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Prepared for

DEPARTMENT OF THE NAVY
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FINAL
QUALITY ASSURANCE PROJECT PLAN ADDENDUM

SOIL GAS INVESTIGATION OF INSTALLATION RESTORATION SITE 12 AREAS OF CONCERN

NAVAL STATION TREASURE ISLAND
SAN FRANCISCO, CALIFORNIA

June 2, 2000

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QUALITY ASSURANCE PROJECT PLAN
ADDITIONAL INVESTIGATION
INSTALLATION RESTORATION SITE 12

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ACRONYMS AND ABBREVIATIONS

ASTM	American Society of Testing and Materials
CLEAN II	Comprehensive Long-term Environmental Action Navy, Contract No. N62474-94-D-7609
COC	Chain of custody
CTO	Contract task order
DQO	Data quality objective
EPA	U.S. Environmental Protection Agency
FID	Flame ionization detector
FSP	Field sampling plan
GC	Gas chromatograph
GCMS	Gas chromatograph/mass spectroscopy
L	Liter
LCS	Laboratory control sample
$\mu g/m^3$	Micrograms per cubic meter
NAVSTA TI	Naval Station Treasure Island
PARCC	Precision, accuracy, representativeness, completeness, and comparability
PRC	PRC Environmental Management, Inc.
PRG	Preliminary remediation goal
QA	Quality assurance
QAPP	Quality assurance project plan
QC	Quality control
RL	Reporting limit
RPD	Relative percent difference
SCD	Sulfur chemiluminescence detector
Site 12 QAPP	Quality Assurance Project Plan for Installation Restoration Program Site 12 Additional Characterization
SWDIV	Southwest Division, Naval Facilities Engineering Command
TCD	Thermal conductivity detector
TCL	Target compound list
TIC	Tentatively identified compound
TtEMI	Tetra Tech EM Inc.
VOC	Volatile organic compound

A1 INTRODUCTION

Tetra Tech EM Inc. (TtEMI), formerly known as PRC Environmental Management, Inc. (PRC), received Contract Task Order (CTO) 369 under Comprehensive Long-term Environmental Action Navy Contract No. N62474-94-D-7609 (CLEAN II) from the Department of the Navy (Navy), Naval Facilities Engineering Command, Engineering Field Activity West. The CTO entails additional site characterization within Installation Restoration Site 12 (Site 12) at Naval Station Treasure Island (NAVSTA TI), San Francisco, California.

The Navy and the regulatory agencies have determined that data gaps for soil gas exist at the Site 12 debris disposal areas. Historical information indicates that the debris was placed before the period covered by the gas monitoring and control requirements of the California Integrated Waste Management Board's Title 27, Article 6, regulations. Health and safely monitoring performed during the previous field work indicates the potential for methane in the debris at Site 12. In support of the remedial investigation (RI) for NAVSTA TI, the Navy will perform a soil gas investigation to determine if landfill gases are being generated at Site 12. The Navy will review the results of the landfill gas investigation and discuss the findings with the regulatory agencies to determine if an action is necessary based on current state law requirements under Title 27. This quality assurance project plan (QAPP) addendum was prepared in support of this investigation as an addendum to the "Quality Assurance Project Plan for Installation Restoration Program Site 12 Additional Characterization" that was approved by SWDIV on April 14, 2000 (Site 12 QAPP).

The Site 12 QAPP documents policies, project organization, and quality assurance and quality control (QA/QC) measures to be implemented for field activities at Site 12. This QAPP addendum addresses matters not discussed in the Site 12 QAPP. The accompanying field sampling plan (FSP) fully describes the project data quality objectives (DQO), which have been developed through the seven-step DQO process (U.S. Environmental Protection Agency [EPA] 1994, 1999).

A1.1 DOCUMENT REQUIREMENTS AND FORMAT

This QAPP addendum is based on Requirements for Quality Assurance Project Plans, EPA QA/R-5 (EPA 1999). EPA QA/R-5 states that the requirements for QAPPs include (1) evaluating DQOs for the project, (2) ensuring that intended measurements and data to be acquired are appropriate, (3) ensuring that

QA/QC procedures are adequate for confirming data quality, and (4) identifying limitations on the use of the data. The following table provides a summary of the elements contained in this QAPP addendum.

QUALITY ASSURANCE PROJECT PLAN ELEMENTS
SITE 12 ADDITIONAL CHARACTERIZATION

A. Project Management	
Element/Content	**Report Section**
A1 Title and approval sheet	Not applicable
A2 Table of contents	Not applicable
A3 Distribution list	Not applicable
A4 Project/task organization	A2
A5 Problem definition/background	A3
A6 Project/task description	A4
A7 Quality objectives and criteria for measuring data	A5
A8 Special training and certification	A2.3
A9 Documentation and records	A6
B. Measurement/Data Acquisition	
Element/Content	**Report Section**
B1 Sampling process design (experimental design)	B2
B2 Sampling methods	B3
B3 Sample handling and custody	B4
B4 Analytical methods	B5
B5 Quality control	B6
B6 Instrument/equipment testing, inspection, and maintenance	B7
B7 Instrument calibration and frequency	B7
B8 Inspection/acceptance of supplies and consumables	B8
B9 Non-direct measurements	B9
B10 Data management	B9
C. Assessment/Oversight	
Element/Content	**Report Section**
C1 Assessments and response actions	C1
C2 Reports to management	C1.3
D. Data validation and usability	
Element/Content	**Report Section**
D1 Data review, validation, and verification	D1.1
D2 Validation and verification methods	D1.2
D3 Reconciliation with user requirements	D2

