 3 weeks of continued physical activity under heat-stress conditions similar to those anticipated for the work. Its loss begins when the activity under those heat-stress conditions is discontinued, and a noticeable loss occurs after 4 days. With a recent history of heat stress exposures (e.g. 5 of the last 7 days), a worker can be considered acclimatized for the purpose of using Table 2-B.

Numerous factors can affect acclimatization and a worker's ability to work in heat, including age and off-work activities (amount of sleep, consumption of alcoholic beverages, prescription and nonprescription mediations (e.g. antihistamines and other medications that decrease the body's ability to carry water or reduce sweating).

WORK/REST REGIMENS AND MONITORING

Table 2-A

Examples of Permissible Heat Exposure Threshold Limit Values
For Un-acclimatized Workers
(Values are given in °F and (°C) WGBT)*

Work - Rest Regimen	**Work Load Category**			
	Light	**Moderate**	**Heavy**	**Very Heavy**
Continuous work	81.5 (27.5)	77 (25.0)	72.5 (22.5)	--
75% Work - 25% Rest, each hour	84.2 (29.0)	79.7 (26.5)	76.1 (24.5)	--
50% Work - 50% Rest, each hour	86 (30.0)	82.4 (28.0)	79.7 (26.5)	77 (25.0)
25% Work - 75% Rest, each hour	87.8 (31.0)	84 (29.0)	82.4 (28.0)	79.7 (26.5)

Table 2-B

Examples of Permissible Heat Exposure Threshold Limit Values
For Acclimatized Workers
(Values are given in °F and (°C) WGBT)*

Work - Rest Regimen	**Work Load Category**			
	Light	**Moderate**	**Heavy**	**Very Heavy**
Continuous work	85.1 (29.5)	80 (27.5)	77 (26)	--
75% Work - 25% Rest, each hour	87 (30.5)	82 (28.5)	78 (27.5)	--
50% Work - 50% Rest, each hour	89 (31.5)	85 (29.5)	82 (28.5)	83 (27.5)
25% Work - 75% Rest, each hour	90 (32.5)	88 (31)	86 (30)	85 (29.5)

Notes on Table 2-A & 2-B:

a. These values are for fully acclimatized workers wearing light weight pants and shirts. For conditions other than this use this table with the correction factors from Table 2-B.

b. These values assume that workers drink frequently and have properly increased salting of food prior to exposure.

c. These values are guidelines. Actual levels may be modified based on individual physiological response and actual work and rest conditions.

d. These values assume that the rest location is cool enough to alleviate heat load conditions.

Table 2-C
Correction Factors for Table 2-A in °F*

Clothing Type	WBGT Correction
Summer work uniform	0 F
Cotton overalls	-3.5 F
Double Cloth (woven material Coveralls	-5 F
Winter work uniform	-7 F
Water barrier, permeable	-11 F

Notes on Table 2-C:
To use this table, identify the most restrictive applicable clothing type involved. Modify Table 2-A temperatures by this amount. For example, the Table 2-A TLV for continuous work, light workload is 86° F. If cotton overalls (+3.5 F) are used with acclimatized workers the Corrected Temperature is 89.5° F.

Table 2-D
Examples of Activities within Metabolic Rate Categories

Categories	Example Activities
Resting	Sitting quietly
	Sitting with moderate arm movements
Light	Sitting with moderate arm and leg movements
	Standing with light work at machine or bench while using mostly arms
	Using a table saw
	Standing with a light or moderate work at machine or bench and some walking about
Moderate	Scrubbing in a standing position
	Walking about with moderate lifting or pushing
	Walking on level at 3.5 mph (6 km/hr) while carrying a 6.6 lb (3 Kg) weight load
Heavy	Carpenter sawing by hand
	Shoveling dry sand
	Heavy assembly work on a noncontinuous basis
	Intermittent heavy lifting with pushing or pulling (e.g. pick and shovel work)
Very Heavy	Shoveling wet sand

2.3 WBGT Determination

If the Wet Bulb Globe Temperature (WBGT) is used to determine if field conditions are conducive to heat stress illnesses, the WBGT is determined through the following equations:

Outdoors with solar load: WBGT = 0.7 NWB + 0.2GT + 0.1DB	(1)
Indoors or outdoors with no solar load: WBGT = 0.7 NWB + 0.3GT	(2)

Where:

WGBT = Wet Bulb Globe Temperature Index
NWB = Natural Wet-Bulb Temperature
DB = Dry-Bulb Temperature
GT = Globe Thermometer Temperature

The factors involved in the above equations can be measured in the following manner:

a. Through the use of a direct-reading heat stress monitor capable of measuring all of the individual factors associated with the WBGT equation. For example, the Reuter-Strokes, Metronics, or Quest heat stress monitors.

b. By measuring the individual factors manually using the following type of equipment

- Natural Wet-Bulb Temperature Thermometer
- Dry-Bulb Temperature Thermometer
- Globe Temperature Thermometer

WBGT should be operated in accordance with the manufacturer's instructions. The location of the WBGT device should be evaluated based on the work. Work inside buildings (no wind), within depressions or excavations, over asphalt or black liners (such as HPDE) would dictate that the device should be located near the area to account for the difference in the globe temperature due to radiance and reflection. Work on open soil/gravel will have a lesser affect on the readings and will allow the readings to be indicative of a large area (up to several miles). (Note WBGT readings for the area can frequently be obtained on a realtime basis from weather stations, or from the internet).

3.0 ADJUSTED TEMPERATURE BASED WORK/REST REGIMENS

When wearing impermeable protective clothing, the use of work/rest regimens based on WBGT is **not** recommended. The WBGT index is designed to account for the effects of evaporative cooling. Vapor barrier clothing impedes the evaporation of sweat and renders the WBGT an inappropriate physiological model. The most important environmental conditions related to heat stress for workers wearing impermeable protective clothing have been suggested to be the ambient dry bulb temperature and the radiant solar heat. These factors are combined into an index called the adjusted temperature using the following formula:

T° adjusted = ambient dry bulb temperature + (13 x % sunshine)

Where: % sunshine is an estimate of the amount of time the sun is covered by clouds thick enough to produce a shadow. The thermometer bulb should be shielded from radiant heat when taking measurements.

The adjusted temperature values are then used to determine the initial work/rest regimen and physiological monitoring frequency. Table 2-E gives the work period and monitoring frequency. Initially, rest periods will be at least 15 minutes. Physiological monitoring that is normally recommended is pulse rate and body temperature. Procedures for each are described below. Initially, both should be done. Pulse rate monitoring may be discontinued with the approval of the PESM if temperature monitoring proves to be effective.

4.0 PHYSIOLOGICAL MONITORING

As the metabolic rate increases in response to work demands, the guideline values in Table 2-A & 2-B decrease to ensure that most workers will not experience a core body temperature above 100.4 F (38 C) for un-acclimatized workers or 101.3 F (38.5 C) for acclimatized workers. One or more of the following measures may mark excessive heat strain, and an individual's exposure to heat stress should be discontinued when any of the following occur.

Physiological monitoring will commence at the discretion of the ESS or when WBGT monitoring is not performed and ambient temperatures exceed 70 F (21 C). . Physiological monitoring should be used whenever work/rest regimens are implemented to verify the effectiveness of the work/rest ratio including the cool down periods.

4.1 Pulse Rate Monitoring

Sustained (several minutes) heart rate is in excess of 180 beats per minute (bpm) minus the individual's age in years (180-age), for individuals with normal cardiac performance, or recovery heart rate greater than 110 bmp after a peak work effort.

Take the pulse immediately at the start of the rest period (P1). Take the pulse again 1 minute into the rest period. If any of the following conditions exist, shorten the next work period by a third:

P1 > 110 beats per minute (bpm)

P2 > 90 bpm

P1 - P2 < 10 bpm.

Pulse rates can be taken with an electronic pulse meter, or manually with a stopwatch for 30 seconds.

4.2 Body Core Temperature

Obtaining an accurate body core temperature for sustained work can be difficult, as the body will start to cool as soon as work is stopped or if protective clothing is removed and evaporation rates are increased. Monitor personnel as soon as possible to obtain an accurate temperature following the manufacturer's instructions for the particular instrument used.

Take the oral, ear or temporal temperature immediately at the start of the rest period. If the temperature exceeds 99.5 F (37.5 C) shorten the next work period by a third. Do not return the worker to hot work in semi-permeable or impermeable clothing until the body temperature is less than 99.5 F (37.5 C).

Body temperatures may be taken with disposable oral thermometers or infrared ear drum scanners, such as the Thermoscan. Note: If a Thermoscan unit is purchased, the Pro Model should be selected. The home model available through drugstores cannot be recalibrated. Temporal infrared thermometers are also available and may be considered to be less intrusive to the workers than oral or ear measurement devices.

(Note- Instruments coming in contact with skin or body fluids (sweat, saliva, etc) should either be used with disposal covers or sanitized between use.)

4.3 Removal from Exposure

If an individual requires a shortening of the work period on more than two consecutive monitoring periods, or repeatedly over a few days, they should be removed from exposure to hot environments, wearing semi-permeable impermeable protective clothing until examined and cleared for such work by the consulting physician.

Table 2-E
Initial Work Period and Physiological Monitoring Frequency

ADJUSTED TEMPERATURES	SCHEDULE
90° F or above	15 minutes
87.5° - 90° F	30 minutes
82.5° - 87.5° F	60 minutes
77.5° - 82.5° F	90 minutes
70° - 77.5° F	120 minutes

Notes on Table 2-E:

a. Schedule is for fit and acclimatized workers in impermeable protective clothing.

b. Work in impermeable protective clothing should include consideration of a buddy rule (no lone workers), particularly at higher temperatures. The observers should be watching for sudden or severe fatigue, lightheadedness, loss of balance, loss of judgment or clumsiness that may be indicative of heat fatigue or heat stress.

c. The above temperatures should be adjusted for the % of sunshine as indicated in Section 3.0.

d. Personnel should be permitted to self-limit exposures and encouraged to observe co-worker observation to detect signs and symptoms of heat strain in others.

e. The monitoring frequencies may be adjusted for individuals after experience with their work in heat stress environments has been gained provided the work involved, PPE, and other factors remain the same.

ATTACHMENT 4

FORMS

This page intentionally left blank.

TETRA TECH EC, INC.

DAILY BRIEFING SIGN-IN SHEET

Date: ______________________ Project Name/Location: ______________________

Shift/Department: ______________________ Person Conducting Briefing: ______________________

1. AWARENESS (e.g., special EHS concerns, pollution prevention, recent incidents, etc.):

____

____

____

____

2. OTHER ISSUES (EHS Plan changes, attendee comments, etc.):

____

____

____

3. ATTENDEES (Print Name):

1.	21.
2.	22.
3.	23.
4.	24.
5.	25.
6.	26.
7.	27.
8.	28.
9.	29.
10.	30.
11.	31.
12.	32.
13.	33.
14.	34.
15.	35.
16.	36.
17.	37.
18.	38.
19.	39.
20.	40.

TETRA TECH EC, INC.

Daily Briefing Sign-In Sheet
(Continued)

41.	56.
42.	57.
43.	58.
44.	59.
45.	60.
46.	61.
47.	62.
48.	63.
49.	64.
50.	65.
51.	66.
52.	67.
53.	68.
54.	69.
55.	70.

Give completed documentation to ESO.

TETRA TECH EC, INC.

SITE SAFETY BRIEFING FORM

Site: ______________________________

Date: ______________________________ Time: ______________________________

OFS No.: ______________________________

Task: ______________________________ Health/Safety Officer: ______________________________

Person Providing Briefing: ______________________________

TOPICS:

- Site SHSP
- Chemical Hazards
- Equipment Hazards
- Electrical Hazards
- Heat Stress
- Personal Decontamination
- Personal Hygiene
- Employee Rights/Responsibilities
- Hazard Evaluations
- Emergency Response Procedures

PERSONS IN ATTENDANCE: (Name/Organization)	PERSONS IN ATTENDANCE: (Name/Organization)

NOTES/COMMENTS:

____

____

____

____

____

TETRA TECH EC, INC.

FIELD TEAM REVIEW SHEET

Each field team shall sign this section after site-specific training is completed and before being permitted to work on site.

I have read and understand this Site-Specific Health and Safety Plan for **OU-1, OU-2A, and OU-2B ALAMEDA POINT, ALAMEDA, CALIFORNIA**.

I will comply with the provisions contained herein.

Print Name	Signature	Date

TETRA TECH EC, INC.

MEDICAL DATA SHEET

Project: ____

Name: ____

Home Telephone Number: ____

Home Address: ____

Age: __________ Height: __________ Weight: __________ Blood Type: __________

Name of Emergency Contact: ____

Telephone Number of Emergency Contact: ____

Drug or Other Allergies: ____

Particular Sensitivities: ____

Do you wear contact lenses? ____

Provide a checklist of previous illness or exposures to hazardous chemicals: ______________

____

What medications are you presently using? ____

____

Do you have any medical restrictions? If yes, explain: ______________________________

____

Name, address, and phone number of personal physician:

____

____

TETRA TECH EC, INC.

CORPORATE ESQ REPORT # ____________

TETRA TECH EC, INC. ***INCIDENT/NEAR MISS REPORT AND INVESTIGATION***			
TYPE OF INCIDENT - CHECK ALL THAT APPLY			
☐ INJURY/ILLNESS ☐ SPILL/RELEASE	☐ VEHICLE DAMAGE ☐ PERMIT EXCEEDENCE	☐ PROPERTY DAMAGE ☐ HIGH LOSS POTENTIAL (NEAR MISS)	☐ FIRE ☐ OTHER
GENERAL INFORMATION			
PROJECT/OFFICE:		REPORT #:	DATE OF REPORT:
DATE OF INCIDENT:		MILITARY TIME: ____	DAY OF WEEK: ____
TtEC SUPERVISOR ON DUTY:		AT SCENE OF INCIDENT: ☐ YES ☐ NO	
LOCATION OF INCIDENT:			
WEATHER CONDITIONS:	ADEQUATE LIGHTING AT SCENE:	☐ YES ☐ NO ☐ N/A	
DESCRIBE WHAT HAPPENED (STEP BY STEP - use additional pages if necessary)			
AFFECTED EMPLOYEE INFORMATION (Include injured person, driver/operator, or employee whose activities resulted in the incident. Use another page to provide information for additional employees)			
NAME:		TtEC EMPLOYEE:	☐ YES ☐ NO
HOME ADDRESS:			
SOCIAL SECURITY #:		HOME PHONE #:	
JOB CLASSIFICATION:		YEARS IN JOB CLASSIFICATION:	
HOURS WORKED ON SHIFT PRIOR TO INCIDENT:		YEARS WITH TtEC:	AGE:
DID INCIDENT RELATE TO ROUTINE TASK FOR JOB CLASSIFICATION:		☐ YES ☐ NO	
INJURY/ILLNESS INFORMATION			
NATURE OF INJURY OR ILLNESS:			
OBJECT/EQUIPMENT/SUBSTANCE CAUSING HARM:			
FIRST AID PROVIDED: ☐ YES ☐ NO			
IF YES, WHERE WAS IT GIVEN: ☐ ON SITE ☐ OFF SITE			
IF YES, WHO PROVIDED FIRST AID:			
WILL THE INJURY/ILLNESS RESULT IN: ☐ RESTRICTED DUTY ☐ LOST TIME ☐ UNKNOWN			

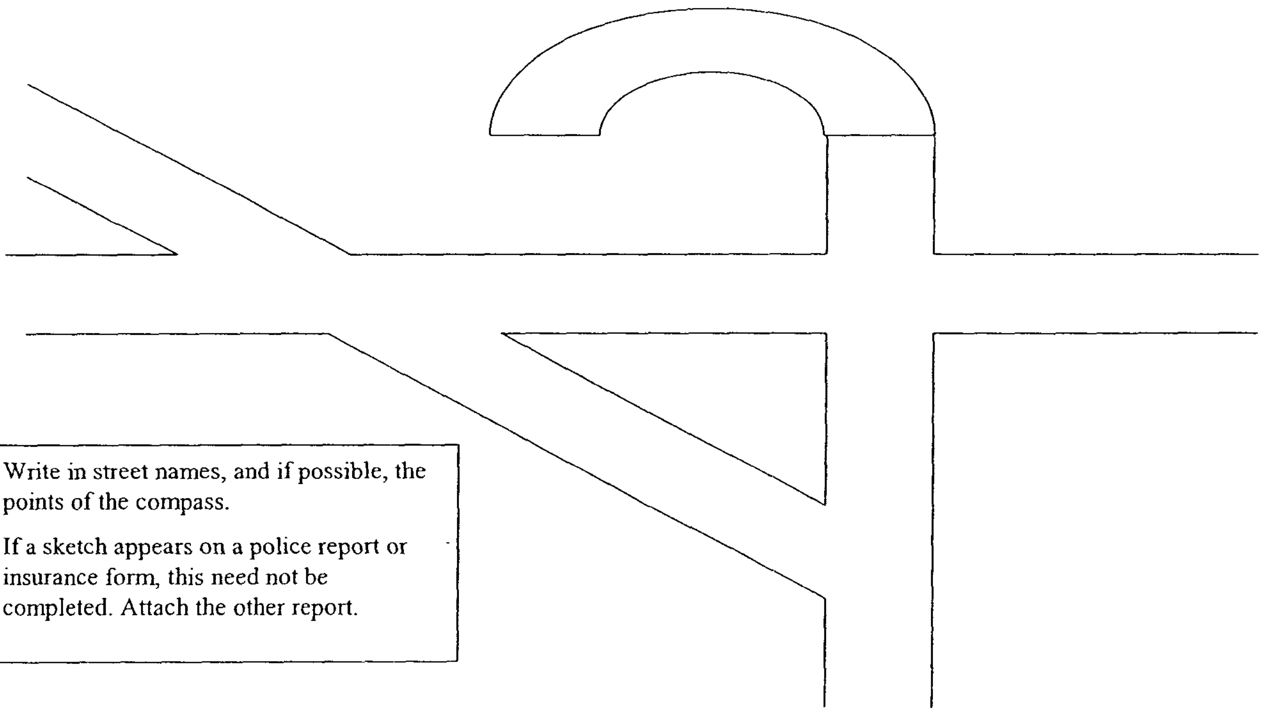
TETRA TECH EC, INC.

MEDICAL TREATMENT INFORMATION		
WAS MEDICAL TREATMENT PROVIDED?:	❒ YES ❒ NO	
IF YES, WAS MEDICAL TREATMENT PROVIDED:	❒ ON SITE ❒ DR.'S OFFICE ❒ HOSPITAL	
NAME OF PERSON(S) PROVIDING TREATMENT:		
ADDRESS WHERE TREATMENT WAS PROVIDED:		
TYPE OF TREATMENT:		
VEHICLE AND PROPERTY DAMAGE INFORMATION		
VEHICLE/PROPERTY DAMAGED:		
DESCRIPTION OF DAMAGE:		
SPILL AND AIR EMISSIONS INFORMATION		
SUBSTANCE SPILLED OR RELEASED:	FROM WHERE:	TO WHERE:
ESTIMATED QUANTITY/DURATION:		
CERCLA HAZARDOUS SUBSTANCE? YES ❒ NO ❒	RQ EXCEEDED? YES ❒ NO ❒ SPECIFY: ________	
REPORTABLE TO AGENCY? YES ❒ NO ❒	SPECIFY: __________________	
WRITTEN REPORT? YES ❒ NO ❒	TIME FRAME: ____________________	
RESPONSE ACTION TAKEN		
PERMIT EXCEEDENCE		
TYPE OF PERMIT:	PERMIT #:	
DATE OF EXCEEDENCE:	DATE FIRST KNOWLEDGE OF EXCEEDENCE:	
PERMITTED LEVEL OR CRITERIA (e.g., Water quality):		
EXCEEDENCE LEVEL OR CRITERIA:	EXCEEDENCE DURATION:	
REPORTABLE TO AGENCY? YES ❒ NO ❒	SPECIFY: ______________________	
WRITTEN REPORT? YES ❒ NO ❒	TIME FRAME: ____________________	
RESPONSE ACTION TAKEN:		
NOTIFICATIONS		
NAME(S) OF TtEC PERSONNEL NOTIFIED:		DATE/TIME:
CLIENT NOTIFIED:	DATE/TIME:	
AGENCY NOTIFIED:	DATE/TIME:	❒ NOT REQUIRED
CONTACT NAME:		
PERSONS PREPARING REPORT		
EMPLOYEE'S NAME: (PRINT)	SIGN:	
EMPLOYEE'S NAME (PRINT)	SIGN:	
SUPERVISOR'S NAME: (PRINT)	SIGN:	

NOTE: Supervisor to forward a copy of Incident Report to immediate supervisor, PESM, ESS or ESC, and other personnel as identified in Table 1 of this procedure ASAP, but no later than 24 hours.

INCIDENT SKETCH

VEHICLE INCIDENTS



Write in street names, and if possible, the points of the compass.

If a sketch appears on a police report or insurance form, this need not be completed. Attach the other report.

INVESTIGATIVE REPORT

DATE OF INCIDENT:________ DATE OF INVESTIGATION REPORT:________

INCIDENT COST: ESTIMATED: $__________ ACTUAL: $__________			
OSHA RECORDABLE(S): ❒ YES ❒ NO # RESTRICTED DAYS_____ # DAYS AWAY FROM WORK_____			
CAUSE ANALYSIS			
Was the activity addressed in an AHA? ❒ YES (Attach a copy) ❒ NO			
IMMEDIATE CAUSES – WHAT ACTIONS AND CONDITIONS CONTRIBUTED TO THIS EVENT? (USE NEXT PAGE)			
BASIC CAUSES - WHAT SPECIFIC PERSONAL OR JOB FACTORS CONTRIBUTED TO THIS EVENT? (USE NEXT PAGE)			
ACTION PLAN			
REMEDIAL ACTIONS - WHAT HAS AND OR SHOULD BE DONE TO CONTROL EACH OF THE CAUSES LISTED? INCLUDE MANAGEMENT PROGRAMS (SEE ATTACHED LIST) FOR CONTROL OF INCIDENTS IF APPLICABLE.			
ACTION	PERSON RESPONSIBLE	TARGET DATE	COMPLETION DATE
PERSONS PERFORMING INVESTIGATION			
INVESTIGATOR'S NAME: (PRINT)	SIGN:		DATE:
INVESTIGATOR'S NAME: (PRINT)	SIGN:		DATE:
INVESTIGATOR'S NAME: (PRINT)	SIGN:		DATE:
MANAGEMENT REVIEW			
PROJECT/OFFICE MANAGER (PRINT)	SIGN:		
COMMENTS:			
PESM or ESC (PRINT)	SIGN:		
COMMENTS:			
NOTE: Attach additional information as necessary. Supervisor to forward copy of Investigative Report to the PM or OM, PESM or ESC ASAP, but no later than 72 hours after the incident. A copy shall be sent to the Director, Health and Safety Programs within 24 hours of completion of the report.			

