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Bechtel

401 West A Street
Suite 1000
San Diego, CA 92101-7905

CLEAN II Program
Bechtel Job No. 22214
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IN REPLY REFERENCE: CTO-0059/000198

August 1, 1995

Department of the Navy
Southwest Division
Naval Facilities Engineering Command
1220 Pacific Highway
San Diego, CA 92131-5187

Attention: Jason Ashman, RPM
Code 1831.JA

Subject: Final Quality Assurance Project Plan
Phase II Remedial Investigation/Feasibility Study,
MCAS El Toro California, CTO-059

Dear Mr. Ashman:

Enclosed are three (3) copies of the Final Quality Assurance Project Plan, Phase II RI/FS, MCAS El Toro, California, prepared for CTO-059 under Contract No. N68711-92-D-4670.

We have submitted the appropriate number of copies of this plan to individuals on the attached transmittal. The Final Quality Assurance Project Plan is being delivered at the same time as the Response to Comments document but each will be delivered under separate transmittals.

If you have any questions, please contact Timothy Latas at (619) 687-8848, or me at (619) 687-8802.

Very truly yours,

David K. Cowser
Project Manager

DC/sp

Attachment: Final Quality Assurance Project Plan for CTO-059

Southwest Division
Naval Facilities Engineering Command
Contracts Department
1220 Pacific Highway, Room 135
San Diego, California 92132-5187

Contract No. N68711-92-D-4670

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

CLEAN II

FINAL QUALITY ASSURANCE PROJECT PLAN PHASE II REMEDIAL INVESTIGATION/ FEASIBILITY STUDY MCAS EL TORO, CALIFORNIA

CTO-0059

Prepared by:

BECHTEL NATIONAL, INC.
401 West A St., Suite 1000
San Diego, California 92101

July1995

Signature: Jon M Gilbert Date: 7-27-95
Jon M. Gilbert, Program Quality Manager

Signature: Timothy W. Latas Date: 7/27/95
Timothy W. Latas, CTO Leader

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ACRONYMS/ABBREVIATIONS

AA	atomic absorption
BAT	best available technology
BCP	BRAC Cleanup Plan
BCT	Base Cleanup Team
BEC	BRAC Environmental Coordinator
BNI	Bechtel National, Inc.
BOD	biochemical oxygen demand
BRAC	Base Realignment and Closure
BTEX	benzene, toluene, ethylbenzene, and xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	(U.S. EPA) Contract Laboratory Program
COC	chain of custody
COD	chemical oxygen demand
COPC	chemical of potential concern
CTO	Contract Task Order
DON	Department of the Navy
DQO	data quality objective
EDL	estimated detection limit
EQL	estimated quantitation limit
FETAX	Frog Embryo Teratogenesis Assay: *Xenopus laevis*
FID	flame ionization detector
FS	Feasibility Study
FSP	Field Sampling Plan
GC	gas chromatograph
GC/MS	gas chromatography/mass spectrometry
H_2SO_4	sulfuric acid
HCl	hydrochloric acid
HNO_3	nitric acid
HPLC	high-performance liquid chromatography
HVOC	halogenated volatile organic compound
IA	immunoassay

ACRONYMS/ABBREVIATIONS (continued)

ICP	inductively coupled argon plasma spectroscopy
IDWMP	Investigation-Derived Waste Management Plan
IR	infrared
IRP	Installation Restoration Program
LUFT	(California) Leaking Underground Fuel Tank (Field Manual)
MCAS	Marine Corps Air Station
MDL	method detection limit
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
NaOH	sodium hydroxide
NCR	NFESC Contract Representative
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center (formerly NEESA)
NPL	National Priorities List
PAH	polynuclear aromatic hydrocarbons
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PID	photoionization detector
ppb	parts per billion
PQL	practical quantitation limit
PR	percent recovery
PRG	(U.S. EPA Region IX) Preliminary Remediation Goal
QA	quality assurance
QA/QC	quality assurance/quality control
QAMS	(U.S. EPA) Quality Assurance Management Section
QAPP	Quality Assurance Project Plan
QC	quality control
RBC	risk-based concentration
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RPD	relative percent difference
RPM	Remedial Project Manager
RTM	Remedial Technology Manager
RWQCB	(California) Regional Water Quality Control Board
SIM	selective ion monitoring

ACRONYMS/ABBREVIATIONS (continued)

SWDIV	Southwest Division Naval Facilities Engineering Command
SOP	Standard Operating Procedure
SVOC	semivolatile organic compound
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
U.S. EPA	United States Environmental Protection Agency
VOA	volatile organic analyte
VOC	volatile organic compound
WIP	Well Investigation Program
WP	Work Plan
XRF	X-ray fluorescence

Section 1
INTRODUCTION

This Quality Assurance Project Plan (QAPP) for Marine Corps Air Station (MCAS) El Toro, Irvine, Orange County, California, has been prepared by Bechtel National, Inc. (BNI), on behalf of the Department of the Navy (DON), Southwest Division Naval Facilities Engineering Command (SWDIV) in accordance with Contract Task Order (CTO)-0059, issued under the Comprehensive Long-Term Environmental Action Navy (CLEAN) II Program, contract No. N68711-92-D-4670.

1.1 PURPOSE

This QAPP has been prepared to assure that the data collected during performance of the Phase II Remedial Investigation/Feasibility Study (RI/FS) for MCAS El Toro are precise, accurate, representative, complete, and comparable to actual site conditions, and that they meet the criteria of technical project procedures during sample collection, sample analysis, and data evaluation.

The goal of the RI/FS process is to characterize the nature and extent of the risks posed by uncontrolled hazardous waste sites and to evaluate possible remedial options. This is a dynamic and flexible process that can be tailored to specific circumstances of individual sites. To meet this goal, careful planning and strategic thinking are required to obtain sufficient information that will support an informed risk management decision to determine the best remedy for each site. The flexibility built into the process allows for an efficient and effective RI/FS that achieves high-quality results in a timely and cost-effective manner. The RI and FS are to be conducted concurrently. The data collected in the RI will influence the development of the remedial alternatives in the FS, which in turn will affect the data needs and scope of the treatability studies and additional field investigations.

A complete site description and a discussion of the CTO scope of work are included in the Phase II RI/FS Work Plan (WP). This QAPP and the Phase II RI/FS Field Sampling Plan (FSP) constitute the Sampling and Analysis Plan for the Phase II RI/FS. A discussion of the CTO sample locations, sample frequency, and rationale is included in the FSP.

1.2 DATA USAGE

Data collected during performance of the RI/FS at MCAS El Toro will be used to:

- characterize sources of contamination at the site;
- assess human health and ecological risks;
- further characterize geologic and hydrogeologic conditions at the site;
- determine the lateral and vertical extent of soil, sediment, soil gas, surface water, and groundwater contamination at the site; and
- evaluate potential remedial and removal alternatives and recommend remedial actions at the sites, if appropriate.

The QAPP is organized as follows:

- Section 2 provides the management structure for the CLEAN II MCAS El Toro project;
- Section 3 discusses the quality assurance (QA) objectives for measurement for the project;
- Section 4 outlines sample collection procedures and requirements;
- Section 5 describes sample custody and documentation;
- Section 6 provides field and analytical quality control (QC) procedures;
- Section 7 describes data quality assessment and management;
- Section 8 explains performance and system audits; and
- Section 9 provides references.

Section 2
PROJECT ORGANIZATION

The project organization for the Phase II RI/FS at MCAS El Toro comprises representatives from the Navy, the Base Realignment and Closure Team, and the CLEAN II Program Team. The overall organization and relationships of these representatives are illustrated on Figure 2-1.

2.1 CLEAN ORGANIZATION

The tasks required for the Phase II RI/FS at MCAS El Toro will be performed by the CLEAN II staff. Specific responsibilities for these staff members are described below.

Program Manager – The Program Manager serves as the primary liaison between the Navy Project Officer and the CLEAN II Contracting Officer. These responsibilities include general oversight of all phases of project execution, coordination of technical review of the WP, and QC.

Operations Manager – The Operations Manager provides routine supervision and oversight of CTO tasks. These responsibilities include assuring that adequate resources are available to complete the work, performing technical reviews of deliverables, coordinating field operations, and resolving any CTO-specific problems that arise.

Project Manager – The Project Manager supervises and coordinates all the work performed on various CTOs at MCAS El Toro. These responsibilities include project execution, staffing, management, oversight, and quality control. The Project Manager also provides project supervision contact directly with the Navy Remedial Project Manager (RPM) to provide for accomplishment of the objectives for each CTO.

CTO Leader – The CTO Leader is in charge of supervising and overseeing all the work performed under the project. These responsibilities include project planning, WP and FSP development, scheduling, and technical execution as well as oversight and project QC for day-to-day field activities.

Quality Manager – The Quality Manager is in charge of developing QC protocols and procedures. These responsibilities include supervising unannounced QA audits to assure that these controls are implemented. Additionally, the Quality Manager is responsible for overseeing corrective action and preparation of QA reports to management.

Technical Integration Manager – The Technical Integration Manager provides oversight of the technical quality of documents produced during CTO execution.

Health and Safety Manager – The Health and Safety Manager is responsible for developing the Health and Safety Plan, assigning health and safety field officers, and providing worker health and safety requirements.

Program Controls Manager – The Program Controls Manager provides the CTO Leader with reports on project tracking, cost, scheduling, estimating, and trending. These responsibilities include overseeing the preparation of the monthly progress report.

Contracts Manager – The Contracts Manager is responsible for the solicitation, selection, and management of contracts with the subcontractors.

Database Manager – The Database Manager is responsible for oversight of database activities for the CTO, including data loading, tracking, verification, and validation. These responsibilities include supervision of project adherence to program data management procedures.

Field Services Manager – The Field Services Manager provides oversight of general field activities and construction management. These responsibilities include planning, scheduling, and monitoring of construction contractor performance.

Technical Staff – The CTO technical staff are responsible for completing all elements of the WP, including field investigation activities, data evaluation, risk analysis, and remedial alternatives screening. Field investigation activities will conducted by field personnel under the direction of a Field Team Leader. In addition to coordinating field activities, the Field Team Leader is responsible for maintaining adherence to the Health and Safety Plan. Specific functions of the field operations and technical staff are listed in Figure 2-1.

Laboratory Coordinator – The laboratory coordinator provides support to the Field Services Manager for oversight of field laboratories, mobile laboratories, and fixed-base laboratories. In particular, this coordinator is responsible for oversight of scheduling, review of analytical results, and quality control of the laboratories.

2.2 BASE CLOSURE TEAM

Navy Base Realignment and Closure (BRAC) Environmental Coordinator (BEC) – The BEC chairs the Base Closure Team (BCT) and is responsible for coordinating environmental restoration and compliance programs and updating the BRAC Cleanup Plan (BCP) at MCAS El Toro.

United States Environmental Protection Agency (U.S. EPA) RPM, California Department of Toxic Substances Control (DTSC) RPM, and California Regional Water Quality Control Board (RWQCB), Santa Ana Region, RPM – These agency RPMs are responsible for overseeing and monitoring the progress of the RI/FS and its conformance with the requirements of the FFA.

2.3 NAVY REMEDIAL PROJECT MANAGER

Navy RPM – The Navy RPM is responsible for coordination of all work performed by the CLEAN II contractors, MCAS El Toro and other Marine Corps representatives, and regulatory agencies, including the SWDIV management team.

Navy Remedial Technology Manager (RTM) – The RTM is responsible for reviewing all documents for the Installation Restoration Program (IRP) for consistency and technical quality across all the bases.

Clean II Program Management Organization

Program Manager

- Quality Manager
- Health and Safety Manager
- Program Controls Manager
- Contracts Manager
- Operations Manager
  - Database Manager
  - Technical Integration Manager
  - Field Services Manager
  - El Toro Project Manager

Navy and Base Closure Team Organization

Navy Remedial Project Manager / Remedial Technical Manager

BRAC Cleanup Team
- Navy BEC
- U.S. EPA RPM
- DTSC RPM
- CRWQCB RPM

El Toro Project Manager

- Organizes El Toro project team
- Establishes budget and schedule
- Reviews and approves RI/FS plans
- Reviews costs and schedule
- Coordinates medical surveillance
- Reports progress to Navy RPM
- Assures that project procedures, controls and contractual requirements are met
- Controls project costs, schedules, and quality
- Assures that safety and health are the project highest priority

Site Health and Safety Officer

- Implements safety and health program/plans
- Monitors daily work practices; recommends safety-related improvements
- Remains cognizant of regulations
- Stop work when there is danger
- Coordinates medical surveillance
- Coordinates project safety training meetings

Field Technical Manager

- Manages sample teams and Field Team Leaders
- Oversees technical aspects of field investigation, including drilling, well logging, well construction, sample collection and packaging, sample management, field data management, data entry into BEIDMS
- Assures that sample teams are trained per procedures
- Assures that quality of data meets DQOs
- Assures that sample teams comply with project procedures
- Manages laboratory coordinator

CTO Leaders

- Develops and revises Work Plan as appropriate
- Provides Field Sampling Plan as appropriate
- Provides Project planning and scheduling
- Oversees day-to-day field activities and quality control
- Reports on results of investigations
- Interprets and evaluates data
- Develops RI reports
- Plans and develops feasibility studies
- Develops remedial alternatives
- Assures that plans meet DQOs

Environmental Site Manager

- Manages field subcontracts for construction/investigation
- Provides government property management
- Monitors cost and schedule performance of contractors
- Is point of contact with Navy ROICC
- Coordinates with CTOL and FTM to assure any changes to Field Sampling Plans are developed to meet schedule requirements
- Assures that safety and health activities are being performed
- Manages labor relations
- Provides adequate staff and field procedures to assure quality of construction/investigations is maintained
- Assures that field staff is trained per procedures
- Assures that contractor staff is trained per procedures
- Provides field procurement
- Maintains field facilities equipment
- Provides utility clearance/site access
- Provides waste management/decontamination

Field Operations and Technical Staff

LEGEND:

- - - - - - - COMMUNICATION

———— LINE OF DIRECT REPORTING

QAPP

Figure 2-1

Project Organization

MCAS El Toro, California

CLEAN II Program

Date: 7/27/95
File No. ORG-21
Job No. 22214-059

Section 3
QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT

This section describes the objectives for data measurement for the RI/FS. These objectives have determined the types of sampling and analytical methods and quality assurance/quality control (QA/QC) procedures that will be followed for this project.

The complete description of the data quality objectives (DQOs) and discussion of their principles are included in the WP for this RI/FS. The data collected and used shall meet the data validation requirements and shall satisfy the quality objectives presented herein. The overall quality objectives of this QAPP are to outline procedures for the collection and assessment of data that are within acceptable tolerances of precision, accuracy, representativeness, completeness, and comparability (PARCC) so that the DQOs can be met.

3.1 SUMMARY OF DATA MEASUREMENT OBJECTIVES

Measurement and analytical data obtained from site sampling will be used to evaluate the nature and extent of contamination at MCAS El Toro. Analytical data obtained from samples will be used in preparing the RI/FS report. For this project, specific DQOs have been identified by following the process outlined in the *Guidance for the Data Quality Objectives Process* (U.S. EPA QA/G-4 1994). This process, as applied to MCAS El Toro Phase II data collection, has been detailed in the WP.

DQOs are statements of the quality of the data needed to support specific decisions or regulatory actions. To assure attainment of the DQOs, the following data measurement objectives are to be considered:

- the specification of particular detection limit requirements;
- the identification of the appropriate laboratory analytical level requirements based on the intended use of the data;
- the selection of the appropriate levels of PARCC for the data; and
- any specific sample-handling issues.

Each of these elements affects the degree of control placed over the collection and analysis of the data as follows:

- the required detection limits affect the methods used for analysis;
- the analytical levels affect the quantity of QC samples used, and the extent of documentation and data validation; and
- the PARCC parameters and handling issues selected affect the type of QC samples appropriate to the sampling process.

3.2 REQUIREMENTS OF DATA MEASUREMENT OBJECTIVES

The overall objectives of this QAPP are to assure that the collected data are of a sufficient quality to support their intended use. This section presents considerations for the DQO process that are applicable to objectives of data measurement.

The DON Installation Restoration Program (IRP) identifies and evaluates past hazardous material disposal sites in order to control the migration of hazardous contaminants. The program also controls hazards that may result from these past disposal operations. The DON requires laboratories that perform studies in support of the IRP to obtain Navy approval prior to beginning field studies or analyses of samples and to maintain that approved status throughout the site characterization. Each laboratory performing analyses must be approved by the Naval Facilities Engineering Service Center (NFESC) Contract Representative (NCR), be certified by the state of California, and comply with the United States Environmental Protection Agency (U.S. EPA) Contract Laboratory Program (CLP) QC requirements and the Navy Laboratory Quality Assurance Program.

The NFESC (formerly Naval Energy and Environmental Support Activity [NEESA]), has adopted three of the five analytical levels identified in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as QC requirements. They are Levels C, D, and E, which correlate with Levels 3, 4, and 5 described in the *Data Quality Objectives for Remedial Response Activities Development Process* (U.S. EPA 1987). MCAS El Toro falls under Level D requirements because it is a National Priorities List (NPL) site. As a Level D site, U.S. EPA CLP methods must be followed whenever possible and must generate CLP deliverables. QA/QC requirements are outlined in the *Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program* (NEESA 1988). Where U.S. EPA methods are not available, methods from other agencies and published methods that have undergone method validation must be used.

3.2.1 Detection Limits

Generally, there are several U.S. EPA analytical methodologies available for analysis of each chemical parameter. Analytical methodology and detection limits are based on regulatory limits, the acceptable level of risk, and analytical method limitations. Risk-based concentrations (RBCs) calculated from the Phase I RI were analyte concentrations based on 10^{-4}, 10^{-5}, and 10^{-6} levels of risk, and these RBCs were used to designate chemicals of potential concern (COPCs). Analytical methods for the Phase II RI/FS, including ecological bioassays, are selected on the basis of their capability to meet detection levels required to characterize COPCs to U.S. EPA Region IX Preliminary Remediation Goals (PRGs) (U.S. EPA 1995) and are described in Appendix B (Table B-1). The PRGs for the COPCs at MCAS El Toro include concentrations for residential and industrial land uses, tap water, and ambient air.

Estimated quantitation limits (EQLs) or estimated detection limits (EDLs) will be used for the CLP methods performed during the Phase II RI/FS as presented in Appendix B. The practical quantitation limits (PQLs), listed in Appendix B for certain methods, are equivalent to the EQLs and are defined as the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine lab operating conditions. Soil detection limits proposed for herbicides, pesticides, and metals are based upon PRGs and background concentrations. For certain COPCs, the listed detection limit does not

satisfy the corresponding PRG. In this case, a low-level standard will be analyzed daily to demonstrate the ability of the laboratory to detect these analytes at levels low enough to satisfy their PRG values. In all cases, the best available technology (BAT) with the lowest possible detection limits obtainable will be implemented to satisfy PRGs for the COPCs. Alternative methods may be implemented by the laboratory, with the necessary regulatory concurrence, for some methods listed in Table B-1 (i.e., U.S. EPA Methods 8240B, 8080A, 8150B, and 8010B/8020A). However, the required compound list and the performance criteria of the listed methods must be satisfied by the alternative methods (8260A, 8081, 8151, and 8021, respectively). Chemical analytes, methods, associated detection limits, and a limited list of PRGs for the COPCs are presented in Appendix B (Table B-1).

Ambient air samples will be sampled and analyzed by U.S. EPA Method TO-14 by a state- and NFESC-certified laboratory. The detection limits for the COPCs will be low enough to satisfy PRGs using gas chromatography/mass spectrometry (GC/MS).

Detection limits for soil gas surveys are based on the requirements defined by the California Regional Water Quality Control Board (RWQCB), Santa Ana Region, and are set at 1 microgram per liter (µg/L) of vapor for all target compounds. The RWQCB, Santa Ana Region, requirements for soil gas investigations are provided in Appendix C. The soil gas will be analyzed for the 23 target compounds listed by the RWQCB, Santa Ana Region; however, other COPCs may be added to the list of analytes based on specific site history.

Three forms of measurement will be made for Phase II RI/FS data gathering: field measurements, field screening, and fixed-base laboratory analytical measurements. The following sections describe the application of detection limits for conducting these two measurement activities.