A1.2 USAGE OF THE DOCUMENT

Each QAPP addendum element is discussed in this document as it pertains to the soil gas investigation at Site 12. The QAPP addendum provides specific guidance and QA/QC criteria for collecting, evaluating, and submitting data while completing this project. All personnel working on the project are required to read and comply with the procedures defined in this document to ensure the quality and usability of the data collected.

A1.3 BACKGROUND

This QAPP addendum amends the "Quality Assurance Project Plan for Installation Restoration Program Site 12 Additional Characterization" that was approved by SWDIV on April 14, 2000 (Site 12 QAPP).

The background and history of TI and Site 12 are discussed in detail in the accompanying FSP and the Site 12 QAPP (TtEMI 2000).

A1.4 DATA QUALITY OBJECTIVES

In support of these sampling efforts, the DQO process, as presented in the following section, has been completed. The steps of the DQO process are presented in the accompanying FSP. Specific DQOs for the soil gas sampling effort are presented in the accompanying FSP. A summary of the DQOs for the soil gas sampling effort is presented in Appendix 1.

DQOs are qualitative and quantitative statements developed through the seven-step DQO process (EPA 1994, 1999). The primary outputs from this iterative methodology are definition of the problem under investigation (Step 1); identification of the decisions that require inputs and resolution (Step 2); identification of those inputs (Step 3); delineation of the study boundaries (Step 4); development of decision rules (Step 5); specification of tolerable limits on errors (Step 6); and optimization of the sampling design (Step 7).

A2 PROJECT AND TASK ORGANIZATION

The project and task organization is described in detail in the Site 12 QAPP (TtEMI 2000).

A2.4 PROJECT SCHEDULE

The implementation schedules for sampling, analysis, and associated reporting are presented in the accompanying FSP.

A3 SITE BACKGROUND AND PROBLEM DEFINITION

The purpose of the work defined in this study is to evaluate whether methane and other volatile organic compounds (VOC) are present at the former debris disposal and other targeted areas within Site 12. Data obtained during the soil gas survey will be used to evaluate whether the vapor concentrations are within limits that are protective of human health and the environment, and to aid in further identifying methane and/or VOC source areas at the site.

Previous investigations at Site 12 have detected methane or other (VOC) concentrations in soil gas samples collected at the site. The soil gas sampling probe locations proposed for this investigation were chosen to provide a grid over known debris disposal areas and to further define VOC concentrations where they were previously detected.

A4 PROJECT AND TASK DESCRIPTION

The following paragraphs summarize the objectives of and the tasks necessary to complete the soil gas investigation at Site 12. The primary objectives, types of data to be collected, data quality standards and criteria, and project documentation are discussed in the following sections. The DQO steps are presented in the accompanying FSP. A summary of the DQO steps is provided in Appendix 1.

A4.1 PROJECT OBJECTIVES

The overall project objective is to evaluate whether methane and other VOCs are present at the former debris disposal and other targeted areas within Site 12. The overall project objective is to determine whether debris that may be present at Site 12 poses a human health risk. Specific project objectives, as related to resolution of specific study questions, are detailed in the accompanying FSP.

A4.2 PROJECT MEASUREMENTS

Analytical methods were selected to provide data of necessary quality to meet the DQOs for this project and to maintain consistency and comparability of the data with previous data. The data collected will also be compared against EPA preliminary remediation goals (PRG) for ambient air.

A4.3 PROJECT QUALITY STANDARDS AND CRITERIA

To promote quality of, and consistency in, data acquisition and evaluation during this project, all project activities will be completed in accordance with the Site 12 QAPP, this QAPP addendum, and the accompanying FSP. This document describes the technical and quality objectives for the project, the intended data collection methods that are appropriate for achieving project objectives, the assessment procedures adequate for confirming that data of the type and quality needed and expected are obtained, and any identified limitations on the use of these data.

Analytical data generated during this project will undergo validation and verification to ensure defensible and acceptable quality. Data validation and usability are further discussed in Section D1 of the Site 12 QAPP (TtEMI 2000). An independent third-party contractor will validate data in accordance with Southwest Division, Naval Facilities Engineering Command (SWDIV) Environmental Work Instruction 4EN.1 (SWDIV 1999). At a minimum, 10 percent of the analytical data will be randomly selected and fully validated. All remaining analytical data will undergo cursory validation.

The assessment tools needed to verify that data quality is maintained throughout the study activities include QC reviews on project documents such as technical, editorial, and QC coordinator reviews; performance and system audits; and laboratory QA/QC procedures. Project audits are further described in Section C1.1 of the Site 12 QAPP. Laboratory QA/QC procedures are addressed in Section B6 of this QAPP addendum.