EXAMPLES OF IMMEDIATE CAUSES	
SUBSTANDARD ACTIONS	SUBSTANDARD CONDITIONS
1. OPERATING EQUIPMENT WITHOUT AUTHORITY	1. GUARDS OR BARRIERS
2. FAILURE TO WARN	2. PROTECTIVE EQUIPMENT
3. FAILURE TO SECURE	3. TOOLS, EQUIPMENT, OR MATERIALS
4. OPERATING AT IMPROPER SPEED	4. CONGESTION
5. MAKING SAFETY DEVICES INOPERABLE	5. WARNING SYSTEM
6. REMOVING SAFETY DEVICES	6. FIRE AND EXPLOSION HAZARDS
7. USING DEFECTIVE EQUIPMENT	7. POOR HOUSEKEEPING
8. FAILURE TO USE PPE PROPERLY	8. NOISE EXPOSURE
9. IMPROPER LOADING	9. EXPOSURE TO HAZARDOUS MATERIALS
10. IMPROPER PLACEMENT	10. EXTREME TEMPERATURE EXPOSURE
11. IMPROPER LIFTING	11. ILLUMINATION
12. IMPROPER POSITION FOR TASK	12. VENTILATION
13. SERVICING EQUIPMENT IN OPERATION	13. VISIBILITY
14. UNDER INFLUENCE OF ALCOHOL/DRUGS	
15. HORSEPLAY	

EXAMPLES OF BASIC CAUSES	
PERSONAL FACTORS	JOB FACTORS
1. CAPABILITY	1. SUPERVISION
2. KNOWLEDGE	2. ENGINEERING
3. SKILL	3. PURCHASING
4. STRESS	4. MAINTENANCE
5. MOTIVATION	5. TOOLS/EQUIPMENT
	6. WORK STANDARDS
	7. WEAR AND TEAR
	8. ABUSE OR MISUSE

MANAGEMENT PROGRAMS FOR CONTROL OF INCIDENTS	
1. LEADERSHIP AND ADMINISTRATION	10. HEALTH CONTROL
2. MANAGEMENT TRAINING	11. PROGRAM AUDITS
3. PLANNED INSPECTIONS	12. ENGINEERING CONTROLS
4. TASK ANALYSIS AND PROCEDURES	13. PERSONAL COMMUNICATIONS
5. TASK OBSERVATION	14. GROUP MEETINGS
6. EMERGENCY PREPAREDNESS	15. GENERAL PROMOTION
7. ORGANIZATIONAL RULES	16. HIRING AND PLACEMENT
8. ACCIDENT/INCIDENT ANALYSIS	17. PURCHASING CONTROLS
9. PERSONAL PROTECTIVE EQUIPMENT	

NOTIFICATION REMINDER
Fatalities or hospitalization (admittance) of three or more individuals requires notification to OSHA within 8 hours. Contact the Director, Health and Safety Programs or Director, ESQ Programs to make the notification. If unavailable, the senior operations person on site should make the notification.

Incident/Near Miss Report and Investigation Instructions

General: The incident report (pages 1 and 2) must be completed within 24 hours. Do not delay the report if any information is unknown. It can be provided later by revising the Report.

Type of Incident: Check all that apply. A High Loss Potential (Near Miss) incident is one that does not result in loss, but under slightly different circumstances, could have resulted in an OSHA Recordable injury, spill, release, permit exceedance, fire, or vehicle/property damage in excess of $500. All High Loss Potential (Near Miss) incidents are to be investigated.

General Information

Project/Office: If the incident occurs on a delivery order contract, give the contract/program name, DO# and location. If the incident occurs on a C&E field project, give the Office location managing the project as well as the project/location.

Report No.: Optional numbering field for offices/projects.

TtEC Supervisor: The TtEC Supervisor responsible for the work effort involving the incident. Do not give a subcontractor supervisor or craft foreman name. If a TtEC Supervisor was the Affected Employee, this field should contain the name of his or her supervisor. The Supervisor is the project supervisor if the incident happens on a project, or the administrative supervisor if the incident happens in the office. E.g., a geologist, acting as an FOL gets injured on a job site, or in a motor vehicle in the course of project work. The TtEC Supervisor is most likely the Project Manager. If the same geologist gets injured lifting a box in his office, the TtEC Supervisor is likely the Office Science Lead.

Location of Incident: The specific location on the project, in the office, or off-site location.

Weather Conditions: Temperature, precipitation, approximate wind speed and direction, cloud cover, relative humidity. This information may be included in the description section, and must be given in detail whenever it is a factor in the cause or impact., e.g., spill, release, heat stress, wind-blown material.

Describe What Happened: This section must be completed in sufficient detail to adequately describe the events and conditions leading up to and resulting from the incident. Try to answer the questions who, what, where, when, and how. This information is then used to determine why (cause). Provide details such as work objective, procedure being used, body position, and PPE. Include diagrams or sketches for all incidents involving vehicles/equipment and other incidents where they aid in providing detail or perspective. Consider attaching photographs. Follow the guidelines in Practical Loss Control Leadership, and consider the impact of each of the following:

P - People
E - Equipment
M – Material
E – Environment

To do an effective job, a visual inspection of the scene is usually necessary along with private interviews of affected employees and witnesses.

Where appropriate, use terms indicating the type of contact, e.g., struck by; struck against; fall from elevation; fall on same level; caught in; caught between or under; caught on; contact with; overstress; equipment failure; environmental release; fire.

Affected Employee Information

TtEC Employee: Direct hire, whether professional, administrative, or craft; full-time or part-time; permanent or temporary. If the affected employee is not a TtEC employee, give the name of the employer and business relationship (e.g., client, subcontractor) in the description section above.

Hours Worked on Shift Prior to the Incident: Only include the amount of time the employee worked that shift or day prior to the incident.

Years with TtEC: For TtEC employees, give the number of years employed with TtEC. If the employee has worked for TtEC for less than a year, do not write <1. Give the answer in fraction of year, or specify the number of months, e.g., 0.1 or 1 month.

Injury/Illness Information

Nature of Injury or Illness: If the incident resulted in an injury or illness, give a brief description of the body part affected and type of injury or illness, e.g., fractured thumb, left hand; carpal tunnel syndrome, right hand.

First Aid Provided: First Aid is any treatment that does not have to be provided by a health care professional, even if it is. E.g., a laceration that is cleaned and bandaged in a clinic may constitute first aid, if sutures are not given.

Will the Injury Result In: Do not delay the report if this information is unknown.

Medical Treatment Information

Was Medical Treatment Provided? Medical treatment is that treatment that must be provided by a licensed medical practitioner, e.g., sutures, prescription medication, etc.

Type of Treatment: This information is important in determining OSHA recordability, since some forms of treatment would not constitute a Recordable case (e.g., one-time administration of prescriptions, negative diagnostic exams). Attach a copy of the treating professional's statement/work release.

Vehicle and Property Damage Information

Vehicle/Property Damaged: For vehicles, indicate VIN and whether it is company owned or leased, business trip rental (Avis) or owned by others.

Description of Damage: Be specific as to the identity of damaged part, location, and extent.

Spill and Air Emissions Information

Substance Spilled or Released: For pure substances, list materials by common name/chemical. For wastes, indicate waste code. For mixtures or contaminated media, provide contaminant name, CAS No., concentration.

RQ Exceeded? Reportable quantity. Contact your ESQ representative for guidance. Specify the RQ for the material, whether you answer yes or no.

Reportable to Agency? If yes, specify the federal, state or local agency that must be provided with verbal and/or written notification.

Written Report? Answer yes if the release requires a written report to be filed and note the time frame.

Response Action Taken: Describe the mitigation efforts, as well as any reports made, beyond initial notification.

Permit Exceedence

Type of Permit: List name of permit including the agency name where applicable (e.g., NPDES, PSAPCA, NOC)

Date of Exceedance: Specify date exceedance occurred (e.g., date discharge in excess of permit limits occurred)

Date First Knowledge of Exceedance: Specify date when first knew there was an exceedence (i.e., date analytical received). This date may be different from the date of the exceedance listed above.

Permitted Level or Criteria: List numerical discharge or emission limit or narrative criteria specified in the permit (e.g., 20 percent opacity limit, Best Management Practices [BMP] implementation per Stormwater Pollution Prevention Plan [SWPPP]).

Exceedence Level or Criteria: Specify actual numerical discharge/emission limit or narrative criteria exceeded (e.g., 22 percent opacity, failure of BMPs (silt fencing collapse) per SWPPP).

Exceedance Duration: Specify time frame by date and hours (using military time) during which exceedance occurred.

See "**Spill/Release Information**" (above) for description of remaining questions.

Persons Preparing Report

Employee's Name: The affected employee described on page 1 should review the report and sign here, as well as other employees witnessing or involved in the incident.

Supervisor's Name: The TtEC Supervisor must review and sign the report indicating agreement. The TtEC Supervisor and the Investigator (next page) should be the same person.

Investigative Report

Report No.: This is the same as the project/office optional report number from page 1 of the Incident/Near Miss Report.

Date of Investigative Report: This date should be within 72 hours of the incident. In cases where the investigation is not completed until a later date, submit the incomplete report within the 72 hours, and a revised report should be submitted when the missing information is obtained.

Incident Cost: For all vehicle/equipment or property damage cases, an estimated or actual loss value must be entered. If an estimated value is entered, the report must be revised when the actual costs are known.

OSHA Recordables: This section should be completed in consultation with the PESM. If it cannot be determined at the time of the report, the PESM should consult with the Director, Health and Safety Programs and revise the report when a determination is made.

No. of Restricted Days: This relates to days of restricted work activity, not restrictions on motion or physical capability. If the employee is capable of doing his normal job the day after the injury and thereafter, there are no restricted days, even if the physician indicates a physical restriction. It does not include the day of the injury.

No. of Days Away from Work: The number of days after the day of the injury that the employee was scheduled to work but could not due to an occupational injury. If the treating physician releases an employee to return to work, but the employee chooses not to come to work, do not count those days. In this case the PESM should contact the Director, Health and Safety Programs.

Cause Analysis

Immediate Causes: Determine the immediate causes, using the example on page 4. If one or more of the examples fits the circumstance, use those words in the cause description. This facilitates statistical analysis of the incident database for program evaluation/modification. However, do not confine your cause determination to the guide words. Explain, e.g., Improper Lifting – employee attempted to lift box by bending at the waist and twisting while lifting. Be sure that the incident description on page 1 is sufficiently detailed to support the causal analysis in this section. An assumption of cause (e.g., improper lifting) from the injury (low back pain) is not acceptable.

Basic Causes: Like the Immediate Causes, use the guide words in the attachment whenever appropriate and explain. For example, improper motivation may be because the correct way takes more time or effort; shortcutting standard procedure is tolerated or positively reinforced; or the person thinks there is no personal benefit to always doing the job correctly.

Note: The investigator is encouraged to review the Practical Loss Control Leadership chapters on *Causes and Effects of Loss* and *Accident/Incident Investigation* before doing the causal analysis. As a check, the investigator may refer to the S.C.A.T. Chart available from the PESM.

Remedial Actions: Include all actions taken or those that should be taken to prevent recurrence. Be sure that actions address the causes. For example, training (safety meetings) may be a necessary response for lack of knowledge, but may be inadequate for improper motivation. If completion dates exceed the 72 hours reporting period, a revised report must be submitted when all remedial actions are complete.

Persons Performing Investigation: The primary investigator is the TtEC Supervisor in charge of the work where the incident occurred. Others participating in the investigation, such as the Project Manager, ESS, QC, site engineer, foreman, etc. should also sign the report.

Management Review: The Project or Office Manager and the PESM or office ESC must sign the report indicating their satisfaction with thoroughness of the investigation and the report, and their concurrence that the action items address the identified causes. This constitutes the peer review, and the report, particularly the description, should be clear to readers not familiar with the project or incident.

TETRA TECH EC, INC.

SITE SAFETY PLAN CHANGE APPROVAL FORM

N62473-06-D-2201 CTO: ___________

Date ______________________ Amendment Number ___________

Project Name: ______________________ Project Number: ___________

Section of SHSP: ______________________ Page Number: ___________

Change to read: ____

____

____

____

____

____

____

Reason for change: ____

____

____

____

____

____

____

Approvals: ______________________________

Project Superintendent or Manager

____

SSHS

____

PESM (CIH)

APPENDIX D

FIELD COMMUNICATION PLAN

This page intentionally left blank.

Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

CONTRACT NO. N62473-06-D-2201
CTO NO. 0012

APPENDIX D

FINAL

FIELD COMMUNICATION PLAN
October 11, 2007

FOR OPERABLE UNIT 2A and 2B DATA GAP SAMPLING
ALAMEDA POINT
ALAMEDA, CALIFORNIA

DCN: ECSD-2201-0012-0002.R1

TETRA TECH EC, INC.
1230 Columbia Street, Suite 750
San Diego, CA 92101-8536

DRAFT ACCEPTED AS FINAL

Marianne Binkin, P.G. 7853
Technical Lead

TABLE OF CONTENTS

PAGE

This page intentionally left blank.

LIST OF TABLES

This page intentionally left blank.

ABBREVIATIONS AND ACRONYMS

DoN	Department of the Navy
DTSC	Department of Toxic Substances
EPA	U.S. Environmental Protection Agency
OU	Operable Unit
RPM	Remedial Project Manager
TtEC	Tetra Tech EC, Inc.
Water Board	Regional Water Quality Control Board

This page intentionally left blank.

1.0 INTRODUCTION

A streamlined decision-making process and clear lines of communication and authority are important during intensive field activities. Timely real-time decisions are needed from the Technical Team to respond to changing field conditions (e.g., need for step-out or step-down sampling due to chemical concentrations in exceedence of screening criteria) and those decisions must be communicated to the field team for action. A streamlined decision-making process will be used to facilitate Technical Team concurrence in order to minimize the need for extra mobilizations to complete the scope of fieldwork or additional characterization at a later date.

1.1 TECHNICAL TEAM

The Technical Team members involved in the decision-making process for Operable Unit (OU)-2A and OU-2B Data Gap Investigation sampling activities are listed in Table D.1-1. These individuals have the authority to make fieldwork-related decisions on behalf of their respective organizations. Final field decisions will be made by the Department of the Navy (DoN) Remedial Project Manager (RPM). Each team member at the outset shall identify an alternate designee who will be given the authority to make decisions in their absence.

The RPM or his designee will be responsible for conveying the decisions and direction of the Technical Team to the Tetra Tech EC, Inc. (TtEC) Technical Lead. Decisions arising from the Technical Team will be documented in the Field Logbook or Field Change Requests (if warranted).

TABLE D.1-1 TECHNICAL TEAM MEMBERS – CONTACT LIST

Name	Organization	Telephone Number	E-mail Address
Anna Marie Cook	U.S. EPA	(415) 972-3029	cook.anna-marie@epa.gov
Dot Lofstrom, P.G.	EPA DTSC	(916) 255-6449	dlofstro@dtsc.ca.gov
Erich Simon	Water Board	(510) 622-2355	esimon@waterboards.ca.gov
Steven Peck	DoN (RPM)	(619) 532-0786	steven.peck@navy.mil

Notes:

EPA – U.S. Environmental Protection Agency
DTSC – Department of Toxic Substances
California-registered Professional Geologist
Water Board – Regional Water Quality Control Board
DON – Department of the Navy
RPM – Remedial Project Manager

1.2 DECISION SUPPORT TOOLS

Decisions made by the Technical Team will be supported through the use of logic diagrams as well as figures, data, and recommendations.

1.2.1 Decision Logic Diagrams

The logic diagrams are included in the Work Plan as Figures 5-1, 5-2 and 5-3 and address soil step-out methodology, groundwater step-down methodology, and groundwater step-out methodology, respectively.

1.2.2 Project Webpage

Revised plume maps, preliminary laboratory data, and recommendations will be posted on a webpage designed to support the decision-making process. Each team member will be supplied a user identification and a password to access the webpage. TtEC will input real-time data to the project webpage as they become available and are required for decision-making purposes.

1.3 DECISION-MAKING PROCESS

The following process steps will be followed:

1. Decision logic diagrams presented in the Work Plan and agreed upon by the Technical Team will be used to guide the OU-2A and OU-2B field investigation activities.
2. An email notification requesting all Technical Team members (and their designees) to review current information will be sent out by the TtEC Technical Lead when a decision-making event is triggered. Events will be grouped as schedule and conditions permit in order maximize efficiency of the decision-making process.
3. Individual Technical Team members will be responsible for reviewing the information placed on the webpage and providing feedback to the TtEC Technical Lead by email within 48 hours. If no response is received from a Technical Team member within this timeframe, then the decision-making making process will proceed.
4. Feedback from the Technical Team members will be compiled by the TtEC Technical Lead and a course of action will be recommended and posted on the webpage within 24 hours. An email notification will be sent to the Technical Team members advising them of the posting. If a difference of opinion exists, a conference call or meeting will be scheduled by the DoN RPM. If a Technical Team member is not available for the call or meeting, their designee will participate. The team members on the call or at the meeting will make the final decision. The DoN RPM will be responsible for communicating the decision or direction to the TtEC Technical Lead.
5. The final decision will be documented in the Field Notebook and Field Change Request (if necessary) and will be posted on the web page.

For this protocol to be effective and successful, and to avoid undue field delays, it is important for Technical Team members to commit to the process early, concur on the logic diagrams, and agree to work together through the process. Any issues that arise before or during the process shall be addressed promptly, clearly, and to Technical Team members' satisfaction.

This page intentionally left blank.

APPENDIX E

REVISED RESPONSE TO COMMENTS ON DRAFT OU-1, OU-2A AND OU-2B DATA GAP SAMPLING WORK PLAN DATED NOVEMBER 3, 2006

This page intentionally left blank.

DTSC COMMENTS ON
DRAFT DATA GAP SAMPLING WORK PLAN
FOR OU-1, OU-2A, AND OU-2B
DATED NOVEMBER 3, 2006
ALAMEDA POINT
ALAMEDA, CALIFORNIA

Comments dated: January 29, 2007

Comments by: Michelle Dalrymple, PG, CEG
Senior Engineering Geologist
Geologic Services Unit

GENERAL COMMENTS

Comment A: *<u>Screening Criteria for Soil</u>. Screening criteria proposed for the step-out and step-down decision rules for soil investigations in this DWP are Environmental Protection Agency Region 9 Residential Soil Preliminary Remediation Goals (PRGs). The data quality objectives (DQOs) for SWMUs state that if the chemical of potential concern (COPC) concentrations in initial soil samples are less than the screening criteria, then the SWMUs are not considered to have leaked contaminants to the environment and no further action is required. However, PRGs are risk-based values intended to address direct human-exposure to impacted soil and should not be used to determine whether a leak has occurred and/or soil contamination has been delineated. In addition, PRGs do not address potential human exposure due to emission of subsurface vapors into building interiors (indoor air). Furthermore, PRGs do not address the potential for leaching of chemicals to groundwater. For example, the PRG for 1,1,1-trichloroethane is 1,200,000 micrograms per kilogram. Concentrations of this and other COPCs that are well below their respective PRGs may pose a future threat to groundwater if allowed to remain in place. The use of PRGs as screening criteria for the SWMU investigations and for step-out/step-down decision rules is inappropriate.*

<u>Recommendation</u>

GSU requests that alternative screening criteria are chosen for the SWMU and soil data gaps such as California Regional Water Quality Control Board Environmental Screening Levels (RWQCB, 2005) for organic chemicals, and Alameda Point background values

for metals to determine the need for further action and/or additional characterization.

Response A:

Based on the EPA's description for use of PRGs, PRGs are regularly used as tools for evaluating and cleaning up contaminated sites. Since they are risk-based concentrations and are commonly used for site "screening" and as initial cleanup goals, if applicable. We understand that the PRGs are not *de facto* cleanup standards; however, they are helpful in providing long-term targets to use during the analysis of different remedial alternatives, which may streamline the consideration of remedial alternatives.

As such, PRGs will be used as the primary screening tool for the field investigation for COCs. However, to avoid confusion, language referencing the use of PRGs as a screening level to determine whether a "leak" has occurred will be amended in the Draft Final Work Plans for OU-1 and OU-2A/2B. Additionally, for metals that exceed the PRGs, the concentrations will be compared to site background levels to determine if additional investigation is required.

Since the purpose of data gap investigations is to complete supplemental investigation to facilitate remedial design, risk assessment is not proposed as part of this effort; therefore, the screening criteria selected are appropriate.

Comment B:

Decision Rules for Groundwater at SWMUs. The sampling methodologies and DQOs for SWMUs described in Section 4 and presented on Table 3-1, respectively, discuss the methodology and decision rules for soil sampling. Decision rules for groundwater sampling are not described in the text or table and should be provided. In addition, in Step 4 of the DQOs on Table 3-1 it is stated that step-down sampling based on groundwater analytical results will not be performed. Without step-down groundwater sampling, characterization of contamination associated with SWMUs at the completion of this phase of work may be incomplete, and additional data may be required.

Recommendation

GSU requests that decision rules are provided for groundwater samples with contamination exceeding screening criteria at SWMU locations. GSU further requests that step-out and step-down sampling is proposed at SWMUs based on groundwater analytical results in an attempt to ensure complete characterization at the end of this phase of work.

Response B: Concur. In addition to the data gap groundwater sampling, collection of groundwater samples at SWMUs with step-out and step-down criteria has been incorporated into the Draft Final Work Plans for OU-1 and OU-2A/2B.

Comment C: Need for Additional Investigation. *It is stated in Section 5 that further investigation of the groundwater contaminant plumes is necessary to ensure proper design of remedial activities. Additional data are being collected to:*

- *Complete the characterization of the various COPC plumes;*
- *Evaluate the fate and transport of individual COPCs;*
- *Monitor the migration of the plume during remedial activities;*
- *Optimize remedial design; and*
- *Evaluate natural attenuation.*

It is also stated in Section 5 that, following completion of this scope of work, it is anticipated that no additional field activities will be required to complete the FS or to support the remedial design. However, a FS has not been completed for OU-2A and OU-2B. It is unknown what the preferred remedy will be at these sites. Additional data and/or pilot testing may be needed subsequent to the selection of a preferred alternative to optimize the remedial design.

Recommendation

Please clarify that, while the proposed investigation is intended to be comprehensive, additional data may be needed at some of the sites following selection of the preferred remedy.

Response C: Concur. The appropriate sections of the Draft Final Work Plans for OU-1 and OU-2A/2B have been updated with the recommended clarification.

Comment D: Basis for Proposed Groundwater Investigation. *It is not possible for GSU to agree with the groundwater investigation approach presented in the DWP because rationales for the design of the proposed groundwater sampling network and other proposed groundwater activities have not been provided. Without this information, it is not possible to determine whether the sampling network and other activities are appropriate to meet the stated objectives.*

Recommendation

The rationale for each activity proposed to address groundwater investigation data gaps should be provided for each site. The rationale for direct-push technology (DPT) and monitoring well

locations should specify why each proposed location is deemed necessary (i.e., upgradient control, downgradient control, plume axis, vertical extent, etc.). This information could be provided on a table (such as Table A.5-2 in Appendix A) but should be supported with site-specific data. In addition to chemical data, site-specific groundwater flow directions and the depth and thickness of the Bay Sediment Unit (BSU) are two factors that affect the proposed groundwater sampling approach. This information should be provided and discussed for each site. Geologic cross-sections and piezometric surface maps should be provided as support for this information (see Specific Comments 3 and 4).