3.2.1.1 FIELD MEASUREMENTS

Field measurements are data collected to characterize field conditions during sampling events. Field measurements will vary depending on the circumstances surrounding a specific sampling event, the type and anticipated concentration of the contaminants, and the media to be sampled. Field data will be reported in units consistent with those of other agencies and organizations to allow comparability of databases. Standardized field measurement protocols will be used to the extent possible to maintain consistency and to obtain results that can be validated. Calibration and maintenance of field equipment and instrumentation will be in accordance with manufacturers' specifications or applicable test specifications and the current version of CLEAN II Standard Operating Procedure (SOP) 6, Instrument Calibration and Use, and will be documented. Field instrument maintenance and calibration is detailed in the FSP.

Field measurements to be taken during performance of the CTO field activities include pH, conductivity, temperature, volatile organic compounds (VOCs) using a handheld flame ionization detector (FID) or field photoionization detector (PID), product thickness, and depth to water. The physical measurements will be recorded with the greatest

precision allowable by the instrument used. Although detection limits will not be specified for these measurements, limits for accuracy and precision will be specified. Detection limits for VOC screening will be determined by the equipment used. Tolerance limits for field instruments are presented in Table 3-1.

3.2.1.2 FIELD SCREENING

Field screening (qualitative and quantitative) will provide data that characterize sample conditions for certain analyte classes. Qualitative field screening devices will include handheld PID and FID, portable gas chromatograph (GC), and portable scintillation counter. Methodologies and instrumentation are described briefly in Appendix A. A list of the field screening instrumentation and their applications and sensitivity levels are presented in Table A-1. The field screening scheme is site-specific and is discussed in further detail in the DQOs, which are discussed in the WP and FSP, for each site.

Field screening will be conducted using a field laboratory and a mobile laboratory. The field laboratory will be provided by the CLEAN II team and will contain the immunoassay test kits, portable GC, and portable scintillation counter. The instrumentation will be used by trained and certified field staff and will follow the appropriate methods and procedures. The mobile laboratory will be provided by the subcontractor and may contain GCs, GC/MS, ICP, and/or IR. A mobile chemist will run the instrumentation for the analytical methods described below and in Appendix A.

Samples with detectable concentrations for VOCs and total petroleum hydrocarbons (TPH) using these qualitative field sampling devices will be submitted to the on-site mobile laboratory or the field laboratory for further analysis and characterization by the appropriate U.S. EPA method. Group and/or compound-specific immunoassay test kits will be used to screen and identify PAHs. The on-site mobile laboratory and immunoassay (IA) test kits will provide quantitative field screening measurements. The mobile or field laboratory may contain several types of analytical instrumentation to field screen for VOCs, SVOCs, TPH, total recoverable petroleum hydrocarbons (TRPH), and metals using the appropriate and most recent version of the U.S. EPA method for each analytical group. In addition to 100 percent of the positive samples from qualitative field screening, a minimum of 5 percent of the nondetects will be submitted for quantitation by an on-site mobile laboratory or a field laboratory.

In general, for the VOC source area (Site 24), the major drainages (Site 25), and the landfill sites (Sites 2, 3, 5, and 17), a minimum of 20 percent of all the field-screened samples will be submitted to a state- or NFESC-certified laboratory using U.S. EPA/CLP methodology to confirm results acquired from the various field screening methods used. From this 20-percent pool of field-screened samples, two-thirds will be randomly selected positives (samples with detected hits above the proposed detection limits), and one-third will be randomly selected nondetects as listed in Table 3-2. For the OU-3 sites, a predetermined number of field-screened samples using IA test kits, mobile, or field laboratory will be submitted to the fixed-base laboratory for confirmation (as described above). The field-screened samples are listed by site in Table 3-2. This predetermined

Table 3-1
Tolerance Limits for Field Measurements

Measurement	Tolerance Limit
pH	+/- 0.1 unit
conductivity	+/- 10 µmhos per cm
temperature	+/- 0.1°F
Volatile organic compounds (by photoionization detector or flame ionization detector)	+/- 5 ppm*
distance	+/- 0.1 ft
product thickness (by interface probe)	+/- 0.01 ft
depth to water	+/- 0.01 ft

*limit may vary depending on instrument capabilities

number for each site was based on the Phase I data, the recommended action (i.e., removal or no further action), and the number of samples proposed during the Phase II RI/FS. QA/QC for the mobile or field laboratory is similar to Level D requirements as discussed in Section 6. The types of field screening described in Appendix A will be used during this Phase II RI/FS; however, the extent and approach in which they will be used will be site-specific and/or sample-specific to meet the concerns and requirements for each site. Additionally, not all analyte groups will have the capability to be field screened and will be directly submitted to the fixed-base laboratory (i.e., dioxins, explosives, pesticides/polychlorinated biphenyls [PCBs], herbicides, and some inorganic parameters). Figure 3-1 provides an overview of the field screening and CLP method confirmation process.

3.2.1.3 FIXED-BASE LABORATORY ANALYSIS

Fixed-base laboratory analysis provides sample-specific data according to NFESC requirements. NFESC Level D requires that U.S. EPA CLP methods be used and that CLP data packages be generated. The level of concern or cleanup level selected for the site directly affects data quality requirements. Therefore, the analytical technique chosen must have a method detection limit (MDL) well below the level of concern. Regardless of the specified MDL, the actual detection limit reported may be sample-specific, especially in the case of samples having complex matrices (i.e., samples containing numerous analytes at widely different concentration ranges). For parameters that have no regulatory or health-risk-based limits, standard U.S. EPA MDLs will be reported. The data measurement objective is to obtain data with detection limits adequate to satisfy the PRG. The primary purpose of a risk assessment is to establish and substantiate the level of concern or cleanup level for the site. Analytical methodologies and instrumentation are described briefly in Appendix A, and their respective detection limits are listed in

Table 3-2
Field Screen/CLP Confirmation

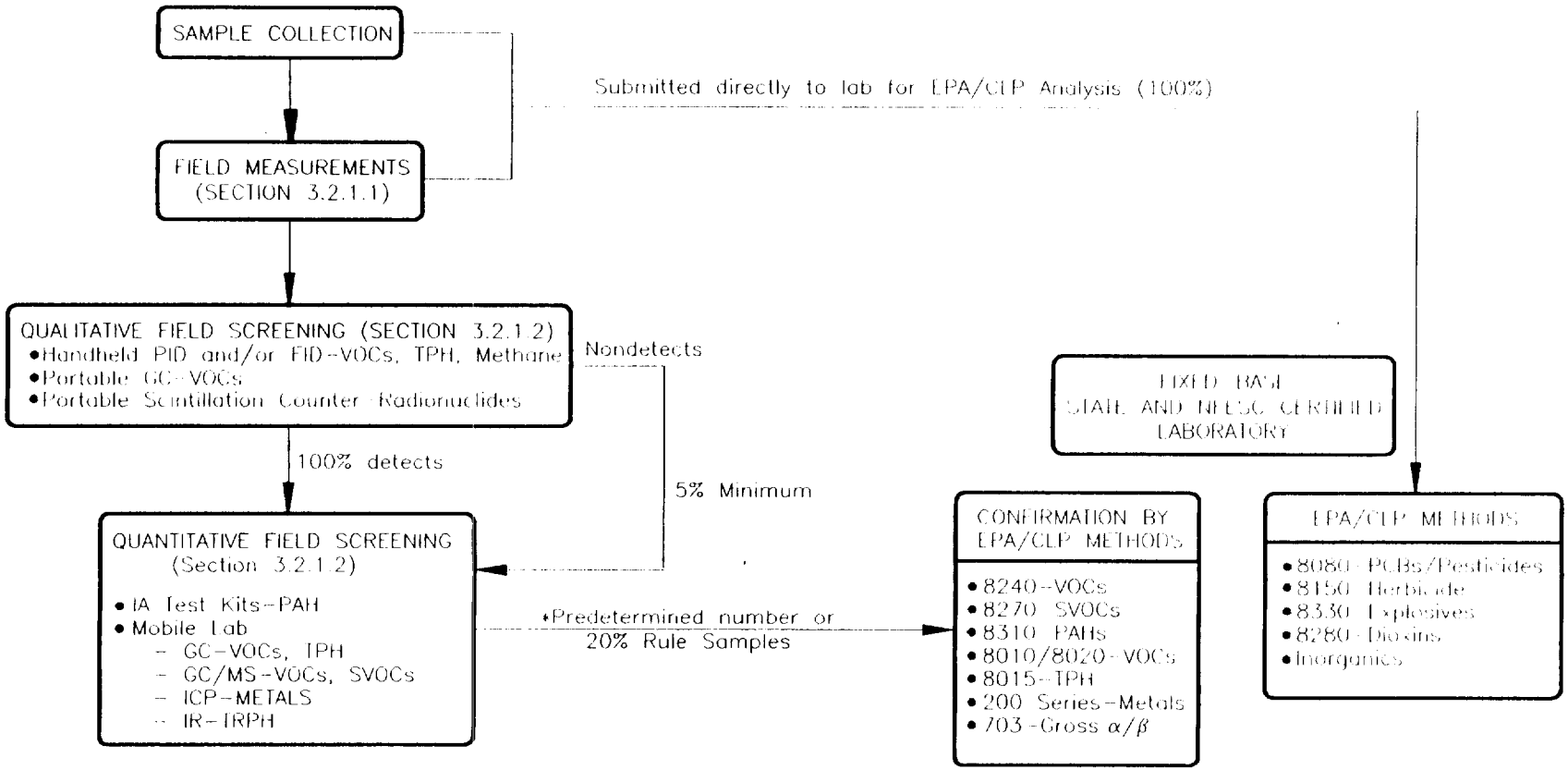
Site Number	Unit Number	Number of Locations	Phase I Samples	Phase II Field Screen Samples	Phase II CLP Confirmation
Site 1	Monitoring Wells	3	0	45	8
Site 2	NA	9	3	126	20% RULE*
Site 3	Unit 1 - Landfill area	3		63	20% RULE*
	Unit 2 - Agua Chinon Wash	NA		N/A	
	Unit 3 - Solvent spill	2		6	3
	Unit 4 - Former Incinerator	3		9	3
Site 4	Unit 1 - Stained area	Removal Action			
	Unit 2 - Drainage ditch	Removal Action			
Site 5	Unit 1 - Landfill area	4		112	20% RULE*
	Unit 2 - Stockpiled IDW	NA			
Site 6	Unit 1 - Concrete apron edge	2	8	6	6
	Unit 2 - Drainage ditch	3	8		9
	Unit 3 - Storage area	3	8	9	3
Site 7	Unit 1 - North pavement edge	Removal Action			
	Unit 2	Site 24	10		
	Unit 3 - New east pavement edge	Removal Action			
	Unit 4 - Drainage ditch	3	5	9	6
	Unit 5 - Open dirt area	2	8	6	3
Site 8	Unit 1 - East storage yard	Removal Action			
	Unit 2 - West storage yard	5	8	20	6
	Unit 3 - Refuse pile	4	10	16	4
	Unit 4 - PCB spill area	Removal Action			
	Unit 5 - Old Salvage yard	6	6	18	6
Site 9	Unit 1 - Pit area	5	7	15	3
	Unit 2 - Drainage area	6	0	18	9
Site 10	Unit 1 - Aircraft matting	8	11	24	5
	Unit 2 - Concrete apron	10	7	30	6
	Unit 3 - Parking lot area	12	0	36	9
	Unit 4 - Parking (Bldg 1589)	2	0	0	6
Site 11	Unit 1 - Concrete Pad	Removal Action			
	Unit 2 - Drainage ditch	Removal Action			
	Unit 3 - Storage yard	6	0	0	
Site 12	Unit 1 - West sludge drying bed	2	10	8	3

(table continues)

Table 3-2 (continued)

Site Number	Unit Number	Number of Locations	Phase I Samples	Phase II Field Screen Samples	Phase II CLP Confirmation
	Unit 2 - East sludge drying bed	4	9	16	3
	Unit 3 - Drainage ditch	Removal Action			
	Unit 4 - Former WWTP	8	21	32	3
Site 13	Unit 1 - Area SE of tank farm	Removal Action			
	Unit 2 - Area SW of tank farm	Removal Action			
Site 14	Unit 1 - Acid disposal area	Removal Action			
Site 15	Unit 1 - Stained areas	Removal Action			
	Unit 2 - SWMU 273	6	7	18	4
Site 16	Unit 1 - Pits perimeter area	3	7	9	3
	Unit 2 - Fire-fighting pits	4	10	16	3
	Unit 3 - Drainage ditch	3	8	0	
Site 17	Unit 1 - Landfill area	5		165	20% RULE*
Site 19	Unit 1 - NE Stained area	Removal Action			
	Unit 2 - Excavated area	Removal Action			
	Unit 3 - Stained area	6	9	18	5
	Unit 4 - Pump station	1	2	0	3
Site 20	Unit 1 - Drainage ditch	1	9	2	2
	Unit 2 - S Drainage ditch	Removal Action			
	Unit 3 - Stained area	Removal Action			
	Unit 4 - Courtyard	3	7	12	3
Site 21	Unit 1 - Storage area	2	9	6	3
Site 22	Unit 1 - Western area	2	8	6	3
	Unit 2 - Eastern area	1	10	0	3
Site 24		33		198	20
Site 25	Unit 1 - Agua Chinon	3		24	3
	Unit 2 - Bee Canyon	1		6	3
	TOTAL		225	1158	189

Notes:
* 20% RULE - 20% of all field screened samples will be submitted to a fixed-base laboratory for confirmation by U.S. EPA/CLP analytical methods. From this 20%, two-thirds will be randomly selected from the positive samples and one-third will be randomly selected from the nondetects.



•NOTE: ACTUAL SAMPLE NUMBER SUBMITTED TO A FIXED-BASE LABORATORY IS SITE SPECIFIC, REFER TO TABLE 3-3 AND SECTION 3.

QAPP
Field Screening/CLP Protocol
Figure 3-1

MCAS El Toro, California

CLEAN II Program

Date: 7/3/95
File No. qapp13-1
Job No. 22214

Appendix B (Table B-1). The project-required detection limits and the RBCs are derived from the Phase I data (Jacobs Engineering 1993). The parameters listed are those for which the detection limits have been recommended by NEESA (1988), U.S. EPA CLP, and the LUFT Manual (LUFT 1989). Laboratory instrumentation and methodologies used to analyze for the suspected and known chemical families at MCAS El Toro are described below.

3.2.1.4 CONFIRMATION METHODS

One goal of the Phase II RI is to use field screening analytical methods to reduce the number of expensive and time-consuming fixed-base laboratory analyses. To accommodate this goal, a predetermined number of field screened samples from the OU-3 sites will be submitted to a state- or NEESA-certified laboratory for Level D analysis. Additionally, all other sites will follow the 20-percent selection rule described in Section 3.2.1.2. Table 3-2 lists the minimum number of samples to submit for confirmation by CLP methodology for each site. The CLP results will then be used to confirm the field screening results.

Statistical comparisons will be used in the confirmation process and will compare the accuracy of the field screening results and the CLP results. The most appropriate statistical method will be selected, and it will be based on the type of distribution of the result values, the result value ranges, and the number of samples. Two commonly used methods are the Student's t-test, used for the comparison of the two population means, and the f-test, based on the comparison of the two population variances.

3.2.1.5 SOIL GAS SURVEY

Soil gas surveys will follow the guidelines outlined in *Requirements for Active Soil Gas Investigation* (RWQCB 1994) for sampling, sample collection and storage, QA/QC requirements, and target compounds (Appendix C). Soil gas investigation will be used to determine the presence and concentration of VOCs in the unsaturated zone. The soil gas surveys will be used to identify the nature and extent of VOCs in soil gas and to evaluate the possible impact to groundwater from VOC-impacted soil.

3.2.2 Laboratory Analytical Levels

Laboratory analytical levels, as defined by NEESA (1988), indicate the degree of analytical QC and data validation required to support the decisions being made based on the data collected. Data collected for this assessment will follow NFESC Level D analyses. The selection of Level D analyses requires standard CLP methods be implemented for all analytical methods used, including VOCs, SVOCs, pesticides and PCBs, and metals.

3.2.3 Precision, Accuracy, Representativeness, Completeness, and Comparability Criteria

PARCC criteria are the qualitative and quantitative indicators of data quality. The objective of this QAPP is to assure that collected data are precise, accurate, representative, complete, and comparable to actual site conditions. PARCC criteria are defined as:

Precision – a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of the relative percent difference (RPD) or standard deviation of the RPD. The quantitative definition of the RPD is given in Section 7.3.

Accuracy – the degree of agreement of a measurement (or an average of measurements of the same thing), x, with an accepted reference or true value, t, usually expressed as the difference between the two values $(x-t)$, or the difference as a percentage of the reference or true value (100 $(x-t)/t$ [percent recovery (PR)]), and sometimes expressed as a ratio (x/t). Accuracy is a measure of the bias in a system and is assessed by spiking samples with known standards and establishing the average recovery. Sample spikes are discussed further in Section 6.

Representativeness – expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. It is the measure of how closely results reflect the actual concentration or distribution of the chemical compounds present in the soil and water sampled. Proposed documentation will establish that protocols have been closely followed and that sample identification and integrity have been assured. Field and trip blanks, and field duplicates will be used to assess field and transport contamination and method variation. Laboratory method blanks will be run to assess laboratory contamination.

Completeness – a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions. The completeness goal will be 90 percent.

Comparability – expresses the confidence with which one data set can be compared to another based on using U.S. EPA-defined procedures where available; if U.S. EPA procedures are not available, the procedures have been defined or referenced in this document. Section 7 further summarizes the quality control evaluation procedures.

Precision and accuracy goals for the major chemical analyses to be performed on samples collected from the site are presented in Table 3-3. These goals or control limits were derived from the U.S. EPA methods. If a method had no listing, a CLEAN II Contract Laboratory QA manual provided the control limits for the remaining methods. The actual precision and accuracy of the chemical data collected will be calculated at the conclusion of fieldwork and laboratory analysis, and will be submitted in the final report. If data do

Table 3-3
Quality Assurance Objectives

Parameter	Method Number	U.S. EPA[a] Method	Precision (RPD[b])	Accuracy (percent recovery)
Aqueous Samples				
BTEX[c]	8020A	GC[d]	20	80-120
HVOCs[e]	8010B	GC	20	80-120
VOCs[f]	8240B	GC/MS[g]	15	80-120
SVOCs[g]	8270B	GC/MS	30	25-125
TPH[i]	8015M-A	LUFT[j]	30	70-140[k]
TRPH[l]	418.1	IR[m]	30[k]	83-107[k]
Metals	200 Series	AA[l] or ICP[m]	20	75-125
Explosives	8330A	HPLC[n]	20	85-115
Herbicides	8150B	GC	25	75-125
Pesticides/ PCBs[o]	8080A	GC	20	40-125
PAHs[p]	8310	HPLC	35[k]	25-110[k]
Dioxins/Dibenzofurans	8280	GC/MS	25[k]	85-115
Gross Alpha/Gross Beta	9310	Scintillation	30[k]	70-130[k]
Nitrate/Nitrite	353.2	Colorimetric	25	85-115
Total Kjeldahl Nitrogen	351.2	Segmented flow analyzer	20[k]	80-120[k]
Total phosphate	365.2	Colorimetric	20[k]	75-125[k]
Total cyanide	335.2	Colorimetric	20[k]	75-125[k]
Total dissolved solids	160.1	Balance	25	85-115
Total organic carbon	415.1	Carbonaceous Analyzer	20[k]	75-125[k]
Biochemical O_2 demand	405.1	—	20[k]	NA[k]
Chemical O_2 demand	410.4	Colorimetric	20[k]	75-125[r,k]
Solid Samples				
BTEX	8020A	GC	20	80-120
HVOCs	8010B	GC	20	80-120
VOCs	8240B	GC/MS	25	60-140
SVOCs	8270B	GC/MS	35	25-110
TPH	8015M-A	LUFT	50[k]	70-140[k]

(table continues)

Table 3-3 (continued)

Parameter	Method Number	U.S. EPA[a] Method	Precision (RPD)	Accuracy (percent recovery)
Solid Samples (continued)				
TRPH	418.1	IR	50[k]	64-121[k]
Metals	200 Series	AA or ICP	20	75-125
Pesticides/PCBs	8080A	GC	40	30-120
PAHs	8310	HPLC	35	25-110
Herbicides	8150B	GC	25	75-125
Nitrate/Nitrite	353.2	Colorimetric	25	85-115
Chromium hexavalent	7196A	Colorimetric	30[k]	42-110[k]
Total cyanide/metallo	335.1/335.2	Colorimetric	20[k]	75-125[k]
Total phosphate	365.2	Colorimetric	20[k]	75-125[k]
Total phenolics	420.1	Segmented flow analyzer	20	80-120
Sulfate	375.4	Colorimetric	25	75-125
Dioxins/Dibenzofurans	8280	GC/MS	25	85-115
Total organic carbon	415.1	Carbonaceous Analyzer	20[k]	75-125[k]
Explosives	8330A	HPLC	20	85-115

Notes:
- [a] U.S. EPA – United States Environmental Protection Agency
- [b] RPD – relative percent difference
- [c] BTEX – benzene, toluene, ethylbenzene and xylenes
- [d] GC – gas chromatography
- [e] HVOC – halogenated volatile organic compound
- [f] VOC – volatile organic compound
- [g] GC/MS – gas chromatography/mass spectrometry
- [h] SVOC – semivolatile organic compound
- [i] TPH – total petroleum hydrocarbons
- [j] LUFT – (California) Leaking Underground Fuel Tank (Field Manual)
- [k] CLEAN II Contract Laboratory QA Manual limits
- [l] TRPH – total recoverable petroleum hydrocarbons
- [m] IR – infrared spectroscopy
- [n] AA – atomic absorption
- [o] ICP – inductively coupled argon plasma spectroscopy
- [p] HPLC – high performance liquid chromatography
- [q] PCB – polychlorinated biphenyl
- [r] PAH – polynuclear aromatic hydrocarbons

not meet the goals prescribed in Table 3-3, they will be retained, but they will be so annotated in any reports in which they are presented. The precision of data reported at or near detection limits may in many cases be low (i.e., RPD in excess of Table 3-3 goals) even though the data may be acceptable (e.g., duplicate values of 0.1 parts per billion [ppb] and 1 ppb result in an apparently "unacceptable" RPD of 164 percent).