A4.4 PROJECT DOCUMENTATION

Field documentation and records maintenance are described fully in the Site 12 QAPP. Additional information on sample and location nomenclature is provided in the accompanying FSP. Sample documentation, such as sample labels, chain-of-custody (COC) procedures, and packaging and shipping, are discussed in Section B4 of the Site 12 QAPP.

A4.4.1 Field Forms

In addition to the fields forms listed in the Site 12 QAPP, a data sheet for soil gas sampling form will be used. This form is presented in Appendix 2 and will be used as a source document in support of the TI database.

A5 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Specific quality objectives and criteria for measurement data as they apply to this project are discussed in the following sections.

A5.1 PROJECT SCOPE AND ENVIRONMENTAL MEDIA

As noted in the FSP, samples may be analyzed for any or all of the following analytes: VOCs, fixed gases, and sulfur compounds. The analytical suite is presented in the FSP.

A5.2 INTENDED DATA USERS AND USES

Data users include stakeholders, such as the regulatory agencies, the Navy, subcontractors to the Navy, and the public. Definitive data, as outlined in Section A5.3 of the Site 12 QAPP, will be required to allow for comparison to PRGs for ambient air.

A5.3 DATA TYPE AND QUANTITY

The data obtained from laboratory analysis can best be categorized as definitive. Definitive data are described in detail in the Section A5.3 of the Site 12 QAPP.

A5.4 ACCEPTABLE LEVEL OF CONFIDENCE IN THE DATA

Determining acceptable limits on decision errors (DQO Step 6) will limit the uncertainty in the data set obtained from this project. Step 6 of the DQO process quantifies the acceptable limits on decision errors.

These limits are needed to define the uncertainty that will be acceptable to all stakeholders (such as regulatory agencies, citizens, and site owners).

The quality of the analytical data will be assessed in terms of precision, accuracy, representativeness, completeness, and comparability (PARCC), as detailed in Section A5.5 of this QAPP addendum. Additionally, professional judgment will be used to assess the practical versus statistical significance of the data collected (EPA 1998). Decision errors based on sample design, and data interpretation will be minimized through multiple internal and external reviews of project data and conclusions. Validation and verification of data generated during field activities are essential to obtaining data of defensible and acceptable quality. Verification methods for field and laboratory activities are presented in Section D of the Site 12 QAPP. Results of the data validation will play a major role in accepting or rejecting data.

A5.5 SPECIFYING PERFORMANCE CRITERIA: PARCC PARAMETERS

All analytical results will be assessed according to the PARCC parameters described in the Site 12 QAPP, as amended below.

A5.5.1 Precision

Precision is the degree of mutual agreement between individual measurements of the same property under prescribed similar conditions. Data precision is affected by field sampling precision and laboratory analytical precision. It is evaluated by collecting and analyzing field duplicates at a frequency of 10 percent. Laboratory analytical precision is evaluated by analyzing sample duplicates at a rate of 5 percent of the total samples collected. The results of the duplicate analysis are used to calculate the relative percent difference used for evaluating precision.

A5.5.2 Accuracy

Accuracy is the degree of agreement between an analytical measurement and a reference accepted as a true value. The accuracy of a measurement system is affected by errors introduced through the sampling process by field contamination, sample collection, and sample handling. Other factors that may affect accuracy are sample matrix, sample preparation, and analytical techniques. The analytical laboratory will conduct a program of sample spiking to evaluate laboratory accuracy in the TO-14 analysis for VOCs.

This program includes analysis of laboratory control spikes (LCS), surrogate standards, internal standards, and method blanks. LCSs are analyzed at a frequency of 5 percent, and surrogate standards and internal standards are added to every sample analyzed. Accuracy for landfill gases and sulfur compounds is monitored through the use of continuing calibration standards.

A5.6 DETECTION AND QUANTITATION LIMTS

Samples will be reported as estimated values if concentrations are less than the laboratory reporting limit (RL) but greater than the method detection limit.

A6 DOCUMENTATION AND RECORDS

Required documentation, including electronic data deliverables and data package requirements, is fully described in the Site 12 QAPP.

B1 MEASUREMENT AND DATA ACQUISITION

The following sections describe requirements for:

- Sampling process design (Section B2)
- Sampling methods (Section B3)
- Sample collection, handling, and analysis (Sections B4, B5)
- QC samples and procedures (Section B6)
- Instrument calibration and maintenance (Section B7)
- Analytical supplies and miscellaneous equipment (B8)

These sections provide adequate detail to evaluate whether the methods used for this project have been verified and documented.

B2 SAMPLING DESIGN (EXPERIMENTAL DESIGN)

The accompanying FSP describes the sampling design for the soil gas investigation.

A summary of the number of samples to be collected and the analyses required can be found in the accompanying FSP. Analytical methods that will be used to analyze samples are presented in Section B-5.

Sampling and analysis will be conducted in accordance with this document, the Site 12 QAPP, the approved FSP, and the health and safety plan.