Response D: The text of the Draft Final Work Plans for OU-1 and OU-2A/2B has been revised and presents a rationale for the selection of monitoring well and direct-push locations. A Bay Sediment Unit isopach map will be developed and included in the OU-2A and 2B work plan. No isopach map was developed for OU-1 because the sites are not contiguous; however, Table 2-1 and the text of the Draft Final Work Plan for OU-1 has been revised with more complete information regarding extent and thickness of the BSU at Sites 6, 7, 8 and 16. In addition, where information is available, the site-specific groundwater flow directions will be added to the maps. The information collected from the data gap investigation activities will be used to update each CSM building upon the previous work at the Site. The new information will be used to fine tune and take the CSMs to the next step of development. The CSMs will be used to guide additional activities, if required, and remediation at the various sites.

Comment E: *Plume Contours. Because the specific rationale for the proposed groundwater sampling locations is not provided, the basis for many of the DPT and monitoring well locations is unclear. Based on a review of maps presented in Section 5 of the DWP, it appears that the proposed groundwater sampling locations are often based on confirming the limits of the composite volatile organic compound (VOC) plumes shown on the various figures. However, insufficient detail has been provided on the figures to determine what these figures actually represent. If the composite VOC plume contours are controlling the proposed sampling locations as it appears, then it is important to verify the accuracy of this information.*

Recommendation

The source of the data upon which the plume interpretations are based should be indicated on the maps. Please include the source and date of the information, a list of the individual VOCs that were composited to define the extent, and the concentration that is

represented by the dashed contour on each figure. The historical data points that were used to create the interpreted plumes should be identified, and the plumes should be queried where uncertain or unknown. Please update this information with recent data from the Basewide Groundwater Monitoring Program (BGMP), if applicable (see Specific Comment 10).

Response E: The source of the data will be indicated in the legend of the maps. The outside contour on each map is approximately the furthest extent of the MCLs of the COCs in that particular area. The objective is to define the extent of groundwater contamination and identify the areas of higher concentration that will need to be remediated. A product of this investigation will be defined groundwater plumes adequate for remedial purposes.

Comment F: *Conceptual Site Models (CSMs). The DWP presents CSMs for sites that have known groundwater contamination and require further investigation. However, the CSMs oversimplify the actual site conditions and do not accurately reflect what is known about the lithology and contaminant distribution. GSU questions the usefulness of these oversimplified depictions of site conditions.*

Recommendation

The CSMs should be revised to more accurately reflect site-specific lithologic data and contaminant distribution, and should be updated as additional data become available.

Response F: The initial purpose for including the preliminary CSMs was to provide an approximate representation of conditions for each site. The information collected from the data gap investigation activities will be used to update each CSM, building upon the previous work at the Site. The new information will be used to fine-tune and take the CSMs to the next step of development. The CSMs will be used to guide additional activities, if required, and remediation at the various sites.

SPECIFIC COMMENTS AND RECOMMENDATIONS

Comment 1 *Section 1.0 – Introduction. The DWP states that the purpose of the data gap sampling is to facilitate preparation of the remedial design and remedial action work plan, but a FS has not been completed or finalized for OU-2A and OU-2B sites. It is unknown what the preferred remedy will be at these sites. Additional data and/or pilot testing may be needed subsequent to the selection of a preferred alternative to optimize the remedial design. Please clarify the current* *status of each site and the path forward following finalization of the Data Summary Report. Please clarify that, depending on the selected remedy, additional data may be needed (see General Comment C).*

Response 1

This section has been amended in the Draft Final Work Plans for OU-1 and OU-2A/2B to reflect the recommendations in this comment and General Comment C.

Comment 2

Section 1.2 – Work Plan Objectives. Please check the completeness of information on Table 1-4, and correct this information as necessary. It appears that some text has been cut-off due to a formatting error.

Response 2

Table 1-4 has been removed and the individual data gaps are discussed in relevant sections in the text of the Draft Final Work Plan for OU-1. In the Draft Final Work Plan for OU2A/2B, Table 1-4 has been updated and formatting issues have been corrected.

Comment 3

Section 2.4 – Geology. This section refers to geologic cross-sections in Appendix B. Please check the quality of the cross-sections provided. Some cross-sections are missing relevant information due to a possible printing error. Also, it is unclear why these cross-sections have been included since they are not specifically discussed in the DWP. The site-specific cross-sections should be referenced and discussed as support for the proposed groundwater sampling approach (see General Comment D) and the CSM (see General Comment F).

Response 3

The initial purpose for including the geologic cross-sections in Appendix B was to provide an approximate representation of Site conditions. Because the value of these generalized cross-sections is limited, the cross-sections have been removed from the Draft Final Work Plans for OU-1 and OU-2A/2B.

Comment 4

Section 2.6 – Site-Specific Hydrogeology.

a. The subsections for each site should be amended to include a description of the hydrogeologic units that are present including information regarding the presence or absence of the BSU, the approximate thickness of the BSU, the depth to the Merritt Sand, and other relevant information. This information is needed to support the proposed groundwater sampling approach at each of the sites (see General Comment D).

b. GSU understands that there is a high degree of local variability in groundwater flow directions at each of the subject sites. However, for the purpose of evaluating the groundwater sampling approach and monitoring well locations proposed in the DWP, flow direction maps are needed (see General Comment D). A series of maps *should be provided because groundwater flow directions typically vary over time. Please include and discuss such maps in the draft final Work Plan.*

Response 4

a. The most important hydrogeologic feature across the site is the location of the BSU. An expanded description of the location of the BSU has been added to the Draft Final Work Plans for OU-1 and OU-2A/2B. A BSU isopach map will be developed and included in the Draft Final Work Plan for OU-2A/2B. No isopach map was developed for OU-1 because the sites are not contiguous; however, Table 2-1 and the text of the Draft Final Work Plan for OU-1 has been revised with more complete information regarding extent and thickness of the BSU at Sites 6, 7, 8 and 16.

b. The site-specific groundwater flow directions will be added to the maps where information is available. Potentiometric maps will be developed at the completion of the data gap investigation activities. The present knowledge of the groundwater flow direction is adequate for the purpose of the work plan activities and has been taken into account in the sampling design.

Comment 5

Section 4.1.2 – AST/UST Sampling Methodology. *There is a large amount of information in this section and on Table 3-1 describing the sampling approach and decision rules that will be used for the various sizes of underground storage tanks (USTs) and aboveground storage tanks (ASTs) to be investigated as part of this DWP. However, according to information contained on Table 1-2 of the DWP, there are only five AST/UST SWMUs requiring further investigation under the CERCLA program. With the exception of one SWMU (AOC 009) that is reportedly includes five ASTs of unknown size, the remaining four AST/UST SWMUs are relatively small (600 to 3,000 gallons). It is unclear why decision rules discuss the sampling approach for ASTs/USTs of 5,000 to greater than 20,000 gallon capacities.*

Also, according to Table 1-3c, one of the five SWMUs (AST 360E) is proposed to be included with AST 360A sampling under the total petroleum hydrocarbon (TPH) program. However, Table 1-5 provides sampling locations, depths, and analyses for this SWMU. Sampling and analytical schedules for other ASTs and USTs being addressed under the TPH program are not provided on Table 1-5. For clarity, please list the ASTs and USTs that are proposed for investigation as part of the scope of this DWP, and describe what is known about their contents and respective sizes. Please simplify and tailor the proposed approach to the five AST/USTs SWMUs that are addressed in this data gap effort. The DWP should specifically address whether or not the

ASTs and USTs in the TPH program are being investigated as part of this data gap sampling effort.

Response 5

The decision rules have been amended in the Draft Final Work Plans for OU-1 and OU-2A/2B to more clearly present the field investigation approach for ASTs/USTs with capacities less than 5,000 gallons. Additionally, tables have been edited and updated for the Draft Final Work Plans. Information regarding the proposed sampling plan is provided in Table A.3-1 in each Work Plan.

Comment 6

<u>Section 4.3.1 – Gap Sampling Methodology</u>. *There are only four Generator Accumulation Points (GAPs) to be investigated as part of this data gap sampling effort. The approximate size of each should be known from maps, site walks, and/or SWMU profile reports. The specific approach for each GAP should be provided to simplify the information contained in this section.*

Response 6

To prepare the Draft Work Plan, previous site documents were reviewed and no clarifying information regarding the size of each GAP was available. Therefore, the field team will investigate the GAP based on its size, as determined by initial field investigations. The text and support tables for investigating GAPs have been updated for clarity in the Draft Final Work Plan for OU-2A/2B.

Comment 7

<u>Section 5.0 – Soil and Groundwater Plume Delineation Sampling and Rationale</u>.

a. *The groundwater step-out and step-down sample criteria of 2 and 20 times the screening criteria, respectively, seem arbitrary and require further elaboration. At most of the sites, the lateral continuity and competency of the BSU aquitard has not been demonstrated. It is possible that vertical migration through or within the BSU has occurred or is occurring. At other sites, the BSU is absent and the FWBZ is in direct hydraulic communication with the SWBZ. Also, the method for the collection of grab groundwater samples, as described in Appendix A, Section 6.3.3, may result in low-biased VOC concentrations due to potential volatile losses and disequilibrium with the surrounding formation. Therefore, the 2 and 20 times criteria should not be applied to these samples. The horizontal and vertical extent should be delineated to the respective Maximum Contaminant Level (MCL) of contaminant of concerns directly beneath and downgradient from known source areas.*

b. *It is stated that step-down samples will be collected from the SWBZ if any COPC is detected in a groundwater sample collected at the* *base of the FWBZ at a concentration of 20 times its screening criterion. However, based on experience at other Alameda Point sites (OU-2B and IR Site 5), permeable portions of the BSU that occur between the FWBZ and SWBZ have been found to contain significant levels of contamination. Often, the SWBZ in these areas shows little or no impact. Therefore, step-down samples should also be collected from permeable intervals within the BSU, if encountered, to evaluate the vertical extent of contamination between the FWBZ and SWBZ. Based on the results of the step-down sampling, monitoring wells may be required in the permeable portions of the BSU between the FWBZ and SWBZ, rather than in the SWBZ.*

Response 7

a. Lateral delineation of groundwater contamination has been changed from 2 times the MCLs to the MCLs. Vertical step down sampling to delineate to MCLs has been added to the Draft Final Work Plans for OU-1 and OU-2A/2B.

b. Continuous lithologic logs will be collected using a CPT rig at all locations requiring groundwater sampling in the SWBZ. The CPT log will identify any significant permeable layers in the BSU. Groundwater samples will be retrieved from these layers using DPT to identify contaminant concentration levels in these layers. No monitoring wells are anticipated to be installed in these permeable layers.

Comment 8

Section 5.1.1.2 – Site 6 Groundwater Investigation (Data Gap 1).

The rationale for the proposed number, depths, and locations of groundwater sampling (DPT points and monitoring wells) must be provided. It is not possible for GSU to evaluate the proposed sampling approach for the groundwater investigation without this information (see General Comment D).

CPT data from previous investigations at IR Site 6 indicate that there may be a sandy interval within the BSU at depths between 20 and 35 feet below ground surface (bgs). Contamination may be present in this interval. GSU requests that step-down samples are collected from permeable intervals within the BSU, if encountered, to evaluate the vertical extent of contamination between the FWBZ and SWBZ (see Specific Comment 7).

Response 8

The sampling rationale has been expanded in the text, tables, and SAP for the Draft Final Work Plan for OU-1 to clarify the rationale for monitoring well and/or direct-push locations. Identified groundwater zones will be investigated, as described in the updated step-down methodology for groundwater.

Comment 9

<u>Section 5.1.2.3 – Site 7 Groundwater Investigation (Data Gap 5)</u>. The information in Table 1-4 is inconsistent with the information provided in this section. Table 1-4 states that the groundwater data gap for IR Site 7 was identified based on polynuclear aromatic hydrocarbons (PAHs) and possible polychlorinated biphenyls (PCBs) in groundwater. According to Table 1-4, the proposed field activity is to sample all existing monitoring wells for PCBs. It is stated that per the Proposed Plan, the PAH issue will be evaluated under the TPH program. However, in Section 5.1.2.3 of the DWP, additional DPT sampling of soil and groundwater is proposed at three locations at IR Site 7. Since the groundwater contamination at this site has been transferred to the TPH Program (with the possible exception of PCBs), GSU questions the need for the additional soil and groundwater investigation proposed under the CERCLA Program. Please clarify the purpose and basis for the groundwater investigation proposed for IR Site 7 in the DWP (see General Comment D).

Response 9

The groundwater data gap sampling proposed for IR Site 7 has been removed from scope of work for the Draft Final Work Plan for OU-1 based on the OU-1 ROD, which states no further CERCLA action is necessary with respect to site-wide groundwater at this Site. However, SWMU-specific sampling, including collection of groundwater samples, will be performed at Site 7. Table 1-4 has been removed from the Draft Final Work Plan for OU-1 (see Response to Comment 5).

Comment 10

<u>Section 5.1.3.2 – Site 8 Groundwater Investigation (Data Gap 7)</u>. GSU questions the interpreted extent of VOCs depicted on Figure 5-9. Benzene has historically been reported at concentrations above the MCL at well M08-03, and recently (Spring 2006) benzene was detected in groundwater from well M08-01 at a concentration of 16 micrograms per liter (µg/L) (ITSI, 2006). The MCL for benzene is 1 µg/L. Based on the known extent of benzene above the MCL at IR Site 8, it is unclear how the proposed DPT sampling will fully define the extent of benzene in groundwater at IR Site 8. Please provide the rationale for the proposed sampling locations (see General Comments D and E).

Response 10

The groundwater data gap proposed for Site 8 has been removed from the scope of work in the Draft Final Work Plan for OU-1. In accordance with the OU-1 ROD, limited groundwater monitoring is still required at Site 8 for benzene and TPH. However, the groundwater sampling will be performed under the basewide sampling program. Therefore, no groundwater sampling is proposed in the OU-1 work plan except as part of the SWMU investigations at this site. Figure 5-9 showing proposed sampling locations for Data Gap 7 has been removed from the Draft Final Work Plan for OU-1.

Comment 11

<u>Section 5.1.3.3 – Site 8 Transformers (Data Gap 6)</u>. There is a discrepancy between Table 1-4 and this section regarding the location of the transformers addressed by this data gap. Table 1-4 indicates that the transformers in question are located at IR Site 7, not at IR Site 8. Please resolve this discrepancy.

Response 11

The data gap regarding transformers was determined to not be a data gap and will not be addressed as part of the OU-1 Work Plan. Table 1-4 has been removed from the Draft Final Work Plan for OU-1 (see Response to Comment 5).

Comment 12

<u>Section 5.1.4.3 – Site 16 Groundwater Investigation (Data Gap 9).</u>

a. *The rationale for the proposed number, depths, and locations of groundwater sampling (DPT points and monitoring wells) must be provided. It is not possible for GSU to evaluate the proposed sampling approach for the groundwater investigation without this information (see General Comment D).*

b. *According to the presentation at the February 21, 2006 BCT meeting, one of the conclusions of the Full-Scale In-Situ Chemical Oxidation Removal Action at IR Site16 South was that soil in the vicinity of the former UST 608 may still have an unknown volume of sorbed mass contributing to the elevated levels of VOCs found in groundwater. Furthermore, it was concluded that the extent of residual soil contamination needs to be determined and removed prior to conducting additional remediation of this area. GSU questions why this data gap is not included in the scope of work proposed as part of this DWP. Please clarify whether this data gap is being addressed under a different scope of work and/or include sampling and analysis required to complete this effort in the draft final Work Plan. Groundwater samples should be collected from the SWBZ in this area to confirm the vertical extent of contamination.*

Response 12

a. The sampling rationale has been expanded in the text, tables, and SAP for the Draft Final Work Plan for OU-1 to clarify the rationale for monitoring well and/or direct-push locations

b. UST (R)-18/NAS GAP 17 (former UST 608-1) is included as part of the SWMU investigation activities at Site 16. Soil and groundwater will be sampled as part of these activities. Step-out/step-down procedures will be followed as applicable. Groundwater samples will not be collected in the SWBZ unless dictated by the groundwater step down procedures because the BSU is continuous in this area and contaminant levels are low in the area of the former UST. The contaminant levels in the FWBZ at the former UST 608-1 have been dropping substantially over the last two years illustrated by quarterly sampling of FWBZ monitoring well 608MJ-MW2. This is the closest monitoring well to the former UST location. The concentration of cis 1,2-DCE has dropped from approximately 65 ug/L in the fall of 2004 to 1.6 ug/L in the summer of 2006. The concentration of PCE in the same time frame dropped from approximately 50 to 14.0 ug/L. PCE was the only chlorinated hydrocarbon above MCLs during the summer 2006 round of sampling.

Comment 13

<u>Section 5.2.1 – Site 9 Data Gap Investigation</u>. *This section states that there are 12 data gaps including 4 SWMUs located within IR Site 9. However, two of the SWMUs listed (OWS-547 and AOC 009) are not located at IR Site 9. Please correct the information provided in this section regarding the number of SWMUs and data gaps at IR Site 9.*

Response 13

These sites were discussed in Site 9 in error. OWS-547 is located in Site 22 and AOC-009 is located in Site 13. The Draft Final Work Plan for OU-2A/2B has been edited and the discussions have been moved to the appropriate sections. Associated tables and figures were also reviewed and updated, as necessary, to reflect these edits.

Comment 14

<u>Section 5.2.1.3 – Site 9 Metals in Soil Investigation (Data Gap 18)</u>. *The comments with respect to metals in soil (comments on Data Gaps 12 and 18 on Table 1-4) discuss chromium, arsenic, aluminum, and lead elevated above background, not above screening levels. The scope of investigation for Data Gap 18 should be expanded to include metals in soil that are elevated above background such as chromium and lead, in addition to arsenic.*

Response 14

As was discussed in the response for General Comment A, metals concentrations in soil will be initially compared to PRGs. If the detected concentration exceeds the PRG, the concentration will be compared to site background concentrations. For the Draft Work Plan, the previous metal results in Site 9 were reviewed and areas with exceedances of the PRG and/or background concentrations were proposed for further investigation. The historical sampling results were reviewed again for the Draft Final Work Plan for OU-2A/2B and any areas not previously investigated were added.

Comment 15 *Section 5.2.1.4 – Site 9 Groundwater Investigation (Data Gaps 11, 12, 13,14, and 17).*

a. *The CSMs for IR Site 9 (Figures 5-13 and 5-16) illustrate the BSU as a silty clay, but the cross-sections in Appendix B show that the BSU is comprised of silty sands, clayey sands, and sandy clays beneath IR Site 9. The composition of the BSU has implications to the CSM because the more permeable lithologies can allow contaminant transport to deeper water-bearing zones. Also, the contaminant plumes shown on the CSMs do not accurately reflect the dissolved contaminant distribution at IR Site 9, particularly in the downgradient direction. GSU requests that a single CSM is presented for IR Site 9 that more accurately depicts lithology and contaminant distribution (see General Comment F).*

b. *The rationale for the proposed number, depths, and locations of groundwater sampling (DPT points and monitoring wells) must be provided. It is not possible for GSU to evaluate the proposed sampling approach for the groundwater investigation without this information (see General Comment D).*

c. *Please provide a figure showing the plume contours to illustrate the horizontal distribution of VOCs in the SWBZ. Please clarify whether the vertical extent of groundwater contamination beneath the site has been defined or will be defined by this investigation.*

Response 15 a. Please see Response to General Comment F.

b. Please see Response to General Comment D.

c. Figures including plume contours for the FWBZ are provided in the Draft Final Work Plans for OU-1 and OU-2A/2B groundwater sites. There are SWBZ plume maps provided for OU-2B sitewide groundwater. SWBZ groundwater plume maps will not be supplied for the remaining areas because of limited contamination and limited groundwater data in the SWBZ. SWBZ plume maps will be provided as appropriate as an end product of the performance of data gap investigation activities. The vertical extent of SWBZ groundwater contamination will be determined from proposed SWBZ monitoring wells and through the updated step-down groundwater sampling criteria.

Comment 16 *Section 5.2.2 – Site 13 Data Gap Investigation. Please clarify that AOC 009 is a fourth data gap located within IR Site 13.*

Response 16 AOC 009 was discussed as part of the Site 9 investigation in error. AOC 009 has been moved to the Site 13 investigation discussion in the Draft Final Work Plan for OU-2A/2B.

Comment 17 _Section 5.2.2.3 – Site 13 Groundwater Investigation (Data Gap 21)._

a. *The CSM for IR Site 13 (Figure 5-19) illustrates the BSU as a silty clay, but the cross-section in Appendix B indicates that the BSU beneath IR Site 13, where present, is predominantly silty sand. Also, the CSM illustrates a plume that extends across the width of the site, but Figure 5-20 shows two plumes that are disconnected. The CSM should be revised to present a more accurate depiction of lithology and contaminant distribution (see General Comment F).*

b. *The rationale for the proposed number, depths, and locations of groundwater sampling (DPT points and monitoring well) must be provided. It is not possible for GSU to evaluate the proposed sampling approach for the groundwater investigation without this information (see General Comment D).*

Response 17

a. Please see Response to General Comment F.

b. Please see Response to General Comment D.

Comment 18 _Section 5.2.3.2 – Site 19 Groundwater Investigation (Data Gap 22)._

a. *The CSM for IR Site 19 (Figure 5-21) illustrates the BSU as a silty clay, but the cross-section in Appendix B indicates that the BSU beneath IR Site 19, where present, is predominantly silty sand, clayey sand, and sandy silt. The CSM should be revised to present a more accurate depiction of lithology (see General Comment F).*

b. *The rationale for the proposed number, depths, and locations of groundwater sampling (DPT points and monitoring wells) must be provided. It is not possible for GSU to evaluate the proposed sampling approach for the groundwater investigation without this information (see General Comment D).*

Response 18

a. Please see Response to General Comment F.

b. Please see Response to General Comment D.

Comment 19 _Section 5.2.4 – Site 22 Data Gap Investigation_. *Please clarify that OWS-547 is a third data gap located within IR Site 22.*

Response 19 OWS-547 was discussed as part of the Site 9 investigation in error. OWS-547 has been moved to the Site 22 investigation discussion in the Draft Final Work Plan for OU-2A/2B. The Work Plan has also been revised to clarify that OWS-547 is a third data gap within IR Site 22 and will be investigated using the general sampling approach detailed in Section 4 of the Draft Final Work Plan for OU-2A/2B.