A further discussion of QA/QC samples to be analyzed is presented in Section 6. Procedures for assessing precision, accuracy, and completeness are presented in Section 7.

The representativeness of data will be assured by the use of established field and laboratory procedures and their consistent application. The comparability of all data will be assisted by reporting each data type in consistent units. Analytical methods employed will be the same or equivalent for all rounds of sampling. The representativeness of data is assured by the establishment of a site-specific FSP and implementation of this QAPP based on proven sampling and analysis techniques. Comparability and representativeness are also assured by the use and consistent application of established field and laboratory procedures.

Audits, internal QC checks, preventative maintenance, and corrective action, as described in other sections of the document, will be implemented toward maintaining the stated QC objectives.

3.3 SAMPLE HANDLING

The QA objective for the sample-handling activities is to verify that decontamination, packaging, and shipping do not introduce variables into the sampling chain that could render the validity of the samples questionable. In order to fulfill this QA objective, blank QC samples will be used as described in Section 6.

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Section 4
SAMPLE COLLECTION

An objective of the sampling procedures outlined in this project plan is to obtain samples that yield results of consistent quality. The use of proper sampling techniques, sampling equipment, strict sampling controls in the field, and appropriate chain-of-custody (COC) procedures will reduce the potential for sample misrepresentation and unreliable analytical data. QA objectives pertinent to proper sampling procedures are outlined in this section.

4.1 SAMPLING DESIGN

A summary and rationale for the proposed sampling locations, sample types, sample analysis, and sample frequency at MCAS El Toro are presented in the FSP. The FSP and WP present detailed descriptions of activities planned for the Phase II RI/FS.

4.2 SAMPLING EQUIPMENT

All nondisposable sampling equipment and material, tools, and field measurement devices will be decontaminated before and after each sample collection or field measurement location to prevent accidental sample contamination or flawed field measurements. Specific decontamination procedures for sampling equipment and field measuring devices are presented in the FSP and in the current version of CLEAN II SOP 11, Decontamination of Equipment.

All disposable equipment that comes into contact with potentially contaminated soil will be disposed according to the Investigation-Derived Waste Management Plan (IDWMP).

4.3 SAMPLE CONTAINERS

All sample containers are to be supplied through the laboratory designated for analytical services. The sample containers will be cleaned and QC-tested by procedures directly related to the specific analyses that may be performed on samples collected in these bottles. Sample containment will follow the prescribed CLP Sample Bottle Repository Program procedures to assure that containers are free of contaminants. This QC testing will be performed by the laboratory prior to shipping the containers to the field sampling team. Preservatives, when required, will be added to the sample container by the laboratory before shipment to the field. Sample containers with caps (e.g., glass jars, volatile organic analyte [VOA] vials, amber bottles, or polyethylene bottles) will be shipped to the user with sample coolers in protective cardboard cartons or other wrapping. To assure data QC, the sampler must use the appropriate sample container as specified by the analytical method for each sample type. Glass containers (including VOA vials) will be provided with Teflon®-lined caps or Teflon® septa, and all polyethylene containers will be provided with polypropylene closures. Tables 4-1 and 4-2 indicate the U.S. EPA method, type of container and preservative required, and the holding time for COPCs for organics and inorganics, respectively.

Table 4-1
Sample Containers[a1], Preservatives, and Holding Times for Organics

Specific Analyses Requested	Volatiles (8010, 8020, 8240)	CA LUFT[b2] TPH[c1]-Gasoline (8015M)	CA LUFT TPH-Diesel (8015M)	TRPH[d3] (418.1)	Semivolatiles (8270), Explosives (8330A)	Herbicides (8150)	Dioxins/ Dibenzofurans (8280)	Pesticides/ PCBs[e4] (8080)
Groundwater and Surface Water								
Preservation	HCl[f6] to pH < 2, cool to 4°C ± 2°C	HCl to pH < 2, cool to 4°C ± 2°C	Cool to 4°C ± 2°C	H_2SO_4[g7] to pH < 2, cool to 4°C ± 2°C	Cool to 4°C 8330A: store in dark	Cool to 4°C ± 2°C	Cool to 4°C ± 2°C	Cool to 4°C ± 2°C
Analytical Holding Time	Hold < 14 days	Hold < 14 days	Hold < 14 days prior to extraction, < 40 days after extraction	Hold < 14 days *< 28 days for analysis*	Hold < 7~~14~~ days prior to extraction, < 40 days *for analysis* ~~after extraction~~	Hold < 7~~14~~ days prior to extraction, < 40 days *for analysis* ~~after extraction~~	Hold< 7~~30~~ days prior to extraction, < ~~40~~45 days for analysis	Hold < 7~~14~~ days prior to extraction, < 40 days after extraction
Required Volume for Analysis	(2) 40-*mL*~~ml~~ VOA[h7] vials	(2) 40-*mL*~~ml~~ VOA vials	(2) 1-liter amber glass bottle	(1) 1-liter amber glass bottle	(2~~4~~) 1-liter amber glass bottle	(2~~4~~) 1-liter amber glass bottle	(2~~4~~) 1-liter amber glass *bottle*[a]~~*~~	(2~~4~~) 1-liter amber glass bottle
Comments	No headspace	No headspace	Fill bottle to neck	Fill bottle to neck	Fill bottle to neck	Fill bottle to neck	~~*~~[a]solvent/-acid rinsed	Fill bottle to neck
Soil								
Preservation	Cool to 4°C ± 2°C	Cool to 4°C ± 2°C	Cool to 4°C ± 2°C	Cool to 4°C ± 2°C	Cool to 4°C ± 2°C	Cool to 4°C ± 2°C	Cool to 4°C ± 2°C	Cool to 4°C ± 2°C
Analytical Holding Time	Hold < 14 days	Hold < 14 days before analysis of gasoline	Hold < 14 days prior to extraction, < 40 days after extraction	Hold < 14 days *< 28 days for analysis*	Hold < 14 days prior to extraction, < 40 days after extraction	Hold < 14 days prior to extraction, < 40 days after extraction	Hold < 30 days prior to extraction, < 45 days for analysis	Hold < 14 days prior to extraction < 40 days after extraction
Required Volume for Analysis	(1) 4-oz widemouth glass jar	(1) 8-oz and (1) 4-oz widemouth jar	(1) 8-oz and (1) 4-oz widemouth glass jar	(1) 8-oz widemouth glass jar	(1) 8-oz widemouth glass jar	(1) 8-oz widemouth glass jar	*(1) 8-oz widemouth glass jar*~~(1) 1-liter amber glass*~~	(1) 8-oz widemouth glass jar
Comments	Minimize headspace	Minimize headspace	Minimize headspace				~~*solvent/ acid rinsed~~	
Soil Gas								

Analytic Holding Time: the holding time for soil gas samples is 30 minutes, but a longer holding time may be permitted if sampling equipment does not show a decrease in volatile organic compound concentration in samples.

Required Volume for Analysis: a minimum of 20 cc of soil gas is required for each analysis; the sample container must be gas tight and not compromise the integrity of the sample (gas-tight syringe, sorbent trap). Tedlar bags may only be used for qualitative analysis.

(table continues)

Table 4-1 (continued)

Notes:

1. All glass jars must have a Teflon®-lined cap or septa (*including* ~~except~~ VOAs) and all polypropylene bottles must have polyethylene caps.
2. CA LUFT – *California* Leaking Underground Fuel Tank (*Field Manual*)
3. TPH – total petroleum hydrocarbon*s*
4. TRPH – total recoverable petroleum hydrocarbon*s*
5. PCB – polychlorinated biphenyl
6. HCl – hydrochloric acid
7. H_2SO_4 – sulfuric acid
8. VOA – volatile organic *analyte*~~analysis~~

Table 4-2
Sample Containers[a1], Preservatives, and Holding Times for Inorganics

Specific Analyses Requested	Total Metals	Total Cyanide	Total Phenolics/ Total Phosphorus	Radionuclides Gross Alpha/Beta	TOC[b2], COD[c3], Sulfate	Nitrate/Nitrite TKN[d4], Ammonia	pH, BOD[e5]
Groundwater and Surface Water							
Preservation	HNO_3[f6] to pH < 2, cool to 4°C ± 2°C	NaOH[g7] to pH > 12, cool to 4°C ± 2°C	H_2SO_4[h7] to pH < 2, cool to 4°C ± 2°C	HNO_3 to pH < 2	H_2SO_4 to pH < 2, cool to 4°C ± 2°C	H_2SO_4 to pH < 2, cool to 4°C ± 2°C	cool to 4°C ± 2°C
Analytical Holding Time	Hold for < 6 mo, 13~~28~~ days for Hg, 24 hr for Cr+6	Hold for < 14 days	Hold for < 28 days	Hold for < 6 mo	Hold for < 28 days	Hold for < 28 days	pH: immediate BOD: Hold for < 48 hr
Required Volume for Analysis	(1) 1-liter plastic container	(1) 500-mL~~ml~~ plastic container	Phenolics: 4-oz glass amber bottle Phosphorus: 4-oz plastic	(1) 1-liter plastic container	COD, Sulfate: 4-oz plastic, TOC: 4-oz glass amber	4-oz plastic bottle	pH: 4-oz plastic: BOD: 16-oz plastic
Comments		if residual chlorine present, add 0.6 g ascorbic acid		do not need to chill	TOC: no headspace		BOD: no headspace
Soil							
Preservation	cool to 4°C ± 2°C	cool to 4°C ± 2°C	cool to 4°C ± 2°C	cool to 4°C ± 2°C	cool to 4°C ± 2°C	cool to 4°C ± 2°C	cool to 4°C ± 2°C
Analytical Holding Time	Hold for < 6 mo, 38~~28~~ days for Hg, 24 hr for Cr+6		Hold for < 28 days	Hold for < 6 mo	Hold for < 28 days	Hold for < 28 days	pH: Hold for < 14 days
Required Volume for Analysis	(1) 8-oz glass jar	(1) 4-oz glass jar	(1) 4-oz glass jar	(1) 4-oz glass jar	(1) 4-oz glass jar	(1) 4-oz glass jar	
Comments							no headspace

(table continues)

Table 4-2 (continued)

Notes:

[a] All glass jars must have a Teflon-lined cap or septa (*including* ~~except~~ VOAs) and all polypropylene bottles must have polyethylene caps.

[b] TOC – total organic carbon

[c] COD – chemical oxygen demand

[d] TKN – total Kjeldahl nitrogen

[e] BOD – *biochemical*~~biological~~ oxygen demand

[f] HNO_3 – nitric acid

[g] NaOH – sodium hydroxide

[h] H_2SO_4 – sulfuric acid

The FSP provides guidance on the appropriate sample containers, sample volumes, preservatives, and holding times for analytical parameters. Each sample cooler containing samples to be analyzed for VOCs will contain a laboratory-supplied trip blank.

4.4 SAMPLE COLLECTION

Field methods and procedures for sample collection will be conducted as described in the FSP and will be in accordance with the current applicable Navy CLEAN II SOPs. Soil gas sample collection will follow procedures described in RWQCB, Los Angeles Region, soil gas guidelines (RWQCB 1994).

4.5 SAMPLE HANDLING AND SHIPMENT

Samples will be transported and stored according to procedures outlined in the FSP. Documentation for sampling activities is detailed in the FSP and discussed in Section 5 of this QAPP.

Sample packaging and shipping procedures are based on U.S. EPA specifications as well as U.S. Department of Transportation regulations (49 *Code of Federal Regulations* [CFR]). "Blue ice" packs or ice will be included in coolers containing samples that require temperature control as specified in the FSP. To assure that required analytical holding times are met, all samples will be delivered to the laboratory by CLEAN II personnel, transported by a laboratory courier, or shipped to the laboratory via an express mail service within 24 hours of sample collection. A description of how to pack and ship samples is contained in the FSP and in the latest CLEAN II SOP 10, Sample, Custody, Transport, and Shipment.

Upon receipt by the laboratory, samples will be stored in accordance with procedures established by the U.S. EPA in the CLP Statement of Work.

Section 5
SAMPLE CUSTODY/DOCUMENTATION

Sample custody and documentation are important elements of generating acceptable data. Each sample or field measurement must be properly documented to facilitate timely, correct, and complete analysis; and to support use of data in the analysis and conduct of remediation at the site. The documentation system provides the means to identify, track, and monitor each sample from the point of collection through final data reporting. Specific documentation requirements are described in the following sections.

5.1 FIELD SAMPLE CUSTODY AND DOCUMENTATION

The most important aspect of sample custody and documentation is thorough, accurate record keeping. These records include a variety of documentation methods, including field logbooks, photographs, sample labels, COC records, and custody seals. Additional discussion of these topics is presented in the FSP.

5.1.1 Field Logbooks

A controlled, permanently bound logbook with consecutively prenumbered pages will be maintained by the sampling team to provide a daily record of significant events, observations, calibration of instrumentation, and measurements taken during field investigations. All field investigation teams will use logbooks, which will be kept as permanent records. Entries will be made in indelible ink. Corrections will consist of single line-out deletions that are initialed and dated by the person making the correction. All entries must be signed and dated.

Field logbooks are intended to provide sufficient, defensible data and observations to enable participants to reconstruct events that occurred during the project. The field logbook entries should be factual, detailed, and objective. Completed field logbooks shall be delivered to the CLEAN II Document Control Center. A description of logbook procedures is in the latest CLEAN II SOP 17, Logbook Protocols.

5.1.2 Photographs

Photographs may be taken of the sample locations to show the surrounding area and objects used to locate the site. The photographs will be used to provide backup documentation for procedures and unusual conditions encountered and the general sampling locations. Photographs will be taken at each sampling location and will be described in the field logbook in accordance with all SWDIV and MCAS El Toro rules regarding photographs. Photographs should include two or more reference points to allow relocation of the sampling point at a later time. The film roll number will be identified by taking a photograph of an informational sign on the first frame of the roll. This sign will display the site name, initials of photographer, film roll number, and date. After the photographs are developed, they will be labeled for cross-referencing with other field data.

5.1.3 Sample Labeling

Sample labels will be attached to each sample container just before, or at the time of, sampling. Sample labels will be made of waterproof paper or plastic with gummed backs and will be completed with indelible ink. Any errors made on the sample label will be corrected with a single line through the error (initialed) followed by the entry of the correct information. Sample labels will clearly indicate the sample number, analysis to be performed, sample preservation, and the field sampler's name or initials as described in the FSP and in the current version of CLEAN II SOP 9, Sample Containers, Preservation, and Handling and SOP 10, Sample Custody, Transfer, and Shipment.

All environmental samples collected to support CTO-0059 will be identified with a unique 9-digit sample numbering system as described in the FSP, the Data Management Plan, and CLEAN II Program Procedure T2.2.

5.1.4 Chain-of-Custody Records

COC records are necessary to physically trace the sample possession from the time of collection to final disposition. A description of COC procedures can be found within SOP 10, identified in the previous section. The record is signed when relinquished or received, each time the sample changes hands. The custody record is completed using waterproof ink. All corrections are made by drawing a line through, initialing, and dating the error, and entering the correct information. Erasures are not permitted.

The COC record is employed as physical evidence of sample custody. The sampler completes a COC record to accompany each sample shipment from the field to the laboratory.

5.1.5 Custody Seals

After samples are collected, custody seals are placed on the sample containers. Custody seals are used to detect if any samples have been subject to tampering between sample collection and analysis. The seal is placed so that it must be broken in order to open the sample container. Two or more custody seals will be placed on the outside of the shipping container or cooler prior to shipment through an overnight carrier. Each custody seal affixed to sample containers and sample coolers will be signed and dated by the field sampler. Custody seals are described in SOP 10, identified in Section 5.1.3.

5.2 LABORATORY SAMPLE CUSTODY AND DOCUMENTATION

Each contract laboratory used during the Phase II RI/FS at MCAS El Toro will be required to establish custody procedures that conform to those required by CLP, as outlined in the CLP User's Guide. These procedures include:

- designation of a sample custodian;
- completion by the custodian of the COC record, any sample tags, and laboratory request sheets (including documentation of sample condition upon receipt);

- laboratory sample tracking and documentation procedures;
- secure sample storage (with the appropriate environment: refrigerated, dry, etc.); and
- proper data logging and documentation procedures, including custody of all original laboratory records.

A designated sample custodian will take custody of all samples upon their arrival at the laboratory. The custodian will inspect all sample labels and custody forms to assure that the information on the labels and forms corresponds. The custodian will also inspect all samples for signs of damage or tampering and temperature discrepancies. Any discrepancies in temperature information or signs of damage or tampering will be documented by the custodian. The custodian will then assign a unique laboratory number to each sample and will distribute the samples to the appropriate analysts or to secured storage areas. All sample transfers in the laboratory will be recorded.

5.3 CORRECTIONS TO DOCUMENTATION

All original recorded data shall be written in waterproof ink. No accountable serialized documents are to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document. If an error is made on an accountable document assigned to an individual, that individual shall make corrections by making a line through the error (initialed) and entering the correct information. The erroneous information shall not be obliterated. Any subsequent error discovered on an accountable document shall be corrected by the person who made the entry. Subsequent corrections must be initialed and dated.

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Section 6
FIELD AND ANALYTICAL QUALITY CONTROL PROCEDURES

Both field and laboratory QA/QC checks will be employed to evaluate the performance of field and laboratory analytical procedures. QA/QC checks will take the form of samples introduced into the sampling, sample transport, and analytical stream to enable evaluation of analytical accuracy and precision. The QA program for mobile laboratory should include the same quality aspects as a fixed-base laboratory and should provide specific QA/QC policies and procedures for all analytical methods and conform to requirements specified in NEESA 20.2-047B Section 4 (NEESA 1988). The QA/QC program for CLEAN II subcontractors will be reviewed and approved by the Navy prior to fieldwork. The subcontractor QAPP should discuss the following subjects:

- QA manual;
- QA/QC procedures and test methods documented;
- calibration procedures;
- traceable reference standards, materials, and preparation;
- QC samples;
- control charts;
- detection limits; and
- record keeping and data recording procedures.

