Final

Sampling and Analysis Plan Amendment Number 2 Operable Unit 2C Landfill Sites 3 and 5

FORMER MARINE CORPS AIR STATION, EL TORO, CALIFORNIA

M60050.003050
MCAS EL TORO
SSIC NO. 5090.3

February 2004

Department of the Navy
Commander, Southwest Division
Naval Facilities Engineering Command
1220 Pacific Highway
San Diego, CA 92132-5190

NAVFAC
Naval Facilities Engineering Command
SOUTHWEST DIVISION

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Prepared for:

Department of the Navy
Commander, Southwest Division
Naval Facilities Engineering Command
1220 Pacific Highway
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Prepared under:

Comprehensive Long-Term Environmental Action Navy (CLEAN II)
Contract Number N62742-94-D-0048
Contract Task Order Number 0078

DEPARTMENT OF THE NAVY
SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132 - 5190

5090
Ser 06CC.AP/0233
February 25, 2004

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Fellow Federal Facility Agreement (FFA) Representatives:

SUBJECT: FINAL SAMPLING AND ANALYSIS PLAN AMENDMENT NUMBER 2, OPERABLE UNIT 2C, LANDFILL SITES 3 AND 5, FORMER MARINE CORPS AIR STATION, EL TORO, CALIFORNIA

Submitted for your records is the *Final Sampling and Analysis Plan Amendment Number 2, Operable Unit 2C, Landfill Sites 3 and 5, Former Marine Corps Air Station, El Toro, California*. This document is an amendment to the *Final Work Plan, Pre-Design Investigation, Operable Unit 2C, Landfill Sites 3 and 5, Former Marine Corps Air Station, El Toro, California* (July 2002). This Sampling and Analysis Plan (SAP) Amendment defines the collection and analysis of supplemental landfill gas samples that will be used to confirm the presence or absence of landfill gases and determine the appropriate engineering and institutional controls at Installation Restoration Program (IRP) Sites 3 and 5 at the former Marine Corps Air Station (MCAS) El Toro.

This SAP Amendment was developed based on the Navy's consultation with representatives of the California Integrated Waste Management Board (CIWMB) and California Department of Toxic Substances Control (DTSC) at a meeting on December 4, 2003, and subsequent discussions with CIWMB and our fellow FFA

representatives via e-mail, letter, and telephone, including a teleconference on February 5, 2004, during which regulatory review comments on the draft SAP Amendment were discussed. A subsequent teleconference was held on February 18, 2004, during which regulatory comments were addressed and verbal concurrence was obtained on finalizing the document.

The enclosed Final SAP Amendment is a supporting document that will advance the Site 3 and 5 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program. Our intense and expedited dialogue on, and your concurrence with, this document helps facilitate our quick implementation of the data collection which will accelerate the decision-making schedule at these two sites.

The Navy appreciates your continued support in this program. Should you have questions or need additional information, please contact Mr. Karnig Ohannessian, Remedial Project Manager, at (619) 532-0796 or me at (619) 532-0784.

Sincerely,

F. ANDREW PISZKIN
Base Realignment and Closure
Environmental Coordinator
By direction of the Commander

Enclosure: 1. Final Sampling and Analysis Plan Amendment Number 2, Operable Unit 2C, Landfill Sites 3 and 5, MCAS El Toro, California – of February 2004

M60050.003050
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SSIC NO. 5090.3

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February 25, 2004

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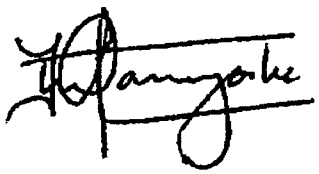
Sampling and Analysis Plan Amendment Number 2
Operable Unit 2C
Landfill Sites 3 and 5
Former MCAS El Toro, California

Contract No. N62742-94-D-0048
Contract Task Order No. 0078

Reviews and Approvals:



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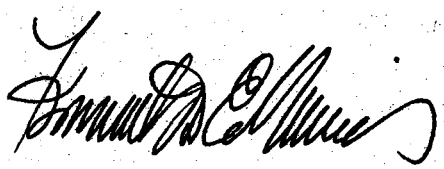

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FINAL WORK PLAN
PRE-DESIGN INVESTIGATION
OPERABLE UNIT 2C
LANDFILL SITES 3 AND 5

DATED JULY 2002

IS ENTERED IN THE DATABASE AND FILED AT
ADMINISTRATIVE RECORD NO. **M60050.002789**

FINAL SAMPLING AND ANALYSIS PLAN
AMENDMENT NUMBER 1
PRE-DESIGN INVESTIGATION
OPERABLE UNIT 2C
LANDFILL SITES 3 AND 5

DATED OCTOBER 2003

IS ENTERED IN THE DATABASE AND FILED AT
ADMINISTRATIVE RECORD NO. **M60050.002989**

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MCAS EL TORO
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DRAFT SAMPLING AND ANALYSIS PLAN AMENDMENT NUMBER 2 OPERABLE UNIT 2C LANDFILL SITES 3 AND 5

DATED JANUARY 2004

IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **M60050.003041**

CONTENTS

APPENDICES

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
%R	percent recovery
Air SWAT	air quality solid waste assessment test
ASTM	American Society for Testing and Materials
BCT	BRAC Cleanup Team
bgs	below ground surface
BNI	Bechtel National, Inc.
BRAC	Base Realignment and Closure
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CIWMB	California Integrated Waste Management Board
CLEAN	Comprehensive Long-Term Environmental Action Navy
CTO	contract task order
DoN	Department of the Navy
DQOs	data quality objectives
DTSC	Department of Toxic Substances Control
Earth Tech	Earth Tech, Inc.
EPA	Environmental Protection Agency
FFA	Federal Facilities Agreement
FID	flame ionization detector
FS	feasibility study
IAS	initial assessment study
IRP	Installation Restoration Program
LCS	laboratory control sample
LEL	lower explosive limit
MCAS	Marine Corps Air Station
MCL	maximum contaminant level
MS	matrix spike
MSD	matrix spike duplicate
n.a.	not applicable
NAVFAC EFD PACIFIC	U.S. Navy, Pacific Division, Naval Facilities Engineering Command
NFECSW-SDIEGO	Southwest Division, Naval Facilities Engineering Command
PACNAVFACENGCOM	Pacific Division, Naval Facilities Engineering Command
PCE	tetrachloroethene
ppm	parts per million
ppmv	parts per million by volume
PRG	preliminary remediation goal
RI	remedial investigation
ROD	record of decision
RPD	relative percent difference
RWQCB	California Regional Water Quality Control Board, Santa Ana Region
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
SVOC	semivolatile organic compound
SWDIV	Naval Facilities Engineering Command, Southwest Division
TC	terrain conductivity
TCE	trichloroethene
U.S.	United States
VOC	volatile organic compound

1. INTRODUCTION

This document is an amendment to the *Final Work Plan, Pre-Design Investigation, Operable Unit 2C, Landfill Sites 3 and 5, Former Marine Corps Air Station, El Toro, California* (Earth Tech 2002). The purpose of this amendment is to collect supplemental landfill gas samples to confirm the presence or absence of landfill gases and to determine appropriate engineering and institutional controls to be implemented at Installation Restoration Program (IRP) Site 3 (Original Landfill) and IRP Site 5 (Perimeter Road Landfill) at the former Marine Corps Air Station (MCAS), El Toro, California. The supplemental data will consist of landfill gas sampling results at Sites 3 and 5.

This work plan amendment was prepared by Earth Tech, Inc. (Earth Tech) on behalf of the United States (U.S.) Department of the Navy (DoN), Southwest Division, Naval Facilities Engineering Command (abbreviated as NFECSW-SDIEGO; formerly abbreviated as SWDIV), as authorized by the U.S. Navy, Pacific Division, Naval Facilities Engineering Command (NAVFAC EFD PACIFIC; formerly abbreviated as PACNAVFACENGCOM) under Contract Task Order (CTO) number 0078 of the Comprehensive Long-Term Environmental Action Navy (CLEAN) II program, contract number N62742-94-D-0048.

In addition, this Amendment includes, as Appendix B, an amendment to the health and safety plan, to address the landfill gas sampling phase of the work.

2. SITE BACKGROUND AND PHYSICAL SETTING

Former MCAS El Toro is located in a semi-urban, agricultural area of Orange County, California, adjacent to the City of Irvine and approximately 8-miles southeast of Santa Ana and 12-miles northeast of Laguna Beach (Figure 2-1). MCAS El Toro covers approximately 4,738-acres. Land use around MCAS El Toro includes commercial, light industrial, and residential. MCAS El Toro closed on 2 July 1999, as part of the Base Realignment and Closure (BRAC) Act.

2.1 SITE 3

Site 3 is located in the eastern portion of former MCAS El Toro (Figure 2-1). Site 3 encompasses approximately 11-acres (BNI 1999b) and is bounded to the northeast by Irvine Boulevard, to the southeast by Desert Storm Road, to the southwest by North Marine Way, and to the northwest by various buildings and open land (Figure A-1). An unlined channel (Agua Chinon Wash) crosses the site from north-northeast to south-southwest. In the area west of Agua Chinon Wash, the subsurface consists of compacted soil and gravel and was used as an office, staging, and decontamination area by the Station remediation contractor (BNI 1999b). Building 746, the Flight Simulator Building, is located west of the boundary of Site 3 on the west side of the wash and is a prominent feature of the area. Exposed soil areas contain non-native grasses. However, most of the site is not conducive to vegetation that would provide a habitat for wildlife.

The Site 3 Landfill was active from 1943 until 1955. It was the original landfill for former MCAS El Toro, and was operated as a cut-and-fill disposal facility. Wastes were burned at a former incinerator to reduce volume prior to burial. Typical of municipal landfills, Site 3 contains a variety of materials disposed at assorted locations. Reportedly, almost any waste that was generated at the MCAS may have been disposed at Site 3. The disposed materials are likely to have included metals, incinerator ash, solvents, paint residues, hydraulic fluids, engine coolants, construction debris, oily wastes, municipal solid waste, and various inert solid wastes (Brown and Caldwell 1986).

The operational portion of the Site 3 landfill is shown as Units 1 and 4 on Figure A-1. Unit 1 was the principal area of the Marine Corps landfill operations. This area comprises approximately 11-acres and is located to the east and west of Agua Chinon Wash. Review of the aerial photographs showed that waste disposal occurred sporadically over time at several locations within Unit 1. Unit 4 is the site of the former incinerator. This unit contains landfill wastes to a depth of approximately 9.5-feet.

Units 2 and 3 were not part of the operational landfill but were included in the Site 3 study area boundary of the Phase II Remedial Investigation (RI). Unit 2 consists of an unlined channel (Agua Chinon Wash). This wash crosses Unit 1 and does not contain landfill wastes. Unit 2 was included in the Feasibility Study (FS) because erosion in this unit could impact the integrity of landfill wastes in Unit 1. Unit 3 is a solvent spill area. This area is approximately 0.5-acres and does not contain landfill wastes. Unit 3 is not a part of the operational landfill, and no chemicals that were detected at Unit 3 exceeded risk-based concentrations (BNI 1996a).

2.2 SITE 5

Site 5 is located in the eastern portion of former MCAS El Toro and on the Tustin Plain near the foothills of the Santa Ana Mountains, approximately 1000-feet northwest of Borrego Canyon Wash (Figure A-2). The site occupies approximately 1.8-acres (BNI 1999b). IRP Site 5 elevations range from approximately 413- to 436-feet above mean sea level. Perimeter Road runs parallel to the site as seen on Figure A-2. The former landfill has become overgrown with non-native grasses. A soil cover ranging from 2- to 7-feet has been placed over the landfill.

The Site 5 landfill was active from approximately 1955 until the late 1960s. It was operated as a cut-and-fill disposal facility. Wastes were typically burned to reduce volume prior to burial. Typical of municipal landfills, Site 5 contains a variety of materials disposed within the landfill. Reportedly, almost any wastes generated at MCAS El Toro may have been disposed of at Site 5. The wastes are likely to have included burnable trash, municipal solid waste, cleaning fluids, scrap metals, paint residues, and unspecified fuels, oils, and solvents (Brown and Caldwell 1986).

During the Phase II RI (BNI 1996b), the study area of Site 5 was designated as Unit 1 and encompassed an area surrounding the operational trench. A waste storage facility, which was 200-feet wide by 450-feet long and defined by a 2-foot high earthen berm was used to contain investigation-derived soils generated during the Phase II RI. This area was designated as Unit 2. Based on the findings of the RI, Unit 1 was revised to include the operational landfill only. In 1997, subsequent to the Phase II RI, the Unit 2 investigation-derived soils were graded over the Unit 1 landfill trench, and Site 5 consisted of just the operational landfill area (BNI 1999b). Site 5 is approximately 60-feet in width by 1,200-feet in length. The depth of the landfill is approximately 15-feet below ground surface (bgs).

2.3 GEOLOGY AND HYDROGEOLOGY

Former MCAS El Toro lies on the southeastern edge of the Tustin Plain, a gently sloping surface of alluvial fan deposits derived primarily from the Santa Ana Mountains. Silts and clays predominate in the central and northwestern portion of former MCAS El Toro, and sands predominate in areas near the foothills. The sands are generally well graded and commonly contain clays. Sandstone and siltstone bedrock crops out in the foothills, including Site 3.

Former MCAS El Toro is located within the Irvine Groundwater Sub-basin Forebay, which has been designated by the Regional Water Quality Control Board, Santa Ana Region (RWQCB) as a public water supply source (RWQCB 1995). The aquifer located directly beneath former MCAS El Toro is not currently used for a municipal water supply; however, it is used for irrigation.

A detailed description of the geology and hydrogeology at Sites 3 and 5 is presented in the respective *Phase II RI Reports* (BNI 1996a, b).