Comment 20 _Section 5.2.4.2 – Site 22 Groundwater Investigation (Data Gap 26)._

a. *The CSM for IR Site 22 (Figure 5-24) illustrates the BSU as a silty clay, but the cross-section in Appendix B indicates that the BSU beneath IR Site 22, where present, is predominantly silty sand and clayey sand. The CSM should be revised to present a more accurate depiction of lithology (see General Comment F).*

b. *The rationale for the proposed number, depths, and locations of groundwater sampling (DPT points and monitoring wells) must be provided. It is not possible for GSU to evaluate the proposed sampling approach for the groundwater investigation without this information (see General Comment D).*

Response 20

a. Please see Response to General Comment F.

b. Please see Response to General Comment D.

Comment 21 _Section 5.2.5.2 – Site 23 Groundwater Investigation (Supplemental Data Gap)._

a. *The CSM for IR Site 23 (Figure 5-26) illustrates the BSU as a silty clay, but the cross-section in Appendix B indicates that the BSU beneath IR Site 23, where present, is predominantly silty sand and clayey sand. The CSM should be revised to present a more accurate depiction of lithology (see General Comment F).*

b. *The rationale for the proposed number, depths, and locations of groundwater sampling (DPT points) must be provided. It is not possible for GSU to evaluate the proposed sampling approach for the groundwater investigation without this information (see General Comment D).*

Response 21

a. Please see Response to General Comment F.

b. Please see Response to General Comment D.

Comment 22

Section 5.3 – OU-2B Data Gap Investigation. Please clarify in this section that the groundwater data gaps identified at each OU-2B site will be addressed using a site-wide approach.

Response 22

The appropriate site-specific sections of the Draft Final Work Plan for OU-2A/2B have been clarified to indicate that the groundwater data gaps identified at each OU-2B site will be addressed using a site-wide approach.

Comment 23

Section 5.3.1 – Site 3 Data Gap Investigation. Table 1-4 identifies Former Building 109 as a data gap at IR Site 3 (Data Gap 27). However, this data gap does not appear to be addressed in the DWP. Please add the proposed sampling approach and rationale for Data Gap 27 to the draft final Work Plan.

Response 23

The appropriate section of the Draft Final Work Plan for OU-2A/2B has been revised to include Former Building 109 as a data gap at IR Site 3. In addition, a section has been added to provide a discussion of the proposed sampling approach and rationale.

Comment 24

Section 5.3.2.3 – Site 4 Building 360 Soil Investigation (Data Gaps 31 and 33).

a. Please provide a reference for the 1998 follow-on investigation described in the fourth paragraph on page 5-34.

b. Please describe the approach that will be used to evaluate metals contamination in soil identified in sample B04-41 on the north side of Building 360 (Data Gap 31).

c. The rationale for the proposed number, depths, and locations of soil and groundwater sampling must be provided. It is not possible for GSU to evaluate the proposed sampling approach for the soil and groundwater investigation without this information (see General Comment D).

Response 24

a. This reference has been added to the Draft Final Work Plan for OU-2A/2B.

b. Shaw is currently performing Six-Phase Heating remediation at Building 360. Additional characterization of metals contamination will be needed at this location. Sampling required for the additional characterization of Building 360 will be coordinated with Shaw. The timing of sampling, which contractor will take the samples and where the results of sampling will be reported will depend on the field schedules for the OU-2A/2B field work and Shaw activities.

c. Please see Response to General Comment D.

Comment 25

<u>Section 5.3.3 – Site 11 Data Gap Investigation</u>. Table 1-4 identifies the source of trichloroethene in well MW03-15 as Data Gap 37 at Site 11. However, this data gap does not appear to be addressed in the DWP. Please add the proposed sampling approach and rationale for the investigation of Data Gap 37 to the draft final Work Plan.

Response 25

Concur. Investigation of source of TCE in well MW03-15 will be added to the Draft Final Work Plan for OU-2A/2B.

Comment 26

<u>Section 5.3.5 – OU-2B Site-Wide Groundwater (Data Gaps 29, 43, 44, and 45)</u>.

a. This section does not discuss the proposed scope of work to investigate elevated levels of dissolved lead found in groundwater on the northern portion of IR Site 3 near Building 517 (Data Gap 29). This groundwater contamination is not commingled with the VOC plumes shown on Figure 5-39. A separate scope of work to investigate the dissolved lead at IR Site 3 should be included in the draft final Work Plan.

b. The CSM for OU-2B (Figure 5-38) illustrates the BSU as a silty clay. This interpretation is oversimplified and is inconsistent with lithologic information shown on the cross-sections in Appendix B. Also, there are two relatively large dense non-aqueous phase liquid (DNAPL) source zones at OU-2B that are not shown on the CSM. Finally, the depth of contamination illustrated on the CSM for OU-2B is inaccurate. Contamination extends well below the base of the BSU. GSU requests that the CSM is revised to present a more accurate depiction of lithology and contaminant distribution (see General Comment F).

c. It should be noted that there are discrepancies in the nomenclature used for hydrogeologic units between the DWP and the RI (SulTech, 2005) and BGMP (ITSI, 2006). The DWP refers to the interval from 20 to 40 feet bgs as the SWBZ (Figure 5-40), while the RI and BGMP refer to this same interval as the FWBZ. The DWP reverts back to the RI/BGMP nomenclature in Table 5-1 for wells screened in this interval (see wells M03-10, M03-12, M03-13, and M03-15). Incidentally, well M03-16, which is a key downgradient monitoring well in this interval, and wells M03-11 and M03-14, which are upgradient and cross-gradient control wells, respectively, are not included on Table 5-1. These wells and other key wells that may be missing from Table 5-1 should be *added. The nomenclature for the hydrogeologic intervals at OU-2B should be re-evaluated in the Data Summary Report.*

d. *A considerable number of new FWBZ and SWBZ monitoring wells are proposed for this investigation. However, GSU cannot concur with this approach because the basis for the proposed locations and depths is not provided. For example, GSU questions the need for the 19 proposed FWBZ monitoring wells. The current monitoring network is comprised mostly of FWBZ wells that, except in immediate VOC source areas, are relatively unimpacted (ITSI, 2006). The data from the RI and other comprehensive studies performed at OU-2B (Tetra Tech EM Inc. and Einarson, Fowler, and Watson, 1998) indicate that the majority of the chlorinated VOC contamination is migrating through deeper intervals (between 20 and 40 feet bgs). However, there are very few monitoring wells screened in this interval. The three downgradient monitoring wells that are screened in this interval (M03-10, M03-15, and M03-16) exhibit some of the highest levels of VOCs found in monitoring wells at OU-2B (ITSI, 2006). This deeper interval and the vertical extent of VOC contamination should be the focus of the proposed investigation. FWBZ monitoring wells may be needed, however, to delineate the extent of benzene and lead at IR Site 3.*

e. *Based on current research regarding the character of dissolved plumes emanating from DNAPL source zones, it is likely that the majority of dissolved contaminant mass in the groundwater at OU-2B occurs in relatively narrow, linear, high-strength plume centers. Judgmental placement of broadly-spaced monitoring wells is not an effective way to characterize such plumes. Recent studies have shown the success of high-resolution monitoring techniques, such as multi-level monitoring transects, to enhance the understanding of contaminant distribution and mass-flux from source areas. This has been shown to be an important tool for evaluating the success of source removal and determining the possible success of monitored natural attenuation (Guilbeault et al., 2005).*

GSU requests that the Navy consider using multi-level monitoring transect(s) perpendicular to the plume axis immediately downgradient from the DNAPL source zones to identify high-strength plume cores and estimate mass-flux as part of the remedial design. Regardless of the selected approach, the rationale for the proposed number, depths, and locations of groundwater monitoring wells must be provided. It is not possible for GSU to evaluate the *proposed sampling approach for the groundwater investigation without this information (see General Comment D). The rationale for the sampling network at OU-2B should be amended to be consistent with Strategies for Monitoring the Performance of DNAPL Source Zone Remedies (Interstate Technology and Regulatory Council, 2004).*

Response 26

a. The Draft Final Work Plan for OU-2A/2B has been updated to include an investigation of lead in groundwater near building 517.

b. Please see Response to General Comment F.

c. The discrepancies in the nomenclature have been corrected and well M03-16 have been added to the appropriate table in the Draft Final Work Plan for OU-2A/2B. Wells M03-11 and M03-14 have not been added to the work plan because they are both outside the area of contamination and have not had chemical exceedances in the last several years of basewide sampling results.

d. The groundwater step-down procedure at DPT and monitoring well locations will be employed to assure that the base of the groundwater contamination has been identified at each location. In areas such as Site 3 where the groundwater contamination is in the Upper Merritt sands monitoring wells designated as FWBZ in the Draft Final Work Plan for OU-2A/2B may be changed to SWBZ wells depending on field observations.

e. Multiple levels of groundwater monitoring wells will be installed throughout OU-2B to determine the vertical and horizontal extent of the groundwater plume. In addition, more discrete multi-level monitoring wells will be installed in at a least 3 locations to determine whether there are any high concentration plume centers emanating from the DNAPL source areas.

Comment 27

<u>Section 7.13 – Quarterly Groundwater Monitoring Well Sampling</u>. Please clarify in this section and in the appropriate sections of the SAP, the plan for newly constructed groundwater monitoring wells following the four quarters of sampling. Does the Navy plan to incorporate these wells into the BGMP?

Response 27

The wells included in the BGMP are re-evaluated on an annual basis. Whether any of the newly installed wells will be added to the BGMP will be evaluated after the four rounds of sampling proposed in the Draft Final Work Plan for OU-2A/2B.

HERD COMMENTS ON
DRAFT SAMPLING AND ANALYSIS PLAN
(FIELD SAMPLING PLAN AND QUALITY ASSURANCE PROJECT PLAN)
FOR OU-1, OU-2A, AND OU-2B DATA GAP SAMPLING
DATED NOVEMBER 10, 2006
ALAMEDA POINT
ALAMEDA, CALIFORNIA

Comments dated: January 8, 2007

Comments by: James M. Polisini, Ph.D.
Staff Toxicologist, HERD

GENERAL COMMENTS

Comment 1: *Significant portions of the sampling methodology and groundwater plume characterization require the review and concurrence of the DTSC Geological Services Unit (GSU) or a DTSC hydrogeologist. The comments contained in this memorandum address only the risk assessment implications of the outlined work plan. However, use of a two times (2x) the health-based screening criteria for identification of the boundary of a groundwater plume is contrary to standard procedure to characterize a groundwater plume to detection limits and has the potential to underestimate the risk and/or hazard associated with any exposure to groundwater. Groundwater plume characterization should be performed to detection limits.*

All the proposed groundwater screening criteria are based on human health values. Unless sufficient justification is provided, demonstrating that Operable Unit-1 (OU-1), OU-2B and OU-2A groundwater is not in communication with the surface water of San Francisco Bay, ecologically-based screening criteria must also be considered when evaluating the potential impact of the groundwater plumes under investigation.

The document reviewed is, according to the cover page, an appendix (Appendix A) to a Draft Work Plan. References to material (e.g., tables or figures) contained only in the main text of the Work Plan, but excluded from this appendix, must be clearly referenced.

As this is a data gaps work plan, some justification must be provided where biased sampling is proposed. For example, a simple statement that four samples will be collected to the east, west, north and south of a point of interest or only at the inflow point for a tank, but not at the *outflow point, are not sufficient to evaluate the proposed level of sampling.*

Response 1: Groundwater plume definition will be performed to MCLs (see Response to General Comment E, DTSC GSU). The Draft Final Work Plans for OU-1 and OU-2A/2B have been revised and include a definitive rationale for the selection of soil, monitoring well and direct-push locations (see Response to General Comment D, DTSC GSU).

SPECIFIC COMMENTS

Comment 1: *Sites 14 and 15, although included in the list of OU-1 sites (Section 1.0, page A.1-1), are not included as part of the scope of work outlined. Some rationale must be provided for dropping OU-1 Sites 14 and 15 from the data gaps work plan.*

Response 1: Sites 14 and 15 have been separated from the other OU-1 sites and have their own separate RODs. Site 15 is now closed and Site 14 is being addressed with its own data gaps work plan.

Comment 2: *The proposed screening criteria (Section 1.2, page A.1-2) are U.S. EPA Region 9 Preliminary Remediation Goals (PRGs) for soil and California Department of Health Services (DHS) drinking water Maximum Contaminant Levels (MCLs) for groundwater. Exclusive use of these two sources raises several risk assessment issue:*

a. *Unless sufficient justification is provided, demonstrating that OU-1, OU-2A and OU-2B groundwater is not in communication with the surface water of San Francisco Bay, ecologically-based screening criteria must also be considered when characterizing and evaluating the groundwater plumes under investigation. Ecologically-based water screening criteria should include Federal National Ambient Water Quality Criteria (NAWQC) and California Water Quality Objectives (WQO).*

b. *DHS drinking water MCLs are not strictly risk-based, but include risk management considerations, and therefore cannot be directly used to provide an estimate of cancer risk and/or non-cancer hazard. Risk-based water concentrations (e. g., U.S. EPA Region 9 tapwater PRGs [EPA, 2004]) could be used to determine the potential risk and/or hazard associated with potential exposure to groundwater contaminants as an interim step toward a full Human*

Health Risk Assessment (HHRA). HERD recommends that groundwater plumes be characterized to detection limits as health based tap water criteria can, on occasion, be below detection limits.

c. *Shallow groundwater depths occur throughout NASA. Exposure to groundwater contaminants via the indoor air inhalation pathway can contribute significant risk and/or hazard for NASA sites. DHS MCLs and EPA Region 9 PRGs do not include exposure via inhalation of indoor air. The groundwater screening criteria must include all COPCs, based on physical characteristics and toxicity, likely to contribute to indoor air exposure at NASA-specific concentrations.*

d. *In addition to DHS drinking water MCLs, Unregulated Chemicals Requiring Monitoring (UCRM) (http://www.dhs.ca.gov/ps/ddwem/chemicals/unregulated/index.htm) should be reported. The Office of Environmental Health Hazard Assessment (OEHHA) Public Health Goals (PHGs) (http://www.oehha.ca.gov/water/phg/index.html) are risk-based concentrations which should be used for chemicals lacking MCLs or to aid estimation of risk and/or hazard associated with groundwater after characterization is completed. A summary table of MCLs, UCRM and PHGs is available (http://www.dhs.ca.gov/ps/ddwem/chemicals/phgs/chemicalinformation.htm).*

Groundwater plume characterization should be performed to detection limits and isopleths of risk and/or hazard be developed for risk management use after full characterization. Any groundwater concentration can be selected for monitoring groundwater fate and transport.

Response 2:

a. The possibility of the groundwater being in direct contact with the surface water will be evaluated as part of data gap investigation activities. Ecological-based water screening criteria will not be used at this time. The objective of the Draft Final Work Plans for OU-1 and OU-2A/2B is to define the lateral and vertical extent of the groundwater plumes for the purposes of remediation design and implementation.

b. A human health risk assessment was previously performed as part of RI activities at these sites. Groundwater contamination will be delineated to MCLs for the purposes of remedial design and implementation.

c. A human health risk assessment was previously performed as part of RI activities at these sites. Groundwater contamination will be delineated to MCLs.

d. Since a risk assessment will not be performed as part of the activities at these sites, the use of the other risk-based numbers will not be required.

Comment 3: *A groundwater concentration of two times the health-based screening criteria (Table A.7-2) is proposed as the comparison criteria for the boundary of the groundwater plume (Section 1.2, page A.1-2). HERD defers to the DTSC GSU, or a DTSC hydrogeologist, regarding the suitability of two times the health-based criteria for monitoring the fate and transport of a groundwater Contaminant of Potential Concern (COPC). However, the risk assessment implications of this proposal are that some unidentified mass of groundwater would exceed health-based criteria creating another risk assessment gap. HERD recommends that groundwater plume characterization be performed to detection limits. Risk-based water criteria (e.g., U.S. EPA Region 9 tapwater PRGs) which can be used to estimate risk and/or hazard can then be used to monitor fate and transport of groundwater COPCs if deemed advisable.*

Response 3: The lateral and vertical extent of groundwater plumes will be characterized using MCLs as discussed in the response to the previous comment which is outlined in the text and tables of the Draft Final Work Plans for OU-1 and OU-2A/2B.

Comment 4: *HERD defers to the DTSC GSU, or a DTSC hydrogeologist, regarding the suitability of the 20 times criterion (Section 1.2, page A.1-3) to assess the potential for groundwater COPCs in the First Water Bearing Zone (FWBZ) to migrate to the Second Water Bearing Zone (SWBZ). This is not a risk assessment issue, except to note that 20 times a true risk-based concentration would equate to a cancer risk of* $2x10^{-5}$ *or a non-cancer Hazard Quotient (HQ) of 20.*

Response 4: Vertical delineation of groundwater contamination will be characterized to MCLs as discussed in the response to Comment 2.

Comment 5: *The copy furnished for HERD review does not appear to contain a Figure A.5-1 in the Data Quality Objectives (DQO) for Oil Water Separators (OWS) (Table A.3-1, page 1 of 10, Step 3). Please correct this reference or include the referenced figure.*

Response 5: Comment noted.

Comment 6: *It appears that step-down groundwater sampling will not be pursued for OWS regardless of the results of the groundwater results (Table A.3-1, page 1 of 10, Step 4). Please provide the justification for proscribing step-down sampling.*

Response 6: Step-down groundwater sampling will be pursued at all SWMU locations. The Draft Final Work Plans for OU-1and OU2A/2B have been amended.

Comment 7: *The presence of concentrations of COPCs which are less than risk-based criteria does not mean facilities 'have not leaked contaminants to the environment' (Table A.3-1, page 1 of 10, Step 5). Please amend this statement to indicate that the facility in this case has not leaked contaminants to the environment at concentrations causing risk and/or hazard above acceptable levels. The conclusion regarding concentrations less than screening criteria should be amended at each occurrence in addition to the one identified.*

Response 7: Concur. This correction has been incorporated throughout the Draft Final Work Plans for OU-1 and OU-2A/2B.

Comment 8: *Evaluation of Underground Storage Tanks (USTs) and Aboveground Storage Tanks (ASTs) should include samples at both ends of the excavation for removed USTs or ASTs or at the inflow and outflow point, if known, regardless of size (Table A.3-1, page 2 of 10 and 3 of 10, Step 4). Please amend the text to remove the single sample collection for USTs or ASTs less than 20, 000 gallons.*

Response 8: There is insufficient background information for each former UST or AST to locate inflow or outflow locations. However, the decision rules have been amended in each Draft Final Work Plan to more clearly discuss the investigation approach for ASTs/USTs. Both ends of ASTs/USTs with capacities greater than 5,000 gallons will be investigated with at least 2 borings.

Comment 9: *Please provide justification for outlining a 'no deeper than' criterion for soil samples from USTs (Table A.3-1, page 2 of 10, step 4). In a data gap work plan, it would seem reasonable to continue to sample soil in the event obvious signs (e.g., staining) of a release are apparent or until groundwater is encountered.*

Response 9: To clarify, the "no deeper than" criterion applies only to the initial sampling. The objective is to collect the initial unsaturated soil sample at approximately the former or current depth of the base of the UST. Further sampling will be performed based on the step-out procedure outlined in the Draft Final Work Plans for OU-1 and OU-2A/2B, including encountering obvious signs of a release. The language in the Draft Final Work Plans for OU-1 and OU-2A/2B was edited to clarify the sampling approach.

Comment 10: *It appears that step-down groundwater sampling will not be pursued for USTs or ASTs regardless of the results of the groundwater results (Table A.3-1, page 3 of 10, Step 4). Please provide the justification for proscribing step-down sampling.*

Response 10: Please see Response to Comment 6.

Comment 11: *Please describe how two samples will be obtained 'at random' for Generator Accumulation Points (GAPs) 100 square feet to 250 square feet in size (Table A.3-1, page 4 of 10, Step 4) or one sample within each third of GAPs greater than 250 square feet.*

Response 11: The word "randomly" was removed from the text to avoid confusion and the text was edited for clarity. At least three samples will be collected from these GAPs greater than 250 square feet in size.

Comment 12: *It appears that step-down groundwater sampling will not be pursued for GAPs regardless of the results of the groundwater results (Table A.3-1, page 4 of 10, Step 4). Please provide the justification for proscribing step-down sampling.*

Response 12: Please see Response to Comment 6.

Comment 13: *Washdown Areas (WDs) are initially described as having 'not been investigated' (Table A.3-1, page 5 of 10, Step 1), but then are grouped because of 'the nature of known contamination in the area' (Table A.3-1, page 5 of 10, Step 4). Please correct this apparent contradiction.*

Response 13: The text has been revised to more clearly describe the rationale for evaluating WDs. The contradictions in the text and appropriate tables have been corrected in the Draft Final Work Plan for OU-1.

Comment 14: *The proposed sampling grid for WDs was developed so that there is a 95 percent probability of detecting a release with a radius of 30 feet (Table A.3-1, page 5 of 10, Step 6). The DTSC Project Manager should determine whether this level of detail is sufficient based on site use history of the WDs under investigation. This comment is meant for the DTSC Project Manager and no response is required from the Navy or Navy contractor.*

Response 14: The WD sampling has been revised in the Work Plan and differs from the previous version.

Comment 15: *Please describe the process by which a subset of the soil investigation sites (Table A.3-1, page 6 of 10, Step 3) were selected for GORE soil gas surveys (i.e., Site 7 and Site 3).*

Response 15: GORE soil gas surveys have been removed from the Draft Final Work Plans for OU-1 and OU-2A/2B.

Comment 16: *As the GORE Module results are only a qualitative measure of Volatile Organic Compounds (VOCs) some NASA-specific base level response must be developed. Please describe the location and collection of GORE Module samples at relatively uncontaminated sites so that 'hot spots' (Table A.3-1, page 6 of 10, Step 2, Step 4 and Step 5) can be identified by comparison to GORE Module measurements at relatively unimpacted sites.*

Response 16: GORE soil gas surveys have been removed from the Draft Final Work Plans for OU-1 and OU-2A/2B.

Comment 17: *Given the qualitative nature of the GORE Module results, variance in collection of unsaturated soil samples for possible comparison to GORE Module results would seem undesirable for inter-sample comparison. Please provide the justification for the allowable variance in depth of unsaturated soil samples of 'every 3 to 5 feet' (Table A.3-1, page 6 of 10, Step 4).*

Response 17: GORE soil gas surveys have been removed from the Draft Final Work Plans for OU-1 and OU-2A/2B.

Comment 18: *The Groundwater Investigation DQOs (Table A.3-1, page 9 of 10) are a hybrid of groundwater characterization and relative risk evaluation. Multiples of 2 times and 20 times health-based criteria previously proposed in this document are now supplemented by a 200 times screening criterion (Table A.3-1, page 9 of 10, step 4) for placement of new SWBZ wells. As stated above, groundwater characterization should be performed to detection limits. Any potential health risk and/or hazard associated with groundwater can be presented after full characterization.*

Response 18: Please see Response to Comment 3.