6.1 GENERAL

QC samples are used to:

- assess data quality in terms of precision and accuracy; and
- verify that sampling procedures, such as COC, decontamination, packaging, and shipping, are not introducing variables into the sampling chain that could render the validity of samples questionable.

Such QC samples are regularly prepared in the field and laboratory so that all phases of the sampling process are monitored. The types of QC samples to be collected during the Phase II RI/FS are discussed below.

6.1.1 Duplicates

Duplicate samples will be collected by the sampling team and will be used to determine the representativeness of the sample. Duplicates will be prepared following standard sampling and preparation techniques. Duplicates are matrix specific.

Duplicate aqueous samples will be collected at a frequency of one per 10 samples collected. For soils, one duplicate sample will be collected per site excluding landfills. Duplicates will be submitted to the on-site mobile laboratory and fixed-base laboratory

"blind" (with no indication of the contents or associate sample) for the same analyses as the samples to independently assess the precision of the laboratory. The procedure for assessing precision is to calculate the RPD and the standard deviation. The RPDs are then plotted on QC charts. Immunoassay test kits will analyze a duplicate field sample to document method reproducibility and will consist of one per every 20 samples. The sample chosen for duplicate analysis is preferably one with a positive detection for the analyte of interest.

6.1.2 Blanks

Blanks will be used to assess whether contaminants are being introduced into the sample at any given point. Six kinds of blanks will be used: trip blanks, equipment rinseate blanks, field blanks, source water blanks, and probe blanks. Trip blanks are prepared by the laboratory for VOC sampling using laboratory-grade organic-free deionized water. The trip blanks are included in the sample supply shipment from the laboratory to the sampling team. Trip blanks are not opened in the field, but are shipped back to the laboratory with the collected samples. Every sample cooler containing samples to be analyzed for VOCs will have a trip blank. Trip blanks will be used to detect contamination introduced during sample handling and shipment. All preservatives used in the field will be included in the trip blanks.

Equipment rinseate blanks are prepared by collecting samples of rinseate to evaluate the success of decontamination procedures. All preservatives used in the field will be included in the equipment rinseate blanks.

Field blanks will be prepared during groundwater sampling activities near jet traffic areas to check ambient airborne contamination. Field blanks will consist of purified water that is taken into the field and transferred from the water container to individual sample vials during sampling at specific locations. All preservatives used in the field will be included in field blanks.

Source water blanks are prepared by collecting samples of the source water used during the final rinse during the decontamination process to assure that the source water is free of any contaminants that may be introduced to the samples during collection. All preservatives used in the field will be included in the source water blanks.

Soil gas blanks will consist of probe/equipment blanks collected prior to soil gas sampling to assure that the equipment is free of any contamination. Additional blanks will be analyzed, when necessary, to assure that cross-contamination does not occur from previously "hot" samples. The sampling procedure for soil gas equipment blanks will follow the guidelines set up by the California RWQCB/Well Investigation Program (WIP) protocol for soil gas investigation.

6.1.3 Spikes

Spikes are samples used to evaluate data accuracy. Spikes are prepared by the on-site mobile laboratory and fixed-base laboratory by spiking samples with representative

constituents for the analyses to be performed. For surrogate spikes, the standards are chemically similar but not identical to the compounds in the fraction being analyzed. The purpose of the surrogate spike is to provide QC on every sample by constantly monitoring for unusual matrix effects and gross sample processing errors. The results are reported with laboratory data as a percent recovery. For inorganics, generally only matrix spikes are measured. Soil gas spikes will consist of surrogate spikes if GC/MS is not used for analyses.

6.2 FIELD QUALITY CONTROL CHECKS

For each sampling event or round, additional samples are taken to fulfill the field QC requirements. These QA/QC samples are to be handled, collected, and analyzed in the same manner as the actual samples collected. A brief description is included below.

One field duplicate will be collected for each 10 samples, or one sample per day, whichever is greater. The total number of samples collected each day should be the sum of potentially contaminated samples. The duplicate will be submitted to the on-site mobile laboratory and fixed-base laboratory as a "blind" sample and will be assigned a unique sample number so that it will not be readily identifiable as a duplicate by the laboratory personnel. No background samples are envisioned in this sampling effort.

Trip blanks will be prepared and supplied by the laboratory for VOC analysis as described in Section 6.1.2. Every sample cooler containing samples to be analyzed for VOCs will have a trip blank.

Equipment rinseate blanks will be prepared by the sample team by collecting samples of decontaminated sampling equipment and apparatus to evaluate the success of equipment decontamination. These blanks will be collected by passing deionized water through or over decontaminated sampling equipment and filling the rinseate sample bottles. At a minimum, one set of equipment rinseate blanks will be prepared per day from one piece of decontaminated equipment per site, per sample matrix. If more than 20 samples are collected in a single day by one team at one site, one equipment rinseate blank will be prepared for each group of 20 or fewer samples. All preservatives used in the field will be included in the equipment rinseate blanks.

Field blanks will be prepared by the sampling team as described in Section 6.1.2 to check for airborne contamination in jet traffic areas. Only specific sampling locations will require a field blank during groundwater sampling. All preservatives used in the field will be included in the field blanks.

Source water blanks will be prepared by the sample team by collecting a sample of the source water used as a final rinse in the decontamination process. At a minimum, one field blank from the different sampling activities at each site (i.e., soil borings, sediment sampling, groundwater sampling) and from each source of water must be collected and analyzed for the same parameters as the related samples. All preservatives used in the field will be included in the source water blanks.

6.3 LABORATORY QUALITY CONTROL CHECKS

Laboratory method blanks and calibration standards will be used by the state and NFESC-certified laboratory (mobile and stationary) during analyses as required by the U.S. EPA CLP Statement of Work (1990 or later version) and the methods being conducted. Laboratory checks will include the procedures detailed below.

- The reagents, gases, and standards required by a method will be traceable to a certified reference standard such as National Bureau of Standards, National Institute of Standards and Technology, U.S. EPA, or use the highest-quality standards available and materials and procedures recorded in a logbook to document traceability.
- Instruments will be calibrated according to the manufacturer's instructions and as required by the U.S. EPA CLP analytical method used. Where there are no specifications for each parameter, a three-point calibration curve will be implemented.
- Calibration of instruments will be documented in a bound logbook and records will be maintained.
- Continuing calibration standards will be analyzed and documented in a logbook for each analytical method performed at the beginning and end of each laboratory shift and during sample analysis as required by the method with calibration records maintained.
- The recovery criteria and percent difference for inorganics and organics continuing calibration shall be within the QC criteria of the requested method.
- An analysis of laboratory method blanks by each analytical method will be made as necessary for the laboratory internal CLP or NFESC QA compliance program and will not exceed 20 samples.
- An analysis of one matrix spike sample will be made for every 20 samples and will be fortified with representative compounds for each analytical method performed.
- An analysis of one matrix duplicate sample will be made for every 20 samples analyzed, or one per batch, whichever is greater.

The term "matrix" refers to the use of the actual media collected in the field. Laboratory QC samples are an aliquot (subset) of the field samples. A routinely collected soil or sediment sample contains sufficient volume for routine sample analysis and additional laboratory QC analysis, including matrix spike and matrix spike duplicate analyses. However, for water samples, triple volumes of samples are supplied to the laboratory for their use. The laboratory is alerted to the presence of this triple volume for matrix spike and matrix spike duplicate analysis by its notation on the corresponding COC document. Laboratory SOPs and specific QA/QC issues will be addressed in the NFESC-approved CLEAN II contract laboratory QA manual.

6.3.1 Control Charts

Control charts will be used by the laboratory to assess QC efforts and to improve processes through graphic displays of a parameter(s) and its variability over time. The parameter plotted on the control will be related to control sample testing, either directly in terms of concentrations or indirectly in terms of divided information (e.g., means of concentrations, ranges of concentration, percent recovery spikes, and RPD) based on duplicate results or slopes of best-square data fits. The laboratory will include in its QA plan a description of the methodology used in control charting. The descriptions of the methodology used in control charting will include the following:

- verification that methods are valid and working correctly prior to beginning control charts;
- number of control samples per run;
- number of runs analyzed;
- parameter to be plotted against time and the formula for developing the parameters;
- statistical/mathematical basis for assigning warning and rejection limits of the charts;
- shifts, trends, or biases that may be revealed by these charts; and
- corrective action for out-of-control events.

6.4 STANDARD OPERATING PROCEDURES

The 15 CLEAN II SOPs that will be implemented during the Phase II RI/FS work at MCAS El Toro are listed below.

- SOP 2 Drill Method Evaluation
- SOP 3 Borehole Logging
- SOP 4 Soil Sampling
- SOP 5 Monitoring Well Installation and Development
- SOP 6 Instrument Calibration and Use
- SOP 7 Water and Free-Product Level Measurement in Wells
- SOP 8 Groundwater Sampling
- SOP 9 Sample Containers, Preservation, and Handling
- SOP 10 Sample Custody, Transfer, and Shipment
- SOP 11 Decontamination of Equipment
- SOP 13 Abandonment of Boreholes and Wells
- SOP 14 Aquifer Testing

- SOP 16 gINT™ System: Borehole and Well Log Data Entry
- SOP 17 Logbook Protocols
- SOP 20 Radiological Screening of Soil Samples

The purpose of SOP 2, Drilling Method Evaluation, is to provide a means of evaluating potential drilling methods that will meet the specific technical objectives and requirements of a proposed field program. The procedure applies to preparation of bid specifications for borehole drilling operations to be performed by a qualified field subcontractor in association with subsurface geologic, geotechnical, hydrogeologic, or hazardous waste investigations.

The purpose of SOP 3, Borehole Logging, is to provide a standardized method and format for field documentation of subsurface conditions encountered during borehole drilling operations. This procedure applies to the field preparation of borehole logs in association with drilling-related activities under the direction of CLEAN II.

The purpose of SOP 4, Soil Sampling, is to provide standardized methods for the field collection of soil samples using manual or rig-assisted techniques. The procedure specifies the methods to be followed by the CLEAN II environmental engineers and geologists for the field collection of surface and subsurface samples.

The purpose of SOP 5, Monitoring Well Installation and Development, is to provide a standardized method and format for the installation and development of vertical monitoring wells intended for periodic gauging of groundwater levels, collection of representative groundwater samples, and measurements of hydraulic characteristics of a particular hydrogeologic unit. The procedure is intended for use by CLEAN II geologists and engineers for general guidance in the construction, development, and documentation of monitoring wells at site investigations for the CLEAN II Program.

The purpose of SOP 6, Instrument Calibration and Use, is to describe the general procedures to be employed for the calibration and use of equipment and instruments commonly used for field measurements and sample screening. The procedure is intended for use with instruments and equipment outside of safety, health physics, or industrial hygiene monitoring purposes.

The purpose of SOP 7, Water and Free-Product Level Measurement in Wells, is to identify the methods to be used for the measurement of water and free-product levels in wells and to provide standardized reporting formats for documentation of data.

The purpose of SOP 8, Groundwater Sampling, is to provide direction to assure that a groundwater sampling event obtains accurate water quality data that is representative of the groundwater being monitored at the time of the collection; and to promote the proper collection of groundwater samples through adherence to a site-specific field sampling plan and implementation of QA/QC measures. The procedure is intended for use by geologists and environmental engineers in association with hydrogeologic/hazardous waste investigations. It applies to the collection and handling of groundwater samples collected from existing or newly installed wells.

The purpose of SOP 9, Sample Containers, Preservation, and Handling, is to assure that the integrity of samples is maintained for analysis. The procedure applies to all environmental samples collected by CLEAN II environmental engineers and geologists. It describes the various sample container types and preservatives available for the collection of samples and provides guidelines for the appropriate handling of these samples.

The purpose of SOP 10, Sample Custody, Transfer, and Shipment, is to assure that the integrity of samples is maintained throughout the sample transfer process. The procedures describe protocols for the custody, transfer, and shipment of environmental and industrial samples from the point of collection to analysis and disposal by a designated analytical laboratory. The procedure applies to all environmental and industrial hygiene samples collected by CLEAN II personnel and submitted for archiving or analysis.

The purpose of SOP 11, Decontamination of Equipment, is to assure correct equipment decontamination procedures are followed to prevent cross-contamination of samples.

The purpose of SOP 13, Abandonment of Boreholes and Wells, is to establish the correct procedure for the abandonment of boreholes and unusable wells to meet federal, state, and local requirements.

The purpose of SOP 14, Aquifer Testing, is to promote consistency and quality in the performance of aquifer testing. The procedures described in SOP 14 present the general approach to the performance of aquifer tests likely to be used in a typical groundwater and/or hazardous waste site field investigation on the CLEAN II Project. The methods cover slug tests, pumping tests, constant-head tests, and falling-head tests; and they are performed to determine hydraulic characteristics of an aquifer and to understand the movement of groundwater through sites under investigation.

The purpose of SOP 16, gINT™ System: Borehole and Well Log Data Entry, is to provide a standardized method for automating borehole and well log construction information. The procedure provides guidelines for organizing, entering, and presenting borehole-log and well-construction data using gINT™ software.

The purpose of SOP 17, Logbook Protocols, is to provide procedure and guidance for the labeling, use, and control of logbooks used to document CLEAN II field data collection activities.

The purpose of SOP 20, Radiological Screening of Soil Samples, is to provide a standardized method for performing field screening radiological measurements of soil samples to be submitted for laboratory analysis.

These SOPs are supplemented by procedures presented in the FSP. These supplemental procedures include land surveying, geophysical methods, air testing, and pilot testing.

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Section 7
DATA QUALITY MANAGEMENT

Data quality management includes data management, data verification and validation, preventive maintenance, data assessment, and corrective actions as described below.

7.1 DATA MANAGEMENT

Project data will consist of various types of data, ranging from field measurements to laboratory analyses. Site data requirements for this RI/FS will be governed by the specific type of data and the DQOs. Unique data type combinations will be available to accommodate specific data collection and reporting needs for this project.

Primary data management activities include the establishment of sampling design; collecting, encoding, verifying, and validating data; the performance of QA/QC evaluation of data; and the generation of output.

The data management staff shares responsibility for high-quality products with RI/FS staff. Data management will be implemented for this CTO as described in the Phase II RI/FS DMP.

7.2 DATA VERIFICATION AND VALIDATION

Data quality assessment will be performed by CTO and data management personnel as designated in the CLEAN II Program organization. Data validation will be performed by an independent subcontractor and will be consistent with CERCLA requirements. Data collected from Phase II RI/FS sampling tasks and used in project reports will be appropriately evaluated and will be included in the Phase II RI/FS Report. The purpose of data quality assessment and validation is to assure that:

- the data collected meet the DQOs outlined in Section 3 of this QAPP and more thoroughly presented in the WP; and
- the data can be used as a basis for remedial action decisions at MCAS El Toro.

If needed, the data should serve as a legal record of the investigations conducted. In order to serve these purposes, all of the following verification criteria must be met:

- date and time of sample collection - required to uniquely identify sample and assess any holding time limitations;
- location of samples including depth, if appropriate - required to uniquely identify samples. (These data shall be provided in the field logbook.);
- COC documentation - required to demonstrate integrity of samples and maintain unique identity of samples (it includes a unique sample identification number, sample collection date and time, and signature of the persons relinquishing and receiving the sample);
- field QA/QC procedures - required to demonstrate sample integrity (it includes field decontamination procedures to prevent cross-contamination, the collection of field blanks, and the collection of duplicate samples during each sampling activity);

- name and location of laboratory - required for COC documentation and to verify laboratory credentials;
- analytical methods - required to assess appropriateness and acceptability of analytical method used;
- detection limits - required to assess the lower limit of parameter identification;
- holding times, and dates of extraction and analysis and preservation - required to assess if the samples were extracted and analyzed within the holding time required; and
- laboratory QA/QC procedures and instrument calibration - required to assess analytical accuracy and sample integrity (spikes, duplicates, method blanks, and surrogates are to be analyzed by the laboratory for each analytical batch at appropriate frequencies).

All collected data will be subjected to the verification process. One hundred percent of all data collected from the fixed-base laboratory will undergo data validation in accordance with NFESC Level D criteria. Data validation will include calculation of precision, accuracy, and completeness as described in Section 7.3. Valid data will be used to determine if the DQOs of the FSP have been met.

7.3 PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

The QA/QC protocol for evaluating precision and accuracy is detailed below.

- Accuracy and precision of analytical techniques will be assessed through matrix spike and matrix spike duplicate samples (respectively) prepared by the laboratory from field samples.
- Analytical precision will be evaluated by comparing analytical results from laboratory matrix spike samples, reported as the RPD between the matrix sample and the matrix spike duplicate, against specified precision limits.
- Accuracy and precision of analytical techniques will be assessed through matrix spike and matrix spike duplicate (respectively) samples prepared by the laboratory from field samples. The spiked sample recoveries will be recorded and reported by the laboratory.
- Independent data validation will be accomplished by the subcontractor.

Data quality assessment will be used to conduct a technical review of the analytical data to determine the adequacy of the data type within the context of the complete data package and to determine whether the data fulfills the DQOs for that particular event. QC samples analyzed in the laboratory will be evaluated by the laboratory to determine the quality of the data in terms of precision, accuracy, and completeness. The procedures used to assess data precision, accuracy, and completeness are described below.

7.3.1 Precision and Accuracy

The assessment procedures in this section are designed to review QC data for the three types of controlled samples: spikes, blanks, and duplicates.

7.3.1.1 SPIKES

The procedure for assessing spikes will be as follows:

1. Tabulate spike sample data and calculate the percent recovery as shown below for each sample:

   $$\text{Percent Recovery} = [(t-x)/a] \times 100\%$$

   where:

   t = total concentration found in the spiked sample,
   x = original concentration in sample prior to spiking, and
   a = actual spike concentration added to the sample

2. Calculate the average and standard deviation of the percent recoveries for each analytical category in the matrix.
3. Identify those samples that exceed the recovery limits stated in Table 3-2.
4. Qualitatively evaluate the significance of data that fall outside the recovery limits. If recovery data fall outside the limits, all related data from that sampling round will be reexamined. Poor data will not be removed from the database, but may result in the qualification of interpretations that rely on those data.

7.3.1.2 BLANKS

The evaluation procedure for blanks will be a qualitative review of the chemical analysis data reported by the laboratory. The procedure for assessing blank samples will be as follows:

1. Tabulate the data from the blank samples. A separate table will be prepared for both field and laboratory blanks.
2. Identify any blanks in which chemicals are detected.
3. If chemicals are not detected in any of the blank samples, their absence will be so stated in the final Phase II RI/FS report.
4. If chemicals are detected in blank samples, the laboratory will be asked to review other recent blank sample results to determine whether or not the finding is an isolated incident. Depending on the significance of the problem, additional blank samples may be submitted to the laboratory to verify that a problem exists and/or to determine that it has been corrected.
5. If any chemicals are found in blank samples, the compound(s) and concentration(s) detected will be reported, and the data for that period will be assessed for potential misinterpretation or high bias. Data will not be removed from the database based on the detection of chemicals in blank samples. Appropriate notations will, however, be made in the appropriate report.

7.3.1.3 DUPLICATES

The procedure for assessing duplicate samples will be as follows:

1. Tabulate spike sample data and calculate the RPD and percent ratio as shown below for each duplicate pair:

   $$RPD = [(x_1 - x_2)/x_1 \times 100\%$$

   where:

   x_1 = concentration of sample 1 of pair,
   x_2 = concentration of sample 2 of pair, and
   x = average of sample 1 and sample 2.

   $$\text{Percent Ratio} = (x_1/x_2) \times 100\%.$$

2. Calculate the average RPD for all duplicate pairs.
3. Calculate the standard deviation of the RPDs using the formula shown below:

   $$\text{Standard deviation(s)} = \{[E(x_1 - x)2]/n\text{-}1\} \; 1/2$$

   where:

   n = number of observed or calculated values,
   x_1 = individual observed or calculated values, and
   x = average of all observed or calculated values.

4. Compare the RPDs with the precision objectives in Section 2 and identify any duplicates that do not meet the precision objectives.
5. Identify any duplicate pairs that have a percent ratio less than 15 percent and compare with samples that do not meet the precision objectives (15 percent is an arbitrary cutoff that provides an independent check on the statistics for the duplicates. RPD data may be distributed in an area worse than the 15-percent cutoff). Data evaluation will focus on the precision objectives unless the 15-percent check indicates that RPD data consistently indicate poor duplicate results.
6. Qualitatively evaluate the significance of data that fall outside the precision objectives. If precision is deemed poor, the laboratory will be notified for appropriate corrective action.