B3 SAMPLING METHODS

This discussion describes the procedures for collecting samples and includes:

- Identification of all sampling methods to be used
- Implementation requirements

- Decontamination procedures
- Materials required

B3.1 SAMPLE COLLECTION AND DECONTAMINATION

The following subsections describe procedures for sample collection, as well as decontamination and disposal of investigation derived waste.

B3.1.1 Sample Collection Procedures

Standard procedures are to be followed for sampling and data collection at Treasure Island. The task manager will define and use the specific sampling procedures presented in the accompanying FSP after approval by the project QA officer. TtEMI standard operating procedures for field work, as amended in this QAPP addendum or the FSP, will be used to conduct the sampling activities.

Samples will be collected using the method described in Section 4.2 of the accompanying FSP.

B3.1.2 Decontamination and Disposal Procedures

Equipment decontamination and waste disposal procedures are discussed in Section 4.6 of the accompanying FSP.

B3.2 SAMPLE CONTAINERS AND HOLDING TIMES

The analytical methods, type of sample containers to be used for each analysis, sample volumes required, and maximum holding times for analysis are presented in Table B-1. All soil gas samples will be collected in stainless-steel canisters. Those requiring analysis for sulfur compounds will be collected in silcosteel-treated stainless-steel canisters.

B4 SAMPLE HANDLING, CUSTODY, AND SHIPPING PROCEDURES

Documentation and records, including field forms and field logbooks, are discussed in Section A4.4 of the Site 12 QAPP. The sample handling and custody requirements for soil gas samples collected at Site 12 are discussed in Section B4 of the Site 12 QAPP, as amended in the following sections.

B4.1 SAMPLE HANDLING

Sample handling procedures are described in detail in Section 4.2 of the accompanying FSP.

B4.1.4 Shipping Procedures

The shipping procedures outlined in the Site 12 QAPP will be followed, with the following exceptions:

- It is not necessary to chill the samples.
- Samples will be shipped within 24 hours of collection because of the relatively short holding time requirements for the sulfur analysis.
- The pressure remaining in the stainless-steel canister (SUMMA™ or SilcoCan™) will be noted on the COC forms.

B4.1.5 Cooler Receipt

Upon receiving a cooler, laboratory personnel will review the contents, sign the COC form and airbill, and retain both documents for their records. In addition to the items noted in the Site 12 QAPP, the stainless-steel canister pressure will be checked and recorded.

B5 ANALYTICAL METHODS

Table B-2 presents methods that will be used to analyze samples collected during soil gas sampling at Site 12. Analytical methods were selected to provide data of necessary quality to meet the DQOs for this project and to maintain consistency and comparability with existing site data. VOCs will be analyzed by EPA Method TO-14, fixed gases by American Society of Testing and Materials (ASTM) D1945, and sulfur compounds by ASTM D5504. These methods will be used because they are adequate to meet reporting limits required for comparison to PRGs for most compounds. For compounds with laboratory reporting limits greater than ambient air PRGs, the laboratory will report estimated values down to the method detection limit. The contract-required reporting limits and a comparison to PRGs for ambient air are listed in Tables B-3 and B-4.

The following subsections provide details on the specific procedures that will be used to analyze samples.

B5.1 METHODS FOR SOIL GAS ANALYSIS

The following subsections discuss preparation and analytical methods for soil gas analyses.

B5.1.2 Analytical Methods

EPA TO-14 - VOCs

EPA Method TO-14 involves full-scan gas chromatography/mass spectroscopy analysis for VOCs in whole air samples collected in evacuated stainless-steel canisters. An aliquot of sample is withdrawn from the canister through a mass flow controller and either cryofocused by liquid argon or concentrated using a multisorbent bed. The focused air is then flash-heated through a hydrophobic drying system which removes water from the sample stream prior to analysis by full-scan GCMS.

ASTM D1945 – Fixed Gases

ASTM D1945 involves GC analysis of landfill gas, ambient air, or stack gas collected in stainless-steel canisters. Samples are analyzed for methane and fixed gases and can be used to speciate individual light hydrocarbons up to C6. Samples are analyzed using a GC equipped with a flame ionization detector and a thermal conductivity detector.

ASTM D5504 – Sulfur compounds

ASTM D5504 involves GC analysis of whole air samples collected in silcosteel-treated, stainless-steel canisters (SilcoCan™). Without this treatment, trace levels of sulfur compounds will react readily with the stainless-steel sampling vessel. Because of this, sulfur compounds have traditionally been collected in Tedlar™ bags. However, the stability of these compounds in Tedlar™ bags is limited to between 24 and 48 hours. The silcosteel process involves chemically bonding a thin layer of fused silica material to the stainless-steel surface of the stainless-steel canister, reducing adsorption and breakdown of active compounds. Because of this, the stability of these compounds is increased to over 3 days. Samples are analyzed using a sulfur chemiluminescence detector.

B6 QUALITY CONTROL

The main functions of any sampling and analysis program are to obtain accurate, representative environmental samples and to provide defensible analytical data. A program to evaluate field and laboratory data was developed to achieve these goals. Quality of the field data will be assessed through the collection and analysis of field QC samples on a regularly scheduled basis. Laboratory QC samples will also be analyzed in accordance with referenced analytical method protocols to ensure that laboratory procedures and analyses are conducted properly.

The following subsections discuss the types of QC samples to be collected and analyzed for the soil gas investigation and their role in the assurance of acceptable project data. Additional QC procedures are not limited to those discussed in this section. Field and laboratory personnel, in accordance with specific method protocols, may implement additional procedures. The following subsections discuss field QC samples, field measurement QC procedures, laboratory QC samples, and laboratory QC procedures.

B6.1 FIELD QUALITY CONTROL SAMPLES

QC samples are collected in the field and used to evaluate the validity of the field sampling effort. Field QC samples are collected for laboratory analysis to check sampling and analytical precision, accuracy, and representativeness. Because dedicated sampling equipment will be used, the only field QC samples required for the soil gas investigation are field duplicates.

B6.2.1 Field Duplicates

Field duplicates are taken to obtain precision data on handling, shipping, storage, preparation, and analysis of soil gas samples. Duplicate samples will be collected using Y-branched tubing at a frequency of 1 for every 10 samples.

B6.2 LABORATORY QUALITY CONTROL SAMPLES

Laboratory QC samples are analyzed to evaluate the quality of preparation and analysis of field samples. Laboratory QC samples are prepared and analyzed at the laboratory to assess analytical precision, accuracy, and representativeness. The types of laboratory QC samples that will be used are discussed in the Site 12 QAPP, as amended in the following sections. Precision and accuracy goals for laboratory QC elements are presented in Table B-5.

B6.2.1 Method Blanks

Method blanks are prepared to determine whether contamination of the field sample is occurring in the laboratory during sample preparation or analysis. A method blank consists of a clean stainless-steel canister and is prepared and analyzed using the same methods and procedures and for the same parameters as field samples. Method blanks are prepared at the frequency prescribed in the individual method.

B6.2.2 Laboratory Control Samples

An LCS is a clean stainless-steel canister that has been spiked with standard reference materials of known concentration. An LCS is analyzed to verify the accuracy of the analytical system. LCSs are prepared and analyzed using the same procedures as field samples, at the frequency prescribed in the individual method. LCSs will only be analyzed for EPA Method TO-14.

B6.2.4 Surrogate Standards

Surrogate standards consist of known concentrations of nontarget analytes that are added to each sample, method blank, and LCS analyzed for TO-14 samples. The surrogate standard measures the efficiency of the analytical method in recovering target analytes from an environmental sample matrix.

B6.2.5 Internal Standards

Internal standards are compounds that are added to every TO-14 standard, method blank, LCS, and sample at a known concentration prior to instrument analysis. They are used as the basis for quantification of target compounds. Internal standards ensure that GCMS sensitivity and response are stable during every analytical run. An internal standard is used to evaluate the efficiency of the sample introduction process and to monitor the efficiency of the analytical procedure for each sample matrix encountered.

B6.3 LABORATORY CONTROL PROCEDURES

The laboratory will conduct quality control procedures as described in the Site 12 QAPP.

B7 INSTRUMENT AND EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Section B7 of the Site 12 QAPP discusses regularly scheduled preventive maintenance and calibration procedures that are used to keep all field and laboratory equipment in good working condition.

B8 INSPECTION AND ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Analytical laboratories are required to provide certified clean containers for all analyses. The subcontract laboratory will maintain an inventory of analytical supplies required for analytical procedures, as described in Section B5.1.

B9 NONDIRECT MEASUREMENTS

The Site 12 QAPP outlines data management in the field and laboratory.

C1 ASSESSMENTS AND RESPONSE ACTIONS

Oversight of QA activities will be completed using three types of audits (performance, system, and field), as described Section C1 of the Site 12 QAPP.

D1 DATA VALIDATION AND USABILITY

Section D1 of the Site 12 QAPP (TtEMI 2000) discusses the requirements and methods for data review, verification, and validation.

D2 RECONCILIATION WITH USER REQUIREMENTS

The overall purpose of the work defined in this study is to evaluate whether methane and other volatile organic compounds (VOCs) are present at the former debris disposal, and other targeted areas within Site 12. The sampling and laboratory methods and procedures detailed throughout this QAPP addendum should provide data of adequate quality to assess the concentrations and extent of chemicals of concern throughout Site 12. Detected concentrations of site-related chemicals will be compared with PRGs for ambient air where applicable to decide if these chemicals are present at concentrations that may pose a human health risk.