Comment 19: *Multiple organic compounds are specified when describing the sampling strategy for the OU-1, OU-2A and OU-2B SWMUs, OWSs (Section 5.1.1, page A.5-2), USTs and ASTs (Section 5.1.2, page A.5-*

3), GAPs (Section 5.1.3, page A.5-5) and WDs (Section 5.1.4, page A.5-6). Naphthalene, when considered for carcinogenic effects, has a significant impact on the total incremental cancer risk via the indoor air inhalation pathway at NASA due to shallow groundwater. Naphthalene must be measured in all media samples where Semivolatile Organic Compounds (SVOCs) or VOCs are measured. HERD recommends that naphthalene be specifically listed as a reportable analyte for all SWMUs and groundwater investigations (Section 5.2, page A.5-7 through A.5-53) where applicable.

Response 19: Naphthalene is typically reported in the SVOC analyte list and will be included as a reportable analyte for all SWMUs, soil, and groundwater investigations, where applicable. Naphthalene is listed in tables in the SAPs for the Draft Final Work Plans for OU-1 and OU-2A/2B.

Comment 20: *Please specify the type of microbial parameters which will be measured in saturated soil samples (e.g., Section 5.1.4, page A.5-7 or Section 5.2.2, page A.5-11).*

Response 20: The Draft Final Work Plans for OU-1 and OU-2A/2B have been edited to incorporate this comment. Microbial parameters for chlorinated contamination will include cell counts for Eubacteria (EBAC), *Dehalococcoides* spp. (DHC), and methanogenic bacteria (MGN) via nucleic acid analysis, and total biomass and microbial community structure via ester-linked phospholipid fatty acid (PFLA). Microbial parameters for petroleum based contamination will include qEBAC, qPAH, qNAH and qBSS.

Comment 21: *HERD defers to the DTSC GSU, or a DTSC hydrogeologist, regarding the 1 year limit on sampling of new groundwater wells stated for most, if not all, groundwater investigations (e.g., Section 5.2.1, page A.5-10).*

Response 21: Comment noted.

Comment 22: *Please correct the typographic error which indicates that 'groundwater samples will be analyzed for NA parameters and microbial parameters' (Section 5.2.3, page A.5-12). The NA entry is not defined and does not appear to belong in this section of text.*

Response 22: NA is an acronym for natural attenuation and was defined in Section 5.1.1. However, to avoid confusion, the acronym will not be used in the Draft Final Work Plans for OU-1 and OU-2A/2B.

Comment 23: *OU-1 Site 16 was identified by stained floors with possible contamination of soil beneath some CANs units (Section 5.2.7, page*

A.5-16). The list of chemical analyses for unsaturated soil samples includes VOCs, PCBs, pesticides and Title 22 elements (Section 5.2.7, page A.5-17). Saturated soil samples and groundwater samples, if collection is possible, are scheduled to be analyzed for PCBs, pesticides and Title 22 elements. Notice of staining is chemically non-specific, no history of use is provided and, therefore, no information is provided to restrict the suite of analytes. SVOCs should be included in the analysis for unsaturated soils and VOCs and SVOCs should be included in the analysis for saturated soils and/or groundwater. A full suite of analyses should be performed for all samples unless prior chemical results, history of use, or known extension of contamination from an adjacent site or facility (e.g., a known groundwater plume) is provided as justification to restrict the chemical analysis.

Response 23: The Draft Final Work Plan for OU-1 has been amended to more clearly indicate that the selection of COCs was based on the ROD, which selected COCs based on site history, previous results, and/or other relevant site background.

Comment 24: *The open side of the OU-2A, Site 9 Wash Rack (Section 5.2.9, page A.5-20) would seem a reasonable location for soil samples in addition to below any cracks or open joints. Additional soil samples should be taken in the area of the open side.*

Response 24: Field sampling locations will be determined by visual inspection to determine the best sampling location based on the physical condition of the wash rack. Clarification to this effect has been added to the text and DQO table in the Draft Final Work Plan for OU-2A/2B.

Comment 25: *Site-by-site review of the proposed sampling procedures for the remaining sites are not provided (Section 5.2.12, page A.5-22 through A.5-53). General comments provided above (e.g., a full suite of analysis lacking sufficient justification to reduce the suite of analysis) should be applied to sampling at all remaining sites.*

Response 25: The appropriate sections of the Draft Final Work Plan for OU-2A/2B have been revised to more clearly reflect that sites will be investigated based on the COCs identified in the previous RIs.

Comment 26: *After 13 years of investigation (1991 – 2004) 'liquid was discovered in concrete vats located inside the Building 360 plating shop' (Section 5.2.24, page A.5-43). The liquid in these vats contained chromium, hexavalent chromium, cadmium and cyanide. Any groundwater samples collected as part of the monitoring activities for the Six Phase Heating (SPH) pilot study for remediation of Dissolved Phase Non-*

Aqueous Phase Liquid (DNAPL) and dissolved phase contaminants must also be analyzed for a full suite of inorganic elements.

Response 26: Please see Response 'b" to DTSC GSU Comment 24.

Comment 27: *Analyzing step out samples only for the COPC which exceeds any screening criteria has the potential to lead to more data gaps. At a minimum, step out samples should include the full suite of COPCs in the group which exceeded any screening criteria (e.g., all SVOCs if benzo(a)pyrene exceeded some screening criteria). Step down samples are proposed to be analyzed for the full suite of analytes specified for the specific area (Section 5.3, page A.5-53).*

Response 27: Step-out/step-down samples will be analyzed for the full suite of analytes in the applicable EPA method. For example, if step-out or step-down samples are required to further investigate an elevated PCE detection, the sample will be analyzed for VOCs and all analytes for the VOC method will be reported. Conversely, if the original sample yielded no elevated concentrations of metals, metals analyses would not be performed on the step-out/step-down sample.

Comment 28: *The work plan states that GORE Modules, for passive soil gas evaluation, will be left in place for two to four weeks (6.3.1, page A.6-4). Please state that the period of deployment must be the same for all GORE Modules.*

Response 28: GORE soil gas surveys have been removed from the Draft Final Work Plans for OU-1 and OU-2A/2B.

Comment 29: *HERD defers to the DTSC GSU, or a DTSC hydrogeologist, for review of the groundwater sampling procedures (Section 6.3.3, pages A.6-7 through A.6-22).*

Response 29: Comment noted.

Comment 30: *The work plan currently states that duplicate soil samples will not be collected due to the heterogeneity of the soil matrix (Section 7.3, page A.7-9) while duplicate groundwater samples will be collected. Some small number of duplicate soil samples should be collected within the same soil type to measure the consistency of field sampling.*

Response 30: Due to the heterogeneity of soil, duplicate samples are not statistically reliable, whether few or many are collected. As such, no duplicate samples for soil will be collected.

Comment 31: *Negative Chemical Abstract Service (CAS) numbers appear in the listing of laboratory quantitation limits, method detection limits (MDLs) and Quantitation Limits (QLs) (Table A.7-1). Please correct these typographic errors or indicate in a footnote that they are place holders for Total Petroleum Hydrocarbon (TPH) and other categories (e.g., Total Organic Carbon).*

Response 31: For analytes where no CAS number has been established, NEDD valid values (which are negative numbers) were used.

Comment 32: Please indicate the source of the chlorinated dioxin equivalency factors used to develop the proposed screening criteria (Table A.7-1, footnote i).

Response 32: Dioxins were originally proposed for OU-2A, Site 13, Incinerator soil investigation, but previous analytical results were non-detect. Therefore, dioxin analysis will be removed from the list of analyses for this site.

Comment 33: *A subset of the soil screening criteria (Table A.7-1) and the groundwater screening criteria (Table A.7-2) were checked, bearing in mind that the MCLs are not strictly risk-based concentrations, and found to be arithmetically correct. As stated above, characterization of groundwater contamination or plumes should be performed to detection limits with later presentation of risk and/or hazard, preferably as risk and/or hazard isopleths for each exposure scenario.*

Response 33: As was stated in previous responses to comments from DTSC GSU and HERD, the sampling results will be compared to PRGs, MCLs, and/or background concentrations, as appropriate.

EPA COMMENTS ON
DRAFT DATA GAP SAMPLING WORK PLAN
FOR OU-1, OU-2A, AND OU-2B
DATED NOVEMBER 3, 2006
ALAMEDA POINT
ALAMEDA, CALIFORNIA

Comments dated: January 29, 2007

Comments by: Anna-Marie Cook
U.S. Environmental Protection Agency
Remedial Project Manager

GENERAL COMMENTS

Comment 1 *Natural Attenuation parameters are mentioned generally in the text of Section 5 of the Draft Data Gap Sampling Work Plan for OU-1, OU-2A, and OU-2B (the Work Plan) but the specific parameters that are considered to be appropriate measures of Natural Attenuation are not listed. Please specify the natural attenuation parameters in the text of the document.*

Response 1 A full list of the natural attenuation parameters has been included in the appropriate sections of the SAPs in the Draft Final Work Plans for OU-1 and OU-2A/2B.

Comment 2 *Throughout the Work Plan, flexibility in the sampling scheme is provided for through the use of "professional judgment" to determine things such as monitoring well placement, additional sampling locations, sample depths, and so on. While professional judgment is certainly an important asset during field work, and while it is impossible to predict every possible scenario prior to field operations, additional information regarding situations where professional judgment may be required and the criteria that will be used should be included in the Work Plan. These criteria should be developed using the data quality objectives (DQO) process. Please provide additional descriptions of decision logic, inputs, etc in cases where "professional judgment" may be in order. For example, rather than saying "additional first water bearing zone (FWBZ) monitoring wells may be installed using professional judgment based on the results of direct push technology (DPT) soil and groundwater sampling", please use the DQO process to develop specific criteria that will be used to* *determine whether another monitoring well is appropriate and revise the text to include these criteria.*

Response 2 In each Draft Final Work Plan, the DQO tables have been amended to incorporate the changes recommended in this comment. To the extent possible, the DQO table provides as many specific criteria as can be expected at this time. As such, it is possible that the investigation team will require input from project leaders and the project team may need to conference with agency representatives if an unforeseen condition is encountered.

Comment 3 *The 2 and 20 times screening criteria factors for groundwater plume delineation appear arbitrary; additional discussion and justification is needed to substantiate these numbers. In addition, please consider that in some cases the full vertical extent of a plume down to below MCLs needs to be delineated for remedial design purposes.*

Response 3 Please see Response to DTSC GSU Comment 7.

Comment 4 *Please clarify the discussion throughout the text regarding the FWBZ, the SWBZ and the BSU. For Sites 9, 13, 16, 19, 22, 23 and most of Site 4 the BSU is not present and there is no differentiation between the FWBZ and SWBZ. Most of these sites have groundwater contamination which needs fuller vertical and lateral delineation. The proposed method of installing wells in the "FWBZ" and the "SWBZ" and down to the BSU does not really apply, from a hydrogeologic standpoint, to these sites. Please revise while also keeping in mind that part of the reason for further investigation of the groundwater is to delineate the plumes to MCLs both laterally and vertically.*

Response 4 The discussion of delineation of groundwater contamination has been changed in each Draft Final Work Plan. The text and related DQOs indicate that groundwater will be delineated to MCLs laterally and vertically.

Comment 5 *Information presented on tables should be referenced and discussed in the corresponding text for consistency and readability. Throughout this report, the information presented in tables does not consistently match that discussed in the text. Additionally, in some cases, new information is presented, such as groundwater sampling at multiple depths, but not discussed in the text. When information is presented in this way, there is no opportunity to discuss the rationale behind these recommendations, and it is therefore difficult to evaluate their effectiveness. Specific comments are presented below.*

Response 5 Comment noted.

SPECIFIC COMMENTS

Comment 1 *Page 1-1, second paragraph: Suggest revising this paragraph to state that additional field work will be performed to assess the tarry refinery waste at Site 13 in order to complete the FS phase and support remedial design. Please include a description of the activities that will be performed in support of this goal and document where the results of the investigations will be presented so as to be used in the FS.*

Response 1 The tarry refinery waste is being investigated using a Site Characterization and Analysis Penetrometer System (SCAPS) and laser induced fluorescence under the data gap investigation for IR Site 13. A reference to the SCAPS investigation will be included in Draft Final Work Plan for OU-2A/2B discussion for Site 13.

Comment 2 *Page 1-2, first bullet: Please include that groundwater will also be investigated as part of the SWMU data collection activities.*

Response 2 The site-specific sections of each Draft Final Work Plan have been revised to include groundwater sampling as part of the SWMU data collection activities.

Comment 3 *Table 1-3a, OU-1 Solid Waste Management Unit Sampling Summary Table: In the last column the "Current Navy Sampling Recommendation" for Solid Waste Management Unit (SWMU) OWS-040B, should be more specific. The entry currently reads, "Characterization combined with OWS-040A," which appears to indicate that only one set of samples will be collected for both oil water separators (OWSs), however the recommendations should be described individually in this table. In addition, the recommendation for WD-040 indicates that this characterization is combined with OWS-40A and OWS-40B. Further, WD-041A is combined with OWS-041 and WD-114 was combined with OWS-114. The last column, the sampling recommendation, should include the media and number of samples each OWS, wash down (WD) area, and for underground storage tank (UST) UST (R)-18/NAS GAP 17. Please provide more detailed recommendations for these data gaps in Table 1-3a.*

Response 3 Table 1-3a has been removed from the Draft Final Work Plan for OU-1 and the individual data gaps are discussed in relevant sections in the text. Table 3-1 of the Draft Final Work Plan for OU-1 summarizes the number of samples and media for each of the SWMUs proposed for investigation.

Comment 4 *Table 1-4 Data Gap Sampling Summary:* *The text in the last column, Potential Field Activity, is missing the last lines of many of the entries. As a result, a complete review of this table is not possible. Please format the table so that all of the text is visible and if possible, provide it for Regulatory Agency review before the next version of the Work Plan is issued.*

Response 4 Comment noted.

Comment 5 ***Table 1-4 Data Gap Sampling Summary:*** *Data Gap No. 12 (page 4) includes defining the source and extent of metals in groundwater at Site 9 by performing additional data review, but Section 5.2.1.4 (Site 9 Groundwater Investigation) includes additional sampling to delineate groundwater contamination at Site 9. Please revise this recommendation in Table 1-4 to include additional sampling as a means to address Data Gap 12.*

Response 5 The sampling table will be revised to match the text of the Draft Final Work Plan for OU-2A/2B.

Comment 6 ***Table 1-4, Data Gap Sampling Summary Table; Table 1-6, Data Gap Summary Table; and Section 5.2.1.4 Site 9 - Groundwater Investigation (Data Gaps 11, 12, 13, 14, and 17), Pages 5-17 and 5-18:*** *The "Data Gap" column in Table 1-4 for Data Gap 11 states "The lateral and vertical extent of sitewide groundwater contamination including VOCs, SVOCs, PCBs, and metals has not been delineated." However, PCBs are not included in the analyses listed for this data gap on Table 1-6 nor are they mentioned in the text. Please resolve this discrepancy.*

Response 6 PCBs have not been an issue in groundwater at Site 9 and other OU-2A/2B sites in the past; therefore, PCBs will not be analyzed in groundwater samples except at OWS locations.

Comment 7 ***Table 1-5, SWMU Site Sampling Locations, Depths, and Analyses:*** *Table 1-5 indicates that the soil and groundwater samples collected from sampling location OWS-547 in OU-2A, Site 22, will not be analyzed for methyl tert butyl ether (MTBE), but due to the proximity of OWS-547 to the former service station at Site 22 and the fact that MTBE has been in use since the 1970s, soil and groundwater samples from this area should also be analyzed for MTBE. Please add MTBE to the list of analyses for OWS-547.*

Response 7 Concur. MTBE will be added to the list of analytes for OWS 547 in the Draft Final Work Plan for OU-2A/2B.

Comment 8. ***Table 1-6, Data Gap Sampling locations, Depths, and Analyses:*** *Table 1-6 is presented as a summary of the data gap investigations presented in Section 5.0, but there are numerous inconsistencies between this table and the information provided in the text. Some examples include, but are not limited to:*

- *The text of Section 5.1.1.2 [Site 6 Groundwater Investigation (Data Gap 1), page 5-4] indicates that DPT groundwater samples will be analyzed for semivolatile organic compounds (SVOCs) and 1,4-dioxane, but Table 1-6 does not include this analysis.*
- *The text of Section 5.1.2.1 [Site 7 Former Building 68-3 Soil Investigations (Data Gap 3], page 5-6) indicates that unsaturated and saturated soil samples will be analyzed for volatile organic compounds (VOCs), but this is missing from Table 1-6. In addition, the text states that groundwater samples will be analyzed for VOCs, natural attenuation parameters (NA) and microbial parameters, but Table 1-6 does not include these analyses.*
- *The text of Section 5.1.4.3 [Site 16 Groundwater Investigation (Data Gap 9), page 5-13] states that saturated soil from new second water bearing zone (SWBZ) monitoring well boreholes will be analyzed for VOCs, SVOCs and 1,4-dioxane, metals, total organic carbon (TOC), grain size, bulk density, and microbial parameters, but these analyses are missing from Table 1-6.*
- *The text of Section 5.2.1.1 [Site 9 Wash-Rack Soil Investigation (Data Gap 15)], states that groundwater samples will be analyzed for TPH Purgeable (TPHp), and TPH Extractable (TPHe) in addition to the analyses included in Table 1-6.*
- *The text of Section 5.2.1.2 [Site 9 Sewers Soil Investigation (Data Gap 16), page 5-16] indicates soil and groundwater samples will be analyzed for metals; however, this is not shown on Table 1-6. Also, the grain size analysis for saturated soil samples is missing from Table 1-6.*
- *The text in Section 5.2.2.2, [Site 13 - Incinerator Soil Investigation (Data Gap 20), page 5-21], indicates unsaturated soil samples will be analyzed for metals, but Table 1-6 (Site 13 - Incinerator Soil) does not include this analysis.*
- *The fifth paragraph in Section 5.2.4.2 [Site 22 - Groundwater Investigation (Data Gap 26), page 5-27] indicates soil and groundwater samples will be analyzed for VOCs (including MTBE), SVOCs (including 1,4-dioxane), TPH-purgeable, TPH-extractable, and metals, but Table 1-6 does not indicate soil sample analyses or hydropunch groundwater sample analyses for Data Gap 26.*

- *The last paragraph on page 5-28 of Section 5.2.5.2 [Site 23 - Groundwater Investigation (Supplemental Data Gap)] indicates samples will be analyzed for TPH-e but this analysis is missing from Table 1-6.*
- *The third paragraph on page 5-29 of Section 5.2.5.2 [Site 23 - Groundwater Investigation (Supplemental Data Gap)], states that groundwater samples from existing monitoring wells will be analyzed total and dissolved metals, but Table 1-6 does not include total or dissolved metals analyses for existing monitoring wells.*
- *The text in Section 5.3.1.1 [Site 3 Building 112 Soil Investigation (Data Gap 28), page 5-30] states that hot spot soil samples will be analyzed for VOCs, SVOCs, TPHp, TPHe, metals, that saturated soil samples will be analyzed for VOCs, SVOCs, metals, TOC, grain size, bulk density, and microbial parameters, but Table 1-6 has no specified analytes. Similarly, the text states that groundwater samples will be analyzed for VOCs, SVOCs, metals, and NA and microbial parameters, but this information is also missing from Table 1-6. For completeness, all analytes should be specified in this Table; the "TBD" entry under number of samples is sufficient to indicate that these are optional samples.*
- *The text in Section 5.3.2.1 [Site 4 Building 163 Soil Investigation (Data Gap 30), page 5-33] indicates that saturated soil samples and groundwater will be analyzed for TPHp and TPHe in addition to the analytes listed in Table 1-6.*
- *The text in Section 5.3.2.3 [Site 4 Building 360 Soil Investigation (Data Gaps 31 and 33), page 5-36] states that groundwater from DPT locations will be analyzed for total and dissolved metals, but Table 1-6 only specifies dissolved metals.*
- *The text in Section 5.3.4.4 [Site 21 Sewer Soil Investigation (Data Gap 41), page 5-42] includes SVOC analyses for groundwater samples in addition to the analytes listed in Table 1-6.*
- *The text in Section 5.3.5 [OU-2B Sitewide Groundwater (Data Gaps 29, 43, 44, 45), page 5-45] states that groundwater samples will be analyzed for both total and dissolved metals, but Table 1-6 does not include total metals.*

Please resolve these discrepancies.

Response 8

The Draft Final Work Plans for OU-1 and OU-2A/2B have been revised for consistency between tables and text.

Comment 9

Section 2.1, Facility History and Current Operations: *This section is missing the date Alameda Point was placed on the National Priorities*

List and the date the base closed. Please revise the text to include this information.

Response 9

The Draft Final Work Plans for OU-1 and OU-2A/2B have been revised to include the date Alameda Point was placed on the National Priorities List (July 1999) and the date the base closed (1997).

Comment 10

Page 2-12, fifth bullet*: Please remove from the tarry refinery waste from being investigated under the TPH program and place it under the CERCLA investigations being performed at this site.*

Response 10

Concur. See Response to Comment 1.

Comment 11

Section 2.2.2.2, Site 13, Page 2-12 and Table 1-5, SWMU Site Sampling Locations, Depths, and Analyses: *The proposed sampling for area of concern (AOC) 009 presented in Table 1-5 [i.e. one initial boring at each of the five former above ground storage tank (AST) locations], implies that the tanks were 5,000 gallons or less in size, based on AST Sampling Methodology presented in Section 4.2.1 (pages 4-4 and 4-5), but the actual sizes of the former ASTs are not presented in the Site 13 description in Section 2.2.2.2. Please modify the text of Section 2.2.2.2 to include the sizes of the former ASTs, which were removed from the site in 1990. If the sizes of the former ASTs cannot be verified, please explain the rationale behind sampling as though each AST was less than or equal to 5,000 gallons or consider a more conservative approach (i.e. more borings per former AST location).*

Additionally, the sixth bullet on page 2-12 indicates the contents of these 5 ASTs were unknown. Table 1-5 indicates soil and groundwater samples collected from AOC 009 will be analyzed for VOCs, SVOCs, TPHe, and TPHp, but not for pesticides, PCBs, and metals. The text indicates ASTs were associated with the Pacific Coast Oil Works refinery which operated from 1879 to 1903 and that they were not demolished until 1990. It is therefore possible that additional materials like pesticides and PCBs were stored in the ASTs in subsequent years. Please consider adding soil and groundwater analyses for pesticides, PCBs, and metals for AOC 009.

Response 11

These ASTs were historically associated with petroleum hydrocarbons (as part of the Pacific Coast Oil Works) and other fuels (located adjacent to aircraft storage area) and were unlikely to have stored pesticides or PCBs. Soil and groundwater samples collected from AOC 009 will be analyzed for VOCs, SVOCs, TPH, and metals.

Comment 12 *Page 2-18, second bullet: Investigation of lead in groundwater should be included in this bullet.*

Response 12 Concur. This recommended change has been incorporated into the Draft Final Work Plan for OU-2A/2B.