7.3.2 Completeness

The completeness of the data consists of an estimate of the amount of data expected from the field program versus the amount of data actually entered into the database that is available for interpretation. Invalidated data will not be eliminated from the database; however, valid data must constitute 90 percent of the total data collected.

The procedure for assessing completeness will be as follows:

$$\text{Percent Complete (\%C)} = (v/t) \times 100\%$$

where:

v = number of valid measurements, and
t = total number of planned measurements.

7.4 PREVENTATIVE MAINTENANCE

All equipment will receive routine maintenance checks in order to minimize equipment breakdowns in the field and in the laboratories. Any equipment found to be operating improperly will be taken out of use, and a notation stating the time and date of this action will be made in the field logbook. The equipment will be repaired, replaced, or recalibrated, as necessary; the time and date of its return to service will also be recorded. Instrument maintenance logbooks are to be maintained in laboratories at all times.

7.5 CORRECTIVE ACTIONS

If QC audits or review of data result in detection of unacceptable data, samples should be reanalyzed (if holding time criteria permit). Should the requirements not be met following reanalysis, the CTO Leader in concurrence with the Quality Manager, Laboratory Coordinator, and Database Manager will be responsible for developing and initiating corrective action. The Quality Manager will be responsible for assessing whether the selected corrective action is adequate.

Corrective action may include reanalyzing samples (if holding time criteria permit); resampling and analyzing; evaluating and amending established sampling and analytical procedures; or reevaluating DQOs and data validation requirements.

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Section 8
QUALITY ASSURANCE OVERSIGHT

QA oversight will follow CLEAN II Program Procedures for performance, system audits, and corrective action oversight. CLEAN II Program or Navy personnel will evaluate the laboratory Quality Assurance Program and Procedures referencing the NEESA process.

The Quality Control Management Plan for CLEAN II provides the requirements and responsibilities that will be carried out by all CLEAN II personnel and CLEAN II subcontractors to attain the designed level of quality. Personnel are qualified and trained in the work that they are assigned.

8.1 PERFORMANCE AND SYSTEM AUDITS

Audits and surveillances of activities are conducted to assure that work is accomplished by trained personnel using approved procedures. These verification activities are conducted by the Quality Manager, assisted by various technical experts who are not directly responsible for accomplishing the work being reviewed. Audits of field sampling activities, laboratories, and administrative activities will be conducted. Verification activities will be accomplished to evaluate the conduct of such activities as sample location, identification and control, COC protocol, field documentation, and calibration of instruments. Verification activities may be scheduled or unscheduled, and will be conducted commensurate and in coordination with work activities.

8.2 CORRECTIVE ACTIONS

Corrective actions will be identified, tracked, and closed out in a timely manner. Project activities that are found to be in noncompliance with quality requirements and cannot be resolved in the normal course of verification activities will be appropriately documented in accordance with approved procedures. Corrective Action Requests will be used to document noncompliance, corrective action commitments, and resolutions.

Corrective action is not complete until the problem has been solved effectively and permanently. Followup action to assure that the problem remains corrected is an important step in the corrective action process.

8.3 QUALITY ASSURANCE REPORTS TO MANAGEMENT

QA reports will be made to the program management on a monthly basis. These reports will contain a discussion of the current status of the project, including the results of performance and system audits, the results of any data quality assessments, any problems, and methods to resolve these problems. In addition, the data quality evaluation results for the project shall be summarized and reported in the QA section of the Phase II RI/FS report.

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Section 9
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APPENDIX A

LABORATORY ANALYTICAL METHODS

Appendix A
LABORATORY ANALYTICAL METHODS

Appendix A contains brief descriptions of analytical methodologies and instrumentation to be used in the field. The appendix discusses field screening and fixed-base laboratory methods to be used during the Phase II RI/FS. Table A-1 lists the various field screening devices, their target analytes and sensitivity levels.

FIELD SCREENING

Field screening methods will consist of both qualitative and quantitative methods to help characterize site and sample conditions. Qualitative field screening methods will be used to determine the absence or presence of the compounds of concern at a specific site. Qualitative field screening devices will include handheld photoionization detector (PID), flame ionization detector (FID), portable GC, and portable scintillometer. Quantitative field screening methods include immunoassay test kits and mobile or field laboratories which will identify the presence of chemicals of potential concern (COPCs) and the concentrations present in the samples at a specific site. All samples with detectable concentrations and a minimum of 5 percent of nondetects determined by qualitative field screening methods will be submitted to an on-site mobile or field laboratory or an immunoassay test kit for identification and quantification of the COPCs. If a mobile or field laboratory is not equipped to analyze samples for certain analytes, the samples will be submitted to a fixed-base laboratory for analysis by CLP methodology. Mobile or field-based laboratories will be set up at MCAS El Toro during Phase II investigation. It may contain several types of analytical instrumentation for performing VOC, SVOC, petroleum hydrocarbon and metals analyses by the appropriate EPA methods. The analytical instrumentation may include several GCs, a TD-GC/MS, and an IR spectrometer with an inductively coupled argon plasma spectroscopy (ICP). The primary purpose in utilizing these instruments is to determine the presence of, and estimate the extent of contamination by the COPCs. Methodologies and instrumentation are described briefly in this section.

Handheld Photoionization Detector or Flame Ionization Detector

A handheld PID or FID will be used to screen samples (soil and ambient air) to determine potential volatile organics and methane present and potential "hot spots." The detector lamp energy for the PID should be 11.7 electron volt (eV) which allows ionization for almost any VOC. Calibration will be performed and recorded daily using isobutylene as the calibration standard. The handheld PID has an analytical range from as low as 0.1 micrograms per kilogram (µg/kg) to 2,000 µg/kg. The handheld FID will be used to screen for VOCs and methane at contamination levels in the range of 0 to 10,000 mg/kg. Calibration will be performed and recorded daily using methane as the calibration standard.

Table A-1
Field Screening Instruments and Sensitivity Levels

Instrument	Parameters	Applicable U.S. EPA[a] Method	Sensitivity Levels
	Qualitative Field Screening		
Handheld PID[b]	VOCs[c]	N/A[d]	0.1 - 2,000 µg/kg[e] vapor
FID[f]	VOCs, TPH[g] (including methane)	N/A	0 - 10,000 mg/kg[h] vapor
Portable GC[i]			
PID	VOCs	U.S. EPA 3810	< 1.0 - 100 µg/L[j] vapor
ECD[k]	Chlorinated VOCs	N/A	
FID	VOCs, TPH	N/A	
Portable Scintillation Counter	Gross alpha/beta	N/A	
	Quantitative Field Screening		
Immunoassay Kits	PAH[l] - soil		10 - 500 µg/kg[m]
Mobile Laboratory			
GC-PID	aromatic VOCs	U.S. EPA 8020	0.5 - 50 µg/kg
GC-FID	TPH, VOCs	U.S. EPA 8015	10 mg/kg - 10,000 mg/kg
GC-ELCD[n]	chlorinated VOCs	U.S. EPA 8010	0.1 - 50 µg/kg
GC/MS[o]	VOCs	U.S. EPA 8240	5 - 100 µg/kg
	SVOCs	U.S. EPA 8270	5 - 1,000 µg/kg
ICP[p]	metals	U.S. EPA 200 series	0.02 - 100 µg/kg
IR[q]	TRPH[r]	U.S. EPA 418.1	10 - 10,000 mg/kg

Notes:
[a] U.S. EPA – United States Environmental Protection Agency
[b] PID – photoionization detector
[c] VOC – volatile organic compound
[d] N/A – not applicable
[e] µg/kg – micrograms per kilogram
[f] FID – flame ionization detector
[g] TPH – total petroleum hydrocarbons
[h] mg/kg – milligrams per kilogram
[i] GC – gas chromatograph
[j] µg/L – micrograms per liter
[k] ECD – electron capture detector
[l] PAH – polynuclear aromatic hydrocarbons
[m] µg/kg – micrograms per kilogram
[n] ELCD – electrolytic capture detector
[o] MS – mass spectroscopy
[p] ICP – inductively coupled plasma
[q] IR – infrared
[r] TRPH – total recoverable petroleum hydrocarbons

Portable Gas Chromatograph

A portable GC will be used to screen for VOCs and total petroleum hydrocarbon (TPH) in soil, water, or vapor. The portable GC utilizes a PID, an FID, and/or an ECD; it is inexpensive and provides a rapid turnaround time. Use of portable GCs will limit the number of nondetect samples submitted to a fixed-base laboratory for analysis. It operates at ambient temperature, so only gas or vapor samples can be analyzed via the headspace method. The headspace analytical method (U.S. EPA Method 3810) consists of analyzing the vapor headspace above a slurry of organic-free water and a soil sample in a volatile organic analyte (VOA) vial. The vials are then placed in a constant-temperature water bath and allowed to equilibrate for at least 30 minutes. An aliquot will be injected into the portable GC for analysis. A distilled water blank will be analyzed to safeguard against possible contamination during this screening method. All samples with detectable concentration and a minimum of 5 percent of nondetects will be sent to a laboratory for further analyses. Under ideal conditions, the portable GC can detect certain COPCs (i.e. TCE, PCE, TPH) at a range of less than 1 µg/kg to 100 mg/kg depending on the analyte. Ambient temperature variations which may cause a shift in retention times will be minimized by performing the analyses in a semiconstant temperature location.

Metals Field Screening

Metals will be screened in the field using ion-selective electrodes and ICP. Ion-selective electrodes may also be used to screen for specific metals in some aqueous samples. Ion-selective electrodes determine the presence of metals in soluble form. The electrodes used at MCAS El Toro in the Phase II RI/FS will screen for lead, copper, cadmium, and silver. The instrument is similar to the pH meter. A separate reference electrode for each ion of interest will be used to analyze for its presence and a specific analyzing electrode will be used to measure its concentration. The reference electrode will calibrate the meter using a minimum of two concentrations of a particular ion. It is recommended that the reference electrode bracket the expected range of concentration for the metal ion of concern, which will include the PRG level for that ion. If sample concentrations exceed the maximum detection limits, dilutions will be performed. The ion-selective electrode is designed with a pellet at the bottom of the electrode that is sensitive to the ion of interest. For example, the copper electrode has a silver pellet sensitive to the copper ion. A buffer is added to the sample and the standard which complexes all other ions and removes 95 percent of the interferences. The result is a quantifiable screen with +/- 2 percent relative percent difference (RPD) compared to ICP or AA analytical methods. Once the buffer is added to the sample, it is stirred and the probe is then placed in the sample, which gives a reading in micrograms per liter that can be compared to the reference electrode for that metal ion. Confirmation will be performed at a fixed-based laboratory using ICP or AA. Ion-selective electrode instrumentation is limited to screening for four metals; therefore, this method will be used along with an ICP during field screening for certain metals in groundwater and soil/sediment samples.

Inductively Coupled Argon Plasma Spectroscopy (ICP)

An ICP is an argon plasma maintained by the interaction of a radio frequency field and ionized argon gas. The ICP can reach extremely high temperatures (10,000 K) which allow complete atomization of elements while minimizing chemical interference effects. The ICP has the capability to detect metals with concentrations ranging from 0.1 to 100 micrograms per liter (µg/L). Aqueous samples analyzed for metals will be extracted using EPA method 3010A and soils will be extracted using EPA method 3050A.

Portable Scintillometer

A portable scintillometer will be used in the field to screen for gross alpha/gross beta emitting particles using the procedures described in the most recent version of CLEAN II SOP 20, Radiological Soil Screening. Field screening procedures can identify increased levels of radioactivity attributable to radiation sources and are performed with commercially available instrumentation and are generally consistent with standard practices by nuclear decommissioning industry Screening is performed to identify the presource of radioactive material above background in soil samples. The surveyor is responsible for performing measurements to characterize background prior to monitoring samples. The Radiological Engineer/Technical Measurement Specialist (RETMS) is responsible for selecting the appropriate instrumentation, specifying calibration techniques, establishing quality control checkpoints, and reviewing all data and calculations.

A thin window pancake Geiger-Mueller (GM) detector provides gross alpha/gross beta detection capability. The instrument provides a response in count rate and can be field calibrated for a response to a specific isotope. The beta threshold, the beta window, and the alpha threshold are adjustable to optimize alpha/beta efficiency and count separation. Alpha, beta, and gamma particles have different energies, thus making it possible to measure each simultaneously or individually by adjusting the detection levels. All raw measurements in counts per minute (cpm) are converted to rationalized radiological units (i.e. disintegrations per minute per 100 centimeters square, microcuries per milliliter) by use of conversion, calibration or efficiency factors as discussed in SOP 20. Conditions that may affect the efficiency of the system include temperature and pH. Temperature effects are minimum with only a slight drop in efficiency as temperature increases. The pH can affect alpha/beta discrimination; however, gross counting is unaffected by pH.

Infrared Spectrophotometer

U.S. EPA Method 418.1 will be used as a screening method to assess the presence of total recoverable petroleum hydrocarbon (TRPH), including oil and grease. The infrared (IR) spectrophotometer measures the total absorbance of infrared at certain wavelengths by hydrocarbon bonds. The method measures the concentration of petroleum hydrocarbons present in the sample extract without providing speciation in concentrations ranging from 10 to 10,000 mg/kg.. Further analysis can be performed to speciate compounds present in the samples.

Immunoassay Field Tests

The immunoassay field test uses technology similar to medical laboratory immunoassay procedures. The tests use an enzyme immunoassay for semiquantitative field measurements for hydrocarbons, pentachlorophenol, PCBs, and PAHs in soil and water. These immunoassay test methods are designated as U.S. EPA Methods 4030, 4010, 4020, and 4035, respectively. Immunoassay kits can be tailored to target specific analytes or classes of analytes, thus eliminating the need for methods to remove interferences in most cases. The soil sample extract and an enzyme conjugate reagent are added to an immobilized antibody. The enzyme conjugate competes with the target compounds present in the sample for binding to the immobilized antitarget compound antibody. The test is interpreted by comparing the color response produced by testing a sample to the color response of the testing standards. The number of samples randomly selected for confirmation by the fixed-base laboratory are site specific and discussed in detail in Section 3 (Table 3-3). QA/QC procedures, such as method blanks and sample duplicates, have been developed for immunoassay-based analytical methods to enable their application in the field. Method detection limits (MDLs) for PAHs is approximately 10 to 500 micrograms per kilogram (µg/kg). Operators of the immunoassay kits will be trained and certified to perform required analyses.

Thermal Desorption Gas Chromatography/Mass Spectroscopy

TD GC/MS will be used in field mobile laboratories to screen and identify VOCs and semivolatile organic compounds (SVOCs) including PAHs using EPA methods 8240 and 8270. One instrument is dedicated to each class of compounds and complies fully QA/QC to U.S. EPA methodologies. The samples are extracted and analyzed by injecting the extract onto a petri dish with an internal standard. The samples are thermally desorbed by a probe that is linked to a GC containing a 15- to 30-meter column. The sample passes through the column and is separated into individual compounds of a specific chemical family. These aliquots are then introduced to the MS for identification and quantitation. TD GC/MS field screening methods can provide consistent compound identification and quantitative analytical measurements equivalent to fixed-base laboratory results using U.S. EPA/CLP methods. EQLs will be used for each analytical method used. A minimum of 20 percent of the samples collected in the field and analyzed will be submitted to a state- or NFESC-certified laboratory for confirmation which is discussed in Section 3.

FIXED-BASE LABORATORY ANALYSIS

Fixed-base laboratory analysis will be conducted according to NFESC Level D requirements. NFESC Level D requires that U.S. EPA CLP methods be used and that CLP data packages be generated. Laboratory instrumentation and methodologies used to analyze for the suspected and known chemical families at MCAS El Toro are described below. Their respective detection limits are listed in Appendix B (Table B-1).

Organic Compounds

The types of analytical instrumentation used to analyze organic compounds (compounds containing carbons) will include GC, GC/MS, and HPLC. AA and ICP spectrophotometer or colorimetric methods will be used for inorganic compounds. A list of chemicals of potential concern and the U.S. EPA methods associated with each compound as well as the projected analytical sample volume, can be found in Appendix B.

Gas Chromatography. This instrument will be used to analyze volatile compounds that readily vaporize in gas, solid, or liquid phases. The GC separates the injected sample into individual components of a specific chemical family. The methods follow U.S. EPA protocols and are specific to certain chemical families that target the chemicals of potential concern based on the history of each site and on the field-screening data. GC analytical methods to be used in the Phase II RI/FS will include U.S. EPA Methods 8010, 8020, 8015, 8080, and 8150. These methods are described briefly below.

U.S. EPA Method 8010 uses an electrolytic conductivity detector. This analytical method is used to determine the presence of chlorinated solvents in gas, solid, and liquid phases. These chlorinated hydrocarbons comprise a list of compounds that contain chlorine (or other halogens) and are readily vaporizable in nature (e.g., trichloroethene [TCE] and tetrachloroethene [PCE]). U.S. EPA extraction Method 5030A will be performed on each sample prior to analysis.

U.S. EPA Method 8020 uses a PID. This analytical method is used to determine the presence of cyclic organic hydrocarbons in the gas, solid, or liquid phases. These cyclic or aromatic compounds comprise compounds that contain the benzene ring (e.g., toluene and xylenes) and are readily vaporizable in nature. U.S. EPA extraction Method 5030A will be performed on each sample prior to analysis.

U.S. EPA Method 8015 uses a FID. This analytical method is used to determine the presence of petroleum hydrocarbons (e.g., gasoline, diesel, and other fuels) in the gas, solid, and liquid phases. The vaporization time depends on the type of petroleum hydrocarbon. For example, heavier hydrocarbons (e.g., diesel or crude oils) take longer to vaporize and degrade than do lighter hydrocarbons (e.g., gasoline or jet fuels). U.S. EPA Extraction Methods 5030A (for gasoline) and 3540B or 3550A (for diesel) will be performed on each sample prior to analysis. Coupled with this method will be an analysis to determine the presence of organolead compounds using the California Leaking Underground Fuel Tank (LUFT) Field Manual method. The sample with the highest concentration of petroleum hydrocarbons per boring will be submitted to a fixed-based laboratory for this analysis.

U.S. EPA Method 8080 uses a electron capture detector (ECD). This analytical method is used to determine the presence of pesticides and PCBs in the solid and liquid phases. Pesticides (e.g., DDT and heptachlor) contain chlorine or phosphorus and are used for agricultural and forest applications, which contribute to the presence of these toxic materials in the surface water and groundwater, and ultimately in water supplies. PCBs

are stable compounds used widely in commercial industry, primarily associated with electrical applications such as transformers or capacitors. U.S. EPA extraction Method 3510B or 3520B, for solid samples, and U.S. EPA extraction Method 3540B or 3550A for aqueous samples will be performed on each sample prior to analysis.

U.S. EPA Method 8150 uses a FID or an ECD. This analytical method is used to determine the presence of herbicides in the solid or liquid phases. Herbicides (e.g., 2-methyl-4-chlorophenoxyproprionic acid [MCPP] and 2,4,5-TP [Silvex]) are acids or salts used for weed control that contribute to the presence of these toxic compounds in the surface water and groundwater and ultimately in water supplies. U.S. EPA extraction Method 3510B or 3520B, for solid samples, and U.S. EPA extraction Method 3540B or 3550A for aqueous samples will be performed on each sample prior to analysis.

Gas Chromatography-Mass Spectroscopy. This instrument uses the GC to separate the injected sample into individual components, which then pass through an interface to the mass spectrometer. For each compound separated by the GC, the mass spectrometer produces information characteristic for each component found in the sample, including its fragments. The purpose of the mass spectrometer is to ionize the sample molecules and separate them according to the respective masses of the ions. It has the capability to identify an unknown component and its fragments by referring to an extensive library of ions or spectra. U.S. EPA analytical methods used in the Phase II RI/FS will include Methods 8240, 8270, and 8280. These methods are described briefly below.