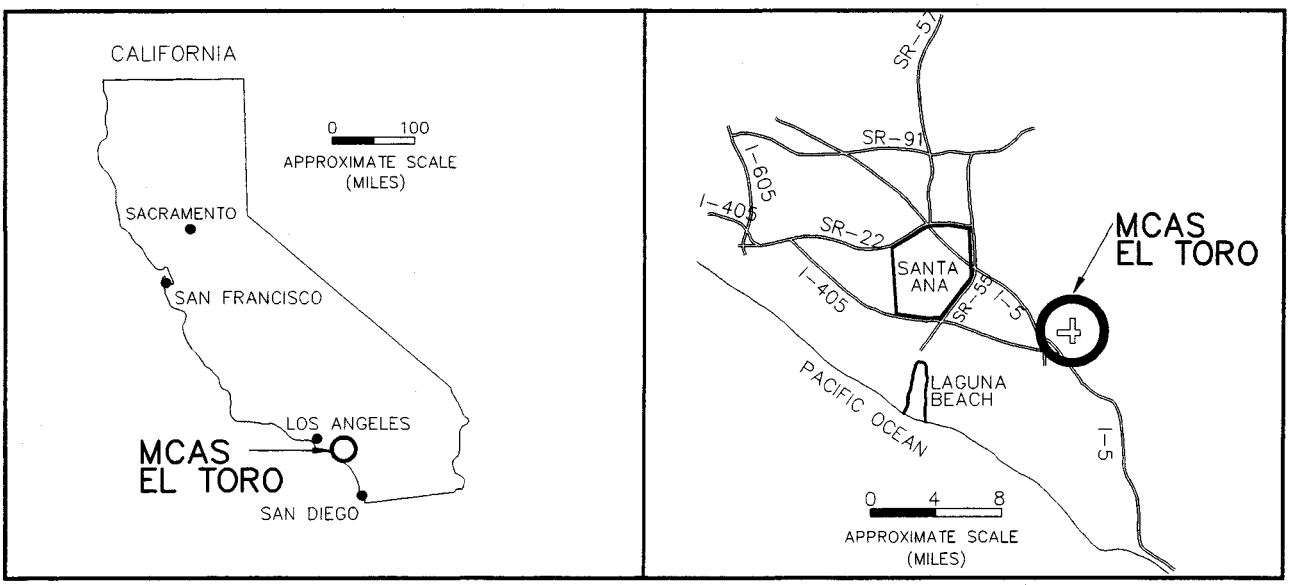
2.3.1 Site 3

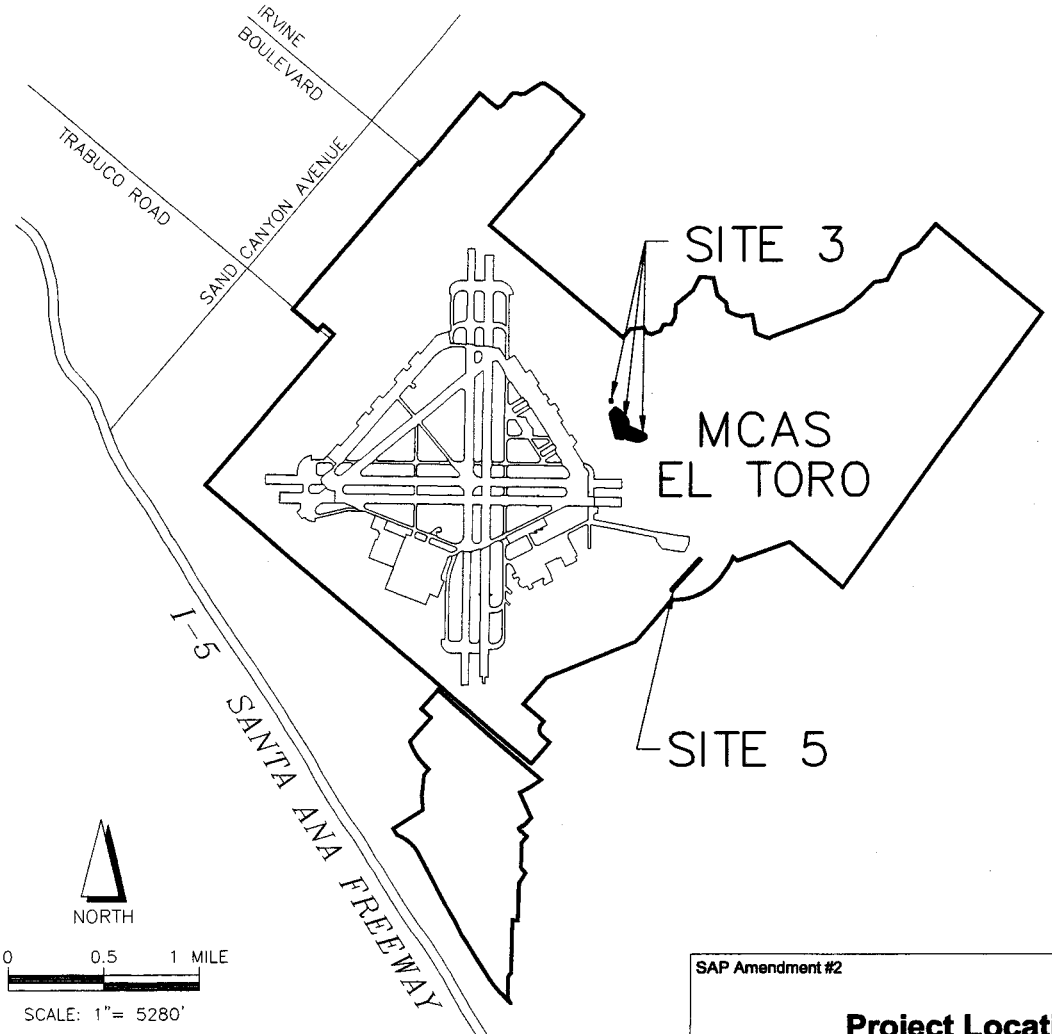
Site 3 lies near the eastern margin of the Tustin Basin, which is filled with Quaternary alluvial deposits. Sandstone bedrock was encountered to the east of the site across Irvine Boulevard. Quaternary deposits consist of unconsolidated sand and gravel with interlayered beds of silt and clay. Groundwater is encountered at approximately 200- to 220-feet bgs.

The groundwater gradient direction is toward the northwest at approximately 0.0083-foot per foot to 0.12-foot per foot. Groundwater gradients to the west of Site 3 decrease to approximately 0.0036-foot per foot. The calculated average linear flow velocity ranges from 0.62-feet per day upgradient of Site 3 to 0.0095-feet per day in the center of Site 3.

2.3.2 Site 5

Site 5 located on a broad alluvial fan that originates on the northeastern edge of the Tustin Plain where Borrego Canyon Wash exits from the foothills of the Santa Ana Mountains. Site 5 lies on Quaternary marine and alluvial sediments. The sediments consist of unconsolidated sand and gravel with discontinuous interbedded deposits of silt and clay.





SAP Amendment #2	Final
Project Location Map	
Pre-Design Investigation IRP Site 3 and Site 5	
Date 02-04	**MCAS El Toro**
Project No. 37380	EARTH TECH, A tyco INTERNATIONAL LTD. COMPANY
	Figure 2-1

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Groundwater is encountered at approximately 160- to 170-feet bgs, and the gradient is toward the northwest at an average of 0.038-foot per foot. Average linear velocities are estimated to range from 0.02- to 1.9-feet per day.

2.4 SURFACE HYDROLOGY

Surface drainage at former MCAS El Toro generally flows toward the southwest following the slope of the land. Several washes originate in the foothills northeast of former MCAS El Toro and flow through or adjacent to the former MCAS boundary en route to San Diego Creek.

Site 3 is located in the lower portion of the Agua Chinon Wash. The downstream extent of this wash crosses the landfill site in a man-made channel. The main portion of the landfill is northwest of the man-made channel, although landfill materials are located on both sides of the wash. Surface water enters the site through a concrete box culvert that is located under Irvine Boulevard. Surface runoff from Irvine Boulevard is discharged into the culvert upstream of Site 3. Surface water exits the site through another concrete box culvert located under North Marine Way. The portion of Agua Chinon Wash within Site 3 is unlined and is about 800-feet long. The wash shows evidence of erosion upstream of the site.

No significant surface drainages occur at or adjacent to Site 5. Borrego Canyon Wash is the closest surface water channel and is located approximately 1000-feet east of the site.

3. PREVIOUS INVESTIGATIONS

The DoN conducted an *Initial Assessment Study* (IAS) at MCAS El Toro in 1985 (Brown and Caldwell 1986) and a *Site Inspection Plan of Action* during 1987 and 1988 (James M. Montgomery Engineers, Inc. 1988).

MCAS El Toro was added to the National Priorities List (NPL) of the Superfund Program on 15 February 1990 due to volatile organic compound (VOC) contamination at the former MCAS boundary and in the agricultural wells west of former MCAS El Toro. A Federal Facilities Agreement (FFA) was signed by the Marine Corps and the DoN in October 1990 with the Environmental Protection Agency (EPA) Region 9, California Department of Health Services (DHS) (part of which is currently the Department of Toxic Substances Control [DTSC]), and the RWQCB.

In March 1993, MCAS El Toro was placed on the list of military facilities scheduled for closure under the BRAC Act. A BRAC Cleanup Team (BCT), including representatives from SWDIV, EPA, DTSC, and RWQCB, was formed to oversee implementation of the FFA.

Implementation of the FFA at former MCAS El Toro included an air quality solid waste assessment test (Air SWAT), a Phase I RI, a Phase II RI, and a FS. Station-wide groundwater sampling is conducted as a component of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Long-Term Groundwater Monitoring Program (BNI 1999b).

3.1 SITE 3

An IAS was conducted in 1986. The study identified a disposal pit (elevated pad located east of Building 746) 15- to 25-feet deep. Three additional disposal trenches (two located on the west side of the Agua Chinon Wash, and one trench located on the east side of the wash), each approximately 300- to 400-feet wide and 20- to 25-feet deep were also identified during the IAS.

The Phase I RI geophysical investigation area encompassed approximately 6.5-acres. The Phase I RI identified four anomalies interpreted as buried waste and three anomalies possibly related to buried waste.

The Phase II RI geophysical survey identified two anomalies to the west of the Agua Chinon Wash and one anomaly to the east of the wash. The geophysical survey was performed along a 50- by 50-foot grid spacing across the Site 3 study area. Survey results indicated low terrain conductivity (TC) within the perimeter of Unit 1. Two anomalies to the west of Agua Chinon Wash and one anomaly to the east appeared to coincide roughly with the locations of trenches from the IAS report and with the elevated pad located to the east of Building 746.

A total of six soil boreholes were advanced, primarily to install monitoring wells during the Phase I RI. Eighteen soil borings and three lysimeter borings were advanced during the Phase II RI. Eight soil borings and three lysimeter borings were drilled during the Phase II RI in and around Site 3, Unit 1. Landfill material, including brick fragments, melted glass, and debris was reported to a maximum depth of 8.5-feet. Three soil borings were located in Unit 4, the former incinerator area. An additional soil boring in Unit 4 also revealed landfill material at depths of 2- to 9.5-feet. Waste material consisted of porcelain, glass, and paper with coarse-grained sand and gravel (BNI 1996a).

Ambient air samples collected at Site 3 during the Phase II RI that indicated low concentrations of methane and VOCs were being emitted from the surface of the landfill. Soil vapor samples indicated results similar to the ambient air samples. Soil samples indicated concentrations of arsenic and beryllium above EPA Region IX preliminary remediation goals (PRGs), but below MCAS El Toro background concentrations. Groundwater samples detected benzene and nickel above their respective maximum contaminant levels (MCLs), although the benzene may have originated from the Tank Farm No. 5 area located southwest of the site, and the nickel concentrations were below MCAS El Toro background values.

The IRP Site 3 waste placement boundary as determined by the Phase I and II RI's was based on non-intrusive methods, including geophysical surveys, interviews with base personnel, reviews of maps and blueprints, results of previous investigations, aerial photographs, and soil borings. A pre-design investigation was conducted in 2002 and 2003 that significantly reduced the waste placement areas at IRP Site 3. Based on the pre-design investigation trenching results, approximately 30,000-cubic yards of waste are contained in Unit 1 at Site 3. This volume is significantly less than the estimate of 163,500- to 243,000-cubic yards of waste used in the RI/FS for Site 3 as presented in the Draft Record of Decision (ROD) (BNI 1999b). The revised waste placement boundary for Site 3 is illustrated in Figure A-1.

3.1.1 Soil Gas Sampling

Soil gas samples from Unit 1, Unit 2, Unit 3, and Unit 4 of the IRP Site 3 were collected during the Air SWAT investigation (Strata 1991) and the Phase II RI (BNI 1996a). A brief discussion of soil gas sampling results, as presented in the Phase II RI report (BNI 1996a), from the Air SWAT investigation and Phase II RI is summarized below. The soil gas sampling was performed in accordance with the IRP Site 3 Phase II RI work plan (BNI 1996a). Perimeter soil gas sampling at Unit 1 of the IRP Site 3 was also conducted at the newly installed wells as part of the pre-design investigation (Earth Tech 2003).

3.1.2 Air SWAT Sampling

Unit 1. *Shallow Soil Gas Sampling* - Five soil gas samples were collected at 5 locations at a depth of 8-feet below ground surface (bgs) and analyzed for target VOCs using EPA Method TO-14. Trichloroethene (TCE) was detected in 2 of the 5 locations at concentrations of 30-micrograms per liter (µg/L) and 6.5-µg/L. Tetrachloroethene (PCE) and chloroform were detected in single sample each at a concentration of 0.19- and 17-µg/L, respectively. Methylene chloride was detected in all 5 shallow soil samples as well as in the blank soil gas sample.

Unit 1. *Perimeter Soil Gas Sampling* – Three landfill gas migration samples were collected at 3 sampling stations inside the perimeter of Unit 1 during the Air SWAT. These samples were analyzed for VOCs and methane. Methane was reported in all 3 migration samples at concentrations ranging from 1.7-parts per million volume (ppmv) to 2.5-ppmv (1.14- to 1.68-µg/L).

3.1.3 Phase II RI

The Phase II RI soil gas sampling was conducted to address the data quality objectives (DQOs) decision regarding whether: (1) soil gas hot spots are present, and (2) landfill gases are migrating into the subsurface soil outside the landfill boundary.

Unit 1. *Shallow Soil Gas Sampling* - Shallow soil gas samples were collected to assess if hot spots are present within Unit 1 (main landfill). As part of shallow soil gas sampling, 47 samples from 36 locations were collected from Unit 1 (grid spacing of 200- x 200-feet). The depth of soil gas sampling was up to 15-feet bgs. These soil gas samples were analyzed for target VOC compounds

and methane using EPA Methods 8010 and 8015 in a mobile laboratory. Freon was detected in 3 samples at concentrations ranging from 1- to 20-µg/L. Chloroform and TCE were detected in a soil gas sample at a concentration of 1- and 3-µg/L, respectively. PCE was detected in a single soil gas sample at a concentration of 2-µg/L.