E1 REFERENCES

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APPENDIX 1

DATA QUALITY OBJECTIVES TABLE

TABLE 1

DATA QUALITY OBJECTIVES SUMMARY
NAVAL STATION TREASURE ISLAND

Step 1 State the Problem	Step 2 Identify the Decision	Step 3 Identify Inputs to the Decision	Step 4 Define the Study Boundaries	Step 5 Develop Decision Rules	Step 6 Specify Acceptable Tolerable Limits on Decision Errors	Step 7 Optimize the Sampling Design
• VOCs and methane have been detected in soil gas samples collected at Site 12. Debris may be generating these gases.	• Has the lateral extent of methane and VOCs in the soil gas been defined? • Are the methane and VOCs generated by contamination in soils within Site 12 or the result of natural gas line leaks? • Are concentrations of methane and other VOCs in soil gas at levels that are a potential toxic or explosion hazard for residents at Site 12? • Are concentrations of methane and other VOCs in ambient air within housing units at levels that are a potential toxic or explosion hazard for residents at Site 12?	• Site history • Previous soil gas investigation results • Validated, defensible chemical data for soil gas from proposed locations • Validated, defensible chemical data for ambient air from selected housing units • Comparison of analytical results to action-specific ARARs that provide guidance on PRGs for air	• The horizontal limits of the study are the areas of known debris disposal and areas where elevated FID and PID readings have been recorded. Step-out locations may be added, as necessary. • The vertical limit of the study area is a depth of 3 feet bgs, which is the approximate depth of the vadose zone.	• If methane or VOCs are present in perimeter soil gas sampling locations, then additional soil gas probe locations will be sampled to define the extent of methane and VOCs. • If sulfur compounds are present, then natural gas line leaks will be repaired prior to further soil gas investigations in the area of the leak. • If analytes are present in soil gas samples at concentrations that represent a potential toxic or explosion hazard, then the exposure pathway and potential risk to human health will be further evaluated. • If analytes are present in ambient air samples at concentrations that represent a potential toxic or explosion hazard within housing units, then additional investigation of ambient air within housing units will be conducted.	• False negative error will be minimized by a review of the existing data and adherence to the selected sampling and analytical methods. • False positive error will be minimized by the proper application of the selected sampling and analytical methods.	• Soil gas samples will be collected at 70 locations where heavy debris was encountered in test pit investigations and where elevated PID and FID readings were detected in the past. Samples will be collected from the vadose zone at a depth of 3 feet bgs. Additional step-out samples may be collected, if necessary, to fully assess the extent of VOCs and methane within the AOCs. • Eleven ambient air samples will be collected inside of housing units in areas of heavy debris. • All samples will be analyzed for fixed gases, methane, and VOCs. Selected samples collected from within 30 feet of natural gas lines will also be analyzed for sulfur compounds.

Notes:
AOC = Area of concern
VOC = Volatile organic compound
ARAR = Applicable or relevant and appropriate requirement
PRG = Preliminary remediation goal
PID = Photoionization detector
FID = Flame ionization detector
bgs = Below ground surface

APPENDIX 2

FIELD FORMS

FIELD DATASHEET FOR SOIL GAS SAMPLING

Site/Facility Name: _____

Date/Time: _____ Project No.: _____

Sample ID: _____ Location ID: _____

Depth: _____

Location sketch:

Sample Container: SUMMA™ canister: _____ SilcoCan™: _____

Sample location purged: Y / N

FID reading: _____ PID reading: _____

Canister pressure prior to sampling: _____

Canister pressure at completion of sampling: _____

Ending pressure noted on COC? Y / N

Notes:

Initials of sampler/Date: _____

TABLES

TABLE B-1

SAMPLE CONTAINER AND HOLDING TIME REQUIREMENTS FOR SOIL GAS SAMPLES SITE 12 – NAVAL STATION TREASURE ISLAND

Parameter	Method Number[a]	Sample Container[b]	Holding Time
Volatile Organic Compounds (VOC)	EPA TO-14	6L SUMMA™ canister	30 days
Sulfur Compounds	ASTM D5504	6L SilcoCan™ canister	72 hours
Fixed Gases	ASTM D1945	6L SUMMA™ canister	30 days

Notes:

ASTM American Society for Testing and Materials

EPA U.S. Environmental Protection Agency

L Liter

[a] Complete method references are presented in Section B5

[b] Samples requiring both TO-14 and ASTM D-5504 will be collected using the 6L SilcoCan

TABLE B-2

ANALYTICAL METHODS FOR SOIL GAS SAMPLES
SITE 12 – NAVAL STATION TREASURE ISLAND

Parameter	Method Number	Analyte List	Technique
Volatile Organic Compounds (VOC)	EPA TO-14	TCL + 30 TIC	GCMS
Sulfur Compounds	ASTM D5504	TCL	GC-SCD
Fixed Gases	ASTM D1945	TCL	GC-FID/TCD

Notes:

ASTM	American Society for Testing and Materials
EPA	U.S. Environmental Protection Agency
FID	Flame ionization detector
GC	gas chromatography
MS	mass spectrometry
SCD	Sulfur chemiluminescence detector
TCD	Thermal conductivity detector
TCL	target compound list
TIC	tentatively identified compounds

TABLE B-3

REQUIRED REPORTING LIMITS FOR SOIL GAS METHODS
SITE 12 - NAVAL STATION TREASURE ISLAND

	Reporting Limit ($\mu g/m^3$)
EPA TO-14	
Freon 12	2.5
Freon 114	3.6
Freon 11	2.9
Freon 113	3.9
Ethylene Dibromide	2.2
m,p-Xylene	2.2
o-Xylene	2.2
1,3,5-Trimethylbenzene	2.5
1,2,4-Trimethylbenzene	2.5
1,3-Dichlorobenzene	3.1
1,4-Dichlorobenzene	3.1
Chlorotoluene	2.6
1,2-Dichlorobenzene	3.1
1,2,4-Trichlorobenzene	3.8
Hexachlorobutadiene	5.4
Propylene	3.5
1,3-Butadiene	4.5
2-Propanol	5.0
Trans-1,2-Dichloroethene	8.1
Vinyl Acetate	7.2
Hexane	7.2
Tetrahydrofuran	6.0
Cyclohexane	7.0
1,4-Dioxane	7.3
4-Ethyltoluene	10.0
Ethanol	3.8
Methyl t-Butyl Ether	7.3
Heptane	8.3
Bromomethane	2.0
Chloromethane	1.0

TABLE B-3 (Continued)

REQUIRED REPORTING LIMITS FOR SOIL GAS METHODS
SITE 12 - NAVAL STATION TREASURE ISLAND

	Reporting Limit ($\mu g/m^3$)
EPA TO-14 (Continued)	
Vinyl Chloride	1.3
Chloroethane	1.3
Methylene Chloride	1.8
Acetone	4.8
Carbon Disulfide	6.3
1,1-Dichloroethene	2.0
1,1-Dichloroethane	2.1
Cis-1,2-Dichloroethene	2.0
Chloroform	2.5
1,2-Dichloroethane	2.1
2-Butanone	6.0
1,1,1-Trichloroethane	2.8
Carbon Tetrachloride	3.2
Bromodichloromethane	13.6
1,2-Dichloropropane	2.3
cis-1,3-Dichloropropene	2.3
Trichloroethene	2.7
Dibromochloromethane	17.3
1,1,2-Trichloroethane	2.8
Benzene	1.6
trans-1,3-Dichloropropene	2.3
Bromoform	21.0
4-Methyl-2-Pentanone	8.3
2-Hexanone	8.3
Tetrachloroethene	3.4
Toluene	1.9
1,1,2,2-Tetrachloroethane	3.5
Chlorobenzene	2.3
Ethylbenzene	2.2
Styrene	2.2
Total Xylenes	2.2

TABLE B-3 (Continued)

REQUIRED REPORTING LIMITS FOR SOIL GAS METHODS
SITE 12 - NAVAL STATION TREASURE ISLAND

	Reporting Limit ($\mu g/m^3$)
ASTM D5504	
Hydrogen Sulfide	5.7
Carbonyl Sulfide	10.0
Methyl Mercaptan	8
Ethyl Mercaptan	10.3
Dimethyl Sulfide	10.3
Carbon Disulfide	12.7
Isopropyl Mercaptan	12.7
tert-Butyl Mercaptan	15
n-Propyl Mercaptan	12.7
Ethyl Methyl Sulfide	12.7
Thiophene	14.0
Isobutyl Mercaptan	15.0
Diethyl Sulfide	15.0
3-Methylthiophene	16.3
Tetrahydrothiophene	14.7
2-Ethylthiophene	18.7
2,5-Dimethylthiophene	18.7
Diethyl Disulfide	20.3
ASTM D1945	
Nitrogen	0.01%
Oxygen	0.01%
Carbon Dioxide	0.001%
Carbon Monoxide	0.001%
Methane	0.001%

Notes:
ASTM American Society for Testing and Materials
EPA U.S. Environmental Protection Agency
$\mu g/m^3$ Micrograms per cubic meter
% Percent

TABLE B-4
AMBIENT AIR PRG vs LABORATORY REPORTING LIMITS
SITE 12 - NAVAL STATION TREASURE ISLAND

Method	Compound	Units	Laboratory Reporting Limit	PRG for Ambient Air	RL<PRG
EPA TO-14	1,1,2,2-TETRACHLOROETHANE	UG/M^3	3.5	0.033	NO
EPA TO-14	1,1,2-TRICHLOROETHANE	UG/M^3	2.8	0.12	NO
EPA TO-14	1,1-DICHLOROETHANE	UG/M^3	2.1	520	YES
EPA TO-14	1,1-DICHLOROETHENE	UG/M^3	2.0	210	YES
EPA TO-14	1,2,4-TRICHLOROBENZENE	UG/M^3	3.8	210	YES
EPA TO-14	1,2,4-TRIMETHYLBENZENE	UG/M^3	2.5	6.2	YES
EPA TO-14	1,2-DICHLOROBENZENE	UG/M^3	3.1	210	YES
EPA TO-14	1,2-DICHLOROETHANE	UG/M^3	2.1	0.074	NO
EPA TO-14	1,2-DICHLOROPROPANE	UG/M^3	2.3	0.099	NO
EPA TO-14	1,3,5-TRIMETHYLBENZENE	UG/M^3	2.5	6.2	YES
EPA TO-14	1,3-BUTADIENE	UG/M^3	4.5	0.037	NO
EPA TO-14	1,3-DICHLOROBENZENE	UG/M^3	3.1	3.3	YES
EPA TO-14	1,4-DICHLOROBENZENE	UG/M^3	3.1	0.31	NO
EPA TO-14	1,4-DIOXANE	UG/M^3	7.3	0.61	NO
EPA TO-14	2-BUTANONE (Methyl Ethyl Ketone)	UG/M^3	6.0	1000	YES
EPA TO-14	2-HEXANONE	UG/M^3	8.3	NA	NA
EPA TO-14	4-ETHYLTOLUENE	UG/M^3	10.0	NA	NA
EPA TO-14	4-METHYL-2-PENTANONE (MIBK)	UG/M^3	8.3	83	YES
EPA TO-14	ACETONE	UG/M^3	4.8	370	YES
EPA TO-14	BENZENE	UG/M^3	1.6	0.25	NO
EPA TO-14	BROMODICHLOROMETHANE	UG/M^3	13.6	0.11	NO
EPA TO-14	BROMOFORM	UG/M^3	21.0	1.7	NO
EPA TO-14	BROMOMETHANE	UG/M^3	2.0	5.2	YES
EPA TO-14	CARBON DISULFIDE	UG/M^3	6.3	730	YES
EPA TO-14	CARBON TETRACHLORIDE	UG/M^3	3.2	1.3	NO
EPA TO-14	CHLOROBENZENE	UG/M^3	2.3	6.2	YES
EPA TO-14	CHLOROETHANE	UG/M^3	1.3	2.3	YES
EPA TO-14	CHLOROFORM	UG/M^3	2.5	0.084	NO
EPA TO-14	CHLOROMETHANE	UG/M^3	1.0	1.1	YES
EPA TO-14	CHLOROTOLUENE	UG/M^3	2.6	730	YES
EPA TO-14	CIS-1,2-DICHLOROETHENE	UG/M^3	2.0	370	YES
EPA TO-14	TRANS-1,2-DICHLOROETHENE	UG/M^3	2.0	730	YES
EPA TO-14	CIS-1,3-DICHLOROPROPENE	UG/M^3	2.3	0.052	NO
EPA TO-14	TRANS-1,3-DICHLOROPROPENE	UG/M^3	2.3	0.052	NO
EPA TO-14	CYCLOHEXANE	UG/M^3	7.0	NA	NA
EPA TO-14	DIBROMOCHLOROMETHANE	UG/M^3	17.3	0.08	NO
EPA TO-14	ETHANOL	UG/M^3	3.8	NA	NA
EPA TO-14	ETHYLBENZENE	UG/M^3	2.2	1100	YES

TABLE B-4
AMBIENT AIR PRG vs LABORATORY REPORTING LIMITS
SITE 12 - NAVAL STATION TREASURE ISLAND

Method	Compound	Units	Laboratory Reporting Limit	PRG for Ambient Air	RL<PRG
EPA TO-14	ETHYLENE DIBROMIDE	UG/M^3	3.9	0.0087	NO
EPA TO-14	FREON 11	UG/M^3	2.9	730	YES
EPA TO-14	FREON 113	UG/M^3	3.9	210	YES
EPA TO-14	FREON 114	UG/M^3	3.6	NA	NA
EPA TO-14	FREON 12	UG/M^3	2.5	NA	NA
EPA TO-14	HEPTANE	UG/M^3	8.3	NA	NA
EPA TO-14	HEXACHLOROBUTADIENE	UG/M^3	5.4	0.086	NO
EPA TO-14	m,p-XYLENE	UG/M^3	2.2	730	YES
EPA TO-14	METHYLENE CHLORIDE	UG/M^3	1.8	4.1	YES
EPA TO-14	METHYL-t-BUTYL ETHER (MTBE)	UG/M^3	7.3	3100	YES
EPA TO-14	o-XYLENE	UG/M^3	2.2	730	YES
EPA TO-14	STYRENE	UG/M^3	2.2	1100	YES
EPA TO-14	TETRACHLOROETHENE	UG/M^3	3.4	3.3	NO
EPA TO-14	TETRAHYDROFURAN	UG/M^3	6.0	0.99	NO
EPA TO-14	TOLUENE	UG/M^3	1.9	400	YES
EPA TO-14	TRICHLOROETHENE	UG/M^3	2.7	1.1	NO
EPA TO-14	VINYL ACETATE	UG/M^3	1.3	0.022	NO
EPA TO-14	VINYL CHLORIDE	UG/M^3	1.3	0.022	NO

Notes:

EPA	U.S. Environmental Protection Agency
UG/M^3	Micrograms per cubic meter
NA	Not applicable
RL	Reporting Limit
PRG	Preliminary remediation goal for ambient air

TABLE B-5

PRECISION AND ACCURACY GOALS FOR SOIL GAS ANALYSIS
SITE 12 – NAVAL STATION TREASURE ISLAND

QC Check	Minimum Frequency	Acceptance Criteria
Surrogate[a]	Every sample, blank, and standard	70-130%
Internal Standard[a]	Every sample, blank, and standard	60-140%
Laboratory Duplicates	5 percent of samples	25% RPD for detections > RL

[a] Applicable to EPA TO-14 only
RPD Relative percent difference
RL Reporting limit