U.S. EPA Method 8240 is used to determine the presence of VOCs that have a boiling point below 200°C. It is applicable to nearly all types of sample matrices. Such compounds include low-molecular weight hydrocarbons, halogenated or cyclic ketones, nitriles, acetates, ethers, sulfides, and acrylates and their characteristic ions. This method may also be used during field screening in a mobile laboratory with TD GC/MS capabilities. U.S. EPA extraction Method 5030A will be performed on each sample prior to analysis.

U.S. EPA Method 8270 is used to determine the presence of SVOCs including most neutral, acidic, or basic organic compounds and their characteristic ions. Such compounds include chlorinated hydrocarbons, pesticides, phenols, and PAHs. This method may also be used during field screening in a mobile laboratory with TD GC/MS capabilities. U.S. EPA extraction Methods 3510B or 3520B will be performed on aqueous samples and U.S. EPA extraction Methods 3540B or 3550A for soils prior to analysis.

U.S. EPA Method 8280 is used to determine the presence of dioxins and dibenzofurans and their fragments in chemical wastes. These highly toxic and teratogenic compounds can be found in fuel oils, sludge, soil, or other complex waste products. They are usually residual products generated by the manufacturing of other chemicals like Agent Orange. An extraction procedure specific for this method is performed on each sample prior to analysis.

U.S. EPA Method TO-14 is used to determine the presence of not only VOCs but also some selected SVOCs. The method strongly recommends the specific detectors such as GC/MS selected ion monitoring (SIM) for positive identification and primary quantitation to assure high quality ambient data are acquired.

High-Performance Liquid Chromatography. This instrument is similar to GC methodology in nature but uses a liquid as a carrier during the analytical process whereas GC uses a gas. The methods using HPLC include EPA Method 8310 and 8330A which may be used during this Phase II RI/FS. EPA Method 8310 can be used to determine the presence of polyaromatic hydrocarbons at sites with low RBCs specifically in the solid and liquid phases. EPA Method 8330A is used to determine the presence of explosives which will be of concern at some OU-3 sites at MCAS El Toro.

Inorganic Compounds

Total Characteristic Leaching Procedure (TCLP). The soluble threshold leachate concentration (STLC) measurement determines those minerals/metals that are soluble under the Waste Extraction Test (WET) conditions and simulates the leaching process that can occur in a landfill. When those constituents are leached from the soil, they become dissolved (mobilized) by water in this layer. Plant roots are concentrated in the area where the minerals are most readily available. Thus, hazardous constituents are taken up by plant roots and in the groundwater, which then may contaminate other water supplies.

Mineralogical and Grain-Size Analyses. The background concentrations for metals at MCAS El Toro must be established to determine the metals contamination from hazardous waste and naturally occurring metal concentrations. Mineral compositions and grain size analyses will be performed to determine the capacity of the soil to retain metals and to determine if the soil samples used in the background studies are appropriate. Mineralogical analysis will be performed using X-ray diffraction, differential thermal analysis, and petrographic techniques. Grain size will be determined using the standard pipette method to separate minerals in soil samples to fine, medium, and course fractions.

Spectrophotometer and Colorimetric Tests. These procedures are used to determine the presence of inorganic matter such as phosphorus, total Kjeldahl nitrogen, phenolics, and cyanide. Some of the target compounds for the Phase II RI/FS will require speciation because only certain fractions of the compounds are chemicals of potential concern. For example, chromium will require further analysis to determine the presence of trivalent chromium and hexavalent chromium. Hexavalent chromium is the most carcinogenic form of chromium and is the chemical of potential concern. The speciation of chromium and cyanide (metallo versus total) will be required and will be performed by a fixed-based CLP laboratory. The U.S. EPA/CLP analytical methods that analyze for these compounds require the use of various instrumentation such as AA spectrophotometry and ICP for metals. U.S. EPA Extraction Methods 3010A or 3020A will be performed on aqueous samples analyzed by ICP or AA and U.S. EPA Method 3050A for soils.

Bioassay Analyses

Assessing the ecological risk at MCAS El Toro will be necessary to determine the toxicity of on-site soils, sediments, and surface waters using standard bioassay (toxicity) tests including:

- earthworm bioassay,
- seed germination and root elongation bioassay,
- amphibian bioassay (FETAX),
- and bacterial luminescence bioassay (MICROTOX).

Earthworms are appropriate for the assessment of toxicity (lethal and sub-lethal) uptake of contaminants at sites because they:

- ingest soil mineral compounds,
- occupy the lower levels of many terrestrial food chains,
- are important in recycling nutrients,
- have wide dispersal, and
- have a close relationship with other biomass.

The uptake of metals, such as, lead, zinc, cadmium, copper and nickel, has been demonstrated in earthworms. One of the primary purposes of the test is to assess the biological availability of the contaminants in the soil at the site with as much precision and accuracy as possible. Control worms will be utilized for QA/QC with ten worms per control group.

Plant toxicity test methods, seed germination and root elongation, estimates the acute toxicity of aqueous hazardous wastes and hazardous waste elutriates to lettuce seedlings. The objectives in using phytotoxicity bioassays are as follows:

- to define the effects contaminant uptake on plant development compared to the soil concentration,
- evaluating toxic chemicals, and
- characterize the spatial distribution of selected contaminants such as metals.

Analytical controls are used to evaluate QA/QC during testing for seed performance.

Amphibian bioassay evaluates the amphibian response to site contaminants. The Frog Embryo Teratogenesis Assay (FETAX) uses the African-clawed frog (*Xenopus laevis*) to determine the effects of contaminants on early life stages (e.g., the development stage).

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APPENDIX B

PROJECT-REQUIRED DETECTION LIMITS BY METHOD AND THE PRELIMINARY REMEDIATION GOALS FOR THE COPCS

Table B-1
Project Required Detection Limits by Methods[a]

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	Proposed Detection Limit water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m^{3}[e])	Tap Water (µg/L)
TPH[f]	**DHS[g]-TPH (CA LUFT[h])**	**8015M-A**	10,000	500				
Methane	**TPH**	**8015**	NL[i]	NL	NL	NL	NL	NL
TRPH[j]	**IR[k]**	**418.1**	10,000	500				
BTEX[l]	**GC[m]**	**8020A**	**MDLs[n]**					
Benzene			50	0.5	1.4	3.2	0.23	0.39
Toluene			50	0.5	1,900	2,700	400	720
Ethylbenzene			50	0.5	2,900	3,100	1,100	1,300
Xylene			50	0.5	980	980	730	1,400
HVOCs[o]	**GC**	**8010B**	**CLP[p] EQLs[q]**					
Benzyl chloride			0.1	0.1	1.4	3.9	0.04	0.066
Bromodichloromethane			0.2	0.2	1.4	3.4	0.11	0.18
Bromoform			2.0	2.0	56	240	1.7	8.5
Bromomethane			3.0	3.0	15	57	52	87
Carbon tetrachloride			0.1	0.1	0.47	1.1	0.13	0.17
Chlorobenzene			0.1	0.1	160	570	21	39
Chloroethane			1.0	1.0	1,100	220	10,000	710
2-Chloroethyl vinyl ether			1.3	1.3	NL	NL	NL	NL

(table continues)

Table B-1 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	Proposed Detection Limit water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m^3[e])	Tap Water (µg/L)
HVOCs[o] (continued)	**GC**	**8010B**	**CLP[p] EQLs[q]**					
Chloroform			0.2	0.2	0.53	1.1	0.084	0.16
Chloromethane			0.3	0.3	2.0	4.3	1.1	1.5
Dibromochloromethane			0.3	0.3	5.3	23	0.08	1.0
Dibromomethane			22	22	650	6,800	37	370
Dichlorodifluoromethane (Freon 12)			0.5	0.5	110	350	210	390
1,1-Dichloroethane			0.7	0.7	840	3,900	520	810
1,2-Dichloroethane			0.3	0.3	0.44	0.98	0.074	0.12
1,1-Dichloroethene			0.7	0.7	.038	0.082	0.038	0.046
cis-1,2-Dichloroethene			0.1	0.1	59	200	37	61
trans-1,2-Dichloroethene			1.0	1.0	170	600	730	120
1,2-Dichloropropane			0.4	0.4	0.68	1.5	0.099	0.16
trans-1,3-Dichloropropene			3.4	3.4	0.51	1.2	0.052	0.081
Methylene chloride			0.2	0.2	11	25	4.1	4.3
1,1,1,2-Tetrachloroethane			0.05	0.05	4.8	12	0.26	0.43
1,1,2,2-Tetrachloroethane			0.1	0.1	0.90	2.4	0.033	0.055
Tetrachloroethene			0.3	0.3	7.0	25	3.3	1.1
1,1,1-Trichloroethane			0.3	0.3	3,200	3,000	1,000	1,300
1,1,2-Trichloroethane			0.2	0.2	1.4	3.3	0.12	0.20

(table continues)

Table B-1 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	Proposed Detection Limit water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m^{3}[e])	Tap Water (µg/L)
HVOCs[o] (continued)	**GC**	**8010B**	**CLP[o] EQLs[p]**					
Trichloroethene			0.2	0.2	7.1	17	1.1	1.6
Trichlorofluoromethane (Freon 11)			0.3	0.3	710	2,400	730	1,300
Trichlorotrifluoromethane (Freon 113)			50[r]	0.5[r]	3,600	3,600	31,000	59,000
Vinyl chloride			0.2	0.2	0.0052	0.011	0.022	0.02
VOCs[s]	**GC/MS[t]**	**8240B**	**CLP EQLs**					
Acetone			100	100	2,000	8,400	370	610
Acetonitrile			100	100	390	4,100	52	220
Acrolein (Propanol)			NL	NL	1,300	12,000	0.021	730
Acrylonitrile			NL	NL	0.13	0.30	0.028	3.7
Allyl alcohol			NL	NL	330	3,400	18	180
Allyl chloride			5	5	3,300	34,000	1.0	1,800
Benzyl chloride			100	100	1.45	3.9	0.04	0.066
Bromoacetone			NL	NL	NL	NL	NL	NL
Bromoform			5	5	56	240	1.7	8.5
Bromomethane			10	10	15	57	52	87
2-Butanone (Methyl ethyl ketone)			100	100	8,700	34,000	1,000	1,900
Carbon disulfide			100	100	16	52	10	21
Chlorobenzene			5	5	160	570	21	39

(table continues)

Table B-1 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	Proposed Detection Limit water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m[3e])	Tap Water (µg/L)
VOCs[a] (continued)	**GC/MS[t]**	**8240B**	**CLP EQLs**					
Chloroethane			10	10	1,100	2,200	10,000	710
2-Chloroethyl vinyl ether			10	10	NL	NL	NL	NL
Chloromethane			10	10	2.0	4.3	1.1	1.5
Chloroprene			5	5	6.3	21	7.3	14
1,2-Dibromo-3-chloropropane			100	100	0.06[u]	1.4	0.00096[u]	0.0048[u]
Dibromomethane			5	5	650	6,800	37	370
1,2-Dibromoethane			5	5	0.0051	0.021	0.0087	0.00076
1,4-Dichloro-2-butene			5	5	0.0076	0.018	0.00072	0.0012
Dichlorodifluoromethane			5	5	110	350	210	390
1,1-Dichloroethane			5	5	840	3,900	520	810
cis-1,2-Dichloroethene			5	5	59	200	37	61
trans-1,2-Dichloroethene			5	5	170	600	73	120
1,3-Dichloropropene			5	5	0.51	1.2	.052	0.081
1,4-Dioxane			NL	NL	14	37	0.61	1.0
Epichlorohydrin			NL	NL	8.6	30	1.0	2.0
Ethylbenzene			5	5	2,900	3,100	1,100	1,300
Ethylene oxide			NL	NL	0.12	0.30	0.19	0.024
Ethyl methacrylate			5	5	340	340	330	550

(table continues)

Table B-1 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	Proposed Detection Limit water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m^3[e])	Tap Water (µg/L)
VOCs[a]	**GC/MS[f]**	**8240B**	**CLP EQLs**					
2-Hexanone			50	50	5,200	55,000	83	2,900
2-Hydroxypropionitrile			NL	NL	20,000	100,000	1,100	11,000
Malononitrile			NL	NL	1.3	14	0.073	0.73
Methacrylonitrile			100	100	1.3	5.1	0.73	1.0
Methylene chloride			5	5	11	25	4.1	43
Methyl methacrylate			5	50	520	55,000	290	2,900
4-Methyl-2-pentanone			50	50	5,200	55,000	8.3	2,900
Propargyl alcohol			NL	NL	130	1,400	7.3	73
Propionitrile			100	100	NL	NL	NL	NL
Pyridine			NL	NL	65	680	3.7	37
Styrene			5	5	2,200	2,200	1,100	1,600
Toluene			5	5	1,900	2,700	400	720
1,1,1-Trichloroethane			5	5	3,200	3,000	1,000	1,300
Trichlorofluoromethane (Freon 11)			10[f]	10[f]	710	2,400	730	1,300
Trichlorotrifluoromethane (Freon 113)			10[f]	10[f]	3,600	3,600	31,000	59,000
1,2,3-Trichloropropane			5	5	0.0066	0.015	0.00096	31
Vinyl chloride			50	50	0.0052	0.011	0.022	0.02
Xylene(s)			5	5	980	980	730	1,400

(table continues)

Table B-1 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	Proposed Detection Limit water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m^{3}[e])	Tap Water (µg/L)
Pesticides/PCBs[v,w]	**GC**	**8080A**	**PQLs[x]**					
Aldrin			2.68	0.04	0.026	0.11	0.00039	0.0040
Alpha BHC			2.01	0.03	NL	NL	NL	NL
Chlordane			40[r]	1[r]	0.34	1.5	0.0052	0.052
4',4'-DDD			7.37	0.11	1.9	7.9	0.028	0.28
4',4'-DDE			2.68	0.04	1.3	5.6	0.020	0.20
4',4'-DDT			8.04	0.12	1.3	5.6	0.020	0.20
Delta BHC			6.03	0.09	NL	NL	NL	NL
Dieldrin			1.34	0.02	0.028	0.12	0.00042	0.042
Endosulfan			9.38	0.14	3.3	34	0.18	1.8
Endosulfan sulfate			44.2	0.66	NL	NL	NL	NL
Endrin			4.02	0.06	20	200	1.1	11
Endrin aldehyde			15.4	0.23	NL	NL	NL	NL
Endrin ketone			3.3[r]	0.1[r]	NL	NL	NL	NL
Heptachlor			2.01	0.03	0.099	0.42	0.0015	0.015
Heptachlor epoxide			55.6	0.83	0.049	0.21	0.00074	0.0074
Lindane (gamma BHC)			2.68	0.04	NL	NL	NL	NL
Methoxychlor			117.9	1.76	330	3400	18	180
PCB 1016			13[r]	1[r]	4.9	65	0.26	2.6

(table continues)

Table B-1 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	Proposed Detection Limit water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m^3[e])	Tap Water (µg/L)
Pesticides/PCBs[v,w] (continued)	**GC**	**8080A**	**PQLs[x]**					
PCB 1221			13[r]	2[r]	0.066	0.34	0.00087	0.0087
PCB 1232			13[r]	1[r]	0.066	0.34	0.00087	0.0087
PCB 1242			43.6	0.65	0.066	0.34	0.00087	0.0087
PCB 1248			13[r]	1[r]	0.066	0.34	0.00087	0.0087
PCB 1254			13[r]	1[r]	1.4	19	0.073	0.73
PCB 1260			13[r]	1[r]	0.066	0.34	0.00087	0.0087
Polyaromatic Hydrocarbons	**HPLC[y]**	**8310**	**PQLs**					
Acenaphthene			1,206	18	360	360	220	370
Acenaphthylene			1,540	23	NL	NL	NL	NL
Anthracene			140	2.1	19	19	1,100	1,800
Benzo(a)anthracene			10	0.15	0.61	2.6	0.0092	0.092
Benzo(a)pyrene			15	0.23	0.061	0.26	0.00092	0.0015[u]
Benzo(b)fluoranthene			12	0.18	0.61	2.6	0.0092	0.092
Benzo(g,h,i)perylene			50	0.76	NL	NL	NL	NL
Benzo(k)fluoranthene			11	0.17	0.61[u]	26	0.092	0.92
Chrysene			100	1.5	6.1[u]	24	0.92	9.2
Dibenzo(a,h)anthracene			20	0.30	0.061	0.26	0.00092	0.0092
Fluoranthene			140	2.1	2,600	27,000	150	1,500

(table continues)

Table B-1 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	Proposed Detection Limit water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m^3[e])	Tap Water (µg/L)
Polyaromatic Hydrocarbons (continued)	**HPLC**	**8310**	**PQLs**					
Fluorene			140	2.1	30	300	150	240
Indeno(1,2,3-cd)pyrene			29	0.43	0.61	2.6	0.0092	0.092
Naphthalene			1,206	18	800	800	150	240
Phenanthrene			429	6.4	NL	NL	NL	NL
Pyrene			180	2.7	2,000	20,000	110	1,100
SVOCs[z]	**GC/MS**	**8270B**	**CLP EQLs**					
Benzyl butyl phthalate			660	10	13,000	100,000	730	7,300
Bis(2-ethylhexyl) phthalate			660	10	32	140	0.48	4.8
Carbazole			NL	NL	22	95	0.34	3.4
2-Chlorophenol			660	10	330	3,400	18	180
4-Chloro-3-methyl phenol			1,300	20	NL	NL	NL	NL
Dibenzofuran			660	10	260	2,700	15	150
Diethyl phthalate			660	10	52,000	100,000	2,900	29,000
Dimethyl phthalate			660	10	100,000	100,000	37,000	370,000
Di-*n*-butyl phthalate			NL	10	6,500	68,000	370	3,700
Di-*n*-octyl phthalate			660	10	1,300	14,000	73	730
Hexachloroethane			660	10	32	140	0.48	4.8

(table continues)

Table B-1 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	Proposed Detection Limit water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m^3[e])	Tap Water (µg/L)
SVOCs[z] (continued)	**GC/MS**	**8270B**	**CLP EQLs**					
Isophorone			660	10	470	2,000	7.1	71
2-Methyl naphthalene			660	10	NL	NL	NL	NL
4-Methyl phenol			660	10	330	3,400	18	180
2-nitrophenol			660	10	NL	NL	NL	NL
4-nitrophenol			3,300	50	NL	NL	NL	NL
n-Nitrosodipropylamine			660	10	630	0.27	0.00096	0.0096
Pentachlorophenol			3,300	50	2.5	7.9	0.056	0.56
Phenol			660	10	39,000	100,000	2,200	22,000
Herbicides[w]	**GC**	**8150B**	**CLP EQLs**					
2,4-D			240	12	650	6,800	37	370
2,4-DB			182	9.1	520	5,500	29	2,990
Dalapon			1,160	58	2,000	20,000	110	1,100
Dicamba			54	2.7	2,000	20,000	110	1,100
Dichloroprop			130	6.5	NL	NL	NL	NL
Dinoseb			14	0.7	65	680	3.7	37
MCPA			49,800	200[r]	33	340	1.8	18
MCPP			38,400	200[r]	65	680	3.7	37

(table continues)

Table B-1 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	Proposed Detection Limit water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m[3e])	Tap Water (µg/L)
Herbicides[w] (continued)	**GC**	**8150B**	**CLP EQLs**					
2,4,5-trichlorophenoxy acetic acid			40	2.0	650	6,800	37	370
2,4,5-trichlorophenoxy propionic acid (Silvex)			34	1.7	520	5,500	29	290
Dioxin	**GC/MS**	**8280**	**CLP EQLs (soil)**					
Octochlorodibenzo-p-dioxins			0.002[r]		0.00072	0.00031	0.0000015	0.000011
Radionuclides	**Scintillation counter**	**703**						
Gross alpha			NL		NL	NL	NL	NL
Gross beta			NL		NL	NL	NL	NL
Explosives	**HPLC (GC/MS)**	**8330A**	**CLP EQLs (soil)**					
HMX			2,200		3,300	34,000	180	1,800
RDX			1,000		4.0	17	0.061	0.61
1,3,5-TNB			250		3.3	34	0.18	1.8
1,3-DNB			250		6.5	68	0.37	3.7
Tertyl			650		650	6,800	37	370
Nitrobenzene			260		33	340	2.1	18
2,4,6-Trinitrotoluene			250		48	64	0.22	2.2
4-Amino-4,6-dinitrotoluene			NL		NL	NL	NL	NL
2-Amino-4,6-dinitrotoluene			NL		NL	NL	NL	NL