Unit 1. *Deep Soil Gas Sampling* - Five deep soil gas samples were collected from 3 lysimeter soil gas probes. TCE was detected at a concentration 2-µg/L in a sample collected from the lysimeter (03LYS2) installed at a depth of 82-feet bgs (30-degree angle boring). Toluene was detected in two lysimeter samples (depths of 82-feet bgs [03LYS1] and 91.2-feet bgs [03LYS3]) at concentrations of 5-µg/L and 3-µg/L, respectively.

Unit 1. *Perimeter Soil Gas Sampling* – Perimeter gas migration samples were collected to assess whether landfill gases are migrating in the subsurface outside the landfill boundary (BNI 1996a). Each of the four perimeter probes was located outside the landfill at a spacing of approximately 1,000-feet along the landfill boundary. Twelve landfill migration soil gas samples were collected from 4 locations at 3 sampling depths of 10-, 25- and 40-feet bgs (except the 40-foot sample at one location, which was collected at 30-feet bgs). Soil gas samples were collected at three sampling depths in accordance with Title 14, Chapter 3, Article 7.8 (Article 17783.5) (BNI 1996a). These regulations are currently under the Title 27 of California Code of Regulations (CCR). These samples were analyzed for VOCs and methane. 1,1-dichloroethene (DCE) was reported at a concentration of 2-µg/L in a single soil gas sample collected at 25-feet bgs. Toluene was detected at a concentration of 2-µg/L in a single soil gas sample collected at 40-feet bgs. Methane was detected in all samples at concentrations ranging from 2- to 19-ppmv (1.3- to 12.8-µg/L). At all locations, maximum methane concentrations were reported from the sample collected at 10-feet bgs.

Unit 2. *Shallow Soil Gas Sampling* - Shallow soil gas samples were collected to assess if hot spots are present within Unit 2 (Agua Chinon Wash). As part of shallow soil gas sampling, 4 samples were collected from Unit 2 (grid spacing of 200- x 200-feet). The depth of soil gas sampling ranged between 11.5- to 15-feet bgs. These soil gas samples were analyzed for target VOC compounds and methane using EPA Methods 8010 and 8015 in a mobile laboratory. VOCs were reported in only 1 sample and included benzene, toluene, ethylbenzene, m,p-xylenes and o-xylene. No halogenated VOCs were reported above the detection limit. The total concentration of VOCs in the sample was 208-µg/L. The concentrations of specific compounds are as follows: benzene (13-µg/L), toluene (36-µg/L), ethlybenzene (59-µg/L), and m,p-xylenes (40-µg/L) and o-xylene (60-µg/L).

Unit 3. *Shallow Soil Gas Sampling* - Shallow soil gas samples were collected to assess if hot spots are present within Unit 3 (solvent spill area). As part of shallow soil gas sampling, 52 samples were collected from 73 locations at the solvent spill area (grid spacing of 20- x 20-feet). The depth of soil gas sampling ranged between 11.5- to 15-feet bgs. These soil gas samples were analyzed for target VOC compounds and methane using EPA Methods 8010 and 8015 in a mobile laboratory. Only Freon 113 was detected in 11 samples at concentrations ranging from 1- to 3-µg/L.

Unit 4. *Shallow Soil Gas Sampling* - Shallow soil gas samples were collected to assess if hot spots are present within Unit 4 (former incinerator). As part of Tier 1 shallow soil gas sampling, 5 samples were collected from 5 locations at Unit 4 and the depth of soil gas sampling was 15-feet bgs. These soil gas samples were analyzed for target VOC compounds and methane using Methods 8010 and 8015 in a mobile laboratory. Tier 2 shallow soil gas sampling was not performed. Freon 113 was detected in 3 samples at concentrations ranging from 3- to 9-µg/L. PCE was detected in 2 samples at concentrations of 2- and 4-µg/L.

3.1.4 Perimeter Gas Sampling – Pre-design Investigation

Under the purview of IRP Site 3 pre-design investigation, four rounds of perimeter soil gas sampling were proposed (Earth Tech 2002). The Round 1, Round 2, and Round 3 soil gas samples were collected on 4 and 5 December 2002, 21 March 2003, and 30 July 2003, respectively, from the four newly installed perimeter gas wells at Site 3. Each well was sampled in both the shallow and deep-screened interval. A total of nine soil gas samples were collected from the IRP Site 3 perimeter wells, including one duplicate and submitted to the laboratory for VOC (EPA Method TO-14 Modified) and fixed gas analysis (oxygen, nitrogen, carbon monoxide, methane, and carbon dioxide) following the American Society for Testing and Materials (ASTM) D 1946 method.

In addition to the fixed-base analytical laboratory analysis, field measurements were collected using a gas analyzer (GEM-500) for fixed gases and a flame ionization detector (FID) for organic vapors in order to identify high concentrations during sampling and to correlate with laboratory results. Based on the field FID readings, a decision whether to send the soil gas samples to the fixed laboratory for analysis was made. If the field FID reading of a particular sample was less than 25-ppmv, then that sample was not submitted to a fixed laboratory for analysis.

3.1.4.1 VOCs

Round 1. Round 1 perimeter soil gas analytical results indicated low concentrations of VOCs (ranging from 4- to 102-µg/L). Total VOCs were calculated as the sum of all detected VOCs for each sample. Soil gas samples collected from two wells (concentrations of 88- and 102-µg/L) had slightly higher concentrations of total VOC than most other soil gas samples. The VOC analytes that contributed to high total VOC concentrations are tetrahydrofuran and 2-butanone (both constituents of well construction materials). Since soil gas samples were collected within few days of well installation, it is possible that these VOC detects were not from the landfill but were contributions from construction activities. The maximum calculated value for total VOCs was 102-µg/L, significantly below the threshold of 300-µg/L established during the RI (BNI 1995).

Round 2. Round 2 perimeter soil gas analytical results indicated very low levels of VOC concentrations (ranging from 0.26- to 11-µg/L). VOC concentrations detected in the two Round 2 soil gas samples (1- and 11-µg/L) are significantly less than concentrations detected in Round 1 soil gas samples (88- and 102-µg/L). The maximum calculated value for total VOCs was 11-µg/L, significantly below the threshold of 300-µg/L.

Round 3. The field methane readings of samples collected from the monitoring wells were all zero and the field FID readings ranged from 3.3- to 10.4-ppmv. Since none of these samples exceeded the 25-ppmv threshold, none of these samples were submitted to the fixed laboratory for analysis.

3.1.4.2 FIXED GASES

Round 1. Methane was not detected above the reporting limit in any of the nine soil gas samples collected from Site 3 wells during Round 1 fixed gas sampling. Oxygen concentrations ranged from 14- to 21-percent. Nitrogen concentrations ranged from 81- to 86-percent. Carbon dioxide concentrations ranged from 0.66- to 6.7-percent. Carbon Monoxide was not detected above the reporting limit in any of the nine samples. The Site 3 fixed gases concentrations correspond to ambient concentrations and are not indicative of landfill gas production or biodegradation of landfill material.

Round 2. Very low methane concentrations ranging from 0.00011- to 0.00014-percent were detected in four soil gas samples collected from four wells during Round 2 soil gas samples. These soil gas concentrations are more than four orders of magnitude lower than the lower explosive limit (LEL)

concentration of 5-percent for methane. Oxygen concentrations ranged from 14- to 20-percent. Nitrogen concentrations ranged from 75- to 77-percent. Carbon dioxide concentrations ranged from 0.72- to 4.6-percent. Carbon monoxide was not detected above the reporting limit in any of the nine samples. The Site 3 fixed gases concentrations correspond to ambient concentrations and are not indicative of landfill gas production or biodegradation of landfill material.

Round 3. The field methane readings of samples collected from the monitoring wells were all zero (below instrument sensitivity). Oxygen concentrations ranged from 16.2- to 20.5-percent. Nitrogen concentrations ranged from 79.5- to 81-percent. Carbon dioxide concentrations ranged from 0- to 3.1-percent. Carbon monoxide was not detected above the reporting limit in any of the nine samples. The Site 3 fixed gases concentrations correspond to ambient concentrations and are not indicative of landfill gas production or biodegradation of landfill material. Since none of the Round 3 samples exceeded the 25-ppmv threshold, none of these samples were submitted to the fixed laboratory.

3.2 SITE 5

Geophysical survey results indicated low TC for most of the survey area with the exception of the utility line located parallel to the buried wastes, a concrete slab and metal grate located west of Building 840, and a portion of the adjacent golf course. Geophysical anomalies that were detected in the survey areas were further investigated by trenching.

A total of three trenches were excavated in lengths varying from 15- to 80-feet and depths ranging from 5- to 8.5-feet. These trenches were located in the areas of geophysical anomalies to determine whether the anomalies were landfill materials. No buried wastes were encountered in any of the trenches.

A total of six soil boreholes were advanced at Site 5, primarily to install monitoring wells and also to further delineate the extent of buried waste. Three boreholes were located outside the Phase II study area boundary and three were within the boundary. Three lysimeter borings were also advanced at Site 5. No wastes were encountered in any of the boreholes.

Ambient air samples collected at Site 5 during the Phase II RI indicated that low concentrations of methane and VOCs were being emitted from the surface of the landfill. Soil vapor samples indicated results similar to the ambient air samples. Soil samples indicated low concentrations of VOCs and semi-volatile organic compounds (SVOCs) below Region 9 PRGs. Groundwater samples analyzed for VOCs, SVOCs, pesticides, metals, and gross alpha- and beta-emitting radionuclides indicated no analytes exceeding MCLs, with the exception of gross alpha concentrations.

A pre-design investigation was conducted at IRP Site 5 in 2002. Based on trenching results, approximately 16,000-cubic yards of waste are contained within Site 5. This volume is significantly less than the estimate of 40,000-cubic yards of waste used in the RI/FS for Site 5 as presented in the Draft ROD (BNI 1999b). The waste placement boundary at Site 5 is illustrated in Figure A-2.

3.2.1 Soil Gas Sampling

Subsurface soil gas samples were collected from within and at the perimeter of the IRP Site 5 landfill during the Air SWAT investigation (Strata 1991) and the Phase II RI (BNI 1996b). A brief discussion of soil gas sampling results, as presented in the Phase II RI report (BNI 1996b), from the Air SWAT investigation and Phase II RI is summarized below. The soil gas sampling was performed in accordance with the final work plan for Phase II RI/FS (BNI 1995). Subsurface soil gas sampling (from soil probes installed at the perimeter) at IRP Site 5 was also conducted as part of the pre-design investigation (Earth Tech 2003).

3.2.2 Air SWAT Sampling

Shallow Soil Gas Sampling - Five soil gas samples were collected at 5 locations at a depth of 8-feet bgs and analyzed for target VOCs using EPA Method TO-14. TCE was detected in 2 of the 5 locations at concentrations of 0.24- and 14.9-µg/L. PCE was detected in two samples at a concentration of 0.41- and 0.49-µg/L. Methylene chloride was detected in all 5 shallow soil samples as well as in the blank soil gas sample at concentrations ranging from 0.35- to 1.02-µg/L.

Perimeter Soil Gas Sampling – Three landfill gas migration samples were collected at three sampling stations at the perimeter of the landfill. These samples were analyzed by fixed laboratory for total organic carbon as methane. Methane was not detected in any of the samples collected.

3.2.3 Phase II RI

The Phase II RI soil gas sampling was conducted to address the DQOs decision regarding whether: (1) soil gas hot spots are present within the landfill area, and (2) landfill gases are migrating into the subsurface soil outside the landfill boundary.

Shallow Soil Gas Sampling - Shallow soil gas samples were collected to assess if hot spots are present within the landfill. As part of shallow soil gas sampling, 21 samples were collected from 17 locations (grid spacing of 100- x 100-feet) at depths ranging from 8- to 15-feet bgs. These soil gas samples were analyzed for target VOC compounds and methane using EPA Methods 8010 and 8015 in a mobile laboratory. Freon 113 was detected in 3 samples at concentrations ranging from 1- to 2-µg/L. TCE was detected in 3 soil gas samples at concentrations ranging from 5- to 10-µg/L, respectively.

Lysimeter/Soil Gas Probe Installation During Phase II RI – Three lysimeters/soil gas probes were installed within boreholes drilled using dual-tube percussion methods. Two lysimeters/soil gas probes were drilled at a 30-degree angle to 100-feet boring length in order to reach a depth of 87-feet bgs. This configuration allowed lysimeters and soil gas probes to be placed beneath the landfill to facilitate sampling for leachate and gases. A background lysimeter was drilled vertically to 87-feet bgs to facilitate collection of samples representative of background or ambient conditions. Toluene was detected at a concentration of 15-µg/L in a deep soil gas sample collected at a depth of 81.4-feet bgs from the angle boring. The vertical boring probe installed at a depth of 84-feet bgs to collect background sample had toluene concentration of 6-µg/L.

Perimeter Soil Gas Sampling – Perimeter gas migration samples were collected to assess whether landfill gases are migrating in the subsurface outside the landfill boundary (BNI 1996b). Eleven perimeter soil gas migration samples were collected from three perimeter probes located outside the landfill at a spacing of approximately 1,000-feet along the landfill boundary. Landfill migration soil gas samples were collected at sampling depths of 10-, 25- and 40-feet bgs. A cone penetrometer test rig was also used to conduct further sampling at 60- and 80-feet bgs at one of the soil gas probes. Soil gas samples were collected at three sampling depths in accordance with Title 14, Chapter 3, Article 7.8 (Article 17783.5) (BNI 1996b). These regulations are currently under the Title 27 of CCR. These samples were analyzed for VOCs and methane. Freon 113 was detected in a sample collected at 40-feet bgs at a concentration of 2-µg/L. TCE was detected in the same sample at a concentration of 25-µg/L. Methane was detected in 9 samples at concentrations ranging from 1- to 25-ppmv (0.7- to 16.8-µg/L). At one location, the maximum reported methane concentration was observed in the 25-feet bgs sample. At other two locations, maximum methane concentrations were reported from the sample collected at 10-feet bgs and in these locations methane concentrations decreased with depth.