Comment 13. *Page 2-19, seventh bullet concerning OWS-372B: There is no guarantee that soil and groundwater beneath this OWS are not contaminated, especially since activities in Building 372 were known to have used solvents, oil and lubricants. As specified in the final RI for this site, soil and groundwater beneath all OWS needs to be investigated. Please revise to include this OWS in the sampling.*

Response 13 Concur. The Draft Final Work Plan for OU2A/2B has been revised to include sampling at OWS 372B.

Comment 14 *Page 2-20, end of bullet paragraph: Please clarify how and when the extent of chromium and cyanide contamination in soil in the vicinity of the SPH treatment system will be investigated.*

Response 14 See response to DTSC GSU Comment 24.

Comment 15 *Page 2-25, bullets: Please include OWS-162 for investigation in this section. Building 162 has yielded high hits of VOCs in soil gas and potential sources must be investigated including OWS. There is not sufficient justification for excluding the soil and groundwater beneath this OWS from sampling.*

Response 15 Although soil gas analyses detected VOCs at OWS-162, soil sampling revealed no detectable concentrations of VOCs or TPH above respective PRGs. Based on this, further soil sampling does not appear warranted at this time.

Comment 16 *Table 3-1, Data Quality Objectives: Table 3-1 appears to be incomplete. The DQOs presented in Table 3-1 provide a general overview of the seven-step planning approach to ensure the environmental data collected are suitable for their intended usage. While the text in Table 3-1 references additional information in the Sampling and Analysis Plan (SAP), Table 3-1 contains the entire discussion of DQOs in the text of this report and therefore should contain a comprehensive description of the seven-step approach. More specific information on samples to be collected, such as whether soil and groundwater will both be sampled, should be included in Step 3. Please revise Table 3-1 to specify whether soil, groundwater, or both will be sampled in Step 3.*

In addition, Step 4 does not adequately address the vertical extent of the study boundary. For example, for the OWSs, it is unclear whether groundwater samples will be collected, and whether step-down soil sampling will be performed and to what depth. Step 4 for AST sites indicates initial samples will be collected at 1 foot below ground surface (ft bgs) from AST locations, with additional step-out sampling to be conducted if necessary. However, no protocols for sampling at depth (between 1 ft bgs and groundwater) are described in Table 3-1. Please revise the text of Table 3-1 to include more specific information regarding the nature and extent of sampling to be collected for the SWMU areas, including defining the vertical extent of contamination and protocols for sampling at depth.

Response 16

The DQO tables have been significantly revised in the SAPs for each Draft Final Work Plan. Specific language regarding sampling protocols was also added to the table, as recommended.

Comment 17

Table 3-1, Data Quality Objectives: *The text under Step 5 (page 1), states "If the COPC concentrations in initial soil samples are less than the screening criteria, then the OWSs have not leaked contaminants to the environment and no further action is required," but a contaminant may be present at a concentration above laboratory reporting limits but below screening criteria. This does not indicate the absence of a release, but could indicate no further action is required. Please revise this statement to read something like, "If the COPC concentrations in initial soil samples are less than the screening criteria, then no further action is required." This language is repeated in Step 5 for UST/ASTs (page 2), GAPs (page 3), and WDs (page 5). Please also revise the text for each of these sections.*

Response 17

The DQO tables and appropriate sections of the text in each Draft Final Work Plan have been significantly revised and reflect the requested language.

Comment 18

Table 3-1, Data Quality Objectives: *It appears that the extent of contamination may not be fully delineated in some cases. Text under Step 5 states "Concentrations greater than the screening criteria in the third step-out sample may be related to native or fill (background conditions) and subsequently no further step-outs will be conducted." While some contaminants may exist at elevated background conditions at parts of the site, Section 1.0 states "at the completion of this scope of work, it is anticipated that no additional field activities will be required to complete the FS phase..." In order to minimize the possibility of additional investigations, we suggest that concentrations greater than screening criteria be compared to existing site* *background data and that additional step-out sampling be conducted, if necessary, to delineate contamination to the extent possible. Please discuss the criteria that will be used to determine whether elevated contaminant concentrations are representative of background or fill conditions and are not part of a larger contamination plume.*

Response 18

Initially, sample results will be compared to applicable PRGs. If a contaminant exceeds the PRG, the concentrations will be compared to site-wide and/or area-wide results to determine whether the exceedance is due to a background condition, such as contaminated fill. If a concentration is above screening criteria, a conference to determine the need for further step outs will be held with appropriate agency representatives.

Comment 19

Table 3-1, Data Quality Objectives, Pages 1-5 and Section 4.2.1, AST/UST Sampling Methodology, Page 4-4: *It appears that samples could be collected from clean fill. Text under Step 4 specifies where samples will be collected at former (removed) UST locations. For example, for removed 5,000 gallon to 20,000 gallon USTs, one sample will be collected near each end of the excavation. It is possible that former tank locations were backfilled with clean fill. Please explain the precautions that will be taken to avoid collecting samples from backfilled areas which may not be representative of residual contamination.*

In addition, it is possible that collection of two samples, one from either end of the excavation (5,000 to 20,000 gallon removed and in-place USTs) may miss contamination if a leak occurred in another part of the UST. Please ensure that one of the sample locations is on the downgradient side of the UST and consider adding additional borings to the remaining sides of the excavation.

Response 19

Field personnel will evaluate subsurface material to assist in determining whether fill material has been encountered in a former UST cavity. The initial soil sample will be retrieved from immediately below the base of fill material, but at no depth greater than 5 feet bgs or the water table, whichever is shallower. The text of the Draft Final Work Plans has been revised to more clearly state this intent.

Additionally, although limited historical information has been available for USTs, field personnel will place at least one sample location in the presumed downgradient portion of the former UST cavity, as recommended. The text of the Draft Final Work Plans has been revised to more clearly state this intent.

Comment 20 *Table 3-1, Data Quality Objectives, Page 3 of 10, and Section 4.2.1, AST/UST Sampling Methodology, Page 4-5:* *The text and Table 3-1 state that sampling will be done in the center of above 20,000 gallon or greater ASTs, whether they are in place or not, but it is unclear how this can be done if the tank is circular. Please explain how sampling will be done for large ASTs that are still in place.*

Response 20 If an AST is circular, a sample will still be collected, as proposed, from the fill piping area, since this is the most likely release point. Additional samples will be collected from the opposite end of the tank. Clarifying language has been incorporated into the Draft Final Work Plans for OU-2A/2B to explain AST sampling. Text on Page 4-5 at the end of Section 4.2.1 states that "Initial samples for an AST without access below the tank will be the same as a UST which is still present..." This language has been amended in the Draft Final Work Plan text and DQO table to clarify that this may apply to ASTs that are still in place.

Comment 21 *Table 3-1, Data Quality Objectives, Page 9 of 10, Step 5:* *It appears that some text may be missing from the last paragraph since the first sentence discusses conditions in the FWBZ, but the last sentence only specifies step-down sampling in the second water bearing zone (SWBZ). The approach to step-down sampling in the FWBZ should also be specified. Please revise this entry to include step-down sampling in the FWBZ.*

Response 21 This section of the DQO tables in the Draft Final Work Plans for OU-1 and OU-2A/2B has been modified to include step-down sampling criteria in the FWBZ.

Comment 22 *Table 3-1, Data Quality Objectives, Page 9:* *Step 4 of the DQOs for the Groundwater Investigation states that the step-down process for delineating vertical contamination in groundwater will proceed to a maximum of 20 ft bgs. Why is the vertical delineation restricted to 20 ft bgs when groundwater contamination is present at depths of at least 60 ft in some places (e.g. Site 4)? Also, the objective of delineating the vertical extent of the groundwater plumes should take into account that many of the sites do not have a distinguishable first and second water bearing zone having no BSU present. Please revise this DQO to indicate the step-down sampling process will proceed to depths that vertically delineate the plumes to the MCL level.*

Response 22 This section of the DQO tables in the Draft Final Work Plans for OU-1 and OU-2A/2B have been modified to include step-down sampling criteria that is not restricted by depth.

Comment 23

Table 3-2 Screening Criteria For Soil Samples, Page 9: *There appears to be a significant discrepancy in Table 3-2 between the Project Action Limit for Soil Samples and the EPA Region 9 Residential preliminary remediation goals (PRGs) on which they are based, according to the footnote, for select metals. The following table presents the metals in question, their Residential PRGs, and the Project Action Limit for Soil Samples as it appears in Table 3-2. Please explain or clarify the significant discrepancy between the two. If errors are found, please review the remainder of Table 3-2 for similar discrepancies.*

Analyte	**Residential PRG (mg/kg)**	**Project Action Level (mg/kg)**
Arsenic	0.39	4.8
Mercury	23	1800
Molybdenum	390	23
Nickel	1600	390
Selenium	390	1600
Thallium	5.2	390
Vanadium	78	24.3

Response 23

The project action levels above were listed in error. As has been addressed in previous comments, soil results for metals will be initially compared to applicable PRGs; however, exceedances will also be compared to expected background concentrations at the 95th percentile confidence level that were assessed during the RIs for OU-1, OU2A, and OU-2B. Clarifying statements have been incorporated into the Draft Final Work Plans for OU-1 and OU-2A/2B and corresponding SAP tables listing Screening Criteria for Soil have been corrected.

Comment 24.

Table 3-3, Screening Criteria for Water Samples: *It is unclear why the project quantitation limits (PQLs) for trichloroethene (TCE), tetrachloroethene (PCE) and cis-1,2-dichloroethene (cis-1,2-DCE) are 5 micrograms per liter (ug/L) when the PQLs for other volatile organic compounds (VOCs) are 0.5 or 1 ug/L. The analytical method detection limits (MDLs) are 0.2 ug/L, so it appears that a lower PQL could be specified. Please specify 0.5 or 1 ug/L as the PQL for TCE, PCE, and cis-1,2-DCE.*

In addition, it is unclear why benzo(a)pyrene was omitted from the table. This semi-volatile organic compound (SVOC) should be included in both the "SVOCs/8270C" and the "SVOCs/8270C (PAHs only)" analyte lists. Please add benzo(a)pyrene to Table 3-3.

Finally, the Project Action Limit for Water Samples column (column #4) contains a number of blank entries for specific pesticides. Please fill in these entries with the appropriate screening criteria or designation.

Response 24

The majority of the PQLs are 5 ug/L. Depending on the laboratory procured, it is possible to have PQL lower than 5ug/L. However, since the MCL for the 3 compounds is 5 ug/L or higher it is not necessary to have a PQL lower than 5 ug/L.

Benzo(a)pyrene has been added to Table 3-3.

The blank entries in column #4 for a number of pesticides have been corrected.

Comment 25

Section 4.0, Solid Waste Management Unit Sampling Program and Rationale, Page 4-1: *Section 4 describes the sampling program and rationale for solid waste management units (SWMUs); however, it is generally unclear how many and what type (soil/groundwater) of samples will be collected from each sampling location throughout Section 4. It appears this information is presented elsewhere, in Table 1-5 (SWMU Site Sampling Locations, Depths, and Analyses) and Section 7.6 (Soil Sampling Step-Down Procedure and Step-Out Criteria), but additional information is needed in Section 4. Please revise the text to include a summary of the sampling to be performed.*

Response 25

The appropriate sections of the Draft Final Work Plans for OU-1 and OU-2A/2B have been revised to clarify the sampling protocol for the SWMUs.

Comment 26

Section 4.1.1 OWS Sampling Methodology, Page 4-2 and Figure 4-2 OWS Sampling Methodology: *Figure 4-2 indicates that if the OWS is greater than or equal to 4 feet deep or access is restricted, then the sample will be collected adjacent to the OWS. The text of Section 4.1.1 states that if the OWS is greater than or equal to 4 feet deep or access is restricted, then (1) sampling will be accomplished at the inlet and outlet piping areas of the OWS and (2) the initial soil sample will be collected from just below the bedding for the OWS, but no deeper than one foot below the bottom of the OWS. The explanation in the text is unclear: will the sampling occur adjacent to the OWS or within* *the OWS? Please review and revise the text and/or Figure 4-2 for consistency.*

Response 26

The site-specific sections of the Draft Final Work Plans for OU-1 and OU-2A/2B have been revised to more clearly explain the soil sample collection proposed at each OWS.

Comment 27

Section 4.1.1, OWS Sampling Methodology, Page 4-2, and Figure 4.2, OWS Sampling Methodology: *The text and Figure 4-2 do not clearly specify how sampling locations will be selected when sampling through the floor of the OWS is necessary. Specifically, there is an inconsistency in the flow chart (Figure 4-2) if a "No" decision is made at the first decision diamond. If there are no cracks and the OWS is not more than 4 feet deep and access is not restricted access, then the flow chart specifies that sampling is to take place through the floor at the location of the crack. This is inconsistent because the first "No" decision may have been made because there were no cracks. In addition, the decision tree does not address sampling at inlet or outlet piping locations. Please resolve the discrepancy that results if no cracks are identified and include the potential for sampling at inlet and/or outlet piping locations.*

Response 27

The Draft Final Work Plans for OU-1 and OU-2A/2B have been revised to clarify the sampling rationale for OWSs.

Comment 28

Section 4.2.1 AST/UST Sampling Methodology, Page 4-4 and 4-5 and Figure 4-3 AST/UST Sampling Methodology: *Figure 4-3 states that a sample will be collected at 6-inches bgs if visible contamination is observed, but this is not discussed in the text. Please revise the text to include sampling of visibly contaminated soil.*

Response 28

The appropriate text of the Draft Final Work Plans for OU-1 and OU-2A/2B has been revised for consistency between figures, tables and text.

Comment 29

Section 4.2.2, AST/UST Sampling Methodology, Page 4-4: *In the first set of bullet points on this page, it is unclear how the depth maxima for each of the different sized underground storage tanks (UST's) will be specified to ensure that soil that was beneath the UST/AST is sampled rather than clean fill. This is of particular concern for removed USTs because a UST of the smallest dimension could potentially be buried to a depth greater than 5 feet. Please specify how sampling will be conducted to ensure that clean fill is not sampled.*

Response 29	Field personnel will evaluate subsurface material to assist in determining whether fill material has been encountered in a former UST cavity. The initial soil sample will be retrieved from 1 foot bgs and the second sample will be collected immediately below the base of fill material, but no greater than 5 feet bgs or the water table, which ever is shallower. The text of the Draft Final Work Plans has been revised to more clearly state this intent.
Comment 30	***Section 4.2.1, AST/UST Sampling Methodology, Page 4-5:*** *The text in this section does not include a description of the analyses to be performed and instead references Table 3-1, Data Quality Objectives, but review of Table 3-1 indicates analytical information is not presented. The text in parallel sections 4.1.1 (OWS Sampling Methodology), 4.3.1 (GAP Sampling Methodology), and 4.4.1 (Wash Down Areas Sampling Methodology) describes the analyses to be performed on samples. Please include a description of soil and groundwater analyses to be performed in Section 4.2.1 and remove the reference to Table 3-1.*
Response 30	The appropriate sections of the Draft Final Work Plans for OU-1 and OU-2A/2B have been updated, as recommended.
Comment 31	***Section 4.3, Generator Accumulation Points (GAPs) and Section 4.4, Wash Down Areas:*** *In cases where gravel was used as bedding material and the gravel is more than 1 foot thick, it may not be appropriate to limit the sampling depth to less than 1 foot below the concrete or asphalt flooring as is done in each of the bullets on page 4-6 and in the last paragraph of page 4-7. It is difficult to get enough fine-grained material for analysis if a sample consists only of gravel. Please revise the text to specify that if gravel bedding more than 1 foot thick is found beneath flooring, the first sample will be collected from the soil surface beneath the gravel.*
Response 31	The appropriate text of the Draft Final Work Plan for OU-2A/2B has been revised to indicate sample collection beneath bedding material may extend deeper than 1 foot if bedding material is thicker than anticipated. There are no GAPs requiring investigation in OU-1.
Comment 32	***Section 4.3.1, GAP Sampling Methodology, Page 4-6:*** *The second and third bullets in Section 4.3.1 indicate additional sample locations will be collected randomly. Please specify how these random locations will be selected.*
Response 32	The Draft Final Work Plan for OU-2A/2B has been revised to clarify that the field geologist will select locations within the specified area

for sampling based on field observations biased to staining or cracks. Random sampling will not be performed.

Comment 33

Section 4.4.2 Wash Down Areas Sampling Methodology, Page 4-7 and Table 3-1, Data Quality Objectives, Page 5: *The text and Step 4 of Table 3-1 state that a third step-out sample will not be performed due to sample coverage based on 50-foot grids. However, step-out sampling may be required in the outer/perimeter grids, where there are no outlying samples. If contamination indicates that delineation outside the boundaries of these wash down areas is needed, a third step-out sample will be necessary, particularly if attempting to delineate the horizontal extent of groundwater contamination. Please revise the text to state that third step-out samples may be necessary if contamination is found along the perimeter grid squares.*

In addition, this approach is inconsistent with the approach discussed in Section 5.3 of the SAP. The SAP states that each set of step-out samples will be 5 feet from the previous set of samples. Please reconcile the procedures for step-out sampling in the Work Plan and SAP.

Response 33

The Draft Final Work Plan text for OU-1 has been revised to reflect the third step-out criteria recommended in this comment. Additionally, the language in the SAP has been edited to be consistent with the Work Plan.

Comment 34.

Figure 4-1, Solid Waste Management Unit Location Map and Figure 5-1, Proposed Data Gap Soil and Groundwater Investigation Locations: *Neither of these figures include the grid sampling that will be done in WD-40 and WD-41A at Site 6 or at WD-114 at Site 8. In addition, samples that will be collected at Building 265 are missing from Figure 5-1. Please revise Figure 5-1 to include all sampling locations, including the WD grid sampling at Sites 6 and 8 and the Building 265 Samples. In addition, please review the text and tables to ensure that all of the soil samples and monitoring wells proposed in the Work Plan are included on Figure 5-1 and on the other Section 5 figures.*

Response 34

The sampling locations proposed for the individual WDs were re-evaluated and the sampling density was adjusted. Revised Figures are included in the Draft Final Work Plan for OU-1.

Comment 35

Section 5.0, Soil and Groundwater Plume Delineation Sampling and Rationale, Page 5-2: *The last paragraph on this page indicates that a plume will be considered well defined if Chemicals of Potential Concern (COPCs) are found to be equal to or less than two times the* *screening criteria for the horizontal extent and 20 times the screening criteria for vertical extent, but this may be an erroneous assumption. A plume may have a large horizontal and/or vertical extent at a concentration that is only slightly above the screening criteria. The extent of this contamination would be missed under the proposed approach. For example, the screening criteria for TCE in groundwater specified in Table 3-3 is 5.0 ug/L. This approach would result in not delineating TCE below 10 ug/L horizontally or 100 ug/L vertically. Screening criteria for COPCs should be set at no higher than the maximum contaminant level (MCL) or the Preliminary Remediation Goals (PRGs) in order to consider the extent of a groundwater plume to be well-delineated. Please propose revised and lower assessment criteria for the delineation of a contaminant plume.*

Response 35

Delineation of groundwater contamination has been changed in the Draft Final Work Plans for OU-1 and OU-2A/2B. Groundwater will be defined to MCLs laterally and vertically.

Comment 36.

Section 5.0, Soil and Groundwater Plume Delineation Sampling and Rationale: *The text in the site-specific subsections does not always specify sampling depths. Sampling depths are described in Section 7.6.1, Step-Down Procedure, and are listed in Table. For example, initial sampling depths for Site 9, Metals Soil Investigation (Data Gap 18) are specified (at 1 ft bgs) on Page 5-16 (section 5.2.1.3). However, in the next section 5.2.1.4, Site 9 Groundwater Investigation (Data Gaps 11, 12, 13, 14, and 17), initial sampling depths are not specified. Due to the large number of samples to be collected, please ensure that the text contains a complete summary of field procedures. Summary tables, such as Table 1-6, should serve as a summary of the text, rather than introducing new information. Please ensure that the tables and text contain consistent information.*

Response 36

The Draft Final Work Plans for OU-1 and OU-2A/2B have been updated to clarify the presumed depths for groundwater sampling; however, groundwater depths are approximate and may change based on observed site conditions. All field procedures are discussed in detail in the SAPs and the Work Plans.

Comment 37

Section 5.0, Soil and Groundwater Plume Delineation Sampling and Rationale, Page 5-2: *The first sentence of the last paragraph on Page 5-2 states "Step-out/step-down procedures will be initiated when COPC are detected at two times and 20 times the screening criteria." This is initially confusing as it appears to contradict previous step-out procedures (in Table 3-1 and elsewhere) for soil sampling which require simply concentrations that exceed screening criteria. It is* *later clarified in this paragraph that this two times factor only applies to lateral groundwater plume delineation; however, it is unclear why groundwater plume boundaries are considered defined if the outermost samples still contain concentrations twice the screening criteria. This indicates that the extent of contamination has not been bounded. Similarly, the rationale behind the 20-times screening factor for step-down groundwater sampling is not described. Additional information regarding the how these numbers were selected and how they will be used is necessary to evaluate their applicability. This appears to be acknowledged in the second sentence on page 5-2, which reads, "This will also likely be a negotiation point with the agencies." It is therefore unclear why this additional information was not included, if this was anticipated to be a point of discussion. Please clarify why the step-out procedure for soil characterization is initiated when concentrations exceed screening criteria, but groundwater concentrations must exceed twice the screening criteria in order to initiate step-out sampling.*

Finally, Page 5-3 states that the step-out/step-down procedures are discussed in detail in Section 7.0. A review of Section 7.0 indicates that step-out/step-down procedures for soil sampling are discussed, as well as step-down procedures for groundwater. However, there appears to be no mention of step-out groundwater sampling using the two times screening criteria system in Section 7.0. Please resolve this discrepancy.

Response 37

Please see Response to DTSC GSU Comment 7.

Comment 38

Section 5.1, OU-1 Data Gap Investigations: *The text, figures, and tables do not consistently present the data gaps investigation. For example, Table 3-1 and Section 4 indicate that sampling will be done to investigate the WD areas, but this is not discussed in Section 5.1 and the grids and sampling locations are not depicted on any of the Section 5 figures. Similarly, sampling will be done at the OWS locations, but this is not included in the text or on the Section 5 figures; OWS sampling locations in respect should be depicted so that proposed locations can be reviewed. Please revise the text to present the full scope of the data gaps investigation at OU-1 sites and provide the WD grids and OWS sampling locations on Section 5 figures.*

Response 38

The noted inconsistencies between the text, figures, and tables have been corrected in the Draft Final Work Plan for OU-1 and corresponding SAP.

Comment 39

Section 5.1.1.1, Site 6 Soil Investigation, Page 5-3 and Section 5.1.3.1 Site 8-Soil Investigation, Page 5-8: *The text in these sections* *states that no further soil investigations are required, but soil will be sampled to evaluate data gaps at the OWS and WD areas, so it is premature to conclude that soil is fully characterized. Please revise the text to indicate that soil sampling is being conducted to address data gaps at Sites 6 and 8.*

Response 39

Consistent with the ROD for OU-1, data gap sampling in soil at Site 8 is only necessary in the northeast corner for lead and PCBs. The remaining soil sampling at Site 8 and all the soil sampling at Site 6 are related to SWMUs. The Draft Final Work Plan text for OU-1 has been revised to clarify this distinction.

Comment 40

Section 5.1.1.2, Site 6 Groundwater Investigation (Data Gap1), Page 5-3, and Figure 5-3, OU1, Site 6 Proposed Soil and Groundwater Investigation Locations: *It is unclear why the text refers to 6 existing monitoring wells at Site 6 when Figures 5-3 and 1-6 depict 7 existing wells in Site 6. Please resolve this discrepancy.*

Response 40

The Draft Final Work Plan for OU-1 has been revised to correct inconsistencies between text, tables, and figures.

Comment 41

Section 5.1.1.2, Site 6 Groundwater Investigation (Data Gap1), Page 5-4 and Section 5.1.4.3, Site 16 Ground water Investigation (Data Gap 9), Pages 5-13 and 5-14: *It is understood that professional judgment may necessitate a change in location of a monitoring well, however criteria that will be used to evaluate changes in the proposed well locations should be specified. These criteria should be established using the DQO process. Also, if a well location is significantly different from the tentative location then the regulatory agencies should be notified with an amended figure for onboard review; a email with an Adobe Acrobat (pdf) copy of a hand marked copy of the figure and relevant sampling results would suffice. Please use the DQO process to develop criteria for adjusting the location of monitoring wells and revise the Work Plan to include this information. In addition, please consider providing the regulatory agencies with a chance to review any significant changes from the proposed monitoring well locations.*

Response 41

To the extent possible, the DQO provides as many specific criteria as can be expected at this time. Significant changes will be discussed with the regulatory agencies prior to implementation as outlined in the field communication plan.

Comment 42

Section 5.1.2.1, Site 7 Former Building 68-3 Soil Investigation (Data Gap 3), Page 5-6: *The second sentence in the second paragraph on this page indicates that samples will be collected at the "hot spots" as*

	shown on the relative color output from the GORE® Screening, but there is no specific information on the meaning of a hot spot. Please provide an unambiguous definition of "hot spot" in the text.
Response 42	The soil investigation proposed for Former Building 68-3 has been revised in the Draft Final Work Plan for OU-1. GORE modules will no longer be utilized.
Comment 43	***Page 5-6 and 5-6, Site 7 Soil Debris Area:*** *Please specify whether soil samples are going to be taken beneath Building 459. It is not know whether the soil contamination extends northward under the building and this data gap needs to be filled.*
Response 43	Soil samples will be collected from beneath Building 459, in the vicinity of Former Building 68-3. The relevant section and corresponding figure has been revised for clarity in the Draft Final Work Plan for OU-1.
Comment 44	***Section 5.1.2.3, Site 7, Groundwater Investigation (Data Gap 7) Page 5-7:*** *The text indicates that 13 monitoring wells were installed and sampled, however the figure indicates that there are 14 monitoring wells within the Site 7 boundary four additional wells beyond the Site 7 boundaries. Please resolve this inconsistency.*
Response 44	Please see Response to DTSC GSU Comment 9.
Comment 45.	***Section 5.1.2.3, Site 7, Groundwater Investigation (Data Gap 7) Page 5-8:*** *The second paragraph on page 5-8 indicates that no new wells are proposed for the FWBZ or the SWBZ and that some monitoring wells may be installed. based on professional judgment, but there are no criteria to guide these decisions. The DQO process should be used to develop criteria to be used to evaluate whether monitoring wells should be installed. Please note, as mentioned in previous comments, that in many locations there is no distinction between the FWBZ and the SWBZ, and that there is no BSU present. Please use the DQO process to develop criteria for the installation of monitoring wells and revise the Work Plan to include this information.*
Response 45	Please see Response to DTSC GSU Comment 9.
Comment 46	***Section 5.1.3.2, Site 8-Groundwater Investigation (Data Gap 7) Page 5-9:*** *Similarly, the text in this section indicates that new monitoring wells may be installed in the FWBZ or SWBZ based on results of direct push technology (DPT) soil and groundwater sampling, but criteria for these decisions have not been provided. Please use the DQO*

process to develop criteria for the installation of monitoring wells and revise the Work Plan to include this information.

Response 46 Please see Response to DTSC GSU Comment 10.

Comment 47 ***Section 5.1.4.3, Site 16 Groundwater Investigation (Data Gap 9), Page 5-13:*** *It is unclear why PCB analysis has not been specified for soil samples. Please revise the Work Plan to include PCB analysis of all samples collected from above the water table at Site 16.*

Response 47 In the Draft Final Work Plan for OU-1, the text has been amended to indicate that the selection of COCs was based on the ROD for the Site. The OU-1 ROD based the selection of COCs on site history, previous investigation results, site use and other relevant background.

Comment 48 ***Section 5.2.1.2 Site 9 - Sewers Soil Investigation (Data Gap 16), Page 5-16:*** *The text in the second paragraph states that samples will not be collected if the water table is not encountered above the base of the backfill, but contamination could also be found in unsaturated soil if the water table is found lower than expected. Please consider collecting and analyzing unsaturated soil samples if saturated soil or groundwater samples cannot be collected.*

Response 48 The Site 9 Sewers Investigation has been incorporated into the Site 9 Groundwater Investigation in the Draft Final OU-2A/2B Work Plan. Select locations along the sewers (biased to bends or joints) within the boundaries of the groundwater plume will be investigated as possible secondary sources of groundwater contamination. Soil samples will not be collected.

Comment 49 ***Section 5.2.1.2 Site 9 - Sewers Soil Investigation (Data Gap 16), Page 5-16:*** *The last sentence of the third paragraph on page 5-16 states that additional samples along the drain or sewer may be collected at upstream locations if initial soil samples contain COPC concentrations greater than screening criteria, but there are no guidelines or criteria for selecting additional locations. For example, based on the isoconcentrations depicted in Figure 5-14, an additional sampling point may be warranted in the southernmost section of storm sewer line in Site 9, near where the sewer line exits Building 410, but it is unclear how the location would be selected. Please use the DQO process and provide guidelines for selecting these additional sampling points.*

Response 49 The sewer investigations have been incorporated into the Site 9 groundwater investigation. Soil sampling will not be performed as part of the sewer investigation.

Comment 50 *Section 5.2.1.4 Site 9 - Groundwater Investigation (Data Gaps 11, 12, 13, 14, and 17), Pages 5-17 and 5-18:* *The last paragraph on Page 5-17, continued on page 5-18, states that step-out/step-down sampling will be conducted if groundwater samples contain contaminant concentrations exceeding 2 times and 20 times the screening criteria, respectively, but it is unclear if step-out/step-down soil sampling will also be required, as soil samples from the borings will be analyzed as well. Please clarify whether step-out/step-down sampling will be conducted based on soil sampling results.*

Response 50 The DPT groundwater sampling methodology has been revised in the Draft Final Work Plan for OU-1 and OU-2A and 2B. Soil samples will no longer be taken at groundwater investigation locations.

Comment 51 *Section 5.2, OU-2A Data Gap Investigation, Page 5-14 and Table 1-6 Data Gap Sampling Locations, Depths, and Analyses:* *In Section 5.2, the installation of FWBZ or SWBZ monitoring wells is proposed following results from DPT/hydropunch investigations. In some cases, the proposed monitoring well locations are not co-located with DPT/hydropunch sampling locations, yet soil sampling is not proposed during monitoring well installation. Table 1-6 indicates that soil samples will not be collected from the 10 FWBZ groundwater monitoring wells to be installed for Groundwater Investigations for Site 13, Site 19, and Site 22. Some of the proposed locations for these wells appear to be located near previous sampling locations; therefore, additional soil sampling in these locations may be redundant. However, some of the proposed locations, such as those in Site 9 within or immediately west of Building 410, are not near previous sampling locations. Please consider the collection and analysis of soil samples during FWBZ groundwater monitoring well installation, particularly if staining is noted or when the new wells will not be near previous sampling locations.*

Response 51 Any area of potential soil contamination is proposed for investigation. There is no evidence of soil contamination at monitoring well locations in OU-2A where there are no nearby soil investigations; therefore, soil samples will not be collected during the installation of monitoring wells in OU-2A.

Comment 52 *Section 5.2.2.1 Site 13 - Lead Soil Investigation (Data Gap 19), Page 5-19:* *The last sentence of the first paragraph of Section 5.2.2.1 states, "Further characterization is required in the area of borings 028-S13-001, 028-S13-002, IMF-06, 028-S13-007, B13-30, B13-31, B13-32, and B13-41" and that these locations are presented on Figure 5-18, but borings 028-S13-001, 028-S13-002, IMF-06, and 028-S13-007 are* *not labeled on Figure 5-18. Please include the locations of these borings on Figure 5-18.*

Response 52

The figures for the Draft Final Work Plan for OU-2A/2B have been revised to label borings 028-S13-001, 028-S13-002, IMF-06, and 028-S13-007.

Comment 53

Section 5.2.2.1 Site 13 - Lead Soil Investigation (Data Gap 19), Page 5-19: *Figure 6-14 in the OU-2A Remedial Investigation Report indicates boring B13-29 contained a lead concentration of 378 mg/kg, which exceeds the California modified residential PRG for lead. Additional sampling to delineate lead contamination to the south and east of boring B13-29 should be done, since the closest borings to the east lie approximately 240 feet away. Please include additional sampling around boring B13-29 as a part of Data Gap 19.*

Response 53

This sampling location was omitted from the Draft Work Plan in error. The recommended changes have been incorporated into the Draft Final Work Plan for OU-2A/2B.

Comment 54.

Section 5.2.2.2 Site 13 - Incinerator Soil Investigation (Data Gap 20), Page 5-20: The text states that a third step-out sample will not be performed due to sample coverage based on 60-foot square grids. However, step-out sampling may be required in the outer/perimeter grids, where there are no additional samples intended. In this case, if contamination requires delineation outside the 5 by 7 grid boundaries, a third step-out sample may be required if attempting to delineate the horizontal extent of contamination.

Response 54

The text of the Draft Final Work Plan for OU-2A/2B has been revised to more clearly state step-out criteria related to the Incinerator soil investigation.

Comment 55

Section 5.2.2.3 Site 13 - Groundwater Investigation (Data Gap 21), Pages 5-21 and 5-22: *One FWBZ monitoring well is proposed southeast of the benzene plume; however, no explanation as to the rationale behind this location is given. The text also states that additional FWBZ monitoring wells may be installed based on the soil and groundwater sampling results, but there are no criteria to guide this decision. Please provide additional details on why this location was selected for a FWBZ monitoring well and criteria for relocating this well and for the installation of additional FWBZ monitoring wells.*

Response 55 Specific criteria for selection monitoring well locations has been included in the Draft Final Work Plan for OU-2A/2B.

Comment 56 ***Section 5.2.2.3 Site 13 - Groundwater Investigation (Data Gap 21), Pages 5-21 and 5-22:*** *It is unclear why the text in the first paragraph of Section 5.2.2.3 states "There appears to be minimal, if any, impact on the SWBZ groundwater" since, according to the OU-2A RI, the SWBZ has only been sampled in the eastern portion of Site 13 at five locations. Based on the information presented in Table 5-1, one SWBZ monitoring well exists cross gradient of the contaminant plumes. Additional investigation of the SWBZ, particularly in the plume areas, does not appear to have been conducted; therefore, the conclusion that there is minimal impact to SWBZ groundwater is premature. Please consider including SWBZ sampling at Site 13 or provide additional justification for the quoted statement.*

Response 56 The SWBZ will be investigated based on the revised step-down step-out criteria provided in the Draft Final Work Plans. The appropriate site-specific sections of the Draft Final Work Plan for OU-2A/2B have been clarified to indicate that the SWBZ will be investigated if conditions in the FWBZ indicate that further investigation is warranted.

Comment 57 ***Section 5.2.3.1 Site 19 - Yard D-13 Soil Investigation (Data Gap 223), Page 5-22:*** *The text states that a third step-out sample will not be performed due to sample coverage based on 25-foot by 35-foot grids. However, step-out sampling may be required in the outer/perimeter grids, where there are no additional samples intended. In this case, if contamination requires delineation outside the grid boundaries, a third step-out sample may be required, particularly if attempting to delineate the horizontal extent of contamination.*

Additionally, the first complete paragraph on Page 5-23 indicates samples associated with Yard D-13 will be analyzed for VOCs only. Section 5.2.3.2 indicates soil and groundwater samples associated with Data Gap 22 for Site 19 will be analyzed for VOCs, SVOCs (including 1,2-dioxane), TPH-purgeable, TPH-extractable, and metals. The activities associated with Yard D-13 were identified as a potential source for groundwater contamination. Therefore, it seems appropriate that sampling activities associated with defining contamination in the possible source area (the Yard D-13) be analyzed for the same suite of analytes as the soil and groundwater samples for the remaining part of the Site. Please include VOCs, SVOCs (including 1,4-dioxane), TPHp, TPHe, and metals analysis for the Yard D-13 soil investigation (Data Gap 23).

Response 57

Clarifying language has been incorporated into the Draft Final Work Plan for OU-2A/2B to indicate that step-out criteria as outlined in Section 5 will be used to delineate the lateral extend of soil contamination.

Soil samples will be analyzed for VOCs, SVOCs, TPHp, TPHe, and metals.

Comment 58

Section 5.2.4 Site 22 Data Gap Investigation, Page 5-25: *The second paragraph in Section 5.2.4 states that the two data gaps within Site 22 are lead in soil and groundwater, but additional detail provided in Sections 5.2.4.1 and 5.2.4.2 indicates the data gaps include more analytes than lead. The data gaps are listed as lead and arsenic in soil, and additional investigation of soil and groundwater for VOCs, SVOCs, TPHp, TPHe, and metals. Please revise the text of Section 5.2.4 to clarify that lead is not the only analyte of concern for the Site 22 data gaps.*

Response 58

The Draft Final Work Plan for OU-2A/2B has been revised to clarify the two data gaps as (1) Lead in soil and (2) Site-wide groundwater.

Comment 59.

Section 5.2.4.1 Site 22 - Lead Soil Investigation (Data Gap 25), Page 5-25 and Figure 5-23, OU-2A, Site 22 (Data Gap 25) Proposed Soil Sampling Locations: *The first paragraph of Section 5.2.4.1 identifies the following three locations where lead concentrations exceeded screening criteria: "in the southwestern area of Site 22 at boring MW-547-5 and near the former gasoline station fuel lines at borings 547-6 and 547-11." A review of Figure 5-23 shows that boring MW-547-5 is located in the southeastern portion of the site; this location appears to have been confused with 547-5. According to information presented in the OU-2A Remedial Investigation Report, the sample collected from 0.5-1 ft bgs from boring MW-547-5 contained a concentration of 9890 mg/kg. Further review of the OU-2A indicates sampling locations 547-6 and 547-11 contained lead concentrations exceeding the screening criteria at 2 ft bgs, but that sampling location 547-5 contained a lead concentration of 18 mg/kg. Based on this information, please revise the text of Section 5.2.4.1 to indicate boring MW-547-5 is located in the southeastern area of Site 22. Additionally, please revise Figure 5-23 to include proposed sampling locations in the vicinity of boring MW-547-5 rather than previous sampling location 547-5.*

Response 59

To correct the noted error, the text and associated figures and tables have been revised in the Draft Final Work Plan for OU-2A/2B.

Comment 60

Section 5.2.4.1 Site 22 - Lead Soil Investigation (Data Gap 25), Page 5-26: *The proposed sampling scheme is to collect samples from 0.5-1 ft bgs and at 5 ft bgs, but since lead tends to have a limited mobility in soil, smaller sampling intervals may be warranted, such as sampling at 0.5 ft bgs, 2 ft bgs, and 5 ft bgs. The text indicates that soil samples collected from 2 ft bgs at locations 547-11 and 547-6 exceeded screening criteria for lead. The OU-2A RI Report indicated these locations were collected after the removal of fuel lines, from the bottom of the excavation areas. Sampling at 5 ft bgs may help to delineate the vertical extent of contamination, but when attempting to delineate the horizontal extent of contamination previously discovered at 2 ft bgs, similar depths should be sampled. Please consider including an additional sample at approximately 2 ft bgs to provide consistency with previous sampling results. Additionally, please discuss measures that will be undertaken to ensure that sampling is not conducted in areas that may contain clean fill and thus may not be representative of residual metals contamination.*

Response 60

Due to the heterogeneity of soils, samples are not proposed to be collected at depths corresponding to historic results (2 ft bgs), unless no previous results exist in that area. Soil will be evaluated by field personnel to determine whether possible fill material has been encountered and the sampling program will be adjusted to ensure that native materials are sampled. Clarifying language has been incorporated into the Draft Final Work Plan for OU-2A/2B.

Comment 61

Section 5.2.4.1 Site 22 - Lead Soil Investigation (Data Gap 25), Pages 5-25 and 5-26: *Table 1-6, as well as the first bullet in section 5.2.4.1 (Page 5-25) indicate samples will be collected from approximately 11 locations for Data Gap 25, but the following three paragraphs (pages 5-25 and 5-26) describe 9 sample locations. Figure 5-23 displays 12 proposed sampling locations. Please resolve these discrepancies.*

Response 61

The section of Draft Final Work Plan for OU-2A/2B that describes the investigation has been amended to coincide with the appropriate figure(s).

Comment 62

Section 5.2.4.2 Site 22 - Groundwater Investigation (Data Gap 26) Page 5-26: *The last sentence of the first paragraph in Section 5.2.4.2 states "There appears to be minimal, if any, impact on the SWBZ groundwater", but only one SWBZ monitoring well is present at Site 22, and it is located cross gradient of the contamination plume. Please provide additional information supporting the conclusion that there is minimal, if any, impact on SWBZ groundwater. If such* *information can not be provided, please include SWBZ sampling as part of the Data Gap 26 groundwater investigation.*

Response 62

The only COC in groundwater at Site 22 is a localized TPH plume from a former service station. The TPH plume is currently being remediated under the TPH program at the site as corrective action area 4C. The groundwater investigation at Site 22 has been removed from the OU 2A/2B Work Plan.

Comment 63

Section 5.3.1.1 Site 3 – Building 112 Soil Investigation (Data Gap 28), Pages 5-30 and 5-31: *The soil sampling methodology for Building 112 may not adequately characterize possible releases from the former zinc smelter. According to the last full paragraph on page 5-30 and the second full paragraph on page 5-31, no soil sampling will be conducted if results of the GORE Module survey do not identify hot spots, but zinc cannot be detected in soil gas and the former location of the zinc smelter cannot be identified by field personnel. Please use a grid based sampling method to evaluate whether there is zinc contamination in soil or explain why this will not be done.*

Response 63

The discussion of proposed soil investigation activities for Building 112 in the Draft Final Work Plan for OU2A/2B has been revised to remove the GORE Modules. The zinc smelter was historically located in one of the shops within Building 112. Therefore, the interior samples will be analyzed for VOCs and metals, and the exterior samples will be analyzed for VOCs, SVOCs, PCBs, and metals.

Comment 64

Page 5-35, last two paragraphs: *How will the vertical extent of the DNAPL and VOC plume be defined in the area of Plume 4-2? The SPH treatment system is treating to a depth of around 45 – 50 feet bgs and there is no way to know if the DNAPL has sunk lower than that depth. Please clarify how post-treatment sampling will answer this concern. Of general concern is that the full vertical and lateral extent of the plumes at OU 2B be defined to the MCL boundary in order to effectively design a remedial system.*

Response 64

The vertical and lateral extent of groundwater contamination will be delineated to MCLs. The Draft Final Work Plan for OU2A/2B has been revised to reflect proposed groundwater contamination delineation.

Comment 65

Section 5.3.2.3, Site 4- Building 360 Soil Investigation (Data Gaps 31 and 33), Page 5-36: *Although the text states that soil samples will not be collected in Building 360, US EPA identified several data gaps involving the extent of metals contamination beneath Building 360.*

Six-phase heating will not address metals contamination, so samples need to be collected. Please explain how and when data gaps associated with the extent of metals contamination beneath Building 360 will be addressed so that the objective that future investigation will not be required after this data gaps investigation is completed can be met.

Response 65

See response to GSU specific comment 24.

Comment 66

Section 5.3.3.3 Site 11 – Building 265 Soil Investigation (Data Gap 36), Page 5-38 and 5-39: Possible releases of TPH and VOCs may not be adequately characterized by the proposed soil sampling methodology. Soil sampling is proposed for shallow soils (0.5-1 ft bgs); however, possible continuing sources of VOCs and TPH present below 1.0 ft bgs may not be detected if VOCs in shallow soil have volatilized. Please consider collection of additional samples below 1 ft bgs.

In addition, it is unclear why these sample locations are not shown on any of the Section 5 figures. Please include the Building 265 sampling on a Section 5 figure.

Response 66

An additional sample will be taken at each location at approximately 5 ft bgs. A figure depicting the proposed sampling has been incorporated into the Draft Final Work Plan for OU-2A/2B.

Comment 67

Section 5.3.5, OU-2B Site-Wide Groundwater (Data Gaps 29, 43, 44, 45), Page 5-44: *It is unclear if a conductor casing or double casing will be used to minimize the potential for contaminant migration from the FWBZ to the SWBZ during drilling and afterwards. Please provide procedures to minimize the potential for contamination of the SWBZ.*

In addition, this figure does not include the 5 new wells installed in Site 11 near the Seaplane Lagoon. Please review the location and depth of these new wells and evaluate whether the two wells proposed near the Seaplane Lagoon are still necessary.

Response 67

The Draft Final Work Plan for OU-2A/2B provides procedures for the installation of groundwater monitoring wells in the SWBZ, which includes conductor casing and other mitigation measures to avoid contaminant migration.

Relevant Figures in the Draft Final Work Plan for OU-2A/2B have been revised to show the location of these shallow FWBZ wells.

Background information on these wells and analytical results have been reviewed and incorporated within the Work Plan.

Comment 68

Page 5-44: *Please clarify the discussion here regarding the FWBZ, the SWBZ and the BSU. For Sites 9, 13, 16, 19, 22, 23 and most of Site 4 the BSU is not present and there is no differentiation between the FWBZ and SWBZ. Most of these sites have groundwater contamination which needs fuller vertical and lateral delineation. The proposed method of installing wells in the "FWBZ" and the "SWBZ" and down to the BSU does not really make sense for these sites. Please revise while also keeping in mind that part of the reason for further investigation of the groundwater in these areas is to delineate the plumes to MCLs both laterally and vertically. Please also keep this comment in mind as it relates to Sections 7.8 through 7.12.*

Response 68

The groundwater contaminant plumes will be delineated to MCLs both laterally and vertically. Additionally, boring logs, particularly soil descriptions, were reviewed in detail in preparation of the Draft Final Work Plans for OU-1 and OU-2A/2B to determine the location and nature of the BSU. Although the BSU was previously indicated to not be present in some areas of Alameda Point, soil descriptions suggested that the BSU is likely present at varying thicknesses. An isopach map showing the extent and thickness of the BSU will be included in the Draft Final Work Plan for OU-2A/2B. No isopach map was developed for OU-1 because the sites are not contiguous; however, Table 2-1 and the text of the Draft Final Work Plan for OU-1 has been revised with more complete information regarding extent and thickness of the BSU at Sites 6, 7, 8 and 16.

Comment 69

Figure 5-39, OU-2B Site-Wide (Data Gaps 29, 43, 44 and 45) Proposed Soil and Groundwater Investigation - FWBZ: *The legend indicates that the green symbols represent the location of proposed SWBZ wells, but the figure title and text in Section 5.3.5 indicate that this figure depicts FWBZ wells. Please resolve this discrepancy.*

Response 69

The appropriate figure in the Draft Final Work Plan for OU-2A/2B has been revised to correct the legend symbols for proposed FWBZ wells.

Comment 70

Section 7.5, Hand Auger and DPT Sampling, Page 7-4 and Section 7.10, FWBZ/SWBZ Continuous Coring Soil and Groundwater Sampling, Page 7-13: *It is unclear how VOCs will be preserved since the core will be cut open, screened for VOCs, and logged before samples are collected. The text states that this VOC screening requires a minimum of 5 minutes, with additional time for setup. During this period, VOCs will likely be lost, so it is recommended samples for VOC analysis be collected before the core is logged and* *that only minimal screening with a photoionization detector (PID) be done before VOC sample collection. Please revise the text to specify collection of samples for VOC analysis as soon as possible after the core bag is cut open or the core is cut.*

Response 70

This procedure and associated section have been revised in the Draft Final Work Plan for OU-2A/2B to minimize volatilization of the soil sample. Once the core is retrieved and cut, one-half of the core will be immediately bagged and placed on ice in a cooler. The other half of the core will be used for logging and headspace screening. Once the sample interval is determined, the core that has been bagged and placed on ice will be retrieved and immediately sampled.

Comment 71

Section 7.6.1. Step Down Procedure, Page 7-5: *The vertical step down distance of 3 to 5 feet is probably too large for OU-1 sites, where the depth to groundwater is 3.5 to 5 feet. At OU-1, the step down distance should be 2 feet, if 2 to 3 samples are needed above the water table. Please revise the text to specify a 2 foot (or less) step down distance for OU-1 sites.*

The timing of step down samples is also unclear, since it is not apparent whether deeper samples will be collected at the same time from the same boring and placed on hold at the laboratory pending analytical results of the initial sample or whether new borings will be done for step-down samples. If samples are all collected at the same time from the same boring and placed on hold at the analytical laboratory, will they be analyzed in order of increasing depth? What factors will guide this decision making process? Please revise the Work Plan to include this information. Please also consider any potential holding time or chain of custody constraints.

The step-down sampling methodology does not clearly indicate whether a groundwater sample will be automatically collected, or whether groundwater will not be sampled in a particular location unless contain concentrations are met. Please revise the sampling scheme to include analysis of groundwater samples at each step-down sampling location regardless of soil contaminant concentrations.

Response 71

The step–down procedure in soils has been removed from the Draft Final Work Plans for OU-1 and OU-2A/2B. Soil sampling depths and procedures in the vadose zone are discussed individually for each Site.

Soil samples at the various depths in a single location will be taken at the same time. The lower soil sample(s) will be submitted to the laboratory with the shallow soil sample. The lab will be told to extract and hold the lower sample(s) pending the results from the shallow soil sample analysis.

Groundwater samples will be automatically collected at SWMUs soil sample locations but will not be automatically collected at other soil sample locations.

Comment 72.

Section 7.6.2, Step-out Criterion, Page 7-5 and 7-6 and Figure 7-1, Step-out./Step Down Sampling Methodology: *The direction(s) for the first and subsequent step-out sample locations is(are) unclear. For example, if a step-out is needed, will step-out samples be done along the grid alignment or at a 45 degree angle to the grid? Figure 7-1 does not specify how the step-out sample locations will be determined. It is also unclear whether unsaturated and saturated soil samples and groundwater samples will be collected at each step-out location. For example, it is unclear for the case where only the 5 ft bgs sample exceeds screening criteria, whether only the 5 ft bgs samples from the step-out locations will be analyzed. A protocol should be developed to identify the next logical location for each step-out sample and the samples to be collected from each additional boring. Please use the DQO process to identify a protocol for determining the direction and number of step-out samples and revise the text to include this information. Please also clarify whether samples from all depths will be analyzed if only deeper samples are found to exceed screening criteria.*

Additionally, please indicate why a maximum of three step-out borings was selected. If the true intent of this sampling plan is to have completed the necessary field activities to support FS phase and/or remedial design, then it is possible that additional step-out borings may be required to delineate the extent of contamination. Please justify or revise the three step-out maximum.

Response 72

The step-down and step-out procedures have been significantly revised in the Draft Final Work Plans for OU-1 and OU-2A/2B to take into account issues identified by the agencies.

Saturated samples and groundwater samples are not being taken at soil step-out locations. Soil step-out samples will only be sampled for the suite of compound(s) detected in the previous sample (ie. TCE detected then analyze for VOCs only. The step-out sample will be at the depth of the exceedance and deeper unsaturated sample depths (ie. if the water table is at 6 feet and the sample at 2 feet had an exceedance, step-out sample would be at 2 feet and deeper to the water table).

If after three step-outs there are still soil analytical exceedances above the screening criteria, the data will be discussed with the regulatory agencies prior to additional activities as outlined in the field communication plan.

Comment 73 *__Section 7.8.1, SWBZ Step-Down Procedures, Page 7-10:__ The last paragraph of Section 7.8.1 indicates precautions will be taken to prevent cross contamination between the FWBZ and the SWBZ if groundwater COPC concentrations are 200 times the respective screening criteria at the base of the FWBZ. Minimizing the possibility of cross contamination between aquifers is extremely important. Please provide rationale behind using this 200 times the screening criteria factor, including why a smaller factor was not selected.*

Response 73 Please see Response to DTSC GSU Comment 7.

Comment 74 *__Section 7.12, SWBZ Groundwater Monitoring Well Installation, Page 7-16:__ The use of centralizers every 10 to 15 feet should be specified for SWBZ wells. Please revise the text to specify the use of centralizers as SWBZ wells are constructed.*

Response 74 The Draft Final Work Plans for OU-1 and OU-2A/2B have been revised to include the use of centralizers every 10 feet.

MINOR COMMENTS

Comment 1. *__Section 5.1.2.2, Site 7 Soil Debris Area Soil Investigation (Data Gap 4), Page 5-6, and Section 5.1.2.3, Site 7 Ground Water Investigation, Page 5-7:__ The use of the word approximately to describe the number of soil and groundwater and soil samples seems inappropriate. The Work Plan should be more specific; for example, the text could be revised to indicate that "a minimum of" 17 samples will be collected in the Soil Debris Area. Please revise the text to specify the minimum number of samples that will be collected.*

Response 1 Where appropriate, the text for each Draft Final Work Plan has been revised to remove the use of the word "approximately" in conjunction with the collection of samples.

Appendix A, Draft Sampling and Analysis Plan for OU-1, OU-2A, and OU2-B Data Gap Sampling, Alameda Point, Alameda, California, November 10, 2006

GENERAL COMMENTS

Comment 1 *Many of the specific comments on the Work Plan also apply to the SAP. For example, the SAP does not include criteria for deciding when additional monitoring wells will be installed. Also, comments on the DQOs table, Table 1-3 of the Work Plan, should be applied to Table A.3-1 in the SAP. Similarly, Section 5 of the SAP appears to correspond to Sections 4, 5 and 7 of the Work Plan, so comments on those sections should also be applied to the SAP. When changes are made to the Work Plan, please also revise the corresponding sections, tables, and figures of the SAP.*

Response 1 Amendments to the Draft Final Work Plans were also incorporated into the corresponding SAPs as indicated by reviewer's comments.

Comment 2 *The step-down/step-out criteria discussed in Section 5.3 are more clear and detailed than those presented in the Work Plan, except that the Work Plan states that the step-out samples be 10 feet or less from the initial sample and the SAP specifies a 5 foot distance. Please reconcile the discrepancies between the SAP and the Work Plan and consider revising the text in the Work Plan (Section 7.6) with the step-down/step-out criteria discussed in Section 5.3 of the SAP.*

Response 2 As previously discussed in other comment responses, the step-down/step-out criteria has been amended in the Draft Final Work Plans for OU-1 and OU-2A/2B. Additionally, as recommended, the Work Plans were revised to resolve discrepancies between the Work Plan text and SAP and to incorporate the clearer language provided in the SAP.

Comment 3 *Sample depths are specified in Tables A.5-1 and A.5-2, but no rationale is provided and the sampling depths are not discussed in the text. At a minimum, the rationale for sampling depths should be discussed in the text. Please provide the rationale for the sampling depths in the text or on these tables.*

Response 3 A discussion of the selection of sampling depths has been incorporated into the Draft Final Work Plans for OU-1 and OU-2A/2B.

SPECIFIC COMMENTS

Comment 1.	***Section 4.1.2, Field Forms, Page A.4-2 and Attachment 1:*** *The text indicates that an example of the boring log form is included in Attachment 1, but this form is missing from the attachment. Please include this form in the final SAP.*
Response 1	This discrepancy has been corrected in the SAP for the Draft Final Work Plans for OU-1 and OU-2A/2B.
Comment 2	***Section 5.2.8, OU-1, Site 16- Groundwater Investigation (Data Gap 9), Page A.5-17:*** *The first sentence of the last paragraph on page A.5-17 states that soil and groundwater samples will be collected at 11 locations as shown on Figure 5-12. The corresponding text in the Work Plan (Section 5.1.4.3, Page 5-13) states that soil and groundwater samples will be collected at 7 locations as shown on Figure 5-12. Please resolve this discrepancy.*
Response 2	This discrepancy has been corrected in the Draft Final Work Plan for OU-1 and the corresponding SAP.
Comment 3	***Section 5.2.19, OU-2A, Site 22- Groundwater Investigation (Data Gap 26), Page A.5-33:*** *The first sentence of the second paragraph of Section 5.2.19 on page A.5-33 states that soil and groundwater samples will be collected at three locations as shown on Figure 5-25. The corresponding text in the Work Plan (Section 5.2.4.2, Page 5-27) states that soil and groundwater samples will be collected at four locations as shown on Figure 5-25. Please resolve this discrepancy.*
Response 3	Site 22 groundwater investigations have been removed from the work plan.
Comment 4	***Section 5.2.20, OU-2A, Site 23- Groundwater Investigation (Supplemental Data Gap), Page A.5-36:*** *The first sentence of the first paragraph on page A.5-36 states that soil and groundwater samples will be collected at 17 locations as shown on Figure 5-27. The corresponding text in the Work Plan (Section 5.2.5.2, Page 5-28) states that soil and groundwater samples will be collected at 13 locations as shown on Figure 5-27. Please resolve this discrepancy.*
Response 5	No SWMUs or site soil are data gaps for Site 23. As described in the RI for this site, the presence of petroleum in soil and groundwater at Site 23 will be addressed under CAA-13 of the TPH Program. Additional investigation will not be conducted as part of this project scope.

Comment 5 ***Section 5.2.24, OU-2B, Site 4- Building 360 Soil Investigation (Data Gaps 31 and 33), Page A.5-44:*** *The first sentence of the second complete paragraph on page A.5-44 states that two borings will be placed about 5 feet from 143-SS-004. The corresponding text in the Work Plan (Section 5.3.2.3, Page 5-36) states that three borings will be placed about 5 feet from 143-SS-004. Please resolve this discrepancy.*

Response 5 This discrepancy has been corrected in the Draft Final Work Plan for OU-2A/2B and the corresponding SAP.

Comment 6 ***Section 5.2.31, OU-2B, Site 21- Sewer Soil Investigation (Data Gap 41), Page A.5-50:*** *The first sentence of the second paragraph in Section 5.2.3.1 on page A.5-50 references Figure 5-34. The corresponding text in the Work Plan (Section 5.3.4.4, Page 5-43) references Figure 5-37. Please resolve this discrepancy.*

Response 6 This discrepancy has been corrected in the Draft Final Work Plan for OU-2A/2B and the corresponding SAP.

Comment 7 ***Section 5.3 Step-Down/Step-Out Criteria, Page A.5-53:*** *The first paragraph of Section 5.3 references Figure A.5-3; however, this figure is not included in the SAP. Please include Figure A.5-3 in the final version of the SAP.*

Response 7 Figures describing the step-down and step-out procedures have been included in the Draft Final Work Plan SAPs.

Comment 8 ***Section 5.3, Step-Down/Step-Out Criteria, Pages A.5-53 and A.5-54:*** *There is a discrepancy in the step-out distances specified in the "Step-Out Criteria" paragraph on page A.5-53 and the text of the fourth and sixth bullets on page A.5-54. The sixth sentence of the paragraph indicates that the distance to the second (and third) step-out samples will be 5 feet from the previous step-out sample, but the text of the fourth bullet states that the second step-out sample "will be at a distance selected by the field geologist." Similarly, the text of the sixth bullet indicates that the distance to the third step-out sample will be selected by the field geologist. Please resolve these discrepancies.*

In addition, the fifth bullet indicates that a step-in sample will be collected if samples from the second step-out sample do not exceed screening criteria, but collection of step-in samples does not appear to be discussed in the Work Plan or elsewhere in the SAP. Please clarify whether step-in samples will be collected and revise the text of the SAP and Work Plan to be consistent.

Response 8

The text related to step-down and step-out sampling has been clarified in each Draft Final Work Plan and corresponding SAPs.

Comment 9

Section 5.3, Step-Down/Step-Out Criteria, Page A.5-54: *The assumption in the text of the last bullet on Page A.5-54 is not valid for organic chemicals (e.g., VOCs, SVOCs, TPH, pesticides, and PCBs) and may not be valid for metals that were used in Alameda Point operations. The text states that if "concentrations on the third step-out are still greater than the appropriate screening criteria, no additional step-outs will be accomplished" and "it will be assumed that the contamination did not originate from a spill or leak." In this case, the contamination will be assumed to be related to background conditions. This assumption is not valid as it does not take into account the potential for widespread contamination, nor is it chemical-specific. For example, elevated metals concentrations may be related to fill material, site operations, or may be naturally occurring, but this is not the case with all COPCs. Additionally, regardless of their origin, contaminants detected above screening criteria may pose health risks. The data gap investigation should not be discontinued because attempts to bound it were unsuccessful. Additional step-out/step-down sampling may be warranted in these situations. Please remove the three step-out limit.*

Response 9

The text related to step-down and step-out sampling has been clarified in each Draft Final Work Plan and corresponding SAPs.

Comment 10

Section 6.3.3, Grab Soil and Groundwater Sampling Procedures, Page A.6-5: *The air knife vacuum extraction system is proposed for advancement of borings for storm drain and sewer site sampling, but it is unclear if this would affect VOC concentrations in soil. Please discuss the potential of the pressurized air/vacuum to affect contaminant concentrations, particularly VOCs, in the subsurface and in samples to be collected.*

Response 10

The use of the air-knife is no longer proposed. Instead, a hand-auger, trowel, or equivalent will be used as a sampling method to investigate these sites.

Comment 11

Section 6.3.3, Grab Soil and Groundwater Sampling Procedures, Page A.6-5 and A.6-6 and Section 6.3.4, DPT and HydroPunch Sampling Procedures, Page A.6-110 and Section 6.3.8, Waste Characterization Sampling Procedures, Page A.6-20: *Text in Step 5 (Section 6.3.3) and Step 3 (Sections 6.3.4 and 6.3.7) in the list of soil sampling procedures indicates soil will be placed into designated containers. Step 6 (Step 4 in Sections 6.3.4 and 6.3.7) then states that for each VOC analysis, three En Core samplers will immediately be* *collected from the sample container. To minimize volatilization of these compounds, it is recommended that En Core samplers be collected directly from the hand auger bucket, when possible. En Core samples should be collected before all other soil samples. Please revise the SAP to specify that En Core samples will be collected before all other soil samples and that VOC samples will be collected directly from the hand auger bucket.*

Response 11

Containerization of soil for VOC analysis will be performed as soon as possible after sampling. This includes the collection of soil in EnCore® samplers. When soil is collected from a hand auger, the soil will be retrieved directly from the hand auger bucket or from a drive sampler, if applicable. A clarification regarding this has been incorporated into the SAPs of each Draft Final Work Plan.

Comment 12

Section 6.3.3, Grab Soil and Groundwater Sampling Procedures, Page A.6-8; Section 6.3.4, DPT and HydroPunch Sampling Procedures, Page A.6-12; Section 6.3.7, Monitoring Well Sampling Procedures, Page A.6-19; and Section 7.3.1, Field Duplicates, Page A.7-9*: Chain of custody (COC) procedures for field duplicates are inconsistent. The text in item number 6 (Section 6.3.3, page A.6-8), item number 8 (Section 6.3.4, page A.6-12), and item number 15 (Section 6.3.7, page A.6-19) states that "FD" for field duplicate will be noted on the COC in the "QC" type column. Field duplicates can be collected for various quality control (QC) purposes, including consistency in field sampling and laboratory analytical procedures. For this reason, field duplicates should be submitted blind to the laboratory. Further, Section 7.3.1, Field Duplicates, states that field duplicates will be assigned unique identifiers so that "the identity of the field duplicates is blind to the analytical laboratory." Please modify the groundwater sampling procedures in Sections 6.3.3, 6.3.4, and 6.3.7 to be consistent with the Section 7.3.1 requirement for blind submittal of Field Duplicate samples to the analytical laboratory and clearly state that COCs should not be marked with "FD" in the "QC" column..*

Response 12

To clarify, the QC column is present only on the portion of the COC that is retained by TtEC. The laboratory is not provided with this information and "blind" field duplicates are supplied to the laboratory. This section of the SAP was revised for clarification in each Draft Final Work Plan.

Comment 13

Section 6.3.3, Grab Soil and Groundwater Sampling Procedures, Pages A.6-7 and A.6-8; Section 6.3.4, DPT and HydroPunch Sampling Procedures, Page A.6-12; and Section 6.3.7, Monitoring

	Well Sampling Procedures, Page A.6-19 *It is unclear why the text of the last bullet in item 5 (Section 6.3.3) and item 7 (Section 6.3.4) requires use of a separate filtration apparatus and transferring the filtrate to the sample container when disposable in-line filters are available. Use of an in-line filter will minimize the oxidation of metals, minimize the potential for cross-contamination, and potentially reduce the amount of equipment that requires decontamination. Further, the monitoring well sampling procedures in Section 6.3.7 specify use of a 0.45 micron in-line filter. Please revise the procedures to specify use of 0.45 micron in-line filters or explain why use of a separate filtration apparatus is appropriate. In addition, if separate filtration apparatus is used, please specify that filtration will be done within 30 minutes of sample collection to minimize oxidation of metals.*
Response 13	The intention was to use in-line filters. The section will be revised to reflect this.
Comment 14	***Section 6.3.7, Monitoring Well Sampling Procedures, Page A.6-18:*** *The text of item 10 indicates that low flow purging will continue "until water quality indicator parameters have stabilized or two tubing volumes have been removed from the well," but it is unclear why tubing volume should be considered as important as parameter stability. Parameter stability is important because water quality parameters indicate when stagnant water has been removed from the well screen and sand pack in the vicinity of the tubing intake and that water representative of the aquifer will be sampled. Removal of two tubing volumes should be considered a default if parameter stability cannot be achieved. Please revise the low flow purging procedure to emphasize stability of water quality parameters (e.g., conductivity, pH, dissolved oxygen, and oxygen-reduction potential).*
Response 14	The tubing volume criteria has been removed form the Draft Final Work Plan for OU-1 and OU-2A/2B.
Comment 15	***Section 6.3.7 Monitoring Well Sampling Procedures, Page A.6-18:*** *The text of item 12 indicates that temperature, pH, and specific conductance will be monitored during purging, but temperature is not a good indicator because solar heating can impact the water temperature in the tubing. Further, dissolved oxygen is a critical parameter because it indicates whether VOCs have been lost through volatilization and metals have been oxidized. If possible, oxidation/reduction potential should be measured. In addition, it is unclear how these measurements will be made (e.g., using a flow-through cell, using aliquots from the discharge tube, etc.). Finally,*

there is a contradiction between items 12 and 13, in that item 13 specifies 6 water quality indicator parameters, but item 12 only specifies 3. Please revise the list of water quality parameters in item 12 to include dissolved oxygen and to de-emphasize temperature and specify the type of equipment that will be used for water quality parameter measurements. Also, please resolve the inconsistency between items 12 and 13.

Response 15

Steps 12 and 13 will be revised to indicate that all the parameters in Step 13 will be measured and the type of equipment to be used for measurement.

Comment 16

Section 6.3.7 Monitoring Well Sampling Procedures, Page A6-19: *The third and fourth bullets on Page A.6-19 state that during groundwater sampling, volatile organic analyte (VOA) vials will be filled first, followed by other glass containers and then plastic containers. However, the order of collection by analysis is not specified. Containers should be filled in order of decreasing volatility. For example, VOA vials for VOC analysis should be filled before those for TPHp or TPHe. Similarly, SVOC containers should be filled before those for PCB or pesticide analysis. Please modify the text to specify the order that containers should be filled.*

Response 16

The text in each work plan has been modified to more clearly described the sampling order by both container type and the respective analyses.

Comment 17

Table A.5-2, Data Gap Sampling Locations, Depths, and Analyses, Page 1: *The reference in the last column (SAP Section) for the Site 7 - Soil Debris Area Soil Investigation, Unsaturated soil samples (Title 22 metals), is given as Section 6.3.1, but, Section 6.3.1 of the SAP details GORE Modules Sampling Procedures. It appears that this reference should have been assigned three rows above, to Site 7 Former Bldg 68 - 3 Soil Investigation, Unsaturated soil. Please correct these references.*

Response 17

This section of the SAP has been corrected in the Draft Final Work Plan for OU-1.

Comment 18

Table A.6-1, Field Equipment Calibration, Maintenance, Testing, and Inspection: *Footnote "a" states that a function check is first performed on the instrument. If the function check is acceptable, the instrument is ready for use, and if the function check is unacceptable, the instrument is calibrated. While the third column states that calibration occurs daily, footnote "a" appears to indicate that this* *calibration may be bypassed if the function check is acceptable. Please clarify the procedures described in this footnote.*

Response 18

The procedures in the footnote will be clarified indicating that the function check and/or calibration will be performed on a daily basis.

WATER BOARD COMMENTS ON
DRAFT DATA GAP SAMPLING WORK PLAN
FOR OU-1, OU-2A, AND OU-2B
DATED NOVEMBER 3, 2006
ALAMEDA POINT
ALAMEDA, CALIFORNIA

Comments dated: February 13, 2007

Comments by: Erich Simon
Project Manager

GENERAL COMMENTS: With regard to comments on the report entitled, *Draft Data Gap Sampling Work Plan for OU-1, OU-2A, and OU-2B, Alameda Point,* Alameda, dated November 3, 2006, we defer to comments prepared by the EPA and DTSC.

Response to General Comment: Comment noted.