(table continues)

Table B-1 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	Proposed Detection Limit water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m^3[e])	Tap Water (µg/L)
Explosives (continued)	**HPLC (GC/MS)**	**8330A**	**CLP EQLs (soil)**					
2,4-Dinitrotoluene			260		130	1,400	7.3	73
2,6-Dinitrotoluene			250		65	680	3.7	37
2-Nitrotoluene			250		NL	NL	NL	NL
3-Nitrotoluene			250		650	6,800	37	370
4-Nitrotoluene			250		650	6,800	37	370
INORGANICS			**CLP CRDLs[aa]/EDLs[bb]**					
Total Cyanide/metallo	Colorimetric	9010/335	NL	10	1,300	14,000	NL	730
Nitrate-Nitrite	Colorimetric	353.2	NL	10	100,000/6,500	100,000	NL	58,000/3,700
Phosphorus	Colorimetric	365.2	51	10	NL	NL	0.073	NL
Sulfate	Colorimetric	375.4	5	5	NL	NL	NL	NL
General Chemistry								
TKN	Segmented flow analyzer	351.2	NL	10.0[r]				
TDS	Balance	160.1	NL	5,000[r]				
TOC	—	415.1	0.5%[r]	500[r]				
BOD	—	405.1	NL	4,000[r]				
COD	Filtration	410.4	NL	5,000[r]				
Total phenolics	Segmented flow analyzer	420.1	500[r]	10[r]				

(table continues)

Table B-1 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	Proposed Detection Limit water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m^3[e])	Tap Water (µg/L)
TAL[cc] Metals[w]								
Aluminum	ICP[dd]	200.7	45	45	77,000	100,000	NL	37,000
Antimony	ICP-MS[ee]	200.8	32	0.02[f]	31	680	NL	15
Arsenic	ICP-MS	200.8	53	0.1[f]	0.32	2.0	0.00045	0.038
Barium	ICP	200.7	2	2	5,300	100,000	0.52	2,600
Beryllium	ICP-MS	200.8	0.3	0.02[f]	0.14	1.1	0.00080	0.016
Cadmium	ICP	200.7	4	4	9.0[u]	850	0.0011	18
Chromium, Hexavalent	GFAA[ff]	7196	200	20	0.20[u]	230	0.000023	0.16[u]
Chromium	ICP	200.7	7	7	210	1,600	0.00016	NL
Cobalt	ICP	200.7	7	7	NL	NL	1.0	NL
Copper	ICP	200.7	6	6	2,800	63,000	NL	1,400
Organic lead	GFAA	DHS method	50	50	NL	NL	NL	NL
Lead	GFAA	200.9	42	3	130[u]	1,000	NL	4.0
Manganese	ICP	200.7	2	2	380	8,300	0.051	180
Mercury	CVAA[gg]	200 Series	0.2	0.2	23	510	0.31	11
Nickel	ICP	200.7	15	40	150[u]	34,000	NL	730
Selenium	HAA[hh]	6010/200 Series	75	5	380	8,500	NL	180
Silver	ICP	200.7	7	7	380	8,500	NL	180
Thallium	ICP-MS	200.8	40	0.03[f]	6.1	140	NL	2.9
Vanadium	ICP	200.7	8	8	540	12,000	NL	260
Zinc	ICP	200.7	2	2	23,000	100,000	NL	11,000

(table continues)

Table B-1 (continued)

Notes:

[a] the compound list provided under each method does not reflect the complete method compound list, only the compounds of potential concern at MCAS El Toro
[b] µg/kg – micrograms per kilogram
[c] µg/L – micrograms per liter
[d] mg/kg – milligrams per kilogram
[e] $\mu g/m^3$ – micrograms per cubic meter
[f] TPH – total petroleum hydrocarbons
[g] DHS – Department of Health Services - U.S. Environmental Protection Agency (U.S. EPA) SW-846 Test Methods for Evaluating Solid Waste
[h] LUFT – California Leaking Underground Fuel Tank Field Manual, November 1989
[i] NL – not listed
[j] TRPH – total recoverable petroleum hydrocarbons
[k] IR – infrared spectroscopy
[l] BTEX – benzene, toluene, ethylbenzene, and xylenes
[m] GC – gas chromatography
[n] MDLs – method detection limits using purge and trap method (U.S. EPA Method 5030)
[o] HVOCs – halogenated volatile organic compounds
[p] CLP – Contract Laboratory Procedure
[q] EQLs – estimated quantitation limits
[r] CLEAN II contract laboratory QA Manual method reporting limits
[s] VOCs – volatile organic compounds
[t] GC/MS – gas chromatography/mass spectroscopy
[u] California-modified Preliminary Remediation Goal (PEA 1994)
[v] PCBs – polychorinated biphenyls
[w] Background detection limits proposed are based on risk-based concentrations and background concentration
[x] PQLs – practical quantitation limits
[y] HPLC – high-performance liquid chromatography
[z] SVOCs – semivolatile organic compounds
[aa] CRDLs – contract-required detection limits
[bb] EDLs – estimated detection limits
[cc] TAL – target analyte list
[dd] ICP – inductively coupled plasma spectroscopy
[ee] ICP-MS – inductively coupled plasma spectroscopy-mass spectrometry
[ff] GFAA – graphite furnace atomic absorption
[gg] CVAA – cold vapor atomic absorption spectroscopy
[hh] HAA – hydride atomic absorption spectroscopy

APPENDIX C

REQUIREMENTS FOR ACTIVE SOIL GAS INVESTIGATION

STATE OF CALIFORNIA
California Regional Water Quality Control Board
Los Angeles Region

REQUIREMENTS FOR ACTIVE SOIL GAS INVESTIGATION
Well Investigation Program
(March 1994)

Volatile organic compounds (VOCs) within the unsaturated zone partition into the adsorbed, dissolved, free liquid, and vapor phases. Measurement of VOCs through an active soil gas investigation allows: 1) evaluation of whether waste discharges of VOCs have occurred which may impact groundwater, 2) determination of spatial pattern and extent of vapor phase soil contamination, 3) establishment of vapor distribution for the design of soil vapor extraction system (SVE), and 4) determination of the efficiency of reduction in threat to groundwater from any cleanup action, including SVE. The work plan should include, but not be limited to, the following:

1.0 SURVEY DESIGN (LOCATION, NUMBER, DEPTH, DATA QUALITY OBJECTIVES)

1.1
Provide a scaled facility map depicting potential sources and proposed sampling points. Include locations and coordinates of identifiable geographic landmarks (e.g., street center-line, benchmark, street intersection, wells, north arrow, property line).

1.2
Locate initial sampling points in potential sources and areas with known soil contamination using an adjustable 10 to 20 foot grid pattern. Provide rationale for the number, location and depth of sampling points. Screen the remainder of the site with a 100-foot or less grid pattern.

1.3
Conduct a close interval (10 to 20 foot grid pattern) and multi-level sampling (5 to 10 feet vertically between points) in areas with known soil contamination and relatively high VOC concentrations.

1.4
Employ an on-site mobile laboratory with laboratory-grade certifiable instrumentation and procedures for real-time analysis of individual VOCs. Non-specific portable organic vapor analyzers and/or GC-based handheld detectors may not be used for analysis (during SVE they may be used for daily or weekly vapor monitoring).

1.5
Maintain flexibility in the sampling plan such that field modifications (grid pattern density, location and depth) can be made as real-time evaluation of analytical test results occurs. Include in the work plan decision-making criteria for these adjustments and explain decisions in the report. Field decisions shall be made in consultation with Regional Board staff.

1.6
Re-sample at any sampling point if anomalous data (i.e., 2 to 3 orders of magnitude difference from surrounding samples) are obtained. Additional points may be required to resolve the spatial distribution of the contaminants within the interval in question.

2.0 SAMPLE COLLECTION

2.1
Obtain samples at an adequate depth (nominally 5 feet) below ground surface (bgs) to minimize potential dilution by ambient air.

2.2
Conduct a site-specific purge volume versus contaminant concentration test at the start of the survey. Conduct this test based on soil type and where VOC levels are suspected to be highest. Adjust the purge rate and time to achieve the optimal purge volume. Discuss specific methods to determine optimal purge rates and volumes. In general, minimize purging to ensure that samples are representative of VOC concentrations at the probe tip. Note that the optimum purge volume may be compound specific. Therefore, it must be selected, in some cases, based on one target compound.

2.3
Explain expected zone of influence for sample points, taking into consideration soil types, land cover, drive point construction and sample purge rate/time/volume. The vertical zone of influence for purging and sampling must not intersect the ground surface.

2.4
Discuss soil gas sample collection, handling and testing procedures. Discuss procedures to prevent collection of samples under partial vacuum.

2.5
Discuss procedures to minimize equipment cross-contamination between sampling points.

2.6
Specify that the sampling equipment (e.g., gas tight syringe, sorbent trap) will not compromise the integrity of the samples. Tedlar bags may only be used for qualitative analysis.

2.7
Assure that the probe tip, probe and probe connectors have the same diameter to provide a good seal between the formation and the sampling assembly. If a space develops between the probe and the formation, as a result of probe advancement, seal (e.g., with bentonite) the area around the probe at the surface to minimize the potential for ambient air intrusion.

2.8
Some sampling systems utilize the probe as a conduit for Teflon tubing that connects to the probe tip. Assure that ambient air in the annular space between the probe and tubing is not in contact with the probe tip.

3.0 LABORATORY ANALYSIS OF SOIL GAS SAMPLES

3.1 TARGET COMPOUNDS

1. Carbon tetrachloride
2. Chloroethane
3. Chloroform
4. 1,1-Dichloroethane
5. 1,2-Dichloroethane
6. 1,1-Dichloroethene
7. cis-1,2-Dichloroethene
8. trans-1,2-Dichloroethene
9. Dichloromethane (methylene chloride)
10. Tetrachloroethene
11. 1,1,1,2-Tetrachloroethane
12. 1,1,2,2-Tetrachloroethane
13. 1,1,1-Trichloroethane
14. 1,1,2-Trichloroethane
15. Trichloroethene
16. Vinyl chloride
17. Benzene
18. Toluene
19. Ethylbenzene
20. Xylenes
21. Trichlorofluoromethane (Freon 11)
22. Dichlorodifluoromethane (Freon 12)
23. 1,1,2-Trichloro-trifluoroethane (Freon 113)

3.2 OTHER TARGET COMPOUNDS

Analysis of other VOCs (e.g., methyl ethyl ketone, methyl isobutyl ketone, ethylene dibromide, petroleum hydrocarbons, etc.) may be required based upon site history and conditions.

3.3 DETECTION LIMIT (DL)

Attain DL of not more than 1 μg/L for all target compounds. Higher DL is acceptable only for the compound(s) whose concentration exceeds the initial calibration range.

3.4 DETECTORS

The following detectors may be used in appropriate combinations:

Electrolytic conductivity detector (ELCD) (e.g., Hall)
Photoionization detector (PID)
Flame ionization detector (FID)
Mass spectrometer (MS)
Electron capture detector (ECD)

3.5.0 IDENTIFICATION OF CALIBRATION STANDARDS & LABORATORY CONTROL SAMPLE (LCS)

3.5.1

All calibration standards and LCS must be properly and clearly identified. The identification must agree with the data on record for the standards & LCS.

3.5.2

Prepare LCS from a second source standard that is totally independent from calibration standards used for the initial calibration. Second source means a different supplier (whenever possible) or a different lot from the same supplier.

3.6.0 GC CONDITIONS

3.6.1
Use a type of column that can separate all the target compounds. No coelution of the target compounds is acceptable unless the compounds can be distinguished and quantified by two different types of detectors in use at that time.

3.6.2
Analyze the initial calibration and daily mid-point calibration check standards, LCS, blank, and samples using the same GC conditions (i.e., detector, temperature program, etc.).

3.6.3
The GC run time must be long enough to identify and quantify all the target compounds.

3.7.0 INITIAL CALIBRATION

3.7.1
Perform an initial calibration:

1. for all 23 compounds listed in Section 3.1;
2. when the GC column type is changed;
3. when the GC operating conditions have changed;
4. when the daily mid-point calibration check cannot meet the requirement in Section 3.8.3; and
5. when specified by Regional Board staff based on the scope and nature of the investigation.

3.7.2
The initial calibration must consist of at least three different concentrations of the standard, with the lowest one not exceeding 5 times the DL for each compound.

3.7.3
Calculate the response factor (RF) for each compound and calibration concentration prior to analyzing any site samples. Calculate the average RF for each compound. The percent relative standard deviation (%RSD) for each target compound must not exceed 20% except for the following compounds which must not exceed 30%:

Trichlorofluoromethane (Freon 11)
Dichlorodifluoromethane (Freon 12)
Trichlorotrifluoromethane (Freon 113)
Chloroethane
Vinyl chloride

3.7.4
Verify the true concentration of the standard solutions used with the LCS after each initial calibration. Conduct the verification using a LCS with a mid-point concentration within the initial calibration range. The LCS must include all the target compounds and the RF must be within ±15% difference from the initial calibration.

3.8.0 DAILY MID-POINT CALIBRATION CHECK

3.8.1
Check the calibration using the calibration standard solution with a mid-point concentration within the linear range of the initial calibration before any sample is analyzed.

3.8.2
The daily mid-point check must include the following compounds and **every** compound expected or detected at the site:

1.	1-Dichloroethane	5.	trans-1,2-Dichloroethene	9.	Trichloroethene
2.	1,2-Dichloroethane	6.	Tetrachloroethene	10.	Benzene
3.	1,1-Dichloroethene	7.	1,1,1-Trichloroethane	11.	Toluene
4.	cis-1,2-Dichloroethene	8.	1,1,2-Trichloroethane	12.	Xylenes

3.8.3
The RF of each compound (except for freons 11, 12 and 113, chloroethane, and vinyl chloride) must be within 85% to 115% of the average RF from the initial calibration. The RF for freons 11, 12 and 113, chloroethane, and vinyl chloride must be within 75% to 125%.

3.9.0 BLANK

3.9.1
Analyze field blank(s) to detect any possible interference from ambient air.

3.9.2
Investigate and determine the source(s) and resolve any laboratory contamination problem prior to analyzing any samples if the blank shows a measurable amount (≥1 μg/L) of the target compound(s).

3.10.0 SAMPLE ANALYSIS

3.10.1
The requirements for initial calibration, daily mid-point check, blank, and LCS must be met before any site samples are analyzed.

3.10.2
Analyze samples within 30 minutes after they are collected to minimize VOC loss. Longer holding time may be allowed if the laboratory uses a special sampling equipment (e.g., sorbent trap, glass bulb) and demonstrates that the holding time can exceed 30 minutes with no decrease in results.

3.10.3
The concentrations of constituent(s) in a sample must not exceed 50% above the highest concentration in the calibration range. Reanalyze the sample using a smaller volume or dilution if 50% above the highest concentration in the calibration range is exceeded.

3.10.4
Attain DL of not more than 1 μg/L for all target compounds. If lesser sample volumes or dilutions a used to off-set possible high concentration of constituents in the initial run, the initial run must be used to calculate the results for constituents that are not affected by the high concentration so that DL of 1 μg/L for these compounds can be achieved.

3.10.5
Quantify sample results using the average RF from the most recent initial calibration.

3.10.6
Add surrogate compounds to all samples if GC/MS is not used for analysis or compound confirmation.

3.11.0 COMPOUND CONFIRMATION

3.11.1
Conduct compound confirmation by GC/MS or surrogate compounds and second column.

3.11.2
If MS is used for analysis, identification must be done through mass spectrum and retention time comparison. Surrogate analysis and second column confirmation are not mandatory.

3.11.3
If surrogate compounds are used, they must be added to all calibration and daily mid-point check standards, blanks, site samples, and samples for second column confirmation to calculate the relative retention time (RRT) for monitoring the retention time shift between GC runs. This is recommended better compound identification when ELCD, PID, ECD, and FID are used for analysis. Two to three different surrogate compounds should be used to cover the different temperature programming range for each GC run.

3.11.4
Surrogate compound concentration must be within the initial calibration range.

3.11.5
Use a surrogate in second column confirmation. Usually one sample is adequate and quantitation is not required. Second column confirmation can be done with a different GC. The representative sample can be collected in Tedlar bag and confirmation can be done off site.

3.11.6
Second column confirmation is not necessary if the compounds present have been identified from confirmed from previous soil gas investigations.

3.12.0 SAMPLES WITH HIGH CONCENTRATION

3.12.1
DL may be raised above 1 μg/L for compounds with high results (i.e., the limit as specified in Section 3.10.3) and those closely eluting compounds for which quantitation may be interfered by the high concentrations.

3.12.2
Quantify sample results according to Section 3.10.4 for analytes which are not affected by the high concentration compounds.

3.12.3
If high concentration in an area is known from previous soil gas analysis, Sections 3.12.1 and 3.12.2 are not necessary when analyzing samples from the area in question.

3.12.4
When dilution with ambient air is used for samples with high results, at least one sample must be diluted and analyzed in duplicate each day to verify the dilution procedure. Ambient air should be checked periodically during each day of analysis.

3.13.0 SHORTENED ANALYSIS TIME

3.13.1
Shorten the GC run time under the following conditions only:

1. The exact number and identification of compounds are known from previous soil and soil gas investigations; and
2. The consultant has been given permission by Regional Board staff to analyze only for specific compounds.

3.13.2
Meet the following requirements when shortening GC run-time:

1. The shortened run time must be approved by Regional Board staff;
2. The compounds must not coelute;
3. Initial calibration, daily mid-point calibration check, LCS, and samples must be analyzed under the same conditions as the shorter GC run-time;
4. Quantitations must be done using the average RF from the initial calibration utilizing the shorter run-time; and
5. A normal run-time must be performed whenever peaks are detected within retention time windows where coelution, as indicated by the calibration chromatograms, is likely.

3.14.0 LAST GC TEST RUN PER DAY OF ANALYSIS

3.14.1
Analyze a LCS as the last GC run of the day. Include the same compounds used in the daily mid-point calibration check analysis, as listed in Section 3.8.2. The RF for each compound must be within 80% to 120% of the average RF from the initial calibration. If the RF is not within these limits, all test results generated from the same day will be considered questionable and may be rejected by this Regional Board.

3.14.2
Analyze a LCS at the detection limit concentration instead of the mid-point concentration if all samples from same day of analysis show non-detect (ND) results. The recovery for each compound must be at least 50%. If it is less than 50%, all the ND results of the samples become questionable.

3.15.0 ON-SITE EVALUATION CHECK SAMPLE

3.15.1
Analyze on-site the evaluation check sample as part of the QA/QC procedures when presented with such a check sample by Regional Board staff. Provide preliminary results on-site.

3.15.2
If the results show that the soil gas consultant has problems with the analysis, all the results generated during the same day may be rejected. Correct all problems before any more samples are analyzed.

3.16.0 SITE INSPECTION

3.16.1
Unannounced, on-site inspection by Regional Board staff is routine. During the inspection, hard copies of the complete laboratory data, including raw data for initial calibration, daily mid-point check, LCS and blank results must be provided upon request. Failure to allow such inspection or to present these records or field data may result in rejection of all sample results.

3.16.2
The soil gas consultant must understand the instruments, analytical and QA/QC procedures and must be capable of responding to reasonable inquiries.

3.17.0 RECORDKEEPING IN THE MOBILE LABORATORY

Maintain the following records in the mobile laboratory:

1.. A hard copy record of calibration standards and LCS with the following information:

a) Date of receipt
b) Name of supplier
c) Lot number
d) Date of preparation for intermediate standards (dilution from the stock or concentrated solution from supplier)
e) ID number or other identification data
f) Name of person who performed the dilutio:
g) Volume of concentrated solution taken for dilution
h) Final volume after dilution
i) Calculated concentration after dilution

2. A hard copy of each initial calibration for each instrument used for the past few months.

3. The laboratory standard operating procedures.

4.0 REPORTING OF SOIL GAS SAMPLE RESULTS AND QA/QC DATA

4.1
Report all sample test results and QA/QC data. Include in the table of sample results all compounds in the analyte list. Report unidentified or tentatively identified peaks. All raw data including the chromatograms must be submitted upon request.