3.2.4 Perimeter Gas Sampling – Pre-design Investigation

Three lysimeters/soil gas probes that were installed during the Phase II RI were sampled as part of the pre-design investigation. As part of the IRP Site 5 pre-design investigation, four rounds of soil gas sampling were proposed from the soil probes installed at the perimeter of the site (Earth Tech 2002). The Round 1, Round 2, and Round 3 soil gas samples were collected on 4 and 5 December 2002, 21 March 2003, and 30 July 2003, respectively. A total of four soil gas samples were collected from the IRP Site 5 soil gas probes, including one duplicate and submitted to the laboratory for VOC (EPA Method TO-14) and fixed gas analysis (oxygen, nitrogen, carbon monoxide, methane, and carbon dioxide) following the ASTM Method D 1946.

In addition to the fixed-base analytical laboratory analysis, field measurements were recorded using a gas analyzer (GEM-500) for fixed gases and a FID for organic vapors. This was done to identify high concentrations during sampling and to correlate with laboratory results. Based on the field FID readings, a decision whether to send the soil gas samples to the fixed laboratory for analysis was made. If the field FID reading of a particular sample was less than 25-ppmv, then that sample was not submitted to a fixed laboratory for analysis. However, irrespective of the field FID reading during Round 1 and Round 2 of pre-design investigation, soil gas samples were sent to the fixed laboratory, in accordance with the work plan (Earth Tech 2002).

3.2.4.1 VOCs

Round 1. The Round 1 soil gas laboratory analytical results indicated low concentrations of VOCs. Total VOCs were calculated as the sum of all detected VOCs for each sample and ranged from 0.12- to 20-µg/L. The maximum calculated value for total VOCs was 20-µg/L, significantly below the hotspot threshold of 300-µg/L (BNI 1995).

Round 2. Round 2 soil gas sampling results from Site 5 wells were similar to Round 1 sampling results. Total VOCs were calculated as the sum of all detected VOCs for each sample and ranged from 0.18- to 19-µg/L. The maximum calculated value for total VOCs was 19-µg/L (05LYS01), significantly below the threshold of 300-µg/L.

Round 3. The field FID readings ranged from 5.3- to 11.0-ppmv. Since none of these samples exceeded the 25-ppmv threshold, none of these samples were submitted to the fixed laboratory for analysis.

3.2.4.2 FIXED GASES

Round 1. Methane was not detected above the reporting limit in any of the three soil gas samples collected from Site 5 wells during Round 1 fixed gas sampling. Oxygen concentrations ranged from 15- to 19-percent. Nitrogen concentrations ranged from 72- to 75-percent. Carbon dioxide concentrations ranged from 1.5- to 3-percent. Carbon Monoxide was not detected above the reporting limit in any of the nine samples. The Site 5 fixed gases concentrations correspond to ambient concentrations and are not indicative of landfill gas production or biodegradation of landfill material.

Round 2. Methane was not detected above the reporting limit in any of the three soil gas samples collected from Site 5 wells during Round 2 fixed gas sampling. Oxygen concentrations ranged from 16- to 19-percent. Nitrogen concentrations ranged from 75- to 79-percent. Carbon dioxide concentrations ranged from 1.4- to 2.9-percent. Carbon Monoxide was not detected above the reporting limit in any of the nine samples. The Site 5 fixed gases concentrations correspond to ambient concentrations and are not indicative of landfill gas production or biodegradation of landfill material.

Round 3. The field methane readings of samples collected from the monitoring wells were all zero (below instrument sensitivity). Oxygen concentrations ranged from 18.9- to 20.1-percent. Nitrogen concentrations ranged from 79.9- to 80-percent. Carbon dioxide concentrations ranged from 0- to 0.4-percent. Carbon monoxide was not detected above the reporting limit in any sample. The Site 5 fixed gases concentrations correspond to ambient concentrations and are not indicative of landfill gas production or biodegradation of landfill material. Since none of the Round 3 samples exceeded the 25-ppmv threshold, none of these samples were submitted to the fixed laboratory.

4. DATA QUALITY OBJECTIVES

The purpose of the additional investigation at Sites 3 and 5 is to confirm the presence or absence of landfill gases (methane) in the landfill subsurface to determine appropriate engineering controls and institutional controls at both landfill sites. To achieve these objectives, the Navy in consultation with the California Integrated Waste Management Board (CIWMB) and the DTSC, has developed this Sampling and Analysis Amendment to collect additional landfill gas data. The EPA DQO process was used for the design of the additional investigation at Sites 3 and 5. Landfill Sites 3 and 5 at MCAS El Toro represent a unique situation where the Navy is fast-tracking remediation to promote reuse. The BCT incorporated elements of the DTSC *Advisory - Active Soil Gas Investigations* (2003) into this Sampling and Analysis Plan Amendment to support the time-sensitive data collection essential for determining appropriate engineering and institutional controls.

4.1 PROBLEM STATEMENT

Limited sampling for landfill gases has been conducted at Sites 3 and 5. Low levels of landfill gases have been detected at the perimeters of both landfills in previous investigations. However, landfill gas concentrations within the landfill waste have not been adequately defined. Therefore, the concentrations of landfill gases within the waste areas are not known, and need to be characterized to determine appropriate engineering and institutional controls at both sites.

4.2 IDENTIFICATION OF DECISION

Following the additional landfill gas sampling and analysis for methane, carbon dioxide, oxygen, and percent LEL, the existing and additional soil gas analytical data will be representative and adequate to assess the distribution of methane at Sites 3 and 5. The study questions for this investigation are:

- What engineering controls and institutional controls are appropriate for the methane concentrations at IRP Sites 3 and 5?
- Do four perimeter monitoring wells provide adequate monitoring for the conditions at Site 5?

4.3 IDENTIFICATION OF INPUTS TO THE DECISION

To resolve the decision statement, landfill gas samples will be collected within the limits of waste at Sites 3 and 5 and analyzed for methane, carbon dioxide, oxygen, hydrogen sulfide, and percent LEL using field instruments. Methane concentrations will also be analyzed by a mobile laboratory using EPA Method 8015-modified. The existing and additional soil gas data at Sites 3 and 5 will also be evaluated.

4.4 STUDY BOUNDARIES

The lateral boundaries of the study areas at Sites 3 and 5 are shown in Figures A-1 and A-2, respectively. The maximum depth of this investigation will be approximately 15-feet bgs. However, based on field conditions and results, and consultations with BCT members, soil gas samples may be collected at 25-feet bgs.

4.5 DECISION RULES

The decision rules for this investigation are:

If the results of the landfill gas sampling within the landfill limits indicate the presence of significant methane concentrations at Sites 3 or 5, ***then*** appropriate engineering and institutional controls will be implemented at Sites 3 or 5 to protect human health and the environment.

If the results of landfill gas sampling within the landfill limits do not indicate significant methane concentrations at Sites 3 or 5, ***then*** less conservative engineering and institutional controls will be evaluated to determine whether human health and the environment can be protected with less costly engineering and institutional control alternatives in consultation with the BCT and CIWMB.

If the methane concentrations in any sample collected at Site 5 exceeds 5% methane, ***then*** three additional perimeter landfill monitoring probes will be installed at Site 5, in addition to the proposed four perimeter landfill gas probes.

4.6 DECISION ERRORS

The decision on the number of landfill gas samples for methane and fixed gas analysis at Sites 3 and 5 will be based on judgment. Therefore, there are no numerical probabilities associated with decision and limits on decision errors. The probability of decision error is controlled by the sampling design and balances the cost of the project design with the likelihood of an incorrect decision.

Spacing of the sampling points at IRP Sites 3 and 5 is approximately 100-feet. However, within the waste areas the lateral spacing ranges from approximately 50- to 75-feet. Locations of the sampling points are selected based on the recommendations of the regulatory agency representatives. Field verification of drawings and accurate mapping of sampling locations and target areas will minimize decision errors.

The analytical methods selected will be documented and will include appropriate verification and validation. Field and fixed laboratory data packages will be independently reviewed for compliance with the methods and specifications of the sampling design. Sampling methods will include field duplicates to assess repeatability and representativeness of the sampling procedures. Sampling methods will follow established operating procedures and be independently documented by field supervisors.

4.7 SAMPLING DESIGN

4.7.1 Soil Gas Sampling within the Landfill Boundary - Direct Push Technique

Landfill gas samples will be collected within the landfill waste boundaries using a direct-push probe at 45 locations (33 locations in Unit 1 and 1 location in Unit 4 at Site 3, and 11 locations at Site 5), in general accordance with the *Advisory – Active Soil Gas Investigations* (DTSC 2003), unless otherwise specified. Landfill gas samples will be collected at depths of 7.5- and 15-feet below ground surface. Selected sampling locations are close to features that would create preferential landfill gas migration conditions. If high methane concentrations are detected at 15-feet below ground surface, additional samples at the deepest part of the landfill may be collected based on the field results and consultations with the regulatory agencies. Landfill gas samples will be collected at Sites 3 and 5 at the locations shown in Figures A-1 and A-2.

4.7.2 Perimeter Landfill Monitoring Wells at IRP Site 5

Four perimeter landfill gas monitoring wells will be installed at Site 5 per the Pre-Design Investigation at Sites 3 and 5 (Earth Tech 2002). However, consistent with the DQO decision rules, if any landfill gas sample collected from a direct push probe location has a methane concentration greater than 5 percent, three additional perimeter gas wells will be installed to monitor landfill gas

migration. The location of these monitoring wells is illustrated in Figure A-2. A typical landfill gas monitoring well is illustrated in Figure A-3. The wells will be installed in accordance with Section A.2.5 of the Sampling and Analysis Plan for the Pre-Design Investigation at Sites 3 and 5 (Earth Tech 2002). The wells will be installed near the perimeter of the waste but not within the waste. The lateral spacing between the wells will not exceed 1,000-feet. The wells will be installed in areas that are geologically permeable to landfill gas migration. Each well will include shallow and deep probes. No intermediate probe is required by 27 CCR 20925 for landfills where the depth of the waste is less than 30-feet. Screened intervals for each well are expected to be 5-6 and 14-15 feet below ground surface, and are based on the results of the trenching investigation conducted at the site.

Perimeter gas sampling will be performed in accordance with Section A.2.6 of the Sampling and Analysis Plan (SAP) for the Pre-design Investigation at Sites 3 and 5 (Earth Tech 2002).

5. FIELD SAMPLING PLAN

Fieldwork will be performed in accordance with applicable CLEAN standard operating procedures (SOP's) (BNI 1999a) and the soil gas sampling SOP (Appendix C) that was generated for the sampling activities at IRP Sites 3 and 5. Earth Tech field personnel will have copies of all referenced SOP's during fieldwork activities. Approved CLEAN SOP's were submitted to the BCT by SWDIV; copies of the SOP's can be provided to reviewers of this document if requested.

5.1 SUBSURFACE CLEARANCE

Project personnel will review and evaluate records pertaining to underground utilities prior to preliminary field marking of sampling locations. The review and evaluation will include available site plans, utility layouts, and the results of previous subsurface investigations and geophysical surveys.

5.2 LANDFILL GAS SAMPLING

Landfill gas samples will be collected in accordance with the SOP developed for this project (Appendix C). The SOP is based on the RWQCB, Los Angeles Region, *Interim Guidance for Active Soil Gas Surveys* (1997) and the DTSC *Advisory – Active Soil Gas Investigations* (2003). Since landfill gas (methane) is the primary concern, only those sections in the SOP that apply to methane sample collection and analysis will be applicable.

The landfill gas probe will be advanced to the desired depth using the direct push method, and hydrated bentonite will be used to seal around the drive rod at ground surface to prevent ambient air intrusion from occurring. The inner soil gas pathway from the probe tip to the surface will be continuously sealed to prevent infiltration. The purge volume test, leak test, and soil gas sampling will be conducted after a minimum of 20-minutes to allow subsurface conditions to equilibrate. Prior to sampling, soil gas pressure will be monitored using a pressure gauge capable of detecting pressures of ± 1-inch of water compared to ambient pressure. Purge volume and leak testing will be conducted in general accordance with Sections 2.3 and 2.4, respectively, of the DTSC *Advisory – Active Soil Gas Investigation* (2003). Pursuant to discussions with the DTSC staff, the 20-percent re-sampling requirement specified in Section 2.3 of the Advisory will be waived. In addition, a leak threshold limit of 10 parts per million (ppm) will be used for the leak detection tracer gas, isopropanol. Leak testing will be conducted prior to collecting all samples. An FID or mobile laboratory using EPA Method 8015 modified will be used to assess for leaks. The purge rate and volume will be performed and documented in accordance with Section 2.5 of the DTSC *Advisory – Active Soil Gas Investigation* (2003). After purging and sampling is completed, the samples will be monitored with a Landtec GEM 500 and FID field instruments for methane, carbon dioxide, oxygen, percent LEL, and isopropanol (the leak test compound). Hydrogen sulfide will be monitored after sample collection using an Interscan INT 1170SP field instrument. Landfill gas samples for methane analysis will be collected in 1-liter Tedlar® bags for field instrument analysis or gas tight syringes for laboratory analysis. Samples with methane detected by the Landtec GEM 500 will be analyzed for methane in a California certified mobile laboratory using EPA Method 8015-modified. If the field sample methane results indicate non-detectable concentrations then that sample will not be sent to the mobile laboratory for analysis. If all field readings indicate non-detectable concentrations of methane, then 10-percent of the landfill gas samples will be analyzed in the mobile laboratory. The landfill gas samples will be analyzed for methane only as shown in Table 5-1 below.

Table 5-1: Planned Soil Vapor Sampling and Analysis Summary

Analysis	Shallow Soil Vapor Samples 7.5-ft. bgs	Intermediate Soil Vapor Samples 15-ft. bgs	Deep Soil Vapor Samples 25-ft. bgs[1]	Field Duplicate Shallow Soil Vapor Samples	Total No. of Samples
Methane (Modified 8015) [2]	45	45	(1)	--	90

NOTES:
(1) 25-ft. deep samples will be collected if high methane levels are detected at 15-ft. bgs
(2) Landfill gas samples with field detected methane.

5.3 SITE 5 PERIMETER VAPOR WELL INSTALLATION

Four perimeter landfill gas monitoring wells will be installed at Site 5 per the Pre-Design Investigation at Sites 3 and 5 (Earth Tech 2002). However, consistent with the DQO decision rules, if any landfill gas sample collected from a direct push probe location has a methane concentration greater than 5 percent, three additional perimeter gas wells will be installed to monitor landfill gas migration. The locations of the four proposed monitoring wells (05_PG01 – 05_PG04) and the three optional monitoring wells (05_PG05 – 05_PG07) are illustrated in Figure A-2. A typical landfill gas monitoring well is illustrated in Figure A-3. The wells will be installed in accordance with Section A.2.5 of the Sampling and Analysis Plan for the Pre-Design Investigation at Sites 3 and 5 (Earth Tech 2002). The wells will be installed near the perimeter of the waste but not within the waste. The lateral spacing between the wells will not exceed 1,000-feet. The wells will be installed in areas that are geologically permeable to landfill gas migration. Each well will include shallow and deep probes. No intermediate probe is required by 27 CCR 20925 for landfills where the depth of the waste is less than 30-feet. Screened intervals for each well are expected to be 5-6 and 14-15 feet below ground surface, and are based on the results of the trenching investigation conducted at the site.

The wells will be drilled and logged under the supervision of a California Registered Civil Engineer or Geologist. The perimeter vapor wells will be constructed in accordance with CIWMB requirements set forth in Title 27, Division 2, Section 20925.

The boreholes for the perimeter vapor wells will be drilled using an 8-inch hollow stem auger to a total depth of 15-feet (the depth of the waste at Site 5), and constructed as double-completion, 1-inch diameter gas monitoring wells. Soil samples will be collected every 5-feet during drilling solely for field screening and lithologic description. Samples will be collected in accordance with CLEAN SOP 4, *Soil Sampling* (BNI 1999a). The lithology will be described, including all soil classification information, as listed in CLEAN II SOP 3, *Borehole Logging* (BNI 1999a). All equipment will be decontaminated before each use in accordance with CLEAN II SOP 11, *Decontamination of Equipment* (BNI 1999a), and Section A-1.4 of the SAP for the Pre-design Investigation at Sites 3 and 5 (Earth Tech 2002).

5.4 PERIMETER VAPOR WELL SAMPLING

Four rounds of soil gas sampling are planned for the newly installed perimeter gas wells. Soil gas samples will be analyzed for fixed gases (including methane) and total VOCs. Perimeter gas sampling and analysis will be performed in accordance with the DTSC Advisory and Sections A.2.6 and A.2.8, respectively, of the SAP for the Pre-design Investigation at Sites 3 and 5 (Earth Tech 2002). The sampling procedures will be as follows:

1. Well casings will be purged of the requisite volume, at a flow rate of 100- to 200-milliliters per minute. The vacuum pump will be removed and the SUMMA® canister attached and filled.

2. Samples will be collected using Summa® cannisters for total VOC analysis.

3. Samples for fixed gases (including methane) analysis will be collected using a vacuum pump and Tedlar bags in a sampling chamber. A site-specific purge volume versus sample concentration test (using a Landtec GEM 500) will be initially performed to evaluate the appropriate volume of vapor to be purged from each casing prior to sample collection.

4. The initial two rounds will also be analyzed at a fixed-base laboratory for target VOC analytes by EPA Method TO-15 and fixed gases by ASTM D1946. If soil gas sample field and laboratory measurements correlate and the laboratory does not identify significant concentrations, subsequent monitoring will be collected with field instruments only.

5. Leak testing will be conducted after the perimeter vapor wells are installed.

5.5 SAMPLE DOCUMENTATION

Sample documentation will be performed in accordance with Section A.2.9 of the SAP for the Pre-design Investigation at Sites 3 and 5 (Earth Tech 2002).

5.5.1 Sample Designation

Landfill gas sample containers will be labeled in accordance with Section A.2.9.2 of the SAP for the Pre-design Investigation at Sites 3 and 5 (Earth Tech 2002).

5.5.2 Sample Custody

Sample packaging will be in accordance with Section A2.9.3 of the SAP for the Pre-design Investigation at Sites 3 and 5 (Earth Tech 2002).

5.6 EQUIPMENT DECONTAMINATION

All non-consumable sampling equipment will be decontaminated in accordance with Section A.2.10 of the SAP for the Pre-design Investigation at Sites 3 and 5 (Earth Tech 2002).

5.7 FIELD QUALITY CONTROL

Field duplicate samples will be collected in accordance with Section A.3.2.1.3 of the SAP for the Pre-design Investigation at Sites 3 and 5 (Earth Tech 2002). Field duplicate samples shall be collected at a frequency of 1 per 10 field samples.

6. QUALITY ASSURANCE PROJECT PLAN

6.1 PROJECT MANAGEMENT

Project tasks and project organization are described in Sections A.3.1 and A.3.2 of the SAP for the Pre-design Investigation at Sites 3 and 5 (Earth Tech 2002).

6.2 MEASUREMENT AND DATA ACQUISITION

Quality assurance and quality control requirements for data acquisition are described in Section A.3.2 of the SAP for the Pre-design Investigation at Sites 3 and 5 (Earth Tech 2002).

6.2.1 Field/Mobile Laboratory Analysis

Landfill soil gas survey samples will be collected in 1-liter Tedlar bags and analyzed using a Landtec GEM 500 field instrument as shown in Table 6-1. Methane will also be reported as percent of the LEL. The sample will be screened with an FID and if flammable gas concentrations exceed 10 ppm, a sample will be collected in a syringe and analyzed in the mobile laboratory using EPA Method 8015-modified for methane and the tracer gas, isopropanol. Hydrogen sulfide will be analyzed with an Interscan INT 1170SP field instrument.

Table 6-1: Project Quality Control Criteria for Landfill Soil Gas Samples

Analyte	Project Decision Threshold[a]	Reporting Limit	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
Landfill Gases (Landtec GEM 500) % by volume					
Methane	0.1	0.1	20	n.a.	n.a.
Oxygen	0.1	0.1	20	n.a.	n.a.
Carbon Dioxide	0.1	0.1	20	n.a.	n.a.
Landfill Gases (FID) ppm					
Flammable gases	10	10	20	n.a.	n.a.
Landfill Gases (Interscan INT 1170SP) ppm					
Hydrogen Sulfide	0.1	0.1	20	n.a.	n.a.
Landfill Gases (Modified 8015) ppm					
Methane	1	1	20	n.a.	75-125
Isopropanol	10	10	20	n.a.	75-125

Notes:

ppm = parts per million
LCS = laboratory control sample
EPA = U.S. Environmental Protection Agency
MS = matrix spike
n.a. = not applicable
RPD = relative percentage of difference
% R = percent recovery
MSD = matrix spike duplicate

[a] Project Decision Threshold is equal to the Reporting Limit, as determined in accordance with the instrument operating manual.
[b] Laboratory-specific performance criteria.

The project quality control criteria for perimeter soil gas samples are presented in Table A-3-3 of the SAP for the Pre-design Investigation at Sites 3 and 5 (Earth Tech 2002).

6.3 PROJECT QUALITY ASSURANCE OVERSIGHT

Requirements for project quality assurance oversight are described in Section A.3.3 of the SAP for the Pre-design Investigation at Sites 3 and 5 (Earth Tech 2002).

6.4 DATA VALIDATION AND USABILITY

Standards for data validation and usability are presented in Section A.3.2 of the SAP for the Pre-design Investigation at Sites 3 and 5 (Earth Tech 2002).

7. REFERENCES

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Appendix A
Figures

UNIT 4
FORMER
INCINERATOR

03SG01

UNIT 3
(NO LANDFILL WASTES)

03SG02
03SG03
03SG04
03SG05
03SG06
03SG07
03SG08
03SG09
03SG10
03SG11
03SG12
03SG13
03SG14
03SG15
03SG16
03SG17
03SG18
03SG19
03SG20
03SG21
03SG22
03SG23
03SG24
03SG25
03SG26
03SG27
03SG28
03SG29
03SG30
03SG31
03SG32
03SG33
03SG34

03PG01
03PG02
03PG03
03PG04

PH17-1
PH17-2
PH17-3
PH17-4
PH17-5
PH17-6
PH17-7
PH16-1
PH16-2
PH16-3
PH16-4
03PH16F
PH13-1
PH13-2
PH13-3
PH13-4
PH21-1
PH21-2
PH21-3
PH21-4
PH1-1 through PH1-25

UNIT 2
AGUA CHINON WASH

UNIT 1
ORIGINAL LANDFILL

Irvine Boulevard
North Marine Way
Desert Storm Road
BLDG 746

LEGEND OF SYMBOLS AND ABBREVIATIONS

- 03SG02 ● PROPOSED SOIL GAS SAMPLING LOCATION
- LANDFILL BOUNDARY AT CONCLUSION OF PHASE II RI PER BNI (1977)
- ESTIMATED LIMIT OF WASTE FOUND DURING PRE-DESIGN TRENCHING ACTIVITIES
- MISCELLANEOUS DEBRIS BOUNDARY
- SURFACE FLUX SAMPLE LOCATION
- 03LYS3 VERTICAL LYSIMETER
- 03LYS2 ANGLE LYSIMETER SHOWING DIRECTION DRILLED
- 03_DGMW65X PHASE I MONITORING WELL
- 03SB15 PHASE II SOIL BORING
- 03WELL06 MONITORING WELL
- 03TR30A TRENCHING LOCATIONS (NOVEMBER/DECEMBER 2003)
- 03TR14B TRENCHING LOCATION (SEPTEMBER 2002)
- PH13-3 ● POTHOLE WITH DEBRIS
- PH13-1 ○ POTHOLE WITHOUT DEBRIS
- 03PG01 PERIMETER GAS MONITORING WELL
- EXISTING BUILDING OR CONCRETE PAD
- EXISTING IMPROVED ROAD
- EXISTING FENCE
- 410 EXISTING ELEVATION CONTOURS (10' INTERVAL)
- EXISTING ELEVATION CONTOURS (2' INTERVAL)
- EXISTING TREE
- EXISTING SIGN
- EXISTING STREET LIGHT
- EXISTING POWER POLE WITH GUY WIRE
- Conc EXISTING CONCRETE
- FH EXISTING FIRE HYDRANT
- Hdwl EXISTING HEADWALL
- BNI BECHTEL NATIONAL, INC.

NORTH

0 60 120
GRAPHIC SCALE IN FEET

IF SHEET IS LESS THAN (24" X 36") IT IS A REDUCED PRINT – SCALE IS REDUCED ACCORDINGLY

SAP Amendment #2 — Final

Site 3
Supplemental Sampling Locations

Pre-Design Investigation IRP Site 3 and Site 5

Date: 02-04	Former MCAS El Toro	Figure
Project No. 37380	EARTH TECH A tyco INTERNATIONAL LTD. COMPANY	A-1

File: G:\ca\LongBeachCA\Remediation\Projects\37380 (CTO-78)\Sites 3 and 5_PDI\CADD\Work Plan Amendment #2\Proposed Soil Gas Boring Locations_V5.dwg Time: Feb 24, 2004 - 11:19am

File: G:\usacaCA\work\Remediation\Projects\37380 (CTO-78)\Sites 3 and 5_PDI\CADD\Work\Amendment #2\Supplemental Sampling Locations.dwg Time: Feb 19, 2004

LEGEND OF SYMBOLS AND ABBREVIATIONS:

- EXISTING IMPROVED ROAD
- EXISTING FENCE
- 430 — EXISTING ELEVATION CONTOURS (10' INTERVAL)
- EXISTING ELEVATION CONTOURS (2' INTERVAL)
- LANDFILL BOUNDARY AT CONCLUSION OF PHASE II RI PER BNI (1997)
- INFERRED UTILITY LINES (PHASE II RI; BNI 1996)
- TRENCHING LOCATION
- 05LYS3 — LYSIMETER
- BNI — BECHTEL NATIONAL, INC.
- 05_PG01 — PROPOSED PERIMETER SOIL GAS MONITORING PROBE LOCATION
- 05_PG05 — OPTIONAL PERIMETER GAS MONITORING PROBE LOCATION
- B11 — PROPOSED SOIL GAS SAMPLING LOCATION

05_PG01, 05TR01B, 437.2, B11, 05LYS1, 05_PG07, B10, 05TR01A, B9, 05TR02A, B8, 05_PG06, 428.6, B7, 05_PG04, B6, 05TR03A, B5, 05LYS2, 05TR04A, B4, PERIMETER ROAD LANDFILL, B3, 05_PG02, 05_PG05, 05TR05A, B2, 05LYS3, PROPOSED SOIL GAS SAMPLING LOCATION, B1, 05TR06A, 05TR06B, 05_PG03, PERIMETER ROAD, Gate, 409.1, 419.87, 406.3, 413.4, 411.4, 406.8, 409.7, 402.7, 414.7, 418.4, 401.0, 406.6, 411.9, 420.7, 424.1, 426.6, 427.4, 424.6, 428.2, 424.8, 435., OBSCURED, Tower, Sand, Green, Wall, Sign, TS, FH, BORREGO CANYON WASH

NORTH

0 75 150

GRAPHIC SCALE

SAP Amendment #2 — Final

Site 5 - Supplemental Sampling Locations

Date: 02-04	Former MCAS El Toro	Figure
Project No. 37380	EARTH TECH — A tyco INTERNATIONAL LTD. COMPANY	A-2

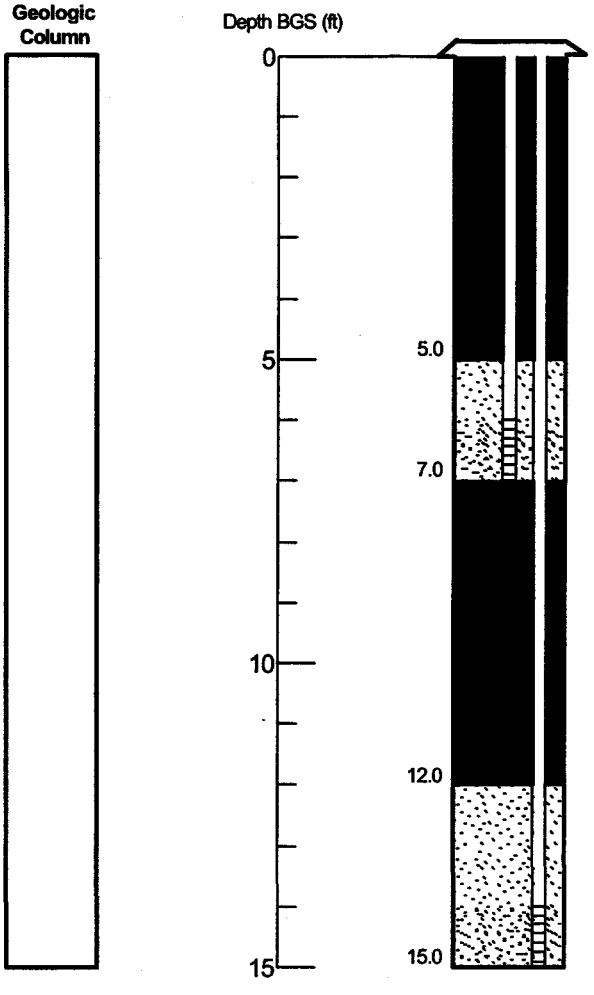
Well Construction Log

Project Name: MCAS El Toro Site 03 and 5 Pre-Design Investigation	Project Number: 37380	Sheet 1 of 1
Well Location: IRP Site 5, MCAS El Toro Northing: Easting:	Well Number: 05-PG.Typ	Well Depth (ft): 15.0/
Driller:	Borehole Diameter (in): 8	Depth to Water (ft): Static: Drilling:
Drilling Agency:	Date Started:	
Drilling Equipment:	Date Finished:	Elevation: ft MSL
Drilling Method: Hollow Stem Auger	Logged by:	Checked by:
Drilling Fluid: None	Number of Soil Samples: 0	Date Checked:

Elevation (TOC): PVC ft MSL

Stick-up Height: ft

Vault Elevation: ft MSL



PROTECTIVE CASING
Material/Type: Steel Flush-Mount Casing with Locking Well Cap
Diameter (in): 12
Depth (ft BGS): 1

GUARD POSTS
No: 4 Type: Steel

SURFACE PAD
Composition and Size: Concrete 2ftx2ft

RISER PIPE
Type and Thickness: Sch. 40 PVC
Diameter (in): 1 inch
Total Length (ft TOC to TOS): 0-6, 0-14
Ventilated Cap (Y/N)

GROUT
Composition and Proportions: Bentonite
Tremied (Y/N)
Interval (ft BGS): 0-5

CENTRALIZERS
Depths (ft): NA

SEAL
Type: Bentonite chips
Source:
Hydration Time: 1/2 Hr Vol. of Fluid Added:
Tremied (Y/N) Interval (ft BGS):0-5, 7-12

FILTER PACK
Type: Monterey Sand
Amount Used:
Tremied (Y/N)
Source:
Grain Size Dist.: # 3 Interval (ft BGS): 5-7, 12-15

SCREEN
Type and Thickness: Sch. 40 PVC
Diameter (in): 1 inch Slot Size (in): 0.020
Interval (ft BGS): 5-6, 14-15

WELL FOOT
Interval (ft BGS): NA

BACKFILL/PLUG
Interval (ft BGS): NA Material: NA
Hydration Time:

Comments:

Figure A-3: Typical Vapor Well

EA M(SB)IRP Site 5, MCAS El Toro\MCAS El Toro Site 03 and 5 Pre-Design Investigation\37380

Appendix B
Health and Safety Plan Amendment

EARTH TECH
A TETRA TECH INTERNATIONAL LTD COMPANY

TASK HAZARD ANALYSIS (THA)
SITES 3 AND 5, OU 2C
FORMER MCAS EL TORO, CA

Evaluated by: J. Bart Dawson, CIH

Date: December 2003

TASK NAME

SOIL GAS SAMPLING

TASK DESCRIPTION

Direct push techniques allow collection of subsurface soil, groundwater and soil gas samples at depths that are not practical using hand augering. Direct push involves the insertion of metal "push rods" into the soil by the use of a hydraulic ram assembly. As depths increase additional rods can be added to provide a continuous run. The direct push probe can be fitted with a variety of sample probes to allow collection of soil in the subsurface environment, or collection of groundwater or soil vapor through a Teflon tube connected to a sampling mechanism at the surface. At the conclusion of direct push sampling procedure the push rods are withdrawn, and the hole can be sealed using grout or allowed to collapse naturally.

Direct push "drilling" produces little to no spoils, regardless of the depths obtained (soil is compressed to the sides of the hole rather than removed along an auger. For this reason, direct push techniques present little potential for the airborne release of contaminants as the rods are advanced or withdrawn.

Approximately 30 direct push soil gas sampling locations will be sampled at 7.5 and 15 feet below ground surface.

CHEMICAL EXPOSURE HAZARDS

- Petroleum hydrocarbon fuels (skin contact)
- BTEX (skin contact)
- Solvents (skin contact)

PPE

Level D Ensemble (Section 7.1.2)

- Hard Hat
- Work uniform
- Safety-toe Boots
- Safety Glasses

Note: Personnel should wear N-Dex nitrile rubber gloves or Ansell Edmont nitrile rubber gloves when handling potentially contaminated push rod.

OTHER SAFETY EQUIPMENT

- First aid kit
- Fire extinguisher (drill rig)

PHYSICAL HAZARDS

- Slips, trips, falls, and protruding objects
- Heavy equipment (drill rig)
- Back strain
- Electrocution (subsurface utilities)

APPLICABLE OPERATIONAL SAFETY PROCEDURES

- Slips, Trips, Falls, and Protruding Objects (Section 6.1)
- Heavy Equipment Operation (Section 6.3)
- Underground Utilities (Section 6.5)

ADDITIONAL SAFETY CONSIDERATIONS

- The *Drill Rig Safety Inspection Checklist* in ENV 521, *Drilling* must be completed prior to the start of direct push activities.
- A subsurface utility clearance of all soil gas sampling locations must be made prior to the start of direct push/soil gas sampling activities.

MONITORING PROCEDURES

No monitoring required.

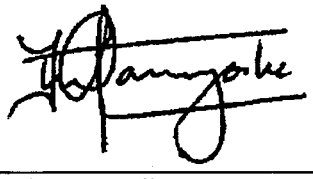
Appendix C
Standard Operating Procedures – Soil Gas Sampling

Earth Tech Project Procedure

Procedure: **Soil Gas Survey**

Date: February, 2004

Revision: 4



Crispin Wanyoike, P.E

Earth Tech Program Manager,
Southwest Division Navy CLEAN

Christopher Barr, CQMgr

Earth Tech Quality Assurance,
Southwest Division Navy CLEAN

CONTENTS

1. PURPOSE

This standard operating procedure (SOP) describes soil gas surveying procedures for use by Earth Tech personnel for projects at Marine Corps Air Station (MCAS) El Toro under the direction of the Naval Facilities Engineering Command, Southwest Division. The work will be conducted by subcontractors under the direction of Earth Tech personnel, in accordance with this procedure.

2. SCOPE

This procedure has been developed to serve as Contract Task Order (CTO) Management-approved guidance for activities at MCAS El Toro. It is not intended to obviate the need for professional judgment that may arise in unforeseen circumstances. Deviations from this procedure in planning or executing planned activities must be approved by the CTO Manager through the use of a Field Change document or revision to the Work Plan (WP) or Sampling and Analysis Plan.

3. RESPONSIBILITIES

The CTO Manager or designee is responsible for ensuring that the soil gas survey activities conducted during the investigations at El Toro are in compliance with this procedure. The CTO Manager is also responsible for ensuring that the soil gas survey is conducted under the supervision of an Earth Tech representative. It is recommended that supervisory personnel have a thorough understanding of the principles of soil gas and the physical characteristics of the vadose zone. This should be determined in consultation with the Technical Director/QA Program Manager. To a certain extent, adequate understanding of the physical characteristics of the vadose zone by field supervisory personnel is site-specific and is subject to the judgment of the Technical Director/QA Manager.

The Field Manager is responsible for ensuring that all project field staff and subcontractor staff are familiar with these procedures. The sampling and analysis methods employed by the subcontractor must be in compliance with the methods listed in this procedure. The methods and equipment proposed for use by the subcontractor will be evaluated prior to awarding the job.

The Technical Director/QA Program Manager is responsible for conducting evaluations to ensure that these procedures are being utilized appropriately.

4. BACKGROUND INFORMATION

The soil gas survey is a semi-quantitative technique for evaluating the distribution of contaminants in soil gas. The resulting data can be used to qualitatively evaluate the potential for, and extent of, certain types of contamination in soil and groundwater.

The use of soil gas surveying to locate potential source areas of subsurface contamination is based on aqueous phase/vapor phase equilibrium in the subsurface. Because of their relatively low solubilities and high vapor pressures, volatile organic compounds (VOCs) have a tendency to partition from the aqueous phase into the soil vapor phase. Certain semivolatile compounds also behave in this manner. Generally speaking, an organic compound with a relatively high Henry's law constant (i.e., the ratio of a compound's vapor pressure to its solubility in water) is likely to partition from soil or groundwater into soil gas. The presence of VOCs in shallow soil gas depends on the following factors: (1) the volatilization of VOCs from soil or groundwater into the soil gas, (2) the presence of a chemical gradient in soil gas between the contaminant source and the ground surface, and (3) the physical properties of the soil. If VOCs are present in the soil gas in large enough quantities, they can be detected during a soil gas survey.

Fixed gas (i.e., oxygen and nitrogen) and biogenic gas (i.e., CO_2, CH_4, N_2O, and H_2S) data obtained during a soil gas survey also provide an indication of potential subsurface contamination. A concurrent increase in carbon dioxide and decrease in oxygen often indicates increased chemical or biological

breakdown of organic compounds. This phenomenon is usually associated with the degradation of petroleum hydrocarbons; however, moisture content, natural organic content, and reduction/oxidation (redox) conditions in the soil can also affect fixed gas/biogenic gas ratios.

5. EQUIPMENT

The following equipment is typically required to conduct the soil gas survey:

- Hydraulic driving/hammering system designed to install or remove sampling probes
- Stainless steel drive points
- Tubing, pumps, and vials for collecting and preparing soil gas and/or groundwater samples
- Oil-less air pump, evacuation chamber, and sample containers for purging and collecting the soil gas samples
- Flowmeter and stop watch

Analytical instrumentation and chemical supplies may include the following:

- Gas chromatographs (GCs)
- Electron capture detector (ECD), flame ionization detector (FID), mass spectrometer (MS)
- Computer-based data management systems
- Ultra high purity grade compressed analytical gases (nitrogen, helium, hydrogen, air)
- Certified standards for target analytes
- High resolution megabore, packed, and capillary gas chromatographic columns
- Fittings, tools, plumbing, and glass syringes required for normal GC operation

6. SAMPLING DESIGN

The design depends on the objectives of the program and the types of contaminants anticipated to be present. The following items shall be considered when designing a soil gas program:

- **Number of Samples.** This depends upon the extent of anticipated contamination, the size of the site, and the selected sample spacing.
- **Anticipated Soil Types.** The lithology must be considered when determining sampling locations, distance between sampling locations, and sampling depth.
- **Depth of Samples.** This will depend on the type of contamination, the depth to groundwater, and the objectives of the survey.
- **Distance Between Samples.** For detecting the limits of plumes, spacing may be 50- to 100- feet or greater. Around a buried tank, spacing may be a few feet. The relative air permeability of the soil type(s) present must also be considered. Soils with low air permeabilities (i.e., clays) may require closer sample spacing. Spacing should be selected based on the objective(s) of the survey, subsurface conditions, and the nature of the target compounds. These factors shall be addressed in the WP and/or Field Sampling Plan (FSP).
- **Sampling Point Selection.** Large spills, leaks, or plumes are often sampled on a predetermined sampling grid. Initial surveys may be random or based on real-time field data. Location access may also be an important factor.
- **Objectives of the Survey.** If plume definition is the objective, probe locations should be established to define the down-gradient and lateral extent of the VOCs in soil vapor. If source

delineation is the objective, probes should be located in proximity to suspected source areas. In either case, some sampling points should be included within the known plume area and well outside contaminated areas in order to provide a basis for correlation and comparison to background levels of VOCs.

- **Timing of Sampling.** Probe locations can be sampled in stages to meet the objectives of the survey. The first stage of sampling may involve widespread spacing of the probes. Later sampling should focus on areas where VOCs were detected during the first stage of sampling to define the lateral extent of soil gas contaminants, or delineate a source area. Later sampling events should include some overlap with earlier sampling points in order to provide a basis for correlation between data sets.
- **Selection of Analytes.** In general, only contaminants with relatively high Henry's law constants are amenable to detection using soil gas. However, biodegradative breakdown products (CO2, O2, and CH4) of less volatile contaminants can be used to evaluate certain semivolatile and non-volatile compounds. Analysis should focus on known indicator compounds at the site. The more analytes selected, the fewer locations that can be sampled in a day. Analytes should be selected to sample the compounds necessary to meet the objectives of the study and to maximize the number of locations sampled in a given period of time.

7. SAMPLE COLLECTION

The following describes procedures for soil gas surveys utilizing direct-push probe advancement in accordance with the DTSC *Advisory – Active Soil Gas Investigations (2003)*. Procedures may be modified based on specific project needs.

- A probe tip is attached to sample tubing for collection of soil vapor samples at discrete intervals. The probe tip must be the same diameter as the drive rod so as not to create a channel for infiltration of surface air into the sampling point. The inner soil gas pathway from the probe tip to the surface is continuously sealed to prevent infiltration. New sample tubing is used at each sample location.

- The drive rod and probe tip are advanced to the desired depth using the direct push method. The drive rod is retracted slightly while the probe tip remains in place, allowing for sampling of soil vapors in an opening between the drive rod and probe tip.

- Hydrated bentonite is used to seal around the drive rod at ground surface to prevent ambient air intrusion from occurring.

- The purge volume test, leak test, and soil gas sampling is conducted after a minimum of 20-minutes to allow subsurface conditions to equilibrate.

- Prior to sample collection, soil gas pressure is monitored using a pressure gauge capable of detecting pressures of ± 1-inch of water compared to ambient pressure. The flow rate of the evacuation pump is determined using a flowmeter.

- Purge volume testing is conducted in general accordance with Section 2.3 of the DTSC *Advisory – Active Soil Gas Investigation* (2003). Pursuant to discussions with the DTSC staff, the 20-percent re-sampling requirement specified in Section 2.3 of the Advisory will be waived.

- Leak testing is conducted in general accordance with Section 2.4 of the DTSC *Advisory – Active Soil Gas Investigation* (2003). A leak detection threshold of 10 parts per million (ppm) will be used for the leak detection tracer gas. The leak detection tracer gas will be isopropanol. An FID

or mobile laboratory using EPA Method 8015 modified will be used to assess for leaks. Leak testing is conducted prior to collecting all samples.

- The purge rate and volume is performed and documented in accordance with Section 2.5 of the DTSC *Advisory – Active Soil Gas Investigation* (2003).

- After purging and sampling is completed, the samples will be monitored with a Landtec GEM 500 and FID field instruments for methane, carbon dioxide, oxygen, percent LEL, and isopropanol (the leak test compound). Hydrogen sulfide will be monitored after sample collection using an Interscan INT 1176 field instrument.

- Landfill gas samples for methane analysis will be collected in 1-liter Tedlar® bags for field analysis or gas tight syringes for laboratory analysis.

- Samples with methane detected by the Landtec GEM 500 will be analyzed for methane in a California certified mobile laboratory using EPA Method 8015-modified. If the field sample methane results indicate non-detectable concentrations then that sample will not be sent to the mobile laboratory for analysis.

- If all field readings indicate non-detectable concentrations of methane, then 10-percent of the landfill gas samples will be analyzed in the mobile laboratory.

Following removal of the drive rod, the steel probe point remains down-hole and the remaining annulus is filled with hydrated bentonite/cement slurry to slightly below grade. The remaining depression is filled to match existing conditions.

Soil gas samples should not contact potentially sorbing materials, such as the pump diaphragm or soft tubing. All components of the sampling system should be checked for contamination by drawing atmospheric air through the system, subjecting it to analysis, and comparing the resulting chromatogram with that of ambient air. Pre-cleaned probes shall be used for each sampling location in order to minimize the possibility of cross-contamination among sampling locations. Sampling components, such as the drive rods, shall be cleaned using steam or pressurized water and detergent at the conclusion of each day and shall be cleaned immediately after use with a portable sprayer as described in Procedure I-F, *Equipment Decontamination* (DON 1998). Sections of drive rods may be reused only if analyses indicate that no target analytes are present. Sampling syringes must be decontaminated prior to use.[1]

Duplicate soil vapor samples for analysis are collected by connecting dedicated sections of polyethylene tubing to a low-volume vacuum pump or syringe and filling a Tedlar bag for field analysis or syringe for laboratory analysis. The pump is purged between sampling locations and is checked for residual contamination either by onsite GC analysis or by collecting field "blanks" that are submitted to a laboratory. Gas containers are normally transferred under chain-of-custody procedures to a commercial laboratory where they are analyzed according to the specified methods. The percentage of duplicates submitted for laboratory analysis depends on project-specific objectives and regulatory specifications that shall be defined in the WP or FSP.

[1] This SOP assumes that syringe sampling will be conducted. Other sampling techniques shall be documented in the project-specific WP or FSP

8. SAMPLE ANALYSIS

Soil gas samples will be analyzed in the field using a GC or GC/MS. The subcontractor must have, on site, operating procedures for the equipment used. Selection of specific instrumentation and techniques is defined in the project WP or SAP. The following is to be used in conjunction with the instrument manufacturers instructions and the referenced method documentation.

8.1 TARGET LIST ANALYSIS

A typical list of the target compounds is shown in Table 1. Actual analytes are specified in the project plans. Specific procedures for operation of the analytical systems are not provided here.

Table 1: Halogenated and Aromatic Hydrocarbons – 24 Target Compound List

Dichlorodifluoromethane	Carbon tetrachloride
Vinyl chloride	Benzene
Chloroethane	1,2-Dichloroethane
Trichlorofluoromethane	Trichloroethene
1,1,2-Trichloro-trifluoroethane	Toluene
1,1-Dichloroethene	1,1,2-Trichloroethane
Methylene chloride	Tetrachloroethene
Trans-1,2-Dichloroethene	1,1,1,2-Tetrachloroethane
1,1-Dichloroethane	Ethylbenzene
Cis-1,2-Dichloroethene	Meta and para-xylene
Chloroform	Ortho-xylene
1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane

RWQCB 1997 Primary Target Compounds

The instrument used for soil gas analyses will be calibrated using high-purity solvent-based standards obtained from vendors providing certificates of traceability. Calibration using solvent-based standards will typically be performed using varying injection volumes of the stock solvent-based standard without dilution. If necessary, stock solvent-based standards will be diluted to an appropriate concentration. Diluted standards will be prepared by introducing a known volume of stock solvent-based standard into a known volume of high-purity solvent.

Initial calibration will be performed for all target compounds. The instrument will be calibrated using a minimum of three standards spanning the working range of the analysis. The lowest standard will not be higher than five times the method detection limit (or 5 micrograms per liter [µg/L]). With the exception of except for trichlorofluoromethane (Freon-11), dichlorodifluoromethane (Freon-12), trichlorotrifluoroethane (Freon-113), chloroethane (CE), and vinyl chloride (VC), the percent relative standard deviation (%RSD) of the response factor (RF) for each target compound will not exceed 20 percent. The %RSD for trichlorofluoromethane (Freon-11), dichlorodifluoromethane (Freon-12), trichlorotrifluoroethane (Freon-113), chloroethane (CE), and vinyl chloride (VC) will not exceed 30%RSD[2]. Identification and quantitation of compounds in the field will be based on calibration under the same analytical conditions as for three-point calibration.

[2] Standards specified in RWQCB 1997

8.1.1 Detection Limits

Detection limits for the target compounds will be no more than 1 µg/L of gas, except when the compound concentration exceeds the initial calibration range requiring sample dilution (smaller sample injection volume), thus resulting in raised detection limits for the analysis. Method detection limits will be verified by annual performance of a method detection limit study, in accordance with the procedures in 40 CFR Part 136.

8.1.2 Compound Confirmation

All compounds detected will be confirmed by either second column or second detector or by GC/MS analysis.

8.1.3 Surrogate Compounds

Two surrogate compounds will be added to all analyzed samples. Surrogate compound concentrations will be within the calibration range. The percent recovery of the surrogate compounds will be calculated and reported with soil gas sample results. The acceptance goal for surrogate recovery is ±25 percent difference from the true concentration of the surrogate compounds. Surrogate compounds added to each sample analyses run will include fluorobenzene (photoionization detector [PID]) and cis-1,3-dichloropropene (PID and electrolytic conductivity detector), each at a true concentration of 5,000 µg/L.

8.1.4 Laboratory Control Sample

A laboratory control sample (LCS) from a source other than initial calibration standard will be used to verify the true concentration of the initial calibration standard. The LCS will include the target compounds and the RF for each compound will be within ±15 percent different from the initial calibration.

8.1.5 Daily Mid-Point Calibration Check

Daily field calibration of the GC will consist of mid-point calibration analyses using the same standard as used for the initial multi-point calibration. The daily mid-point calibration check will include the 12 target compounds as specified in the previously referenced requirements. The RF of each compound (except for Freon-11, Freon-12, Freon-113, CE, and VC) will be within 15 percent difference of the average RF from the initial calibration. The RF for the Freon-11, Freon-12, Freon-113, CE, and VC will be within 25 percent difference of the initial calibration. If these criteria are not met, the GC will be re-calibrated.

Daily calibration will be performed prior to the first sample analysis of the day. One-point calibration will be performed for all compounds detected at a particular site to ensure accurate quantitation. Subsequent calibration episodes, if deemed necessary, will consists of at least one injection of the standard exhibiting a similar detector response as that of samples encountered in the field.

8.1.6 End-of-Day GC Test Run

A LCS will be analyzed at the end of each day. The LCS will contain the same compounds as the daily mid-point calibration standard (minimum 12 compounds). The LCS must be from a second source independent from the initial multi-point calibration standard. The RF for each compound will be within 20 percent difference of the average RF for the initial calibration. If these criteria are not met, additional LCS will be analyzed to satisfy these criteria.

8.2 METHANE BY GC/FID

Soil gas samples for methane may be analyzed in the field using a field-operable gas chromatograph equipped with a FID following a modified 8015 procedure. Detection limits for the methane analysis will be one part per million by volume (ppmv).

8.2.1 Initial Multi-Point Equipment Calibration

Methane soil gas analyses will be calibrated using a compressed gas standard obtained from a certified vendor. Initial calibration will be performed using three standard injections of varying volume to establish a three-point calibration curve. This will typically include 200 µL, 400µL, and 600 µL injections of the gas-phase methane standard. The three-point calibration will be used to establish an average response factor (ARF) for use in quantitated methane concentrations in field samples. Identification and quantitation of methane in the field will be based on calibration under the same analytical conditions as for three-point calibration.

8.2.2 Laboratory Control Sample

An LCS from a second source is not required for the methane analysis.

8.2.3 Daily Mid-Point Calibration Check

Daily calibration of the gas chromatograph will consist of a mid-point calibration analysis using the compressed gas methane standard used for the initial multi-point calibration. The RF will be within 20 percent difference of the average RF from the initial calibration. If these criteria are not met, the GC will be re-calibrated. Daily calibration will be performed prior to the first sample analyses of the day. Subsequent calibration episodes, if deemed necessary, will consist of at least one injection of the standard exhibiting a similar detector response as that of samples encountered in the field.

8.2.4 End-of-Day GC Test Run

A LCS will be analyzed at the end of each day. The RF will be within 20 percent difference of the average RF for the initial calibration. If these criteria are not met, additional LCSs will be analyzed to satisfy these criteria.

8.2.5 Leak Test Tracer Gas Analysis

The leak test tracer compound, isopropanol, may be analyzed using a field operable gas chromatograph equipped with an FID using EPA Method 8015 Modified. Isopropanol soil gas analyses will be calibrated using a compressed gas standard obtained from a certified vendor.

8.3 LANDFILL GASES BY FIELD INSTRUMENT

Soil gas analysis for methane, carbon dioxide and oxygen will be analyzed in the field using a Landtec GEM-500. Soil gas analysis for hydrogen sulfide will be performed in the field using a Interscan INT 1170SP. Work shall be performed in accordance with manufacturers instructions. Quality control samples will be collected in accordance with Table 3.

8.3.1 Initial Equipment Calibration

The instrument will be calibrated using compressed gas standards obtained from a certified vendor.

8.3.2 Calibration Verification

Periodically through the working day but no less than once every 10 samples, the calibration gases will be used to verify instrument performance. If values exceed acceptance limits, the instrument will be diagnosed and recalibrated. If recalibration is required, all measurements collected since the last acceptable calibration verification will be redone.

8.3.3 Closing Calibration Verification

At the end of the working day, the calibration gases will be used to verify instrument performance. If values exceed acceptance limits, the instrument will be diagnosed and recalibrated. If recalibration is required, all measurements collected since the last acceptable calibration verification will be redone.

8.4 DECONTAMINATION PROCEDURES

Probes and equipment in contact with the soil gas sample stream will be decontaminated prior to initiation of sampling. Decontamination of soil gas sampling equipment will be conducted by repeated washing and/or by baking in the gas chromatograph oven. Washing will include the use of a phosphate-free detergent wash, tap water rinse, organic-free water rinse, and followed by air-drying.

9. DOCUMENTATION/RECORDS

Each soil gas sampling event shall be documented by the subcontractor in a bound logbook or appropriate field log sheets. The following information shall be recorded for each soil gas sampling event:

- Sample number
- Project name and number
- Sampling location and depth
- Date and time
- Name(s) of sampling personnel
- Site location
- Miscellaneous observations
- Analytical equipment utilized (e.g., GC, column, detector)

Other documentation will be recorded on a daily basis in the bound field notebook, and will include the following:

- Calibration results
- Blank measurement results

The original field records will be placed in the project files immediately upon completion of fieldwork. Subcontractors shall prepare a detailed report summarizing the methodologies used during the survey, the results obtained, and an interpretation of the results. This report will be incorporated into the site characterization report or equivalent document.

10. QUALITY CONTROL

Measurements collected to ensure the data meet the requirements of the project will include field and laboratory quality control analysis. Quality control samples will be collected in accordance with Table 2.

Table 2: Field Quality Control Analysis Requirements for Soil Gas Surveys

Description	Frequency	Precision Goal (%Rec)
Background Sample [a]	One per day	N/A
Syringe Blank	As needed [a]	N/A
Field Duplicate	1 per 10 field samples	25%

%Rec percent recovery.
N/A not applicable
[a] A syringe/background sample will be analyzed using ambient air. If VOCs are not detected, the ambient air sample will represent the background sample and syringe blank. If VOCs are detected in the ambient air sample, a syringe blank will be analyzed using ultra-high-purity helium or nitrogen gas.

10.1 Field Sampling Quality Control Measurements

10.1.1 Field Duplicates

Field duplicates shall be collected and analyzed at a frequency of 1 per 10 samples. The field duplicate shall be within 25% RPD of the original analysis

10.1.2 Field Blank

The syringes used for soil gas sample collection will be filled with ambient air or high-purity carrier-grade gas from a compressed gas cylinder. The ambient air or high-purity gas will be injected directly into the GC. The blank injection will serve to detect contamination of the syringe to be used for sampling and verify the effectiveness of equipment decontamination procedures.

Table 3: Field Quality Control Analysis Requirements for GEM-500 Surveys

Description	Frequency	Precision Goal (%Diff)
Initial Calibration	Beginning of day	Manufacturer specification
Background Sample [a]	One per day	N/A
Field Duplicate	1 per 10 field samples	±25
Calibration verification	1 per 10 field samples	±10
Closing calibration verification	End of day	±10

%Diff percent difference
N/A not applicable
[a] A background sample will be analyzed using ambient air. Concentrations will be documented for comparison to samples.

10.1.3 Leak Test Tracer Gas Analysis

The soil gas sample will be screened with an FID and if flammable gas concentrations exceed the detection limit of 10 ppm, the sample will be analyzed for isopropanol in the mobile laboratory using EPA Method 8015 Modified. The detection limit for isopropanol using EPA Method 8015 Modified will be 10 ppm or less.

10.2 Laboratory Quality Control Measurements

Laboratory measurements shall include calibration and quality control as specified in Table 4.

Table 4: Summary of Quality Assurance/Quality Control Analytical Requirements for Soil Gas Surveys (Calibration and Laboratory Control Samples)

Description	Frequency	Precision Goal (%RSD or %DIFF)
Initial Multi-point Calibration (24 Target Compounds)	At the beginning of the soil gas survey, unless the RPDs of the initial laboratory check sample or daily mid-point calibration check samples exceed their goals	20–30
Initial Laboratory Control Sample (24 Target Compounds)	At the beginning of the survey, following the initial three-point calibration	15
Daily Mid-point Calibration Check (12 Target Compounds)	At the beginning of each day	15
Last GC Test Run	At the end of the day if all samples from that day of analysis show non-detect (ND) results	At least 50% of recovery.

%DIFF percent difference

10.2.1 Laboratory Duplicate

Laboratory duplicates shall be analyzed at a frequency of 1 per 10 samples. The duplicate shall be within 15% RSD of the original analysis. Failure of results to achieve the criteria shall require corrective action before continuing analysis.

10.2.2 Laboratory Blank

A blank of ambient air or purified air will be run at a minimum of 1 per 10 samples if all samples have detectable concentrations of any target analytes, demonstrating the analytical system is in control.

11. HEALTH AND SAFETY

Soil gas surveyors are considered task-specific workers and, therefore, must meet all requirements of said workers for health and safety reasons. In addition, adherence to safe work practices as outlined in the site-specific Health and Safety Plan (HSP) is required. Analyses should be conducted in a location that will not contaminate analytical equipment nor expose the public or analyst to unacceptable levels of contaminants. "Detector" and "vent" outlets should be vented through a combustion furnace (>1,500°F), an activated charcoal filter, or to an external atmosphere not endangering the general public. If anticipated conditions warrant a real-time immediate response instrument such as an organic vapor analyzer, PID, HNU, Thermo, or Draeger or Sensidyne tubes, it should be used to monitor the atmosphere.

When real-time instrument response exceeds the permissible exposure limit (PEL), or the more conservative threshold limit value (TLV), appropriate previously defined personal protective equipment (PPE) will be donned, and alternate arrangements to ensure analytical personnel safety shall be considered. If safe alternatives are not achievable, the soil gas survey will be discontinued immediately.

When there is a danger of leakage from sample or gas standards containing hazardous materials and reagents, they should be stored outside of the workplace occupied by the analyst, in a manner consistent with storage of hazardous or compressed gases and in a configuration such that the public will not be endangered by exposure.

In addition to the aforementioned precautions, the following safe work practices will be employed:

Chemical Hazards Associated With Soil Gas Survey

- Avoid skin contact with and/or incidental ingestion of solvents.
- Utilize PPE as deemed necessary while collecting samples and performing analyses.

- Refer to Manufacturer Safety Data Sheets (MSDSs), safety personnel, and/or consult sampling personnel regarding appropriate safety measures.
- Take necessary precautions when handling reagents and samples.

Physical Hazards Associated With Soil Gas Survey:

- To avoid possible back strain associated with sample collection, use the large muscles of the legs, not the back, when retrieving soil gas probes.
- To avoid heat/cold stress as a result of exposure to extreme temperature and PPE, drink electrolyte replacement fluids (1 to 2 cups per hour is recommended) and, in cases of extreme cold, wear fitted insulating clothing.
- Be aware of restricted mobility due to the wearing of PPE.

12. REFERENCES

Department of the Navy (DON). 1998. *Project Procedures Manual, U.S. Navy PACDIV Installation Restoration Program (IRP).* Prepared for Pacific Division, Naval Facilities Engineering Command (PACNAVFACENGCOM). October.

Environmental Protection Agency. 1988. *Response Engineering and Analytical Contract Standard Operating Procedures.* Research Triangle Park, NC: Environmental Response Team.

———. 1991. *Soil Vapor Extraction Technology: Reference Handbook.* February.

RWQCB, 1997. Los Angeles Regional Water Quality Control Board. *Interim Guidance for Active Soil Gas Investigations* (February 25, 1997).

California Department of Toxic Substances Control (DTSC), California Regional Water Quality Control Board, Los Angeles Region (RWQCB). 2003. *Advisory – Active Soil Gas Investigations.*

13. ATTACHMENTS

None.

Appendix D
Response to Comments

Document Title:

(1) Draft, Sampling and Analysis Plan, Amendment Number 2, Operable Unit 2C, Landfill Sites 3 And 5, Former Marine Corps Air Station, El Toro, California [January, 2004]

Reviewer: John Broderick, SLIC/DOD Section, California Regional Water Quality Control Board, Santa Ana Region, February 4, 2004

Comment No./ Reviewer	Section/ Page No.	Comment	Response
GENERAL COMMENTS			
1.		We have reviewed the above referenced document, dated January 2004, which we received January 12, 2004. We have no comments.	Comment noted.

Document Title:

(1) Draft, Sampling and Analysis Plan, Amendment Number 2, Operable Unit 2C, Landfill Sites 3 And 5, Former Marine Corps Air Station, El Toro, California [January, 2004]

Reviewers: United States Environmental Protection Agency Dated: 2004

Comment No./ Reviewer	Section/ Page No.	Comment	Response
GENERAL COMMENTS			
1.		As I stated last week, because this data is being collected primarily to address an ARAR which is governed by IWMB regulations, EPA's position on the current sampling is that the Navy should meet the requirements of the IWMB.	Comment noted.

Document Title:

(1) Draft, Sampling and Analysis Plan, Amendment Number 2, Operable Unit 2C, Landfill Sites 3 And 5, Former Marine Corps Air Station, El Toro, California [January, 2004]

Reviewer: Michael B. Wochnick, Supervisor, Remediation, Closure, and Technical Services, California Integrated Waste Management Board, Feb. 10, 2004.

Comment No./ Reviewer	Section/ Page No.	Comment	Response
GENERAL COMMENTS			
1.		The California Integrated Waste Management Board (CIWMB) staff has reviewed your proposal for the investigation of landfill gas from the landfill sites 3 and 5 at El Toro. The proposal includes collection of landfill gas samples utilizing direct push probes inside the waste at 30 and 11 locations within landfill sites 3 and 5 respectively in order to determine the concentration of landfill gas as methane within the waste fill mass. We approve your workplan for this investigation as long as landfill gas sample collection are performed using Quality Assurance guidance provided in the California Department of Toxic Substances Control's (DTSC) Advisory for Active Soil Gas Investigation dated January 13, 2003.	Comment noted.

Document Title:

(1) Draft, Sampling and Analysis Plan, Amendment Number 2, Operable Unit 2C, Landfill Sites 3 And 5, Former Marine Corps Air Station, El Toro, California [January, 2004]

Reviewers: Dave Murchison, Engineering Geologist, Cypress Geological Services Unit, Department of Toxic Substances Control, February 4, 2004

Comment No./ Reviewer	Section/ Page No.	Comment	Response
GENERAL COMMENTS			
1.		There appears to be a data gap with respect to groundwater conditions at the two sites. GSU requests that the contractor include a more detailed discussion of groundwater depths, groundwater depth below base of the landfills, gradient directions, and a review of available groundwater contamination data for upgradient and downgradient wells. The discussion should pay particular attention to VOC's and industrial metals such as nickel and chromium.	Data Quality Objectives (DQO's) developed for the Sites 3 and 5 pre-design investigation include confirmation of landfill refuse boundaries, an assessment of geotechnical/engineering design parameters for landfill cover materials, and an evaluation of the need for a landfill gas collection system. These DQO's are discussed in Section 3 of the Final Pre-Design Investigation Workplan (Workplan) (Earth Tech 2002). Groundwater characterization was completed in the Remedial Investigation/Feasibility Study, and no further action was recommended for groundwater in the Draft Record of Decision for Landfill Sites 3 and 5 (March 1999). However, the Navy will review the most recent data set to determine the need to re-evaluate groundwater conditions, and include a discussion of this review in the revised Technical Memorandum. Groundwater and surface water conditions were previously discussed in the Workplan and the Remedial Investigation Report (BNI 1996).
2.		GSU is concerned that the language of the Addendum is unclear with respect to proposed soil vapor well installation at Site 5. The contractor should clarify exactly which wells will be installed in this investigation and which wells will only be installed based on field findings.	Four proposed perimeter soil vapor monitoring wells will be installed at Site 5 (wells 05_PG01, 05_PG02, 05PG03, and 05_PG04, as shown in Figure A-2 of the SAP Amendment). Consistent with the DQO decision rules, if any landfill gas sample (direct push probe location) has a methane concentration greater than 5-percent, three additional perimeter soil vapor monitoring wells (05_PG05, 05_PG06, and 05_PG07, as shown in Figure A-2 of the SAP Amendment) will be installed to monitor landfill gas migration. The pertinent language is clarified in the revised Addendum.
3.		The proposed Standard Operating Procedure (Appendix C) for Soil Gas Survey, dated December 2003 should be revised to take current regulatory guidance into account. GSU recommends the SOP be revised to conform to the current DTSC and LARWQCB guidance, and attaches a copy for reference. While the SAP Amendment asserts (page 5-1) that the SOP is based on the LARWQCB Interim guidance for Active Soil Gas Surveys (1997), GSU does not concur that the proposed SOP is substantially similar to the guidance above, or to the more recent guidance attached to this memorandum. GSU recommends the adoption of the attached guidance, and	The Standard Operating Procedure (Appendix C) has been revised to take current DTSC and LARWQCB regulatory guidance into account. 3.1. Comment noted. A 20-minute minimum equilibration time per Section 2.2.6 of the DTSC guidance document has been incorporated into the SAP Amendment. 3.2. Comment noted. Monitoring of soil gas probe pressure readings accurate to plus or minus 1-inch of water has been incorporated into the SAP Amendment.

Document Title:

(1) Draft, Sampling and Analysis Plan, Amendment Number 2, Operable Unit 2C, Landfill Sites 3 And 5, Former Marine Corps Air Station, El Toro, California [January, 2004]

Reviewers: Dave Murchison, Engineering Geologist, Cypress Geological Services Unit, Department of Toxic Substances Control, February 4, 2004

Comment No./ Reviewer	Section/ Page No.	Comment	Response
		notes the following specific issues by way of illustration: 3.1. For probes installed with the direct push method where the drive rod remains in the ground, purge volume test, leak test, and soil gas sampling should not be conducted for at least 20 minutes following probe installation. 3.2. Prior to sampling, the soil gas pressure should be documented using a Magneflux® or equivalent sensitive pressure gauge capable of detecting pressures of plus or minus 1-inch of water compared to ambient pressure. The contractor may wish to document local atmospheric pressure change to compare with this soil gas pressure data. 3.3. Purge volume testing should be performed and documented as described in Section 2.3 and subparagraphs of the attached guidance. 3.4. Leak testing should be performed and documented as described in Section 2.4 and subparagraphs of the attached guidance. Leak testing should be performed during the collection of all samples. 3.5. The purge rate and purge volumes should be performed and documented as described in Section 2.5 of the attached guidance. 3.6. The use of a bubble flowmeter may interfere with proper purge volume testing, and GSU recommends against this proposed method of flow control. 3.7. GSU does not regard the use of Tedlar® bags as valid for VOC analysis other than for methane, and recommends the use of opaque gas-tight syringes or Summa® canisters for most analyses. 3.8. GSU recognizes that the attached guidance does not provide for the proposed use of a Landtec GEM 500 landfill gas analyzer in the field. GSU suggests that the procedures be modified to use the Landtec analyzer after the sampling procedures above are complete for each sampling point. The samples collected can then be analyzed or discarded based on field data.	3.3. Comment noted. The purge volume test per Section 2.3 of the DTSC guidance document has been incorporated into the SAP Amendment. 3.4. Comment noted. An FID or mobile lab is used to assess the presence of leak detection tracer gas. Consistent with DTSC Comment # 4 (see below), a leak threshold of 10 ppm is used. 3.5. Comment noted. The purge rate and purge volumes are performed in accordance with Section 2.5 of the DTSC guidance document. 3.6. Comment noted. Section 5 of Standard Operating Procedure has been revised to remove the reference to the use of a bubble flowmeter. 3.7. A Tedlar® bag or field instrument is used for methane monitoring for both the direct push and perimeter gas probes. Tracer gas samples are collected using a syringe. Perimeter gas samples for VOC analysis are collected in Summa® canisters. 3.8. Comment noted. A LandTec GEM 500 and an FID are used to detect methane or tracer gas after completing the above sampling procedure.

Document Title:

(1) Draft, Sampling and Analysis Plan, Amendment Number 2, Operable Unit 2C, Landfill Sites 3 And 5, Former Marine Corps Air Station, El Toro, California [January, 2004]

Reviewers: Dave Murchison, Engineering Geologist, Cypress Geological Services Unit, Department of Toxic Substances Control, February 4, 2004

Comment No./ Reviewer	Section/ Page No.	Comment	Response
4.		GSU concurs with the proposed methods of choosing samples for laboratory analysis and the number of samples proposed for laboratory analysis with the following caveat. The leak detection gas or compound should be detectable by the field instruments (FID, Landtec, or other proposed instrument) at a low concentration (10 ppm or less). This can be documented using the manufacturer's specifications and need not be demonstrated by laboratory testing as a part of this investigation.	Comment noted. Field instruments with a leak test tracer gas detection limit of 10 ppm or less have been incorporated into the SAP Amendment.
5.		GSU requests that samples analyzed by EPA Method TO-15 include 2-butanone and tetrahydrofuran in the list of analytes.	Consistent with the workplan, samples collected from the Site 5 perimeter vapor wells are analyzed by EPA Method TO-15. 2-butanone and tetrahydrofuran analyses are included in this method.
6.		GSU concurs with the adoption of Title 27, Division 2, Section 20925 well requirements. GSU requests that the specific construction details follow the requirements of Sections 2.2.4 and 2.2.5 of the attached guidance.	Comment noted. Monitoring well construction details follow the requirements of Sections 2.24 and 2.25 of the DTSC guidance document. This has been incorporated into the SAP Amendment.
7.		GSU is concerned that intermittent base flow in Agua Chinon Wash during the rainy season may saturate part of the waste in Site 3, and tend to mobilize contaminants. The contractor should prepare a cross section traversing the main bodies of waste and the channel of Agua Chinon Wash, and showing the relative positions and elevations of the channel and the waste so that this concern can be evaluated.	A cross section showing the relative positions and elevations of the channel and the waste is included in the Draft Pre-Design Investigation Technical Memorandum as Figure E-2 in Appendix E. This will be revised to include additional trenching data, if necessary.