APPENDIX A

SOIL GAS INITIAL CALIBRATION

SITE NAME: _____ LAB NAME: _____ DATE: _____

ANALYST: _____ STD LOT ID NO.: _____ INSTRUMENT ID: _____

NORMAL INJECTION VOLUME: _____ INJECTION TIME: _____

COMPOUND	DETECTOR	1st CONC RT/RRT	1st CONC MASS/CONC	1st CONC AREA	1st CONC RF	2nd CONC RT/RRT	2nd CONC MASS/CONC	2nd CONC AREA	2nd CONC RF	3rd CONC RT/RRT	3rd CONC MASS/CONC	3rd CONC AREA	3rd CONC RF	RF_{ave}	SD_{n-1}	%RSD	ACC RGE

OR

COMPOUND	DETECTOR	RT/RRT	MASS/CONC	AREA	RF	RF_{ave}	SD_{n-1}	%RSD	ACC RGE
Compound 1		_____	1st conc	_____	_____				
		_____	2nd conc	_____	_____				
		_____	3rd conc	_____	_____				
Compound 2 (Surrogate)									

SOIL GAS DAILY MID-POINT CALIBRATION STANDARD

AND

SOIL GAS LABORATORY CONTROL SAMPLES (LCS)

SITE NAME: _____ LAB NAME: _____ DATE: _____

ANALYST: _____ STD LOT ID NO.: _____ INSTRUMENT ID: _____

NORMAL INJECTION VOLUME: _____ INJECTION TIME: _____

COMPOUND (SURROGATE)	DETECTOR	RT/RRT	MASS/CONC	AREA	RF	%DIFF	ACC RGE

SOIL GAS SAMPLE RESULTS

SITE NAME: _____ LAB NAME: _____ DATE: _____

ANALYST: _____ COLLECTOR: _____ INSTRUMENT ID: _____

NORMAL INJECTION VOLUME: _____

Sample ID	Sample 1	Sample 2	Sample 3 ....
Sampling Depth			
Purge Volume			
Vacuum			
Sampling Time			
Injection Time			
Injection Volume			
Dilution Factor			

COMPOUND	DETECTOR	RT	AREA	CONC	RT	AREA	CONC	RT	AREA	CONC
Compound 1										
Compound 2										
Compound 3										
.										
.										
.										
.										
.										
Surrogate 1										
Surrogate 2										

Total Number of Peaks
by Detector 1 (specify)
by Detector 2 (specify)

Unidentified peaks and/or other analytical remarks

ALTERNATIVE FORMAT FOR REPORTING SOIL GAS SAMPLE RESULTS

SITE NAME: _____ LAB NAME: _____ DATE: _____

Sample ID Sampling Depth	Sample 1	Sample 2	Sample 3 ...
COMPOUND	CONC	CONC	CONC
Compound 1			
Compound 2			
Compound 3			
.			
.			
.			
.			
.			
.			

(Page 1 of 2, Results Summary)

SITE NAME: _____ LAB NAME: _____ DATE: _____

ANALYST: _____ COLLECTOR: _____ INSTRUMENT ID: _____

NORMAL INJECTION VOLUME: _____

Sample ID	Sample 1		Sample 2		Sample 3 ...	
Sampling Depth						
Purge Volume						
Vacuum						
Sampling Time						
Injection Time						
Injection Volume						
Dilution Factor						
COMPOUND DETECTOR	RT	AREA	RT	AREA	RT	AREA
Compound 1						
Compound 2						
Compound 3						
.						
.						
.						
Surrogate 1						
Surrogate 2						
.						
.						
Total Number of Peaks						
by Detector 1 (specify)						
by Detector 2 (specify)						

Unidentified peaks and/or other analytical remarks

(Page 2 of 2, Analytical Raw Data)

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD - L.A. REGION
QA/QC CHECK LIST FOR SOIL GAS SAMPLE ANALYSIS

Date: _____ By: _____

Name of soil gas company: _____

Name of site: _____

Each step should be answered with "Yes" except for the first two items in No. 8 below. Any "No" answer indicates some problems and the laboratory must correct any problems before proceeding.

1. Initial Calibration

Date calibration standards received _____

Supplier _____ Lot No. _____

Date or ID _____
(of prepared working calibration standards)

Perform 3 point initial calibration Yes No

Date performed _____

Keep a copy of initial calibration in the mobile laboratory Yes No

Include all 23 target compounds. Yes No

The lowest concentration for each compound is not more than 5 ug/L Yes No

%RSD for each compound is not more than 20% Yes No

%RSD for Freons, Chloroethane and Vinyl Chloride (VC) are not more than 30% Yes No

2. Laboratory Control Sample (LCS)

Date LCS received _____

Supplier _____ Lot No. _____

LCS is from different source Yes No

Date or ID _____
(of prepared working LCS solution)

Perform LCS analysis after initial calibration Yes No

Date performed _____

QA/QC CHECK LIST FOR SOIL GAS SAMPLE ANALYSIS (Page 2)

Include all 23 target compounds	Yes	No
RF for each compound is within 15% difference from the average RF of initial calibration	Yes	No
RFs for Freons, Chloroethane, and VC are not more than 25%	Yes	No
Keep a copy of this LCS check in the mobile lab	Yes	No

3. Daily Mid-point Calibration Check

If initial calibration is performed on the day of sample analysis, skip the steps in No.3.		
Perform a daily mid-point calibration check	Yes	No
Include all required 12 compounds	Yes	No
RF of each compound is within ±15% difference from the average RF of initial calibration	Yes	No
RFs for Freons, Chloroethane, and VC are not more than 25%	Yes	No

4. Blank

Perform a method blank each day on site before analyzing any sample (No peak detected)	Yes	No

5. Sample Analysis

Collected samples analyzed within 30 minutes	Yes	No
Reanalyze samples (dilution) when sample concentration exceeds 50% above the highest concentration in the initial calibration range	Yes	No
Attain DL of not more than 1 ug/L	Yes	No
Quantify sample results using the average RF from the most recent initial calibration	Yes	No
If dilution is used, perform a duplicate analysis on one sample per day	Yes	No

6. Shortened Analysis Time

If shortened run time is not to be used, skip the steps in No.6.		
Approved by Regional Board staff	Yes	No

Perform a separate initial calibration using the same shortened run-time as sample	Yes	No
Pass this initial calibration by the same requirements as the initial calibration in No. 1	Yes	No
If this initial calibration is done on a previous date, a mid-point calibration check is performed on the day samples are analyzed with shortened run-time and pass the requirements in No. 3	Yes	No
The sample results are quantified using the average RF from the shortened time initial calibration	Yes	No

7. Last GC Analysis Per Day of Analysis

Perform a LCS each day as the last run	Yes	No
RF for each compound is within 80-120 % of the average RF of initial calibration	Yes	No
RFs for Freons, Chloroethane and VC are within 70-130% of the average RF of initial calibration	Yes	No
If all samples from same day show ND results		
(a) LCS is analyzed at DL concentration (1 ug/L)	Yes	No
(b) Recovery for each compound is at least 0.5ug/L	Yes	No

8. Confirmation of Compound Identification

Use GC/MS for analysis (if yes, stop)	Yes	No
Use GC/MS for confirmation (if yes, stop)	Yes	No
Use 2nd column confirmation for identification	Yes	No
Use surrogate in calibration standards, LCS, blank, samples	Yes	No

Remarks:

STATE OF CALIFORNIA
California Regional Water Quality Control Board
Los Angeles Region

REQUIREMENTS FOR ACTIVE SOIL GAS INVESTIGATION
Well Investigation Program
(March 1994)

Volatile organic compounds (VOCs) within the unsaturated zone partition into the adsorbed, dissolved, free liquid, and vapor phases. Measurement of VOCs through an active soil gas investigation allows: 1) evaluation of whether waste discharges of VOCs have occurred which may impact groundwater, 2) determination of spatial pattern and extent of vapor phase soil contamination, 3) establishment of vapor distribution for the design of soil vapor extraction system (SVE), and 4) determination of the efficiency of reduction in threat to groundwater from any cleanup action, including SVE. The work plan should include, but not be limited to, the following:

1.0 SURVEY DESIGN (LOCATION, NUMBER, DEPTH, DATA QUALITY OBJECTIVES)

1.1
Provide a scaled facility map depicting potential sources and proposed sampling points. Include locations and coordinates of identifiable geographic landmarks (e.g., street center-line, benchmark, street intersection, wells, north arrow, property line).

1.2
Locate initial sampling points in potential sources and areas with known soil contamination using an adjustable 10 to 20 foot grid pattern. Provide rationale for the number, location and depth of sampling points. Screen the remainder of the site with a 100-foot or less grid pattern.

1.3
Conduct a close interval (10 to 20 foot grid pattern) and multi-level sampling (5 to 10 feet vertically between points) in areas with known soil contamination and relatively high VOC concentrations.

1.4
Employ an on-site mobile laboratory with laboratory-grade certifiable instrumentation and procedures for real-time analysis of individual VOCs. Non-specific portable organic vapor analyzers and/or GC-based handheld detectors may not be used for analysis (during SVE they may be used for daily or weekly vapor monitoring).

1.5
Maintain flexibility in the sampling plan such that field modifications (grid pattern density, location and depth) can be made as real-time evaluation of analytical test results occurs. Include in the work plan decision-making criteria for these adjustments and explain decisions in the report. Field decisions shall be made in consultation with Regional Board staff.

3.0 LABORATORY ANALYSIS OF SOIL GAS SAMPLES

3.1 TARGET COMPOUNDS

1. Carbon tetrachloride
2. Chloroethane
3. Chloroform
4. 1,1-Dichloroethane
5. 1,2-Dichloroethane
6. 1,1-Dichloroethene
7. cis-1,2-Dichloroethene
8. trans-1,2-Dichloroethene
9. Dichloromethane (methylene chloride)
10. Tetrachloroethene
11. 1,1,1,2-Tetrachloroethane
12. 1,1,2,2-Tetrachloroethane
13. 1,1,1-Trichloroethane
14. 1,1,2-Trichloroethane
15. Trichloroethene
16. Vinyl chloride
17. Benzene
18. Toluene
19. Ethylbenzene
20. Xylenes
21. Trichlorofluoromethane (Freon 11)
22. Dichlorodifluoromethane (Freon 12)
23. 1,1,2-Trichloro-trifluoroethane (Freon 113)

3.2 OTHER TARGET COMPOUNDS

Analysis of other VOCs (e.g., methyl ethyl ketone, methyl isobutyl ketone, ethylene dibromide, petroleum hydrocarbons, etc.) may be required based upon site history and conditions.

3.3 DETECTION LIMIT (DL)

Attain DL of not more than 1 $\mu g/L$ for all target compounds. Higher DL is acceptable only for the compound(s) whose concentration exceeds the initial calibration range.

3.4 DETECTORS

The following detectors may be used in appropriate combinations:

Electrolytic conductivity detector (ELCD) (e.g., Hall)
Photoionization detector (PID)
Flame ionization detector (FID)
Mass spectrometer (MS)
Electron capture detector (ECD)

3.5.0 IDENTIFICATION OF CALIBRATION STANDARDS & LABORATORY CONTROL SAMPLE (LCS)

3.5.1

All calibration standards and LCS must be properly and clearly identified. The identification must agree with the data on record for the standards & LCS.

3.5.2

Prepare LCS from a second source standard that is totally independent from calibration standards used for the initial calibration. Second source means a different supplier (whenever possible) or a different lot from the same supplier.

3.8.0 DAILY MID-POINT CALIBRATION CHECK

3.8.1
Check the calibration using the calibration standard solution with a mid-point concentration within the linear range of the initial calibration before any sample is analyzed.

3.8.2
The daily mid-point check must include the following compounds and **every** compound expected or detected at the site:

1.	1-Dichloroethane	5.	trans-1,2-Dichloroethene	9.	Trichloroethene
2.	1,2-Dichloroethane	6.	Tetrachloroethene	10.	Benzene
3.	1,1-Dichloroethene	7.	1,1,1-Trichloroethane	11.	Toluene
4.	cis-1,2-Dichloroethene	8.	1,1,2-Trichloroethane	12.	Xylenes

3.8.3
The RF of each compound (except for freons 11, 12 and 113, chloroethane, and vinyl chloride) must be within 85% to 115% of the average RF from the initial calibration. The RF for freons 11, 12 and 113, chloroethane, and vinyl chloride must be within 75% to 125%.

3.9.0 BLANK

3.9.1
Analyze field blank(s) to detect any possible interference from ambient air.

3.9.2
Investigate and determine the source(s) and resolve any laboratory contamination problem prior to analyzing any samples if the blank shows a measurable amount (≥1 μg/L) of the target compound(s).

3.10.0 SAMPLE ANALYSIS

3.10.1
The requirements for initial calibration, daily mid-point check, blank, and LCS must be met before any site samples are analyzed.

3.10.2
Analyze samples within 30 minutes after they are collected to minimize VOC loss. Longer holding time may be allowed if the laboratory uses a special sampling equipment (e.g., sorbent trap, glass bulb) and demonstrates that the holding time can exceed 30 minutes with no decrease in results.

3.10.3
The concentrations of constituent(s) in a sample must not exceed 50% above the highest concentration in the calibration range. Reanalyze the sample using a smaller volume or dilution if 50% above the highest concentration in the calibration range is exceeded.

3.12.2
Quantify sample results according to Section 3.10.4 for analytes which are not affected by the hig concentration compounds.

3.12.3
If high concentration in an area is known from previous soil gas analysis, Sections 3.12.1 and 3.12.2 are not necessary when analyzing samples from the area in question.

3.12.4
When dilution with ambient air is used for samples with high results, at least one sample must be diluted and analyzed in duplicate each day to verify the dilution procedure. Ambient air should be checked periodically during each day of analysis.

3.13.0 SHORTENED ANALYSIS TIME

3.13.1
Shorten the GC run time under the following conditions only:

1. The exact number and identification of compounds are known from previous soil and soil gas investigations; and
2. The consultant has been given permission by Regional Board staff to analyze only for specific compounds.

3.13.2
Meet the following requirements when shortening GC run-time:

1. The shortened run time must be approved by Regional Board staff;
2. The compounds must not coelute;
3. Initial calibration, daily mid-point calibration check, LCS, and samples must be analyzed under the same conditions as the shorter GC run-time;
4. Quantitations must be done using " average RF from the initial calibra utilizing the shorter run-time; and
5. A normal run-time must be performed whenever peaks are detected within retention time windows where coelution, as indicated by the calibration chromatograms, is likely.

3.14.0 LAST GC TEST RUN PER DAY OF ANALYSIS

3.14.1
Analyze a LCS as the last GC run of the day. Include the same compounds used in the daily mid-point calibration check analysis, as listed in Section 3.8.2. The RF for each compound must be within 80% to 120% of the average RF from the initial calibration. If the RF is not within these limits, all test results generated from the same day will be considered questionable and may be rejected by this Regional Board.

3.14.2
Analyze a LCS at the detection limit concentration instead of the mid-point concentration if all samples from same day of analysis show non-detect (ND) results. The recovery for each compound must be at least 50%. If it is less than 50%, all the ND results of the samples become questionable.

SOIL GAS INITIAL CALIBRATION

SITE NAME: _____ LAB NAME: _____ DATE: _____

ANALYST: _____ STD LOT ID NO.: _____ INSTRUMENT ID: _____

NORMAL INJECTION VOLUME: _____ INJECTION TIME: _____

COMPOUND	DETECTOR	1st CONC RT/RRT	1st CONC MASS/CONC	1st CONC AREA	1st CONC RF	2nd CONC RT/RRT	2nd CONC MASS/CONC	2nd CONC AREA	2nd CONC RF	3rd CONC RT/RRT	3rd CONC MASS/CONC	3rd CONC AREA	3rd CONC RF	RF_{ave}	SD_{n-1}	%RSD	ACC RGE

OR

COMPOUND	DETECTOR	RT/RRT	MASS/CONC	AREA	RF	RF_{ave}	SD_{n-1}	%RSD	ACC RGE
Compound 1		_____	1st conc	_____	_____				
		_____	2nd conc	_____	_____				
		_____	3rd conc	_____	_____				
Compound 2 (Surrogate)									

SOIL GAS DAILY MID-POINT CALIBRATION STANDARD

AND

SOIL GAS LABORATORY CONTROL SAMPLES (LCS)

SITE NAME: _____ LAB NAME: _____ DATE: _____

ANALYST: _____ STD LOT ID NO.: _____ INSTRUMENT ID: _____

NORMAL INJECTION VOLUME: _____ INJECTION TIME: _____

COMPOUND (SURROGATE)	DETECTOR	RT/RRT	MASS/CONC	AREA	RF	%DIFF	ACC RGE

ALTERNATIVE FORMAT FOR REPORTING SOIL GAS SAMPLE RESULTS

SITE NAME: _____ LAB NAME: _____ DATE: _____

Sample ID Sampling Depth	Sample 1	Sample 2	Sample 3 ...
COMPOUND	CONC	CONC	CONC
Compound 1			
Compound 2			
Compound 3			
.			
.			
.			
.			
.			
.			

(Page 1 of 2, Results Summary)

SITE NAME: _____ LAB NAME: _____ DATE: _____

ANALYST: _____ COLLECTOR: _____ INSTRUMENT ID: _____

NORMAL INJECTION VOLUME: _____

Sample ID	Sample 1		Sample 2		Sample 3 ...	
Sampling Depth						
Purge Volume						
Vacuum						
Sampling Time						
Injection Time						
Injection Volume						
Dilution Factor						
COMPOUND DETECTOR	RT	AREA	RT	AREA	RT	AREA
Compound 1						
Compound 2						
Compound 3						
.						
.						
.						
Surrogate 1						
Surrogate 2						
.						
.						
Total Number of Peaks						
by Detector 1 (specify)						
by Detector 2 (specify)						

Unidentified peaks and/or other analytical remarks

(Page 2 of 2, Analytical Raw Data)

APPENDIX A

SOIL GAS INITIAL CALIBRATION

SITE NAME: _____ LAB NAME: _____ DATE: _____

ANALYST: _____ STD LOT ID NO.: _____ INSTRUMENT ID: _____

NORMAL INJECTION VOLUME: _____ INJECTION TIME: _____

COMPOUND	DETECTOR	1st CONC				2nd CONC				3rd CONC				RF_{ave}	SD_{n-1}	%RSD	ACC RGE
		RT/RRT	MASS/CONC	AREA	RF	RT/RRT	MASS/CONC	AREA	RF	RT/RRT	MASS/CONC	AREA	RF				

OR

COMPOUND	DETECTOR	RT/RRT	MASS/CONC	AREA	RF	RF_{ave}	SD_{n-1}	%RSD	ACC RGE
Compound 1		_____	1st conc	_____	_____				
		_____	2nd conc	_____	_____				
		_____	3rd conc	_____	_____				
Compound 2 (Surrogate)									

SOIL GAS DAILY MID-POINT CALIBRATION STANDARD

AND

SOIL GAS LABORATORY CONTROL SAMPLES (LCS)

SITE NAME: _____ LAB NAME: _____ DATE: _____

ANALYST: _____ STD LOT ID NO.: _____ INSTRUMENT ID: _____

NORMAL INJECTION VOLUME: _____ INJECTION TIME: _____

COMPOUND (SURROGATE)	DETECTOR	RT/RRT	MASS/CONC	AREA	RF	%DIFF	ACC RGE

SOIL GAS SAMPLE RESULTS

SITE NAME: _____ LAB NAME: _____ DATE: _____

ANALYST: _____ COLLECTOR: _____ INSTRUMENT ID: _____

NORMAL INJECTION VOLUME: _____

Sample ID	Sample 1	Sample 2	Sample 3 .....
Sampling Depth			
Purge Volume			
Vacuum			
Sampling Time			
Injection Time			
Injection Volume			
Dilution Factor			

COMPOUND	DETECTOR	RT	AREA	CONC	RT	AREA	CONC	RT	AREA	CONC
Compound 1										
Compound 2										
Compound 3										
.										
.										
.										
.										
.										
Surrogate 1										
Surrogate 2										

Total Number of Peaks
by Detector 1 (specify)
by Detector 2 (specify)

Unidentified peaks and/or other analytical remarks: