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NAS CORPUS CHRISTI
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SAMPLING AND ANALYSIS PLAN FOR REMEDIAL INVESTIGATION AND FEASIBILITY STUDY AT THE FORMER GUNNERY TRAINING COMPLEX, NAS CORPUS CHRISTI TX

9/1/2013

RESOLUTION CONSULTANTS

SAMPLING AND ANALYSIS PLAN

REMEDIAL INVESTIGATION/FEASIBILITY STUDY
MUNITIONS RESPONSE PROGRAM
FORMER GUNNERY TRAINING COMPLEX
NAVAL AIR STATION CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

Version Number: 0

Prepared For:

Department of the Navy
Naval Facilities Engineering Command Southeast
Building 135 North, P.O. Box 30
Jacksonville, Florida 32212-0030

Prepared By:

Resolution Consultants
A Joint Venture of AECOM & EnSafe
1500 Wells Fargo Building
440 Monticello Avenue
Norfolk, Virginia 23510

Contract Number: N62470-11-D-8013
CTO JM45

September 2013

SAP WORKSHEET #1: TITLE AND APPROVAL PAGE
(UFP-QAPP Manual Section 2.1)

INTERNAL DRAFT
SAMPLING AND ANALYSIS PLAN

Remedial Investigation/Feasibility Study
Munitions Response Program
Former Gunnery Training Complex
Naval Air Station Corpus Christi
Corpus Christi, Texas

Version Number: 0

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Date: 2013.09.23 12:05:03 -05'00'

Tina Cantwell, Resolution Consultants
Project Chemist/ Quality Assurance Officer/Date

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Judy Solomon, NAVFAC Atlantic
Quality Assurance Officer/Chemist/Date

Claire Barnett, PE
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Claire Barnett, Resolution Consultants
Task Order Manager/Date

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Arne Olsen, NAVFAV SE
Remedial Project Manager/Date

EXECUTIVE SUMMARY

Resolution Consultants has prepared this Uniform Federal Policy Sampling and Analysis Plan (UFP SAP) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62470-11-D-8013 Contract Task Order JM45. This UFP SAP has been prepared for a Remedial Investigation and Feasibility Study (RI/FS) to address the past use of Munitions and Explosives of Concern and Munitions Constituents (MEC/MC) for a Munitions Response Site Gunnery Training Complex at Naval Air Station Corpus Christi, Texas.

A Site Inspection, conducted in 2010, concluded that an RI/FS should be conducted to support a remedial response or no further action determination. This RI/FS will be focused on determining the extent to which MC poses a risk to human health and the environment, and what remedies may be needed, if any. MEC was not anticipated, nor found in the Site Inspection. The planned RI is intended to efficiently and effectively establish a sound basis for remedial decision-making.

This SAP outlines the organization, objectives, planned activities, and data review/reporting procedures associated with the RI. Protocols for sample collection, handling, and storage, chain-of-custody, laboratory and field analyses, data validation, and reporting are also addressed herein. This SAP was generated for, and complies with, applicable United States Department of the Navy, United States Environmental Protection Agency (U.S. EPA) Region 6, and Texas Commission on Environmental Quality requirements, regulations, guidance, and technical standards, as appropriate. This includes the Department of Defense, Department of Energy, and U.S. EPA Interagency Data Quality Task Force environmental requirements regarding federal facilities, as specified in the Uniform Federal Policy Quality Assurance Project Plan guidance (U.S. EPA 2005) and the Navy's SAP guidance. Field activities conducted under this SAP will be conducted in accordance with Resolution Consultants' Standard Operating Procedures and a Site-Specific Health and Safety Plan.

Table of Contents

Figures

Tables

Appendices

List of Acronyms

AB/SYN	Air Blast and Synchronized Gun
amu	Atomic Mass Unit
bgs	Below ground surface
^{o}C	Degrees Celsius
CAS	Chemical Abstracts Service
CCC	Calibration check compound
CCV	Continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLEAN	Comprehensive Long-Term Environmental Action Navy
COPC	Contaminant of potential concern
CSM	Conceptual site model
CSR	Closed Skeet Range
CTO	Contract task order
CV	Calibration verification
CWM	Chemical warfare material
%D	Percent difference
DDT	4,4'-dichlorodiphenyltrichloroethane
DoD	Department of Defense
DoD ELAP	Department of Defense Environmental Laboratory Accreditation Program
DQO	Data quality objective
DVA	Data validation assistant
ERA	Ecological Risk Assessment
EB	Equipment blank
ECO	Ecological receptors
EDD	Electronic data deliverable
EICP	Extracted ion current profile
eQAPP	Electronic Quality Assurance Project Plan
FD	Field duplicate
FRC	Federal Records Center
FS	Feasibility study
FTL	Field team leader
FTR	Fixed target range
GC	Gas chromatograph
GC/MS	Gas chromatograph/mass spectrometer
GCAL	Gulf Coast Analytical Laboratories
$^{GW}Soil_{Ing}$	Soil-to-groundwater leaching of chemicals of concern to Classes 1 and 2 groundwater
$^{GW}Soil_{Class\ 3}$	Soil-to-groundwater leaching of chemicals of concern to Class 3 groundwater
HH	Human health receptors
HHRA	Human Health Risk Assessment

HSM	Health and safety manager
ICAL	Initial calibration
ICP	Inductively coupled plasma
ICP/MS	Inductively coupled plasma/mass spectrometer
ICS	Interference check solution
ICV	Initial calibration verification
ID	Identification
IDW	Investigation-derived waste
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
LOD	Limit of detection
LOQ	Limit of quantification
µg/L	Micrograms per Liter
MC	Munitions constituents
MDL	Method detection limit
MEC	Munitions and explosives of concern
mg/kg	Milligram per kilogram
mg/L	Milligram per Liter
MPC	Measurement performance criteria
MS/MSD	Matrix spike/matrix spike duplicate
N	Normal sample
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
NAFAC LANT	Naval Facilities Engineering Command Atlantic
NAVFAC SE	Naval Facilities Engineering Command Southeast
NELAP	National Environmental Laboratory Accreditation Program
NIRIS	Naval Installation Restoration Information Solution
NTR	North Trap Range
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PAH	Polynuclear Aromatic Hydrocarbon
PAL	Project action limits
PCL	Protective concentration level
PM	Project manager
POC	Point of contact
PSQ	Principal Study Question
QA	Quality assurance
QAO	Quality assurance officer
QAPP	Quality assurance project plan
QC	Quality control
QSM	Quality systems manual
r^2	Least squares regression coefficient/coefficient of determination
%R	Percent recovery

RCRA	Resource Conservation and Recovery Act
RF	Response factor
RI	Remedial investigation
RIC	Reconstructed ion chromatogram
RPD	Relative percent difference
RPM	Remedial project manager
RRT	Relative retention time
RSD	Relative standard deviation
SAP	Sampling and analysis plan
SAR	Small Arms Range
SDZ	Surface danger zone
SI	Site Inspection
SIM	Selective ion monitoring
SKR	Skeet Range
SOP	Standard operating procedure
SPLP	Synthetic precipitation leaching procedure
SRA	Screening risk assessment
STR	South Trap Range
SSO	Site safety officer
TAC	Texas Administrative Code
TACAN	Tactical air navigation
TBD	To be determined
TCEQ	Texas Commission on Environmental Quality
TOC	Total Organic Carbon
TOM	Task order manager
$^{Tot}Soil_{Comb}$	Total Soil Combined (Combined ingestion, dermal contact, inhalation of volatiles and particulates, and ingestion of aboveground and below-ground vegetables with chemicals of concern in surface soil)
TRRP	Texas Risk Reduction Program
Tt	Tetra Tech, Inc.
UFP	Uniform Federal Policy
UFP SAP	Uniform Federal Policy Sampling and Analysis Plan
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
U.S. EPA	United States Environmental Protection Agency
WWII	World War II
XRF	X-ray Fluorescence

SAP WORKSHEET #2: SAMPLING AND ANALYSIS PLAN IDENTIFYING INFORMATION

(UFP-QAPP Manual Section 2.2.4)

Site Name/Number: Gunnery Training Complex,
Naval Air Station (NAS) Corpus Christi, Texas

Contractor Name: Resolution Consultants

Contract Number: Comprehensive Long-Term Environmental Action (CLEAN)

Contract Title: N62470-11-D-8013

Work Assignment No: JM45

1. This sampling and analysis plan (SAP) was prepared in accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP)* (U.S. EPA 2005) and United States Environmental Protection Agency (U.S. EPA) *Guidance for Quality Assurance Project Plans, EPA QA/G-5* (U.S. EPA 2002).

2. Identify regulatory program: National Oil and Hazardous Substances Pollution Contingency Plan and Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

3. This SAP is a project-specific SAP.

4. List organizational partners (stakeholders) and identify the connection with lead organization:

Organization Partners/Stakeholders	Connection
U.S. EPA Region 6	Lead Regulatory Oversight
Texas Commission on Environmental Quality	Lead Regulatory Oversight
Naval Facilities Engineering Command Southeast	Lead Agency
NAS Corpus Christi	Property Owner
The Management Edge	Tier I Team Partner
Resolution Consultants	Tier I Team Partner

5. Lead organization: Naval Facilities Engineering Command Southeast

6. If any required SAP elements and required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below: Not Applicable, as there are no exclusions.

SAP WORKSHEET #3: DISTRIBUTION LIST

(UFP-QAPP Manual Section 2.3.1)

SAP Recipients	Title	Organization	Telephone Number	E-mail Address or Mailing Address
Arne Olsen	Navy Remedial Project Manager	Naval Facilities Engineering Command Southeast 135 Ajax Street North, PO Box 30 Jacksonville, Florida 32212-0030	904-542-6159 904-654-3059 (cell)	arne.olsen@navy.mil
Ross Ybarra	Lead Environmental Protection Specialist/Point of Contact	Naval Air Station Corpus Christi, Public Works Department 11001 D Street, Building 19 Corpus Christi, Texas 78419	361-961-2170 361-658-9572 (cell)	ross.ybarra@navy.mil
Tara Hubner	Project Manager	U.S. Environmental Protection Agency Region 6, Multimedia Planning and Permitting Division (6PD) RCRA Federal Facilities Section 1445 Ross Avenue, Suite 200 Dallas, Texas 75202	214-665-7246 972-571-2439 (cell)	hubner.tara@epa.gov
Allan Posnick	Project Manager	Texas Commission on Environmental Quality PO Box 13087 Austin, Texas 78711	512-239-2332 512-739-0668 (cell)	allan.posnick@tceq.texas.gov
Claire Barnett	Task Order Manager	Resolution Consultants 5724 Summer Trees Drive Memphis, Tennessee 38134	901-937-4425 901-634-4554 (cell)	cbarnett@ensafe.com
Ben Elliott	Project Engineer/ Technical Lead	Resolution Consultants 10918 Whisper Valley San Antonio, Texas 78230	210-545-9527 512-635-4229 (cell)	belliott@ensafe.com
Tina Cantwell	Project Chemist/Data Manger/ Quality Assurance Officer	Resolution Consultants 5724 Summer Trees Drive Memphis, Tennessee 38134	901-937-4315	tcantwell@ensafe.com
Brett Hamby	Field Team Leader	Resolution Consultants 4545 Fuller Drive, Suite 342 Irving, Texas 75038	972-791-3222 940-577-5755 (cell)	bhamby@ensafe.com
Brenda Martinez	Laboratory Project Manager	Gulf Coast Analytical Laboratories 7979 GSRI Rd Baton Rouge, Louisiana 70820	225-769-4900	brenda.martinez@gcal.com

SAP WORKSHEET #4: PROJECT PERSONNEL SIGN-OFF SHEET

(UFP-QAPP Manual Section 2.3.2)

Project Personnel Sign-Off Sheet					
Name	**Organization/Title/Role**	**Telephone Number**	**Signature/e-mail receipt**	**SAP Section Reviewed**	**Date SAP Read**
Navy and Regulator Project Team Personnel					
Arne Olsen	Navy Remedial Project Manager	904-542-6159		All	
Ross Ybarra	NAS Corpus Christi Point of Contact	361-961-2170		All	
Tara Hubner	U.S. EPA Region 6 Project Manager	214-665-7246		All	
Allan Posnick	TCEQ Project Manager	512-239-2332		All	
Resolution Consultants Project Team Personnel					
Claire Barnett	Resolution Consultants/TOM	901-937-4425		All	
Ben Elliott	Resolution Consultants/Project Engineer	512-635-4229		All	
Tina Cantwell	Resolution Consultants/Chemist/QAO/Data Manager	901-937-4315		All	
Brett Hamby	Resolution Consultants/Field Team Leader	940-577-5755		All	
Subcontractor Personnel					
Brenda Martinez	Laboratory Project Manager	225-769-4900		Worksheets #6, #12, #14, #15, #19, #20, #23-28, #30, and #34-36	

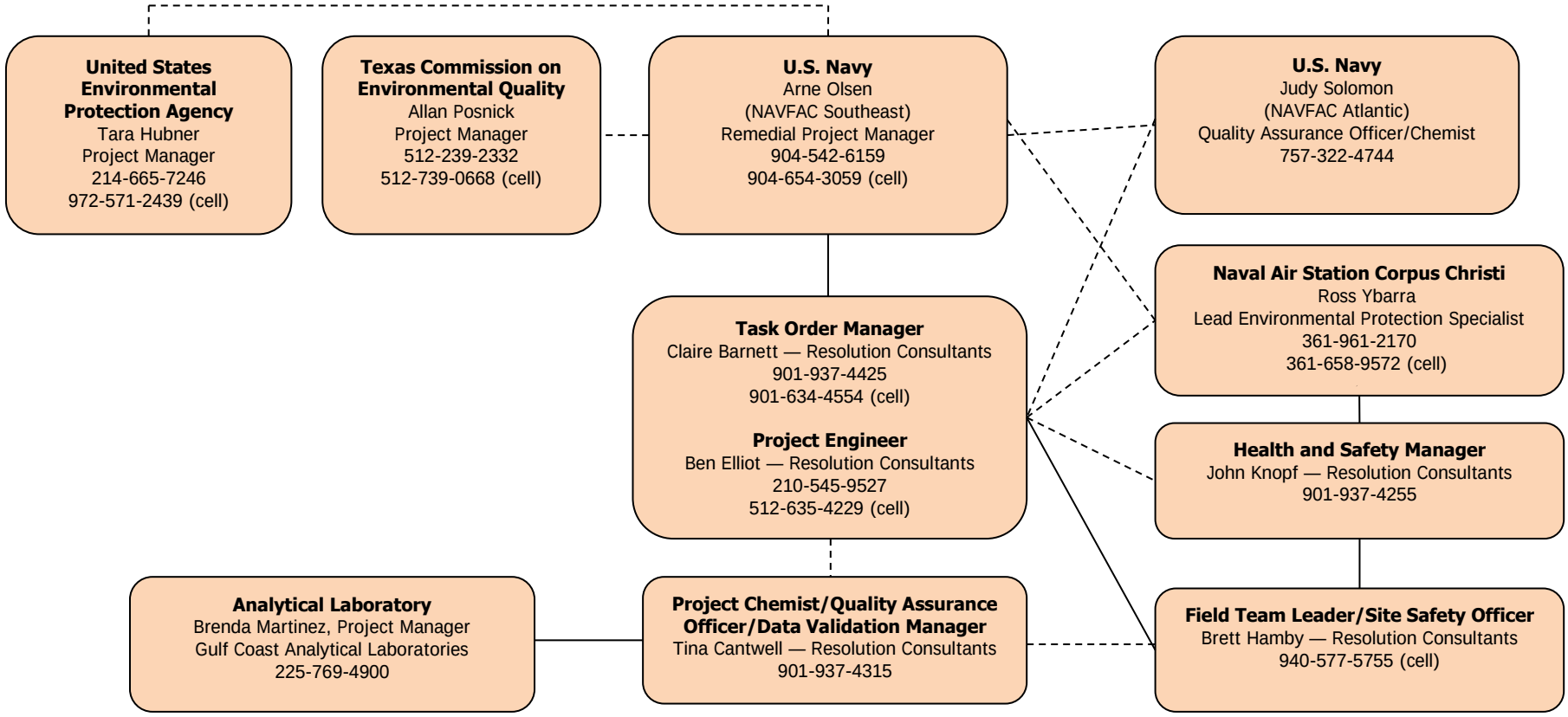
Notes:

Persons listed on this worksheet will be responsible for distributing the SAP to the appropriate people within their organizations.

U.S. EPA = United States Environmental Protection Agency
TCEQ = Texas Commission on Environmental Quality
NAS = Naval Air Station
TOM = Task Order Manager
QAO = Quality Assurance Officer

SAP WORKSHEET #5: PROJECT ORGANIZATIONAL CHART

(UFP-QAPP Manual Section 2.4.1)



SAP WORKSHEET #6: COMMUNICATION PATHWAYS

(UFP-QAPP Manual Section 2.4.2)

The communication pathways for the SAP are shown below.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Regulatory Agency Interface	Navy RPM TCEQ RPM U.S. EPA RPM	Arne Olsen Allan Posnick Tara Hubner	904-542-6159 512-239-2332 214-665-7246	The Navy RPM informs the regulatory agencies of work progress on a periodic basis.
Field Progress Reports	Resolution Consultants FTL Resolution Consultants TOM	Brett Hamby Claire Barnett	940-577-5755 901-937-4425	The Resolution Consultants FTL will contact the Resolution Consultants TOM on a daily basis via phone, and every 1-2 days summarizing progress via e-mail.
Gaining Site Access	Resolution Consultants FTL NAS Corpus Christi POC	Brett Hamby Ross Ybarra	940-577-5755 361-961-2170	The Resolution Consultants FTL will contact the NAS Corpus Christi POC verbally or via e-mail at least 3 days before commencement of field work to arrange for access to the site for all personnel.
SAP Changes prior to Field/ Laboratory work	Resolution Consultants TOM Navy RPM TCEQ RPM U.S. EPA RPM	Claire Barnett Arne Olsen Allan Posnick Tara Hubner	901-937-4425 904-542-6159 512-239-2332 214-665-7246	Any change of the approved SAP will be made only upon authorization by the Navy RPM and regulatory agencies. The Resolution Consultants TOM is responsible for initiating any SAP change requests via the communication channels described for the Navy and regulatory agencies.
Obtaining Utility Clearances for Intrusive Activities	Resolution Consultants FTL NAS Corpus Christi POC	Brett Hamby Ross Ybarra	940-577-5755 361-961-2170	The Resolution Consultants FTL will coordinate verbally or via e-mail with NAS Corpus Christi POC at least 7 days in advance of the site access to initiate the utility clearance process for all intrusive sampling locations. The Resolution Consultants FTL will contact both the Texas 811 utility locator service and NAS Corpus Christi POC verbally or via e-mail at least 3 days prior to commencement of field work to complete a utility clearance ticket for the areas under investigation.
Field Corrective Actions	Resolution Consultants FTL/SSO Resolution Consultants TOM Navy RPM	Brett Hamby Claire Barnett Arne Olsen	340-577-5755 901-937-4425 904-542-6159	FTL informs TOM verbally within same day; TOM informs Navy RPM via e-mail within 24 hours that corrective actions have been implemented. Corrective actions will be documented in weekly progress reports. Navy RPM will notify TCEQ and U.S. EPA of any significant corrective actions taken.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Stop Work due to Safety Issues	Resolution Consultants TOM Resolution Consultants FTL/SSO Resolution Consultants HSM Navy RPM NAS Corpus Christi POC	Claire Barnett Brett Hamby John Knopf Arne Olsen Ross Ybarra	901-937-4425 940-577-5755 901-937-4255 904-542-6159 361-961-2170	The site is not suspected to contain CWM or MEC. However, if suspect CWM or MEC is encountered, all field personnel shall immediately withdraw upwind from the work area, secure the site and contact the Navy RPM. The contractor shall maintain site security until the Navy provides written direction regarding the procedure to be followed for performing further RI/FS work at the site. Any field team member who observes an unsafe situation has the authority to stop work. The responsible party verbally informs the TOM and subcontractor within 1 hour of recommendation to stop work and within 24 hours of recommendation to restart work. Responsible party follows verbal notification with an e-mail to the Project Team within 24 hours. If a subcontractor is the responsible party, the subcontractor PM must verbally inform Resolution Consultants SSO within 15 minutes and the Resolution Consultants SSO will then follow the procedure listed above.
SAP Changes in the Field	Resolution Consultants FTL/SSO Resolution Consultants TOM Navy RPM TCEQ RPM U.S. EPA RPM	Brett Hamby Claire Barnett Arne Olsen Allan Posnick Tara Hubner	940-577-5755 901-937-4425 904-542-6159 512-239-2332 214-665-7246	FTL informs TOM verbally within the same day; TOM informs Navy RPM via e-mail within 24 hours; TOM sends a concurrence letter, if warranted, within 7 calendar days and the RPM signs the letter within 5 business days of receipt. The scope change is to be authorized before work is executed. Document the change on a field task modification request form (within 2 business days) or SAP amendment (within timeframe agreed to by Project Team). Any change of the approved SAP affecting the scope or implementation of the sampling program will be made only upon authorization of the Navy RPM and regulatory agencies.
Recommendations to stop work and initiate work upon corrective action	Resolution Consultants FTL/SSO Resolution Consultants TOM Navy RPM TCEQ RPM U.S. EPA RPM	Brett Hamby Claire Barnett Arne Olsen Allan Posnick Tara Hubner	940-577-5755 901-937-4425 904-542-6159 512-239-2332 214-665-7246	Responsible party verbally informs the TOM, FTL, and subcontractors within 1 hour of recommendation to stop work and within 24 hours of recommendation to restart work. Responsible party follows verbal notification with an e-mail to the Project Team within 24 hours. Significant corrective actions will be communicated to the regulatory agencies.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Sample Receipt Variances	Laboratory PM Resolution Consultants TOM Resolution Consultants FTL	Brenda Martinez Claire Barnett Brett Hamby	225-769-4900 901-937-4425 940-577-5755	The Laboratory PM will notify (verbally or via e-mail) the Resolution Consultants FTL immediately upon receipt of any chain of custody/sample variances for clarification or direction from the Resolution Consultants FTL. The Resolution Consultants FTL will notify (verbally or via e-mail) the Resolution Consultants TOM within 1 business day, if corrective action is required. The Resolution Consultants TOM will notify (verbally or via e-mail) the Laboratory PM and the Resolution Consultants FTL within 1 business day of any required corrective action.
Analytical Data Quality Issues	Laboratory PM Resolution Consultants TOM Resolution Consultants Project Chemist Navy RPM	Brenda Martinez Claire Barnett Tina Cantwell Arne Olsen	225-769-4900 901-937-4425 901-397-4315 904-542-6159	The laboratory PM notifies (verbally or via e-mail) the Resolution Consultants chemist within 1 business day of when an issue related to laboratory data is discovered. Resolution Consultants chemist notifies Resolution Consultants TOM within 1 business day. Resolution Consultants chemist notifies the Resolution Consultants TOM verbally or via e-mail within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has been detected that could affect this project and/or other projects. Resolution Consultants TOM verbally advises the Navy RPM within 24 hours of notification from the project chemist. The Navy RPM takes corrective action that is appropriate for the identified deficiency. The Navy RPM, may at his discretion, contact the Navy QAO/Chemist for assistance in problem resolution. If there are significant data quality or non-useable data issues the Navy QAO/Chemist will be contacted to ensure the issues do not have the potential to impact other Navy projects.
Analytical Corrective Actions	Laboratory PM Resolution Consultants Chemist	Brenda Martinez Tina Cantwell	225-769-4900 901-397-4315	The laboratory shall notify the Resolution Consultants chemist of any analytical data anomaly within 1 business day of discovery. After the laboratory receives guidance from the Resolution Consultants chemist, the laboratory shall initiate any corrective action to prevent further anomalies.
Reporting Data Validation Issues/ Data Validation Corrective Actions	Resolution Consultants Project Chemist Resolution Consultants TOM	Tina Cantwell Claire Barnett	901-397-4315 901-937-4425	The Resolution Consultants project chemist/data validator, performing validation as specified in Worksheets #34, #35, and #36, will contact the laboratory as soon as possible if issues are found that require corrective action. If the Resolution Consultants project chemist/data validator identifies non-usable data that require corrective action, the Resolution Consultants TOM will coordinate with the project chemist to take corrective action appropriate for the identified deficiency to ensure the project objectives are met. Corrective action may include resampling and/or reanalyzing the affected samples, as determined by the TOM.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Notification of Non-Usable Data	Laboratory PM Resolution Consultants TOM Resolution Consultants Chemist Navy RPM TCEQ RPM U.S. EPA RPM	Brenda Martinez Claire Barnett Tina Cantwell Arne Olsen Allan Posnick Tara Hubner	225-769-4900 901-937-4425 901-397-4315 904-542-6159 512-239-2332 214-665-7246	If the laboratory determines that any data they have generated is non-usable, the Laboratory PM will notify (verbally or via e-mail) the Resolution Consultants project chemist within 1 business day of when the issue is discovered. The Resolution Consultants project chemist will notify (verbally or via e-mail) the Resolution Consultants TOM within 1 business day of the need for corrective action, if the non-usable data is a significant issue (i.e., critical sample data). Corrective action may include resampling and/or reanalyzing the affected samples. If the Resolution Consultants project chemist or data validator identifies non-usable data during the data validation process, the TOM will be notified verbally or via e-mail within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has resulted in non-usable data. The Resolution Consultants TOM will take corrective action appropriate for the identified deficiency to ensure the project objectives are met. The Resolution Consultants TOM will notify (verbally or via e-mail) the Navy RPM of any problems with the laboratory or analysis that could significantly affect the usability of the data or project failures that impact the ability to complete the scope of work. The Navy RPM, may at his discretion, contact the Navy project chemist for assistance in problem resolution. Such notification will be made within 1 business day of when the issue is discovered. The Navy RPM will notify the TCEQ and TCEQ RPMs when any significant corrective action is taken.

Notes:

RPM = Remedial project manager
TOM = Task order manager
POC = Point of contact
CWM = Chemical warfare material
HSM = Health and safety manager
TCEQ = Texas Commission on Environmental Quality
U.S. EPA = Environmental Protection Agency
RI/FS = Remedial Investigation/Feasibility Study
FTL = Field team leader
NAS = Naval Air Station
SSO = Site safety officer
MEC = Munitions and explosives of concern
SAP = Sampling and Analysis Plan
PM = Project manager
QAO = Quality Assurance officer

SAP WORKSHEET #7: PERSONNEL RESPONSIBILITIES TABLE

(UFP-QAPP Manual Section 2.4.3)

Name	Title/Role	Organizational Affiliation	Responsibilities
Arne Olsen	Remedial Project Manager/ Manages project activities for the Navy	Naval Facilities Engineering Command Southeast	Primary Point of Contact for the Navy. Oversees project implementation, including scoping, data review, and evaluation, on behalf of the Navy.
Ross Ybarra	Activity Point of Contact/ Oversees onsite project activities	Naval Air Station Corpus Christi	Point of Contact for base-specific activity. Oversees onsite activities.
Tara Hubner	Project Manager/ Regulatory Support	U.S. EPA Region 6	Functions as primary U.S. EPA interface. Participates in scoping and data review/evaluation, and provides review and approval of project deliverables.
Allan Posnick	Project Manager/ Regulatory Support	TCEQ	Functions as primary TCEQ interface. Participates in scoping and data review/evaluation, and provides review and approval of project deliverables.
Claire Barnett	Contractor Task Order Manager/ Manages project on a daily basis	Resolution Consultants	Primary point of contact for Resolution Consultants. Oversees project implementation, including financials, schedule, and technical aspects.
Ben Elliott	Contractor Project Engineer/ Manages project on a daily basis	Resolution Consultants	Secondary point of contact for Resolution Consultants. Assists in overseeing project implementation, including financials, schedule, and technical aspects.
Brett Hamby	Field Team Leader/Site Safety Officer/ Manages field operations and oversees site activities to ensure safety requirements are met	Resolution Consultants	Supervises, coordinates, and performs field activities. Responsible for onsite project-specific health and safety training and monitoring site conditions.
Tina Cantwell	Project Chemist/Quality Assurance Officer/Data Validation Manager/ Oversees quality and chemistry aspects of project	Resolution Consultants	As project chemist, prepares laboratory scopes of work, and coordinates laboratory related functions with laboratory. Performs or oversees data reviews and quality assurance of data validation deliverables. As quality assurance officer, ensures quality aspects of the project are implemented, documented, and maintained. As data validation manager, performs or oversees data validation and data input in both the project database and the Navy's Naval Installation Restoration Information Solution database.
John Knopf	Health and Safety Manager/ Oversees health and safety activities	Resolution Consultants	Oversees the Resolution Consultants Health and Safety Program.
Brenda Martinez	Laboratory Project Manager/ Analytical Subcontractor	Gulf Coast Analytical Laboratories	Oversees quality and technical aspects related to subcontracted analytical services.

Notes:
U.S. EPA = United States Environmental Protection Agency TCEQ = Texas Commission on Environmental Quality

SAP WORKSHEET #8: SPECIAL PERSONNEL TRAINING REQUIREMENTS TABLE

(UFP-QAPP Manual Section 2.4.4)

All field personnel will have appropriate training to conduct the field activities to which they are assigned. Each site worker will be required to have completed appropriate Hazardous Waste Operations and Emergency Response training specified in Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations 1910.120(e). Additionally, the field team leader will have the 30-hour OSHA Standards for Construction training.

SAP WORKSHEET #9: PROJECT SCOPING SESSION PARTICIPANTS SHEET

(UFP-QAPP Manual Section 2.5.1)

Project Name:	Remedial Investigation/Feasibility Study	**Site Name:** Gunnery Training Complex	
Projected Sampling Date(s):	Fall 2013	**Site Location:** NAS Corpus Christi, Texas	
Project Manager:	Claire Barnett, PE/Ben Elliott, PE — Project Engineer		
Date of Session:	27 June 2013		
Scoping Session Purpose:	Conceptual Site Model, Data Quality Objectives, and Sampling Design		

Name	Title/role	Affiliation	Phone #	E-mail Address
Arne Olsen	Remedial Project Manager	NAVFAC SE	904-542-6159	arne.olsen@navy.mil
Ross Ybarra	Lead Environmental Protection Specialist/ Point of Contact	NAS Corpus Christi NAVFAC SE, Public Works Department	361-658-2170	ross.ybarra@navy.mil
Allan Posnick	Remedial Project Manager	TCEQ — Corrective Action	512-239-2332	allan.posnick@tceq.texas.gov
Tara Hubner, PG	Remedial Project Manager	U.S. EPA Region 6	214-665-7246	hubner.tara@epa.gov
Ben Elliott, PE	Project Engineer	Resolution Consultants	512-635-4229	belliott@ensafe.com

Notes:

NAS = Naval Air Station
NAVFAC SE = Naval Facilities Engineering Command Southeast
TCEQ = Texas Commission on Environmental Quality
U.S. EPA = U.S. Environmental Protection Agency

Comments/Decisions:

A site walk though was conducted during the 28 November 2012 partnering meeting at NAS Corpus Christi. At the request of the Navy Remedial Project Manager, on 14 June 2013, Resolution Consultants issued Sampling and Analysis Plan (SAP) worksheets #10, #11, and #17 to the project team for review prior to the data quality objectives (DQO) scoping session. The DQO scoping session was held on 27 June 2013, at the NAS Corpus Christi partnering team meeting in Austin, Texas. At the DQO scoping meeting, the project team reviewed and discussed the conceptual site models, project quality objectives/systematic planning process statements, and sampling design and rationale. The TCEQ and U.S. EPA requested clarification on the approach to vertical delineation of potential contamination, particularly with respect to groundwater.

Action Items:

Resolution Consultants was tasked with completing the full SAP and submitting it to the project team for review. The SAP will address vertical delineation of potential contamination, including groundwater quality.

Consensus Decisions:

None

SAP WORKSHEET #10: CONCEPTUAL SITE MODEL

(UFP-QAPP Manual Section 2.5.2)

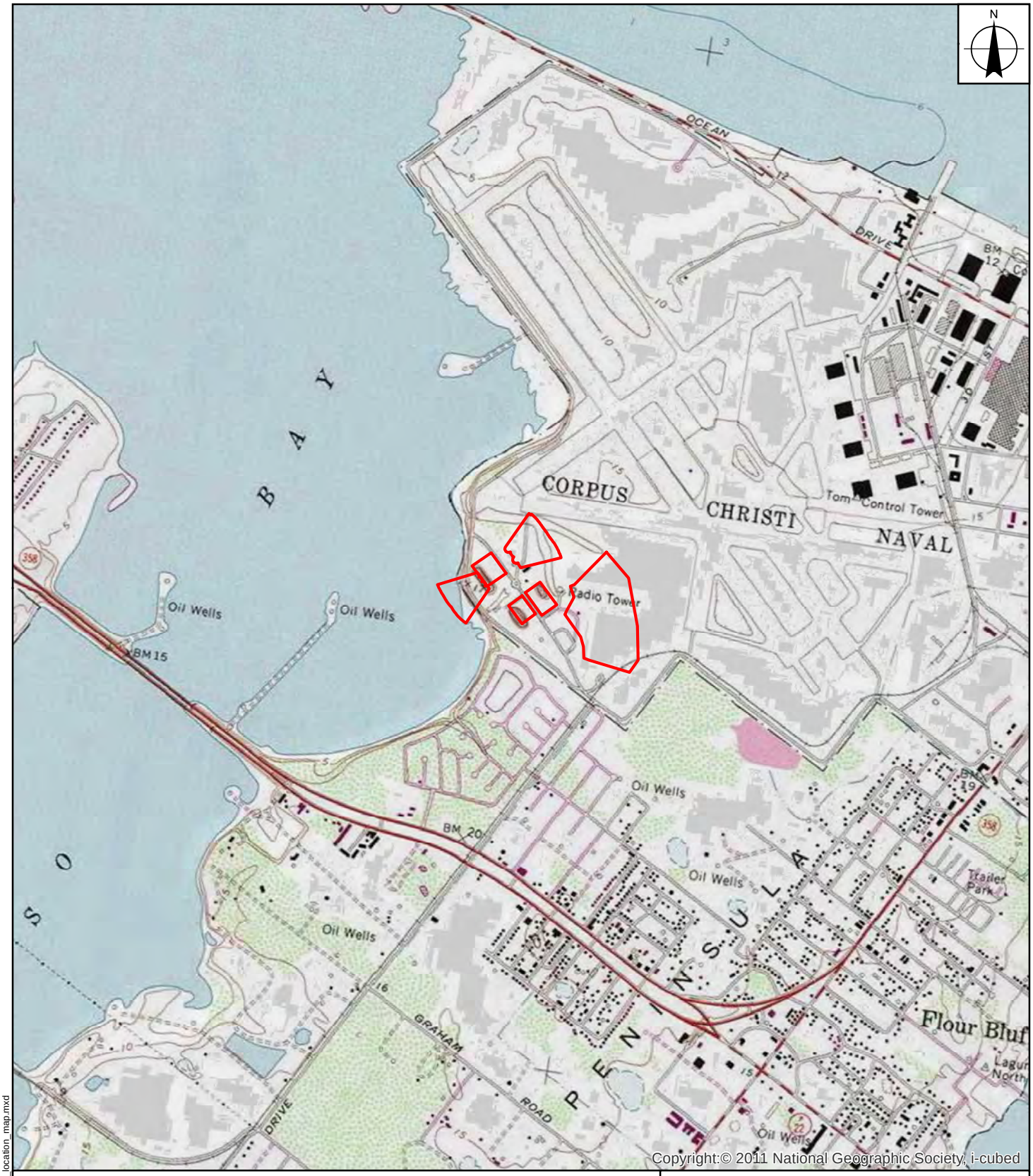
This worksheet presents a brief site description, history, and a conceptual site model (CSM) for former Gunnery Training Complex at Naval Air Station (NAS) Corpus Christi, Texas. The preliminary CSM, originally introduced in the Site Inspection (SI), describes potential contamination routes and possible exposure pathways to humans and ecological receptors, and serves as the basis for the Remedial Investigation (RI) sampling and analysis program. This preliminary CSM will be refined based on sampling results conducted during the RI. The RI objectives are to determine 1) the extent of impacted soil that poses a risk to human health and the environment and 2) whether the soil exhibits leaching potential for chemicals of potential concern (COPCs) to migrate to groundwater.

10.1 Site Location and History

NAS Corpus Christi is in Nueces County, Texas, and lies approximately 140 miles southeast of San Antonio and approximately 25 miles south of the former Naval Station Ingleside, across Corpus Christi Bay (Figure 10-1). The installation encompasses 2,844 acres and lies within the corporate bounds of the city of Corpus Christi. NAS Corpus Christi is situated on the northern end of the Encinal Peninsula and is bounded on three sides by water; Oso Bay lies to the west, Corpus Christi Bay to the north, and Laguna Madre to the east. A barrier island (Mustang Island) lies east of Laguna Madre and separates Corpus Christi from the Gulf of Mexico. Residential neighborhoods and State Highway 358 bound the installation on the south.

The former Gunnery Training Complex, constructed in July 1941, was in the southwestern corner of NAS Corpus Christi, south of the installation runways. The complex was used to train Naval Aviation cadets in aviation and gunnery, as well as provide small arms training and qualification for installation officers, enlisted men, and security forces. The complex, shown in Figure 10-2, contained the following small arms training ranges:

(1) Small Arms Range (SAR)
(2) Fixed Target Range (FTR)
(3) Air Blast and Synchronized Gun (AB/SYN) Range
(4) North Trap Range (NTR)
(5) South Trap Range (STR)
(6) Skeet Range (SKR)
(7) Closed Skeet Ranges (CSR)



Legend

Range Boundary

0 2,000 4,000 Feet

FIGURE 10-1
AREA LOCATION MAP
GUNNERY TRAINING COMPLEX
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: C. BARNETT	DATE: 4/2/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER: XXXX

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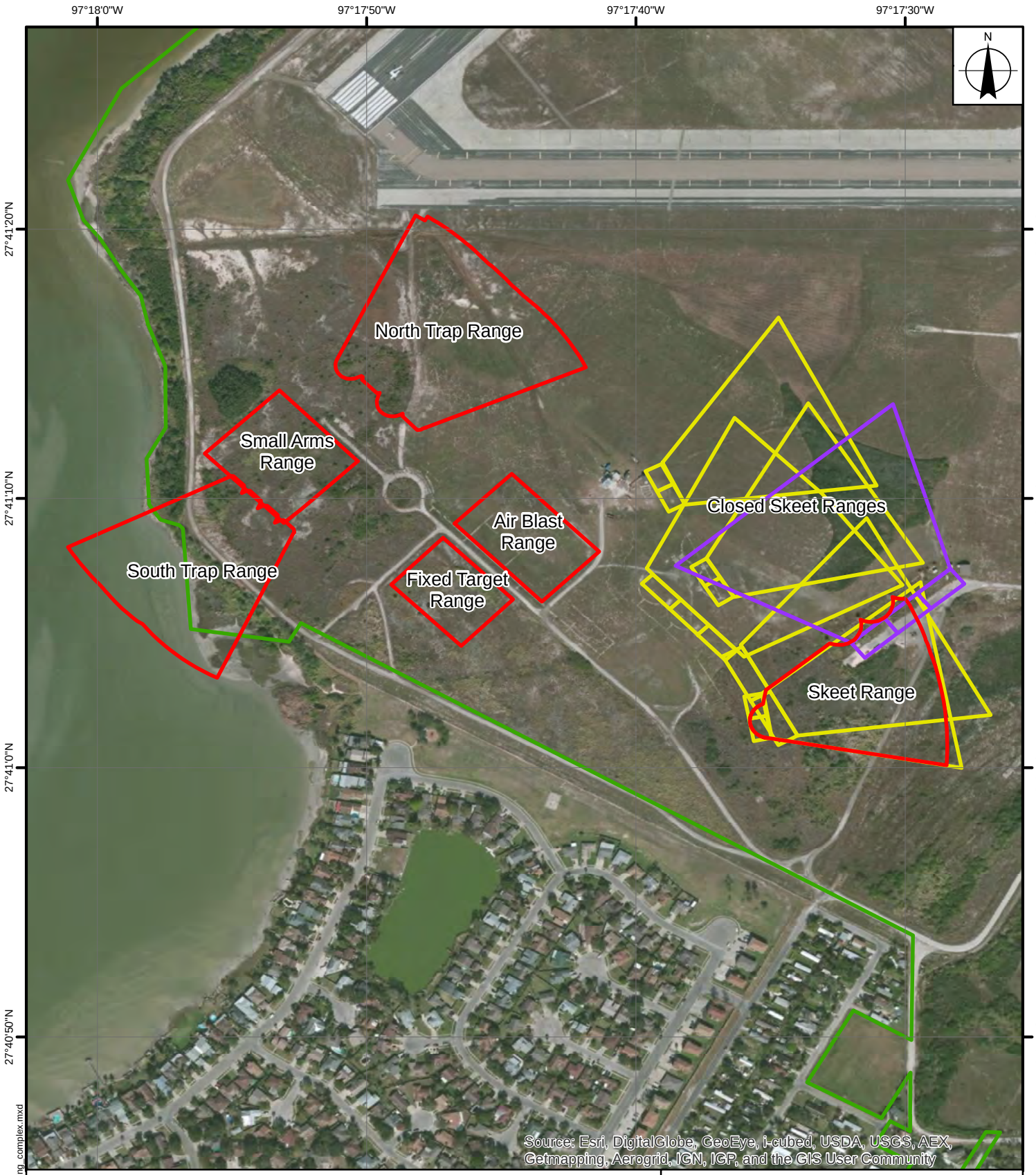

Legend

- Current Range
- Firing Range
- Former Range
- Installation Boundary

0 500 1,000 Feet

FIGURE 10-2
GUNNERY TRAINING COMPLEX
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: C. BARNETT	DATE: 4/2/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER: XXXX

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Note that the SKR was actually comprised of several different skeet and trap ranges, with separate locations and periods of operation. The majority of these skeet and trap ranges are included in the CSR. Also included at the former Gunnery Training Complex were three earthen berms, an armory, an instruction building and carpentry shop, a paint and oil shed, and three buildings devoted to chemical warfare training. The complex was constructed with a service road running down the center of the complex.

Currently, the former Gunnery Training Complex is bounded on the south and west by the installation patrol road (Perimeter Road) and fence. The fence separates the installation from a residential neighborhood to the south. Oso Bay lies to the west; a skeet range (formerly Sand Skeet Club and now closed) lies to the east. A TACAN aviation radar tower lies north of the complex; 1,000 feet beyond the tower are the runways.

10.2 Previous Investigations

Prior investigations at the site include:

- *Preliminary Assessment* (PA) (Malcolm Pirnie 2005) — The PA provided an assessment of the conditions with respect to munitions and explosives of concern (MEC) and munitions constituents (MC). According to the PA, there is no physical evidence of MEC at the former Gunnery Training Complex. The area is not currently used. Future use is not expected to change.

- *Site Inspection* (TetraTech [Tt] 2010) — The SI included sampling for polynuclear aromatic hydrocarbons (PAHs), nitroglycerin, and select metals (antimony, arsenic, copper, lead, tin, and zinc); found elevated soil concentrations exceeding screening levels; and concluded that a Remedial Investigation/Feasibility (RI/FS) was needed to determine the extent to which MC poses a risk to human health and the environment, and what remedies may be needed, if any.

10.3 Site Location, History, and Physical Features Fixed Target Range — FTR

The former FTR (Figure 10-2) was a World War II (WWII)-era training range located in the southwestern portion of the installation within the former NAS Corpus Christi Gunnery Department Training Complex.

FTR
Size — 1.8 acres
Former use — machine gun range, oriented SW
Primary elements — a covered shelter, eight tripod-mounted machine gun platforms, a series of fixed target sets of unknown composition, and a backstop earthen berm
Berm dimensions — 375 ft long x25 ft high
Angle of fire — 15 degrees, 24,600 ft downrange
Safety fan — ±25 degrees, 17,500 ft downrange
Total surface danger zone (SDZ) — 8,355 acres
Munitions — .30 caliber rounds

The FTR is flat, with a slight slope to the south, and no natural lakes, rivers, or streams are present on the FTR site. Historical documentation (station records and drawings) and NAS Corpus Christi personnel indicated that no other explosives or munitions were used at the site and the site was not used for any other purpose. The site boundary for the FTR encompasses the firing arc, target area, and impact area. There is no evidence of MEC at the FTR. The range was demolished by unknown means sometime after 1970, and the area is not currently used for military purposes. Current use is as open undeveloped land. Future use is not expected to change.

Potential or Known Contamination — FTR

At the firing points of the FTR, lead (from lead-based primers) and unburned smokeless powders (primarily containing nitroglycerin) may have accumulated in the surface soil as a result of ejection of unburned powders and lead from shotguns. Downrange of the firing points, metals (primarily lead and to a lesser extent antimony, arsenic, copper, tin, and zinc) may be present in surface soil.

During the SI, nitroglycerin in soil was found to be below Texas Risk Reduction Program (TRRP) Tier 1 $^{Tot}Soil_{Comb}$ Protective Concentration Levels (PCLs) and TRRP Tier 2 $^{GW}Soil_{Ing}$ PCLs. The SI demonstrated that the surface soil at the FTR was contaminated with lead and antimony at concentrations greater than the TRRP Tier 1 Residential PCLs, 0.5 acre total combined soil ($^{Tot}Soil_{Comb}$) and Tier 2 soil to groundwater ($^{GW}Soil_{Ing}$) PCLs (Figure 10-3). Because the horizontal and vertical extent of antimony and lead impacted soil was not delineated, the SI recommended that the FTR site proceed to the RI phase, in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) guidelines.

10.4 Site Location, History, and Physical Features North Trap Range — NTR

The former NTR (Figure 10-2) was a WWII-era training range located in the southwestern portion of the installation within the former NAS Corpus Christi Gunnery Department Training Complex.

The NTR is mainly flat, with a slight slope to the north and west toward a drainage swale that cuts across the eastern and northern portions of the range. There are no natural lakes, rivers, or streams present on the North Trap Range.

97°17'50"W

97°17'45"W

27°41'5"N

FTR-SS031 [0-1']

PARAMETER	RESULT	TIER 1 PCL
LEAD	1160	500

FTR-SS033 [0-1']

PARAMETER	RESULT	TIER 1 PCL
ANTIMONY	346	15
LEAD	6350	500

FTR-SS034 [0-1']

PARAMETER	RESULT	TIER 1 PCL
LEAD	1290	500

FTR-SS038 [0-1']

PARAMETER	RESULT	TIER 1 PCL
ANTIMONY	19.5	15
LEAD	4210	500

FTR-SS037 [0-1']

PARAMETER	RESULT	TIER 1 PCL
ANTIMONY	22.1	15
LEAD	3320	500

FTR-SS030 [0-1']

PARAMETER	RESULT	TIER 1 PCL
LEAD	778	500

FTR-SS032 [0-1']

PARAMETER	RESULT	TIER 1 PCL
ANTIMONY	29	15
LEAD	7120	500

FTR-SS041 [0-1']

PARAMETER	RESULT	TIER 1 PCL
LEAD	700	500

FTR-SS036 [0-1']

PARAMETER	RESULT	TIER 1 PCL
ANTIMONY	116	15
LEAD	4440	500

FTR-SS039 [0-1']

PARAMETER	RESULT	TIER 1 PCL
LEAD	842	500

FTR-SS039 [0-1'] - DUP

PARAMETER	RESULT	TIER 1 PCL
LEAD	855	500

FTR-SS047 [0-1']

PARAMETER	RESULT	TIER 1 PCL
LEAD	873	500

FTR-SS046 [0-1']

PARAMETER	RESULT	TIER 1 PCL
LEAD	1270	500

FTR-SS043 [0-1']

PARAMETER	RESULT	TIER 1 PCL
LEAD	639	500

54

55

Legend

- Exceedance of TRRP Tier 1 Total Soil Combined PCL
- No Exceedance
- Soil Sample Location
- Former Firing Line
- Fixed Target Range Boundary
- 54 Composite Sample, No Exceedances

Notes:
- All units are milligrams/kilogram
- FTR-SS030 [0-1'] Sample Identification and Depth Interval

1 inch = 50 feet

0 25 50 75 100 Feet

N

FIGURE 10-3
SI SOIL SAMPLE LOCATIONS
METAL EXCEEDANCES
FIXED TARGET RANGE
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: C. BARNETT	DATE: 4/15/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER: XXXXX

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The site boundary for the NTR encompasses the firing arc, target area, and impact area where the lead shot and broken clay targets would be found.

NTR
Size — 8.5 acres
Former use — trap range, oriented northeast
Primary elements — four wooden plank trap arcs facing to the northeast, a trap house centered in front of each arc, and a clay target storage house behind the firing arcs
Firing arc — 63-foot radius semi-circle (4 total)
Total SDZ — 37 acres
Munitions — small arms, primarily shotguns (12-, 16-, 20-gage, and .410 caliber ammunition)

Historical documentation (station records and drawings) and NAS Corpus Christi personnel indicated that no other explosives or munitions were used at the site and the site was not used for any other purposes. There is no evidence of MEC at the NTR. The runways at NAS Corpus Christi were expanded in 1953, and the range was most likely closed within this timeframe due to the construction in the area. The range was demolished sometime after May 1959, and the area is not currently used for military purposes. Current use is as open undeveloped land. Future use is not expected to change.

Potential or Known Contamination — NTR

At the firing points of the NTR, lead (from lead-based primers) and unburned smokeless powders (primarily containing nitroglycerin) may have accumulated in the surface soil as a result of ejection of unburned powders and lead from shotguns. Downrange of the firing points, metals (primarily lead and to a lesser extent antimony, arsenic, copper, tin, and zinc) and PAHs (from pitch tar used in the clay pigeon targets) may be present in surface soil.

During the SI, nitroglycerin in soil was found to be below TRRP Tier 1 $^{Tot}Soil_{Comb}$ PCL and TRRP Tier 2 $^{GW}Soil_{Ing}$ PCLs. PAHs, specifically benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene, were detected in surface soil composite samples and subsamples at concentrations greater than the TRRP Tier 1 $^{Tot}Soil_{Comb}$ PCL. However, all four PAHs are asphalt-related compounds. Based on the proximity to the road, the exceedances noted are attributable to pavement since no other locations away from the road appear affected (thus no release from historical operations). Therefore, the SI recommended no further action.

Lead was detected in one composite surface soil and one surface soil subsample at concentrations greater than the TRRP Tier 1 $^{Tot}Soil_{Comb}$ PCL (Figure 10-4); therefore, the SI recommended that the NTR site proceed to the RI phase, in accordance with CERCLA guidelines.

97°17'50"W

97°17'40"W

27°41'20"N

27°41'20"N

NTR-SS018 [0-1']

PARAMETER	RESULT	TIER 1 PCL
LEAD	563	500

NTR-SS018D [0-1']

PARAMETER	RESULT	TIER 1 PCL
LEAD	1030	500

Legend

- Exceedance of TRRP Tier 1 Total Soil Combined PCL
- No Exceedance
- Soil Sample Location
- Former Firing Line
- North Trap Range Boundary
- 1 — Sampling Grid and Grid Identification

Notes:
- All units are milligrams/kilogram
- NTR-SS018 [0-1'] Sample Identification and Depth Interval

Color Key:
- 18 = Exceedance of Tier 1 PCL
- 19 = No Exceedance

1 inch = 100 feet

0 100 200 Feet

N

FIGURE 10-4
SI SOIL SAMPLE LOCATIONS
METAL EXCEEDANCES
NORTH TRAP RANGE
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: C. BARNETT	DATE: 4/15/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER: XXXXX

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10.5 Site Location, History, and Physical Features South Trap Range — STR

STR
Size — 7 acres
Former use — trap range, oriented southwest
Primary elements — four wooden plank trap arcs facing to the northeast, a trap house centered in front of each arc, and a clay target storage house behind the firing arcs; a skeet house was also centered 50 yards in front of each firing arc
Firing arc — 63-foot radius semi-circle (4 total)
Total SDZ — 35 acres
Munitions — small arms, primarily shotguns (12-, 16-, 20-gage, and .410 caliber ammunition)

The former STR (Figure 10-2) was a WWII-era training range located on the southwestern side of the Training Complex. The STR is predominantly flat, with a slight slope to the south and west toward Oso Bay. There are no natural lakes, rivers, or streams present on the STR.

Historical documentation (station records and drawings) and NAS Corpus Christi personnel indicated that no other explosives or munitions were used at the site and the site was not used for any other purposes. There is no evidence of MEC at the STR. The site boundary for the STR encompasses the firing arc, target area, and impact area where the lead shot and broken clay targets would be found. The range was demolished after May 1959, and the area is not currently used for military purposes. Current use is as open undeveloped land. Future use is not expected to change.

Potential or Known Contamination — STR

At the firing points of the STR, lead (from lead-based primers) and unburned smokeless powders (primarily containing nitroglycerin) may have accumulated in the surface soil as a result of ejection of unburned powders and lead from shotguns. Downrange of the firing points, metals (primarily lead and to a lesser extent antimony, arsenic, copper, tin, and zinc) and PAHs (from pitch tar used in the clay pigeon targets) may be present in surface soil.

During the SI, nitroglycerin in soil was found to be below TRRP Tier 1 $^{Tot}Soil_{Comb}$ PCL and TRRP Tier 2 $^{GW}Soil_{Ing}$ PCLs. PAHs, specifically benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene, were detected in surface soil composite samples and subsamples at concentrations greater than the TRRP Tier 1 $^{Tot}Soil_{Comb}$ PCL. However, all five PAHs are asphalt-related compounds. Based on the proximity to the road, the exceedances noted are attributable to pavement since no other locations away from the road appear affected (thus no release from historical operations). Therefore, the SI recommended no further action.

Arsenic was detected in one composite surface soil sample at concentrations greater than the TRRP Tier 1 $^{Tot}Soil_{Comb}$ PCL. Copper was detected in one composite soil sample at concentrations greater than the TRRP Tier 1 $^{Tot}Soil_{Comb}$ PCL. Lead was detected in one composite soil sample and

one soil subsample at concentrations greater than the TRRP Tier 1 $^{Tot}Soil_{Comb}$ PCL and Tier 2 $^{GW}Soil_{Ing}$ PCL. Therefore, the SI recommended that the STR site proceed to the RI phase, in accordance with CERCLA guidelines. Figure 10-5 shows the SI soil sampling exceedances for metals.

10.6 Site Location, History, and Physical Features Closed Skeet Ranges — CSR

The former CSR (Figure 10-2) was a WWII-era training range located on the easternmost side of the Gunnery Department Training Complex. Comprised of five skeet firing arcs facing to the northeast situated end-to-end, the CSR consisted of approximately 17 acres. During the SI, the CSR was divided into two investigation areas: 1) the *Skeet Range*, described as 5.7 acres of the original skeet range that fell outside of the boundary of the Sands Skeet Club; and 2) the remaining *Closed Skeet Ranges*. Additional sampling in the Skeet Range is not necessary to assess remedial alternatives; therefore, this section focuses on the CSR.

CSR
Size — 17 acres
Former use — five skeet firing arcs, oriented northeast; relocated 100 ft to the north in 1973 and 400 feet to the east in 1982, each time with two new skeet arcs
Primary elements — a "high" skeet house on the left side of each arc, a "low" skeet house on the right side, and a trap house centered in front of each arc. Wooden fences, approximately 15 feet in height, separated each firing arc. Other structures: clay target storage houses, observation shelters.
Munitions — small arms, primarily shotguns (12-, 16-, 20-gage, and .410 caliber ammunition)
Total SDZ — 900-foot radius SDZ for each skeet arc)

The CSR is mainly flat, with a slight slope to the south. There are no natural lakes, rivers, or streams present on the CSR.

Historical documentation (station records and drawings) and NAS Corpus Christi personnel indicated that no other explosives or munitions were used at the site and the site was not used for any other purposes. There is no evidence of MEC at the CSR. The site boundary for the CSR encompasses the firing arc, target area, and impact area where the lead shot and broken clay targets would be found. The range was, after being relocated in 1973 and 1982, shut down in 2003. It was demolished on an unknown date, and the area is not currently used for military purposes. Current use is as open undeveloped land. Future use is not expected to change.

97°18'0"W

97°17'50"W

27°41'10"N

27°41'10"N

10

11

1

2

3

4

5

6

7

8

9

1A 1B 1C 1D 2A 2B 2C 2D 2E 3A 3B 3C 3D 4A 4B 4C 4D 4E 5A 5B 5C 5D 5E 6A 6B 6C 6D 6E 7A 7B 8A 8B 8C 8D 8E 9A 9B 9C

STR-SS009 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
ARSENIC	27	24
COPPER	1070	550
LEAD	1510	500

Legend

- Soil Sample Location
- Former Firing Line
- South Trap Range Boundary
- Installation Boundary
- 1 — Sampling Grid and Grid Identification

Notes:
- All units are milligrams/kilogram
- STR-SS009 [0-1'] Sample Identification and Depth Interval

Color Key:
- 9 = Exceedance of Tier 1 PCL
- 8 = No Exceedance

1 inch = 100 feet

0 50 100 150 200 Feet

N

FIGURE 10-5
SI SOIL SAMPLE LOCATIONS
METAL EXCEEDANCES
SOUTH TRAP RANGE
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: C. BARNETT	DATE: 4/15/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER: XXXXX

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Potential or Known Contamination — CSR

At the firing points of the CSR, lead (from lead-based primers) and unburned smokeless powders (primarily containing nitroglycerin) may have accumulated in the surface soil as a result of ejection of unburned powders and lead from shotguns. Downrange of the firing points, metals (primarily lead and to a lesser extent antimony, arsenic, copper, tin, and zinc) and PAHs (from pitch tar used in the clay pigeon targets) may be present in surface soil.

During the SI, nitroglycerin in soil was found to be below TRRP Tier 1 $^{Tot}Soil_{Comb}$ PCL and TRRP Tier 2 $^{GW}Soil_{Ing}$ PCL. PAHs, specifically benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene, were detected in surface soil composite samples and subsamples at concentrations greater than the TRRP Tier 1 T $^{Tot}Soil_{Comb}$ PCL (Figure 10-6).

Antimony and arsenic were detected in two composite surface soil samples at concentrations greater than TRRP Tier 1 $^{Tot}Soil_{Comb}$ and TRRP Tier 2 $^{GW}Soil_{Ing}$ PCLs. Lead was detected in 12 composite surface soil samples and one surface soil subsample at concentrations greater than TRRP Tier 1 $^{Tot}Soil_{Comb}$ and TRRP Tier 2 $^{GW}Soil_{Ing}$ PCL. Figure 10-7 shows the SI soil sampling exceedances for metals.

Due to the elevated PAHs and metals concentrations exceeding screening levels, the SI recommended that the CSR site proceed to the RI phase, in accordance with CERCLA guidelines.

10.9 Site Geology and Hydrogeology

No borings have been completed at the former Gunnery Training Complex to depths deeper than 12 inches; therefore, subsurface information is not complete. However, available data from the PA (Malcolm Pirnie 2005) and SI (Tt 2010) suggest the following regional lithology:

The coastal plain of the Corpus Christi area is underlain by Pleistocene river, delta, and shoreline sediments deposited during the interglacial periods. NAS Corpus Christi is underlain by the Beaumont Formation, characterized by barrier islands and beach deposits composed of fine grained sands. Numerous pimple mounds and poorly defined relic beach ridges characterize the land surface. Locally active sand dunes are present in undisturbed areas. The barrier island and beach deposits of the Beaumont Formation are typically less than 60 feet thick. Other stratigraphic units, in order of increasing age, include the Montgomery Formation, Lissie Formation, Willis Formation, and the Goliad Sand. (Malcolm Pirnie 2005).

97°17'40"W 97°17'30"W 97°17'20"W

27°41'10"N

CSR-SS026 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
BENZO (A) ANTHRACENE	12.4	5.7
BENZO (A) PYRENE	18	0.56
BENZO (B) FLUORANTHENE	11.2	5.7
INDENO (1,2,3-CD) PYRENE	7.56	5.7

CSR-SS019 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
BENZO (A) PYRENE	3.7	0.56

CSR-SS025 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
BENZO (A) ANTHRACENE	85.5	5.7
BENZO (A) PYRENE	79.5	0.56
BENZO (B) FLUORANTHENE	102	5.7
DIBENZO (A,H) ANTHRACENE	12.8	0.55
INDENO (1,2,3-CD) PYRENE	47.2	5.7

CSR-SS018 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
BENZO (A) ANTHRACENE	26.2	5.7
BENZO (A) PYRENE	31	0.56
BENZO (B) FLUORANTHENE	44.4	5.7
DIBENZO (A,H) ANTHRACENE	6.25	0.55
INDENO (1,2,3-CD) PYRENE	21.6	5.7

CSR-SS012 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
BENZO (A) ANTHRACENE	46.3 J	5.7
BENZO (A) PYRENE	50 J	0.56
BENZO (B) FLUORANTHENE	69.8 J	5.7
DIBENZO (A,H) ANTHRACENE	11.8	0.55
INDENO (1,2,3-CD) PYRENE	40.4 J	5.7

CSR-SS012 [0-1'] - DUP **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
BENZO (A) ANTHRACENE	84.3 J	5.7
BENZO (A) PYRENE	91.7 J	0.56
BENZO (B) FLUORANTHENE	126 J	5.7
DIBENZO (A,H) ANTHRACENE	21.5	0.55
INDENO (1,2,3-CD) PYRENE	77.5 J	5.7

CSR-SS006 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
BENZO (A) ANTHRACENE	50.1 J	5.7
BENZO (A) PYRENE	55.7 J	0.56
BENZO (B) FLUORANTHENE	83.3 J	5.7
DIBENZO (A,H) ANTHRACENE	14.9 J	0.55
INDENO (1,2,3-CD) PYRENE	50.3 J	5.7

CSR-SS006 [0-1'] - DUP **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
BENZO (A) PYRENE	6.3 J	0.56
BENZO (B) FLUORANTHENE	9.39 J	5.7
DIBENZO (A,H) ANTHRACENE	2.15 J	0.55
INDENO (1,2,3-CD) PYRENE	5.93 J	5.7

CSR-SS005 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
BENZO (A) PYRENE	6.53 J	0.56

CSR-SS004 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
BENZO (A) PYRENE	4.82 JL	0.56

CSR-SS003 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
BENZO (A) PYRENE	0.878 J	0.56

CSR-SS002 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
BENZO (A) PYRENE	1.88	0.56
DIBENZO (A,H) ANTHRACENE	0.887	0.55

CSR-SS001 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
BENZO (A) ANTHRACENE	16.1	5.7
BENZO (A) PYRENE	21.6	0.56
BENZO (B) FLUORANTHENE	34.2	5.7
DIBENZO (A,H) ANTHRACENE	5.74	0.55
INDENO (1,2,3-CD) PYRENE	17.6	5.7

27°41'0"N

X:\Navy\NAS_Corpus_Christi\mxd\1_csr_path.mxd

Legend

- Soil Sample Location
- Former Firing Line
- Skeet Range
- Current Range
- Former Range
- 1 Sampling Grid and Grid Identification

Notes:
- All units are milligrams/kilogram
- CSR-SS006 [0-1'] Sample Identification and Depth Interval

Color Key:
- 12 = Exceedance of Tier 1 PCL
- 13 = No Exceedance

1 inch = 200 feet

0 200 400 Feet

N

FIGURE 10-6
SI SOIL SAMPLE LOCATIONS
PAH EXCEEDANCES
CLOSED SKEET RANGES
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: C. BARNETT	DATE: 4/15/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER: XXXXX

97°17'40"W

97°17'30"W

97°17'20"W

27°41'10"N

27°41'0"N

CSR-SS033 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
LEAD	666	500

CSR-SS036 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
LEAD	35700	500
ANTIMONY	609	15
ARSENIC	134	24

CSR-SS028 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
LEAD	506	500

CSR-SS021 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
LEAD	684	500

CSR-SS015 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
LEAD	616	500

CSR-SS032 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
LEAD	868	500

CSR-SS031 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
LEAD	744	500

CSR-SS027 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
LEAD	946	500

CSR-SS020 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
LEAD	1060	500

CSR-SS004 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
LEAD	47600	500
ANTIMONY	1600	15
ARSENIC	577	24

CSR-SS014 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
LEAD	616	500

CSR-SS002 [0-1'] **COMPOSITE**

PARAMETER	RESULT	TIER 1 PCL
LEAD	509 JL	500

Legend

- Exceedance of TRRP Tier 1 Total Soil Combined PCL
- No Exceedance
- Soil Sample Location
- Former Firing Line
- Current Range
- Former Range
- Skeet Range
- 1 Sampling Grid and Grid Identification

Notes:
- All units are milligrams/kilogram
- CSR-SS002 [0-1'] Sample Identification and Depth Interval

Color Key:
- 36 = Exceedance of Tier 1 PCL
- 13 = No Exceedance

1 inch = 200 feet

0 200 400 Feet

N

FIGURE 10-7
SI SOIL SAMPLE LOCATIONS
METAL EXCEEDANCES
CLOSED SKEET RANGES
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: C. BARNETT	DATE: 4/15/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER: XXXXX

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According to the PA, depth to groundwater at NAS Corpus Christi ranges from 4 to 16 feet below ground surface (bgs), although in the vicinity of the former Gunnery Training Complex, it ranges from 8 to 16 feet bgs. The shallow groundwater zone is subject to saltwater intrusion due to the three bays surrounding NAS Corpus Christi. The water table aquifer (to approximately 250 feet bgs) is predominantly sandy material overlying a low permeability clay zone. Regional groundwater flow is to the northeast; however, at the former Gunnery Training Complex, groundwater flow is west toward Oso Bay. Total dissolved solids in groundwater near the former Gunnery Training Complex range from 300 to 11,000 milligrams per Liter; there are no identified users of the shallow groundwater zone. Artesian aquifers underlying NAS Corpus Christi (250 to 2,800 feet bgs) are moderately to highly saline; potential use is limited. NAS Corpus Christi obtains potable water from Lake Corpus Christi, 40 miles northwest of the installation. (Malcolm Pirnie 2005).

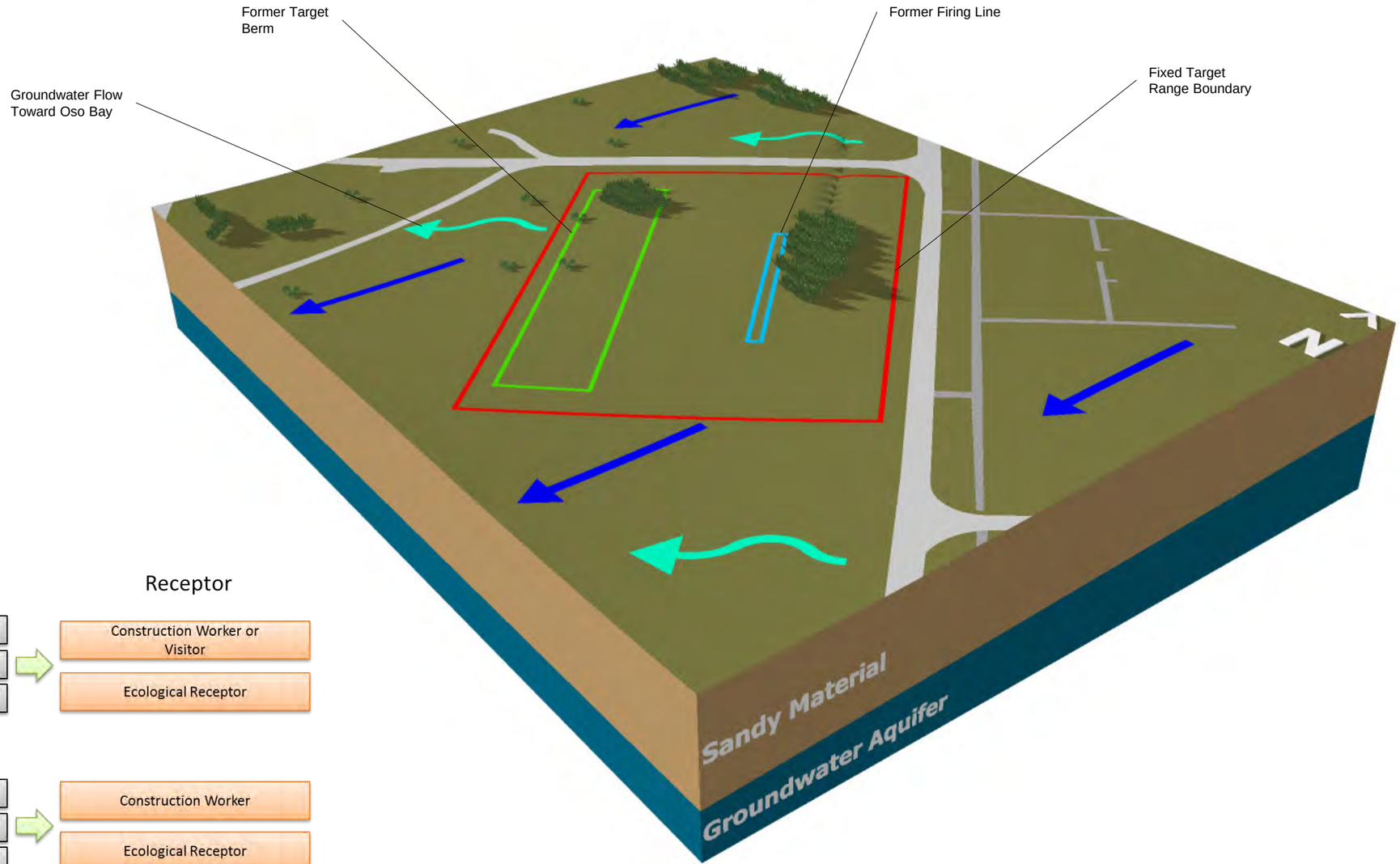
The *Final Affected Property Assessment Report Installation Restoration Sites 1, 3, and 4 and Building 8* (EnSafe 2001) classified the shallow aquifer at NAS Corpus Christi as a Class 3 groundwater resource based on the *Draft-Final Aquifer Characterization Report, Building 8* (EnSafe/Allen & Hoshall 1996) and the Potential Receptor Survey conducted during the Affected Property Assessment.

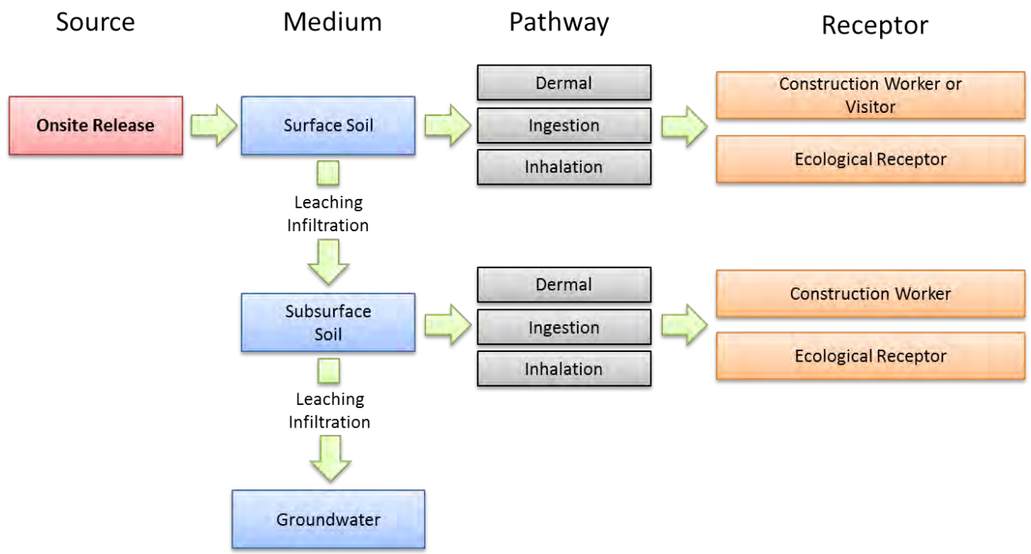
During the SI, soil samples were collected at depths ranging from 1 to 3 feet bgs, with most samples being from the 0 to 1 foot bgs interval. Generally, the lithology of the soil consisted of gray to tan very fine grained silty to clayey sand. Groundwater was not encountered during the SI.

10.10 Conceptual Site Models — All Ranges

The information presented in the preceding sections was used to develop the former Gunnery Training Complex CSMs shown on the following figures:

- Figure 10-8 Fixed Target Range
- Figure 10-9 North Trap Range
- Figure 10-10 South Trap Range
- Figure 10-11 Closed Skeet Ranges





Component Credits: Low Shrubs, XYZ Visualizations; bush, Stefevr

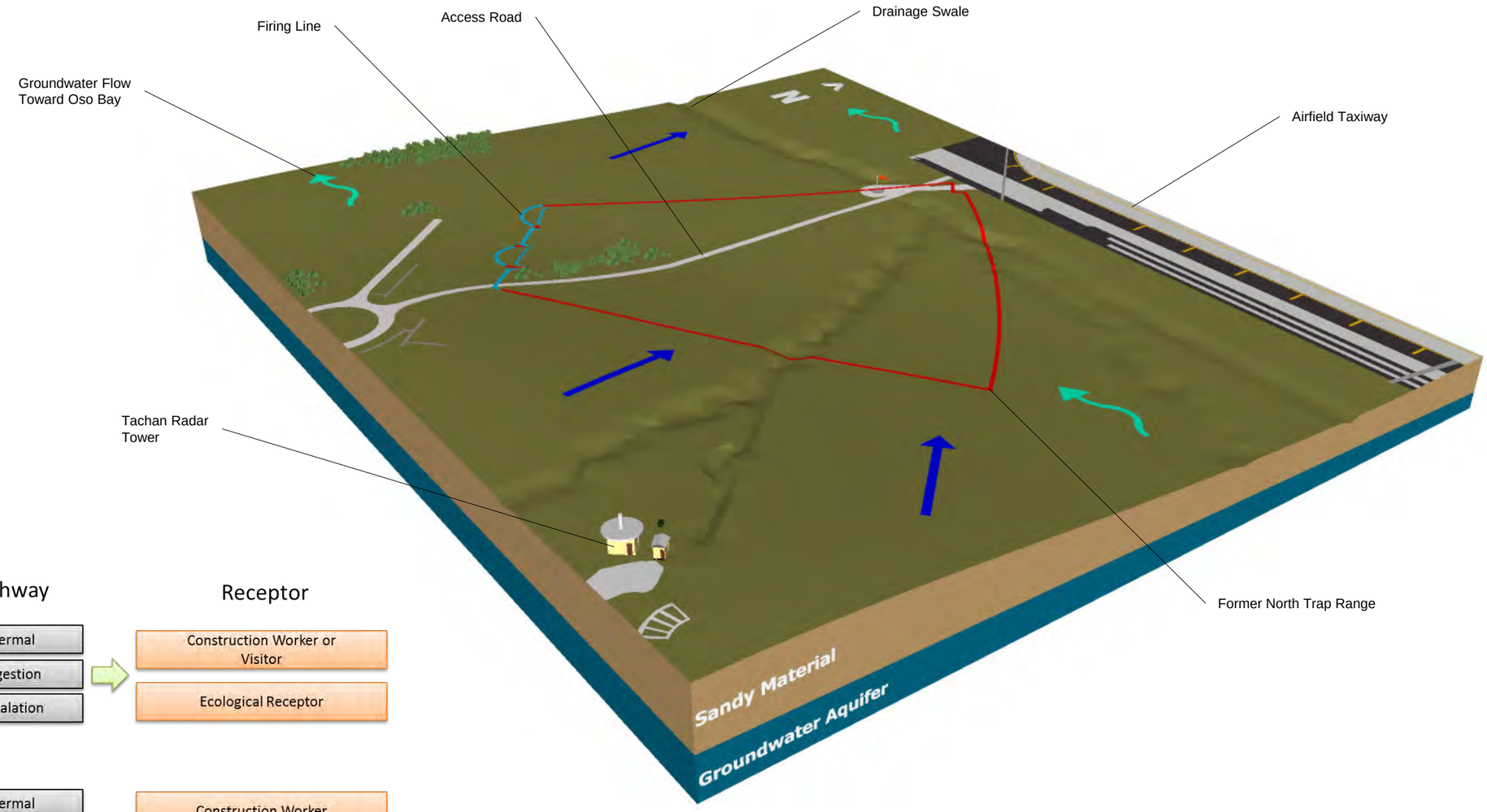
Legend

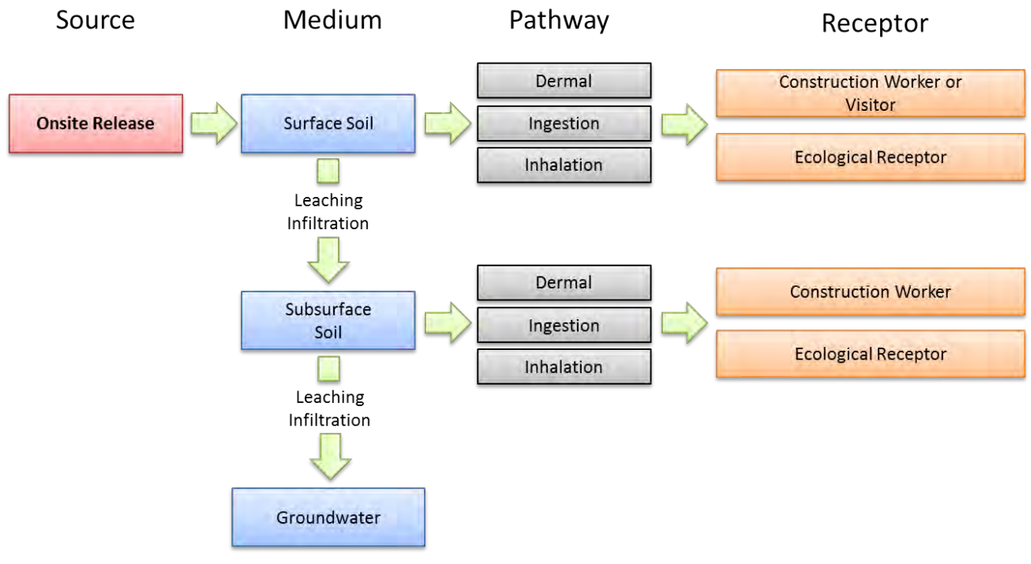
- Groundwater Flow
- Surface Flow
- Approximate Fixed Target Range Boundary
- Approximate Former Firing Line
- Approximate Former Target Berm

FIGURE 10-8
CONCEPTUAL SITE MODEL
FIXED TARGET RANGE
NAS CORPUS CHRISTI
CORPUS CHRISTI, TX

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: C. BARNETT	DATE: 03/26/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER:





Component Credits: Low Shrubs, XYZ Visualizations; bush, Stefevr; Windsock, vidicious

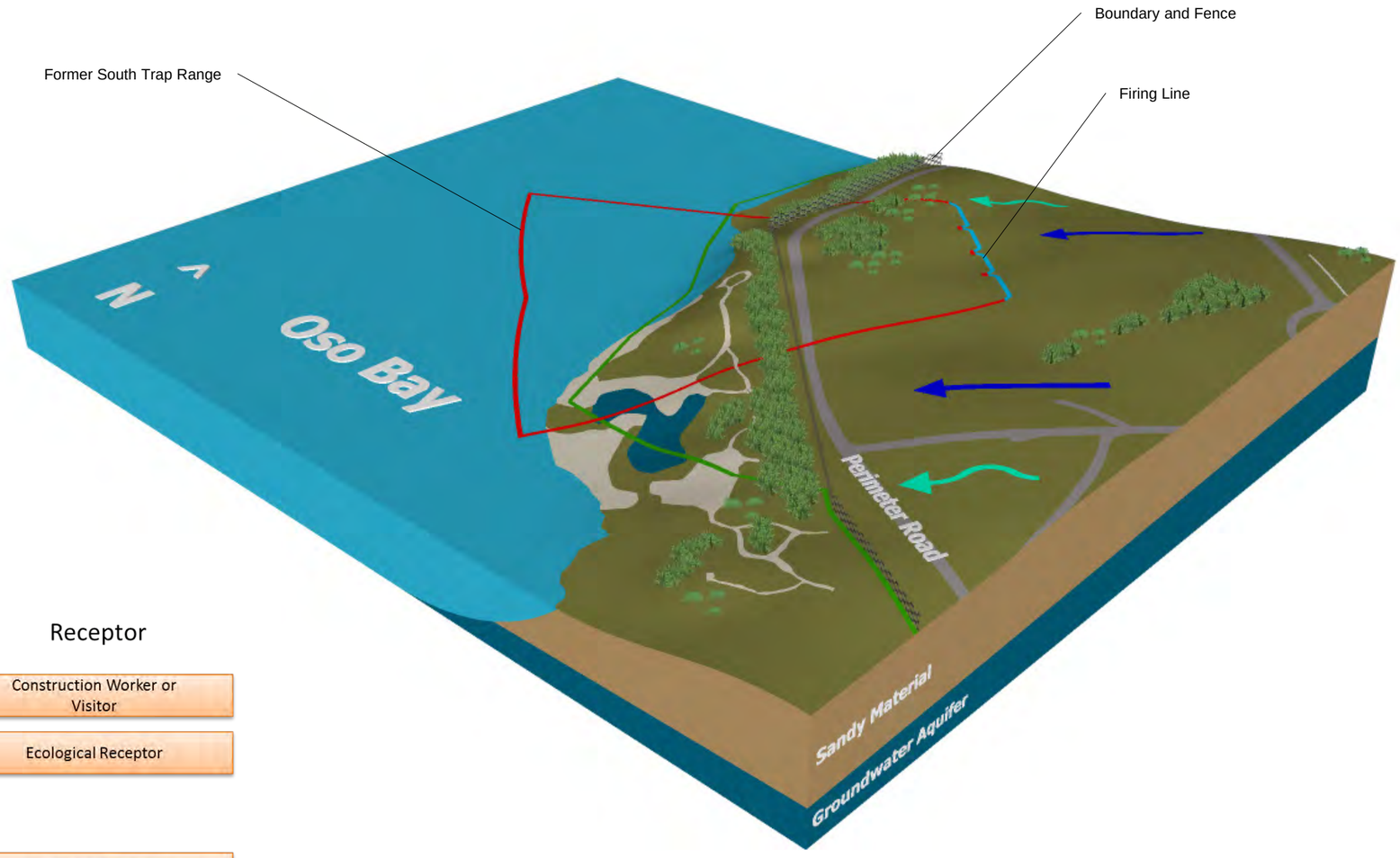
Legend

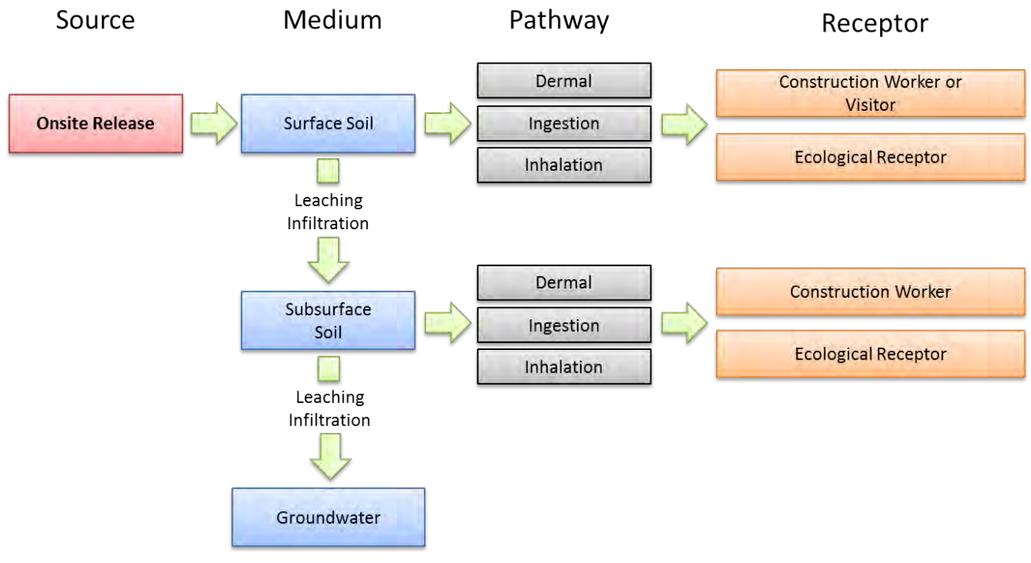
- Approximate Former Firing Line
- Approximate North Trap Range Boundary
- Groundwater Flow
- Surface Flow

FIGURE 10-9
CONCEPTUAL SITE MODEL
NORTH TRAP RANGE
NAS CORPUS CHRISTI
CORPUS CHRISTI, TX

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: C. BARNETT	DATE: 03/26/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER:





Component Credits: bush, Stefevr; Low Shrubs, XYZ Visualizations

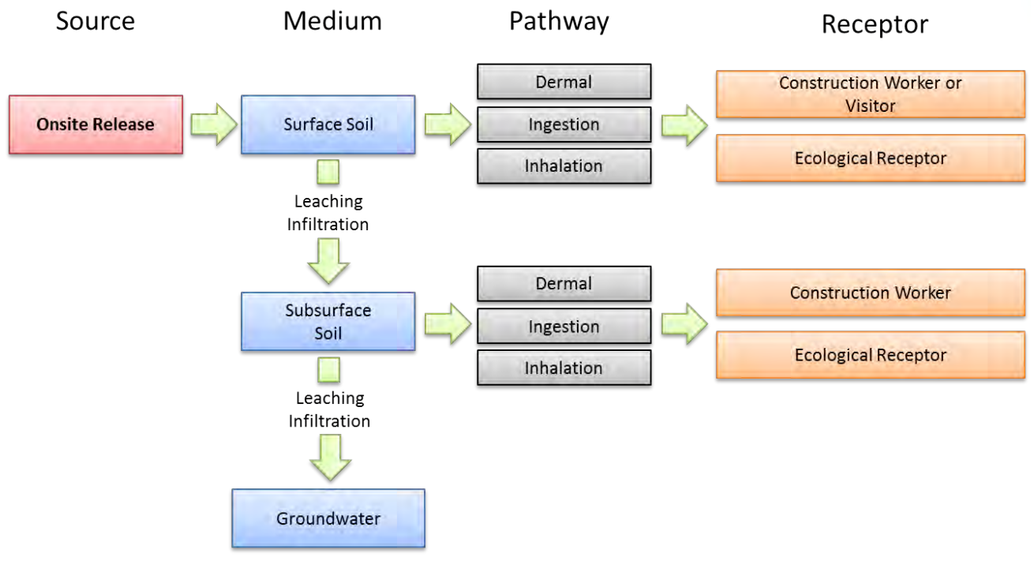
Legend

- Approximate Former Firing Line
- Approximate Installation Boundary
- Groundwater Flow
- Surface Flow
- Approximate South Trap Range Boundary

FIGURE 10-10
CONCEPTUAL SITE MODEL
SOUTH TRAP RANGE
NAS CORPUS CHRISTI
CORPUS CHRISTI, TX

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: C. BARNETT	DATE: 03/26/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER:



Component Credits: Low Shrubs, XYZ Visualizations; bush, Stefevr; Windsock, vidicious; tree, amilagroso

Legend

- Groundwater Flow
- Surface Flow
- Approximate Former Firing Line
- Approximate Current Range Boundary
- Approximate Former Range Boundary
- Approximate Skeet Range Boundary

FIGURE 10-11
CONCEPTUAL SITE MODEL
CLOSED SKEET RANGES
NAS CORPUS CHRISTI
CORPUS CHRISTI, TX

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: C. BARNETT	DATE: 03/26/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER:

10.10.1 Nature and Extent — Data Gaps

As discussed above, constituents were identified in the SI at four sites above TRRP PCLs, but extent was not fully delineated. These are summarized in Table 10-1.

Table 10-1
Nature and Extent Data Gaps from the SI
Constituents Detected above PCLs

Site	Metals	Polycyclic Aromatic Hydrocarbons	Munitions Constituents
FTR	Lead, antimony	None	Below PCLs
NTR	Lead	Not Applicable [a]	Below PCLs
STR	Arsenic, copper, lead	Not Applicable [a]	Below PCLs
CSR	Antimony, arsenic, lead	benzo(a)anthracene benzo(a)pyrene benzo(b)fluoranthene dibenzo(a,h)anthracene indeno(1,2,3-cd)pyrene	Below PCLs

Notes:
PCLs = Protective concentration levels
[a] = PAHs were associated with asphalt paving materials, and not recommended for further evaluation in the RI

X-ray fluorescence (XRF) was used to delineate metals during the SI, with 85 percent correlation for the former Gunnery Training Complex as a whole. However, some of the sampling proposed in the RI to delineate data gaps will address areas with poor correlation.

Additional sampling, described in Worksheet#17, is required to delineate nature and extent for metals and PAHs.

10.10.2 Migration Pathways — All Ranges

As a result of lead in surface soil, a potential risk exists to human health. Lead in surface soil could potentially migrate to subsurface soil and sediment via surface water flow. Clay pigeons may be a potential source of PAHs to soil and sediment via surface water runoff.

Lead in surface soil could also potentially infiltrate to the shallow water-bearing zone based on exceedances of the TRRP soil to groundwater PCL. However, the likelihood for migration to groundwater was determined to be low in the SI (Tt 2010) given the soil's cation-exchange capacity, pH, and total organic carbon. The potential PAH migration from soil to groundwater is also low considering PAHs' low solubility and affinity for soils.

Further evaluation of soil-to-groundwater leachability is an objective of the RI.

10.10.3 Receptors, Exposure Pathways, and Future Land Use — All Ranges

Current human receptors include Navy personnel that may use the site, construction or maintenance workers, Navy-escorted visitors (e.g., contractors conducting environmental or ecological surveys), and trespassers (e.g., authorized personnel who may wander outside of designated areas). The facility's current land uses are expected to remain unchanged in the near future. Therefore, the following human health exposure scenarios will be evaluated during the risk assessment, consistent with current and projected land use:

- Construction/maintenance worker
- Visitor/trespasser

Residential exposures are not considered a reasonable land use, given the proximity of the former ranges to the airfield.

Potential ecological receptors include terrestrial plants and invertebrates, birds, and mammals. Ecological receptors may be exposed through direct contact with or ingestion of contaminated media, as well as through the food chain (i.e., by ingesting plants and animals that have been impacted through uptake of soil contaminants). Site habitats will be characterized using TCEQ's Tier 1 Ecological Exclusion Criteria Checklist to assess whether viable ecological receptors are present.

SAP WORKSHEET #11: PROJECT QUALITY OBJECTIVES/SYSTEMATIC PLANNING PROCESS STATEMENTS

(UFP-QAPP Manual Section 2.6.1)

11.1 Problem Statement

Results generated during the Site Inspection (SI) indicate that soil was impacted by site constituents (antimony, arsenic, copper, lead, and polynuclear aromatic hydrocarbons [PAHs]); however, the current dataset is insufficient to determine the extent of impacted soil that poses a risk to human health and the environment and assess whether soil contamination has the potential to leach to groundwater.

11.2 Goals of the Study

The goal of the Remedial Investigation/Feasibility (RI/FS) is to further evaluate the nature and extent of impacted soil and assess potential risk to human health and the environment. To fill data gaps identified in the SI, additional soil samples will be collected and analyzed for antimony, arsenic, copper, lead, and PAHs in areas that exceeded screening levels in two intervals: extent samples in surface soil at in the 0- to 1-foot below ground surface (bgs) interval and vertical delineation samples in the 1- to 2-foot bgs interval. Findings will provide information to determine if additional investigation is required, establish a sound basis for remedial decision-making, or to request no further action. Supplemental data will also be collected to further assess soil-to-groundwater leachability.

Principal study questions (PSQs), developed to define decision statements to resolve the problem, are as follows:

- PSQ1: Do concentrations in soil exceed human health project action levels (PALs), resulting in the need for further evaluation via human health risk assessment (HHRA)?

- PSQ2: Do sufficient ecological receptors exist at the site or in the immediate vicinity, resulting in the need for further evaluation via ecological risk assessment?

- PSQ3: Contingent on responses to PSQ1 and PSQ2, do chemicals of potential concern (COPC) concentrations in soil pose unacceptable risks to human health and/or ecological receptors, thus requiring follow-up action?

- PSQ4: Do locations with the highest soil concentrations exhibit leaching potential, thus indicating the potential for COPCs to mobilize to groundwater?

Based on these PSQs, the following project decision statements have been developed:

- Assess whether COPCs in soil exceed PALs.

- Identify the presence of ecological receptors; if identified, supplemental sampling may be necessary (not currently included in Worksheet #17).

- Evaluate whether COPCs in soil pose an unacceptable risk to human health or ecological receptors (if present) and therefore, require corrective action.

- Assess the potential for COPCs to mobilize from soil to groundwater.

Analytical data and other information collected during both the SI and RI field investigations will be used to address the above-stated PSQs and project decision statements.

11.3 Information Inputs to Resolve the Problem

The inputs needed to resolve the project problem statement identified in Section 11.1 include the following measurements, observations, data, and PALs as described below. Details of the sampling design are presented in Worksheet #17.

- Chemical Data: Soil will be sampled for select metals (antimony, arsenic, copper, and lead) and PAHs to supplement the existing dataset to determine if target analytes are present. The concentrations of any detected target analytes will be compared to their respective PALs as part of the risk evaluation to support the decision making process. Historical soil chemical data (SI data) will be used in the evaluation.

- Soil-to-Groundwater Evaluation Parameters: To allow development of site-specific Tier 2 protective concentration levels (PCLs), if it is determined appropriate for any of the ranges in the former Gunnery Training Complex, total organic carbon (TOC) and pH will be determined for a subset of select soil samples at each site. Tier 2 PCLs will be calculated in accordance with 350 Texas Administrative Code (TAC) Subchapter D.

In addition, as a supplemental line of evidence regarding the potential for contaminant migration from soil to groundwater, the Synthetic Precipitation Leaching Procedure (SPLP) analysis will be performed for select metals (antimony, arsenic, copper, and lead) and PAHs at the highest concentration locations in each small arms range being assessed by the RI field investigation. These data are necessary for fate and transport evaluations.

- Ecological Checklist and Screening Risk Assessment: Site habitats will be characterized using the Texas Commission on Environmental Quality's (TCEQ's) Tier 1 Ecological Exclusion Criteria Checklist to determine if ecological communities at the site and in the nearby surrounding area could be affected by site activities and if the impact could have an adverse effect at a community- or population-level. Such information will be considered in determining the need for a Screening Risk Assessment (SRA). The results of the SRA (if required) will determine the need for conducting a Baseline Ecological Risk Assessment.

- Sample Location Data: Sample location horizontal coordinates and vertical depths will be measured for use in mapping each location so that data can be analyzed and presented in a spatial context. Horizontal coordinates of each sample location will be determined by Global Positioning System, which will allow for future reacquisition of the locations if further investigation or remedial action is necessary.

- Geologic Information: Historical information onsite-specific geology obtained during the previous SI activities will be supplemented during the RI/FS through observations made during soil boring activities. Onsite geologists/engineers will use the Unified Soil Classification System to thoroughly describe soil characteristics.

- Project Action Limits: This RI/FS requires laboratory data be compared to screening values so that appropriate decisions can be made. Laboratory quantitation limits must be low enough to measure COPC concentrations equal to or less than the applicable screening values. Chemical data will be compared to PALs, as detailed on Worksheet #15, as an initial screening value to assess site COPCs. The PAL hierarchy and sources are as follows.

  — Human Health (Direct Exposure Evaluation): Soil analytical results will be evaluated against: 1) Texas-Specific Soil Background Concentrations (where applicable);

2) Texas Risk Reduction Program (TRRP) Tier 1 commercial/industrial PCLs (June 2012), 0.5 acre total combined soil ($^{Tot}Soil_{Comb}$); and 3) Tier 1 soil to groundwater ($^{GW}Soil_{Class3}$), 0.5 acre PCLs for Class 3 groundwater. As previously discussed, site-specific parameters (pH and TOC) may be used in the Tier 2 equations to develop site-specific PCLs for further evaluation of the data.

— Ecological: Soil analytical results will be evaluated using Ecological Screening Benchmarks from the *Update to Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas RG-263 (Revised)*, (January 2006), Table 3-4 Ecological Benchmarks for Soil. Typically, the table lists benchmarks for earthworms and plants; the lower of these values will be used for the ecological screening. Table 3-4 also lists the median Texas background concentration for most metals. Where the median background is higher than the benchmark, the background value will be used in the evaluation in accordance with the guidance document. According to the TCEQ website, the *Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas* is currently under revision; before performing the ecological risk evaluation, Resolution Consultants will confirm whether the updated guidance document is available and use it as applicable.

— Soil-to-Groundwater Pathway: SPLP analytical results from all four ranges will be compared to TRRP Tier 1 Commercial/Industrial Screening Levels (June 2012) for Class 3 groundwater ($^{GW}GW_{Class3}$). SPLP analytical results from the South Trap Range (adjacent to Oso Bay) also will be compared to Texas Aquatic Life Surface Water Risk-Based Exposure Limits for saltwater, chronic criteria (2011). The SPLP evaluation will be used as a supplemental line of evidence regarding the potential soil to groundwater migration pathway.

- Risk Assessments: Previously collected SI data will be used along with the newly collected RI data to determine the nature and extent of COPCs and to assess risk to human and ecological receptors at the Fixed Target Range, North Trap Range, South Trap Range, and Closed Skeet Range. These risk assessments will be conducted in accordance with U.S. Environmental Protection Agency (U.S. EPA) protocols and Navy guidance documents for HHRAs and ecological risk assessments (if performed).

11.4 Boundaries for the Study

The populations of interest for soil are the soils that have been contaminated either directly (by site operations) or indirectly (by subsequent migration of contaminants), as documented in the SI Report. An investigation of groundwater underlying the site and surface water in adjoining water bodies is beyond the scope of this investigation but may be required in the future based, in part, on the results of this investigation.

The horizontal study boundary for the RI will encompass each area that, based on the SI Report, was impacted by site activities. Lateral expansion of this horizontal study boundary is necessary where COPCs were identified above screening levels to further characterize the extent of contamination for remedy selection.

The vertical study boundary for soil in the SI was limited to 1 foot. The vertical boundary for the RI is extended to include the 1- to 2-foot interval bgs to determine whether COPCs have migrated downward. Typically, the COPCs for the former Gunnery Training Complex, (antimony, arsenic, copper, lead, and PAHs) tend not to migrate to a significant depth. Therefore, for the purpose of this RI, the direction of contact soil risk assessment will be based on concentrations to a maximum depth of 2 feet. The exposure unit represented by the exposure point concentrations will be the entire volume of contaminated soil, divided as necessary to allow separate evaluations of the two sampling intervals, 0- to 1-foot and 1- to 2-feet.

Temporal boundaries are not a significant consideration in this study because concentrations are anticipated to be relatively unchanged (stable) over the course of time needed to conduct the environmental investigations and into the foreseeable future; therefore, no temporal constraints exist.

11.5 Analytical Approach

The RI will address data gaps and assess potential threats to human health and the environment at the former Gunnery Training Complex. Biased sampling locations will be collected within, and as necessary to delineate contamination, the exterior of the suspected contaminated areas based on the SI. Sampling locations may be adjusted based on field observations and professional judgment.

Initial determinations on the need for follow-up action will be based on whether analytical data exceed PALs. Prior to implementing decision rules, risk managers will review the analytical data, human health and ecological screening results, and effective pathways to determine if the site poses any unacceptable risk. The resulting decision rules are summarized below.

Decision Rule 1: If a COPC at a sampling point exceeds its human health soil PAL, then that sampling point will be considered within the extent of contamination. Concentrations of COPCs below human health PALs will be considered outside of the extent of contamination and No Further Action will be recommended.

Decision Rule 2: If a COPC at a sampling point exceeds its human health soil PAL, then an HHRA will be performed to determine if unacceptable risks are present. If a COPC at a sampling point is below its acceptable human health risk level, then No Further Action is required to evaluate risks to human health.

Decision Rule 3: If the ecological checklist and resulting scientific management decision indicate the presence of sufficient ecological habitat, then an ecological SRA will be performed to determine if unacceptable risk is present.[1] If the ecological checklist and/or SRA, along with the resulting scientific management decision do not indicate the presence of sufficient ecological habitat, then No Further Action is required to evaluate ecological risks.

Decision Rule 4: If the results of the HHRA or SRA (if required) indicate a soil COPC presents an unacceptable risk to human health and/or environment, then follow-up action may be required. Conversely, if results of the risk assessment indicate that soil COPCs do not present an unacceptable risk for human health and/or environment, then No Further Action will be recommended.

Decision Rule 5: If soil concentrations exhibit leaching potential for COPCs to mobilize to groundwater, then evaluate of the need for groundwater investigation; otherwise, do not recommend a groundwater investigation be initiated on the basis of soil concentrations.

[1] Supplemental sampling may be necessary to further characterize receptors if a Baseline Ecological Risk Assessment is needed. If required, sampling will be scoped upon completion of the Screening Risk Assessment.

11.6 Performance Criteria

The objective of this section is to complete the following:

- Identify potential sources of study error (i.e., field error, analytical error)
- Establish and identify the methods used to reduce potential sources of error
- Determine how decision errors will be managed during the project

Sampling Strategy — The soil sampling design was developed to further characterize contaminant concentrations historically detected in soil at the site. Biased sampling will be used to collect soil from additional locations to fill data gaps for decision making purposes. This sampling approach was determined to be the most appropriate due to the availability of previous sampling data at the site.

Sources of Error — Sources of error in the RI may be divided into two main categories: sampling errors and measurement errors. A sampling error occurs when the sampling design, planning, and implementation do not provide for a representative range of heterogeneity at the site. A measurement error occurs because of performance variance from laboratory instrumentation, analytical methods, and operator error. The U.S. EPA identifies the combination of all these errors as a "total study error" (U.S. EPA 2006). One objective of the investigation is to reduce the total study error so that decision-makers can be confident that the data collected accurately represent the chemical characteristics of the site.

Managing Decision Error — The investigation will utilize decision-error minimization techniques in sampling design, sampling methodologies, and laboratory measurement of COPCs. Possible decision errors will be minimized during the field investigation by using the following methods:

- Use standard field sampling methodologies (as discussed in Worksheets #18 and #21).

- Use applicable analytical methods and standard operating procedures (SOPs) for sample analysis by a competent analytical laboratory having Texas National Environmental Laboratory Accreditation Program accreditation, and be accredited through the Department of Defense Environmental Laboratory Accreditation Program.

- Confirm analytical data to identify and control potential laboratory error and sampling error by using spikes, blanks, and replicated samples.

Decision errors associated with judgmental sampling are based on sample design and measurement errors. Assuming that the best possible professional judgment was used to develop the biased sampling plan (i.e., sampling locations positions), the most important decision errors will be associated with field and laboratory techniques involved in the collection and analysis of the data.

Sampling Methodologies and Procedures

Possible decision errors generated by sampling errors will be minimized during the field investigation by applying standardized field sampling methodologies (discussed in Worksheets #18, #20, #21, and #22). Sampling activities will be performed in accordance with the SOPs specified in this Sampling and Analysis Plan.

Field Data Logs — All sample information will be transcribed into a field logbook and/or onto field data sheets.

Analytical Laboratory Sample Management — The sample matrix, number of samples, and number and type of laboratory quality assurance/quality control samples are summarized in the worksheets #18, #19, #20, and #30. Also included on this combined worksheet are details on the analytical group, sample volumes, sample container specifications, preservation requirements, and maximum and holding times.

The laboratory will provide electronic data deliverable files, portable document format files of the data deliverables for all project data, and a hard copy of data deliverables for all results. Designated samples will be used to obtain necessary subsamples for laboratory quality control measurements (i.e., analytical sample duplicate and sample matrix spike/matrix spike duplicate). Tasks will be completed using the laboratory SOPs.

Resolution Consultants will provide data validation services and verify and evaluate the usability of the data as described in Worksheets #34 through #36.

Portable document format copies of all analytical data packages will be stored on CD-ROM, archived in the NAVFAC Atlantic Administrative Record, and uploaded onto the Naval Installation Restoration Information Solution system at the close of the project. All other data generated in the field and reports generated for the project will be stored as computer readable data files by Resolution Consultants.

11.7 Sampling Design

Non-statistical methods (professional judgment), based on historical sampling locations, will be used as the primary basis for the sampling design. This approach was chosen to identify the extent of specific COPCs and assess whether or not an impact to human or ecological receptors has occurred. The sample design, rationale, and locations are presented in summarized in Worksheets #17 and #18. These worksheets identify where soil samples will be collected and the analyses to be conducted for each sample.

SAP WORKSHEET #12: FIELD QUALITY CONTROL SAMPLES

(UFP-QAPP Manual Section 2.6.2)

Measurement Performance Criteria Table — Field QC Samples				
QC Sample	**Analytical Group**	**Frequency**	**Data Quality Indicators**	**Measurement Performance Criteria**
Equipment Rinsate Blanks	PAHs and select metals (antimony, arsenic, copper, and lead)	One per matrix per sampling event [1]	Accuracy/Bias/ Contamination	No analytes > ½ µ, except common lab contaminants, which must be < LOQ
Field Duplicates	PAHs and select metals (antimony, arsenic, copper, and lead)	One per 10 field samples	Precision	Values > 5X LOQ: RPD must be ≤30 (aqueous); ≤50 (solids)[2].
Matrix Spike/Matrix Spike Duplicate	PAHs and select metals (antimony, arsenic, copper, and lead)	One pair per 20 field samples	Accuracy/Bias/ Precision	Percent recoveries — DoD QSM Limits RPD must be ≤ 30 (PAHs) RPD must be ≤ 20 (metals)
Cooler Temperature Indicator	All	One per cooler	Representativeness	Temperature less than 6 degrees Celsius

Notes:

[1] Equipment rinsate blanks will be collected if decontamination is required and will not apply if dedicated equipment is used.

[2] If duplicate values are less than five times the LOQ, the absolute difference should be less than or equal to two times the LOQ.

QC = Quality control
PAHs = Polynuclear aromatic hydrocarbons
LOQ = Limit of Quantitation
RPD = Relative Percent Difference
DoD QSM = *Department of Defense Quality Systems Manual for Environmental Laboratories*, Version 4.2, October 2010 or the most recent version at the time of sampling.

SAP WORKSHEET #13: SECONDARY DATA CRITERIA AND LIMITATIONS TABLE

(UFP-QAPP Manual Section 2.7)

Secondary Data Criteria and Limitations Table				
Secondary Data	**Data Source (originating organization, report title and date)**	**Data Generator(s) (originating organization, data types, data generation / collection dates)**	**How Data Will Be Used**	**Limitations on Data Use**
Historical Background Information	*Final Preliminary Assessment, Naval Air Station Corpus Christi, Texas,* April 2005	*Originating Organization*: Malcolm Pirnie, Inc. *Data Types*: Background information *Data Collection Dates*: 2005	Background information was used in planning of the sampling effort	None
Historical Background Information	*Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) for Small Arms Ranges, Naval Air Station Corpus Christi, Texas,* 1 November 2009	*Originating Organization*: Tetra Tech NUS, Inc. *Data Types*: Background information *Data Collection Dates*: 2009	Background information was used in planning of the sampling effort	None
Historical Background Information, Conceptual Site Model, Conclusions and Recommendations, Analytical Data	*Site Inspection Report for the Gunnery Training Complex, Naval Air Station Corpus Christi, Texas,* July 2010	*Originating Organization*: Tetra Tech NUS, Inc. *Data Types*: Background information, conceptual site model, analytical data, findings and recommendations *Data Collection Dates*: 2010	Background information, current conceptual site model, and findings and recommendations were used in planning of the sampling effort. Analytical data will be used during the Remedial Investigation/Feasibility Study to assess potential risk and remedial decisions.	None

SAP WORKSHEET #14: SUMMARY OF PROJECT TASKS

(UFP-QAPP Manual Section 2.8.1)

The following project tasks are summarized below:

- Field Tasks
- Analytical Tasks
- Data Management and Review
- Project Report

Field Tasks

Mobilization/Demobilization — Mobilization includes procurement of field equipment and supplies; a Site walkover; mobilization of field staff, equipment, and supplies to the Site; and Site set-up. The Navy Remedial Project Manager (RPM) and Naval Air Station (NAS) Corpus Christi point of contact (POC) will be notified of Resolution Consultants' mobilizations a minimum of 1 week before the start of field activities.

A field team orientation meeting will be conducted prior to starting the fieldwork to familiarize the team personnel with the Site-specific health and safety requirements, the objectives and scope of the field activities, and chain-of-command. This meeting will be attended by the field staff and conducted by the Field Team Leader (FTL).

Demobilization includes removing field equipment and supplies from the site, returning rented equipment, managing investigation-derived waste (IDW), performing general site cleanup, organizing and finalizing field paperwork, and entering field records/data into the database.

Utility Clearance — The Resolution Consultants FTL will coordinate verbally or via e-mail with NAS Corpus Christi POC at least seven days in advance of the site access to initiate the utility clearance process for all intrusive sampling locations. The Resolution Consultants FTL will contact both the Texas 811 utility locator service and NAS Corpus Christi POC verbally or via e-mail at least three days prior to commencement of field work to complete a utility clearance ticket for the areas under investigation.

Utilities that are identified in the field, but not shown or incorrectly located on the work approval documentation, will be marked directly on the document and returned to the NAS Corpus Christi POC for inclusion in the Geographic Information System database.

Soil Sampling — Soil samples (0-1 foot below ground surface [bgs] and 1-2 feet bgs) will be collected using a stainless steel spoon, trowel, hand auger, or disposable sampler in accordance with Standard Operating Procedure (SOP)-3-21. The areas to be sampled will be cleared of any surface debris (i.e., leaves, twigs). Larger debris items such as twigs, roots, or stones are removed from the sample prior to transfer to the appropriate sample container. All soil samples will be collected as discrete grab samples. After sampling, each borehole will be backfilled to within 6 inches of grade using soil cuttings removed from the borehole. The numbers and types of samples to be collected at each site along with associated analytical programs are presented in Worksheets #17, #18, and #19. Sample handling will be in accordance with SOP-3-03A and SOP-3-04A.

Ecological Receptor Survey/Checklist — A field survey of potential ecological receptors will be conducted within a 0.5-mile radius of each range to properly evaluate ecological risk. The Texas Environmental Commission on Environmental Quality (TCEQ) Tier I ecological exclusion criteria checklist will be used to assess whether or not further ecological evaluation is necessary. This checklist will aid in determining whether there are incomplete or insignificant ecological exposure pathways due to the nature of the affected property setting and/or the condition of the affected property media. The TCEQ Tier I ecological exclusion checklist is in Appendix A.

Field Documentation Procedures — Field documentation will be performed in accordance with Resolution Consultants SOP-3-02. Sample collection information will be recorded in bound field notebooks or specific field forms. Samples will be packaged and shipped according to Resolution Consultants SOP-3-04A.

A summary of field activities will be properly recorded in indelible ink in a bound logbook with consecutively numbered pages that cannot be removed. Logbooks will be assigned to field personnel and stored in a secured area when not in use.

All entries will be written in indelible ink, and no erasures will be made. If an incorrect entry is made, striking a single line through the incorrect information will make the correction; and the person making the correction will initial and date the change. Boring logs, sampling forms, and other field forms will also be used to document field activities.

Surveying —Soil sampling locations will be marked in the field using a wooden stake or brightly colored pin flag. Coordinates of each sample location will be determined by Global Positioning System, in accordance with SOP-3-07.

Field Quality Control Tasks — Field quality control (QC) samples will be collected as part of each sample round, including field duplicates, matrix spikes, and matrix spike duplicates, and equipment rinsate blanks (if sampling tools are decontaminated in the field). Worksheet #20 presents the field QC sample summary.

Decontamination — Non-disposable equipment that comes into contact with the sample medium will be decontaminated to prevent cross-contamination between sampling points. Decontamination of sampling equipment will not be necessary for dedicated and disposable samplers. Decontamination of reusable sampling equipment (e.g., non-disposable spoons and hand augers) will be conducted prior to sampling and between samples at each location. The decontamination procedures in SOP-3-06 will be followed.

Investigation-Derived Waste — Solid or liquid decontamination fluids will be generated during field activities. To the extent possible, soil removed during sampling activities but not included in the sample volume shipped to the laboratory for analysis will be replaced into the boring from which it was removed.

If non-disposable equipment is used to collect soil samples, liquid IDW decontamination fluids will be handled in accordance with Resolution Consultants SOP-3-05TX. All aqueous IDW will be containerized in drums provided by the NAS Corpus Christi Public Works Department. The Public Works Department will pick up the filled drums and stage them at the designated waste accumulation area to await waste characterization analyses. Based on waste characterization results, the drummed IDW will be transported and appropriately disposed at a Navy-approved offsite disposal facility coordinated through the NAS Corpus Christi Public Works Department. Used personal protective equipment will be bagged and disposed of as regular trash in an appropriate facility waste container.

Analytical Tasks

To support the environmental decisions, the analytical laboratory will hold and maintain current National Environmental Laboratory Accreditation Program (NELAP) accreditation in Texas. In addition, the laboratory will be accredited through the Department of Defense Environmental Laboratory Accreditation (DoD ELAP). The laboratory analytical data packages will contain summary forms, raw data, laboratory review checklists and exception reports and will comply with TCEQ's *Regulatory Guidance for Review and Reporting of Chemical of Concern Concentration Data under TRRP* (RG-366/TRRP-13 May 2010).

Chemical analyses will be performed by Gulf Coast Analytical Laboratories (GCAL) who holds accreditation from both the Texas NELAP and DoD ELAP. Analyses will be performed in accordance with the analytical methods identified in Worksheet #19 and the laboratory will strive to meet the project quantitation limit goals specified in Worksheet #15. GCAL will perform the chemical analyses following laboratory-specific SOPs identified in Worksheet #23. Full laboratory SOPs are available upon request.

The laboratory will report soil results on a dry-weight basis. Results of percent moisture will be reported in each analytical data package and associated electronic data deliverable (EDD) files. This information will also be captured in the project database, which will eventually be uploaded to the Naval Installation Restoration Information Solution (NIRIS) database.

Data Management and Review

The principal data generated for this project will be from field data and laboratory analytical data. The field forms, chain of custody, air bills, and logbooks will be placed in the project files after the completion of the field program. The field logbooks for this project will be used only for this site, and will also be categorized and maintained in the project files after the completion of the field program. All project records will be maintained in a secure location.

Data Tracking — The Resolution Consultants Task Order Manager (TOM), or designee, is responsible for the overall tracking and control of data generated for the project. Data are tracked from generation to archiving in the project specific files. The project chemist, or designee, is responsible for tracking the samples collected and shipped to the contracted laboratory. Upon receipt of the data packages from the analytical laboratory, the project chemist will oversee the data validation effort, which includes verifying that the data packages are complete and that results for all samples have been delivered by the analytical laboratory.

Resolution Consultants shall submit all Administrative Record Files, Site Files, and Post Decision Files in accordance with the specifications defined in the NAVFAC *Environmental Restoration Recordkeeping Manual* (NAVFAC, 2009). Additionally, Resolution Consultants will update and manage the project related documents, data, and maps in NIRIS. Project related spatial data including maps, models, and associated collected or created data will also be uploaded into NIRIS. All documentation submittals for NIRIS will be coordinated with the Navy RPM.

Data Storage, Archiving, and Retrieval — After the data are validated, the data packages are entered into the Resolution Consultants file system and archived in secure files. The field records including field logbooks, sample logs, chain-of-custody records, and field calibration logs will be submitted by the Resolution Consultants FTL to be entered into the file system before archiving in secure project files. Project files are audited for accuracy and completeness. Project files will be kept in a secured, limited access area. At the completion of the Navy contract, files will be shipped to the Federal Records Center for storage where the files will remain until 50 years after the last decision document for NAS Corpus Christi.

Data Security — Access to Resolution Consultants project files is restricted to designated personnel only. The Resolution Consultants data manager maintains the electronic data files, and access to the data files is restricted to qualified personnel only. File and data backup procedures are routinely performed.

Electronic Data — Laboratory data, provided in electronic format, will be verified for accuracy prior to use and during the data validation process. After data are validated, the electronic data results will be uploaded into the Resolution Consultants database for use in data evaluation and subsequent report preparation. The project database will be on a password protected secure network and access to changing data files will be restricted to qualified personnel. The Resolution Consultants TOM (or designee) is responsible for the overall tracking and control of data generated for the project. All final electronic data and administrative records will be compiled uploaded into NIRIS for final repository.

Data Review and Validation — After receipt of analytical laboratory results, Resolution Consultants will verify data completeness as specified on Worksheet #34. To ensure that the analytical results meet the project quality objectives, the laboratory data will undergo verification and validation as cited in Worksheets #34 through #36 and described below. The usability assessment processes are described in Worksheet #37.

Prior to data validation, electronic laboratory data will be verified for accuracy against the hardcopy laboratory report and the electronic quality assurance project plan (eQAPP) will be established using the project-specific criteria defined in Worksheets #12, #19, and #28. The laboratory will be requested to resubmit electronic data found to be inaccurate.

During the data validation process, the Resolution Consultants Data Validation Assistant (DVA) tool will be used to review method accuracy and precision data from field and laboratory QC samples contained in the laboratory EDD and qualify that data according to the project-specific eQAPP. The DVA tool uses the power of EarthSoft's EQuIS relational database to assemble a series of Excel worksheets into a DVA workbook for the validator that present:

- Data validation QC elements that need review, compared to control limits stored in the project-specific eQAPP.
- Associated sample results for duplicated samples and blanks.
- A place to make the necessary qualifications and result updates directly into an electronic format documentation of qualifications using coded reasons.
- A list of all samples affected by the qualification.

Laboratory calibration will be assessed against the criteria presented in Worksheet #24 using the hardcopy laboratory report and the results of these findings will be added to the Excel DVA workbook. The DVA workbook ultimately serves as an EDD to update the project database with the validator's changes. Using standard EQuIS tools that check and load data, qualifiers and edits are directly uploaded to the database, thereby eliminating the manual data entry process and allowing for 100 percent of data to be reviewed prior to uploading to the project database.

Screening Risk Assessment — The screening level risk assessment will include an evaluation of direct exposure of community-level receptors (e.g., plants, fish) to maximum detected concentrations of constituents in surface soil and will include food-web modeling with up to four higher trophic-level wildlife receptors (e.g., raccoon, heron). In addition, consistent with the Navy guidance *Reviewing Ecological Risk Assessment Deliverables* (July 2004), a conceptual site model will be completed including a description of site habitat, ecological resources and ecological problem formulation.

Project Reports

Resolution Consultants will compile, review, and evaluate available data, conduct risk assessments, and produce a Remedial Investigation (RI) Report. If, during data evaluation, additional information is required to complete the RI process, Resolution Consultants will prepare recommendations for the Navy to fill data gaps as a modification to this Sampling and Analysis Plan. The RI Report will be prepared as an inclusive document for prior field investigations (i.e., the Site Inspection). Report elements will include a summary of field efforts, deviations from the work planning documents (if any), data tables and figures, comprehensive discussion of the nature and extent of contamination, and all other standard Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/Navy requirements for RI Reports, and conclude whether additional action(s) are warranted or if a no further action determination can be made.

After the RI report is completed, a Feasibility Study (FS) and remedial alternatives analysis report will be prepared. This document will serve to frame the remedy selection and identify optimization opportunities. The overall objective of the FS report will be to develop and evaluate potential remedies that permanently and significantly reduce the hazard/threat to public health, welfare, and the environment using criteria established by CERCLA for remedy selection.

SAP WORKSHEET #15: REFERENCE LIMITS AND EVALUATION TABLES

(UFP-QAPP Manual Section 2.8.1)

Matrix:	Soil							
Analytical Group:	Polynuclear Aromatic Hydrocarbons							
Analyte	**CAS No.**	**Project Action Level (HH) (mg/kg)**	**Project Action Level (ECO) (mg/kg)**	**Project Action Level Source**	**Project Quantitation Limit Goal (mg/kg)**	**LOQ[1] (mg/kg)**	**LOD[1] (mg/kg)**	**MDL[1] (mg/kg)**
2-Methylnaphthalene	91-57-6	17.077	—	TX $^{GW}Soil_{Ing}$	5.7	0.00333	0.00333	0.00105
Acenaphthene	83-32-9	236.37	20	TX Eco RG-263	6.7	0.00333	0.00165	0.00083
Acenaphthylene	208-96-8	408.66	—	TX $^{GW}Soil_{Ing}$	140	0.00333	0.00165	0.00053
Anthracene	120-12-7	6,889.84	—	TX $^{GW}Soil_{Ing}$	2,300	0.00333	0.00165	0.00023
Benzo[a]anthracene	56-55-3	5.65	—	TX $^{Tot}Soil_{Comb}$	1.9	0.00333	0.00165	0.00067
Benzo[a]pyrene	50-32-8	0.56	—	TX $^{Tot}Soil_{Comb}$	0.19	0.00333	0.00165	0.00040
Benzo[b]fluoranthene	205-99-2	5.71	—	TX $^{Tot}Soil_{Comb}$	1.9	0.00333	0.00165	0.00089
Benzo[g,h,i]perylene	191-24-2	1,780.34	—	TX $^{Tot}Soil_{Comb}$	590	0.00333	0.00333	0.00072
Benzo[k]fluoranthene	207-08-9	57.23	—	TX $^{Tot}Soil_{Comb}$	19	0.00333	0.00165	0.00031
Chrysene	218-01-9	560.63	—	TX $^{Tot}Soil_{Comb}$	190	0.00333	0.00333	0.00035
Dibenz(a,h)anthracene	53-70-3	0.55	—	TX $^{Tot}Soil_{Comb}$	0.18	0.00333	0.00333	0.00041
Fluoranthene	206-44-0	1,917.26	—	TX $^{GW}Soil_{Ing}$	640	0.00333	0.00165	0.00061
Fluorene	86-73-7	298.54	30	TX Eco RG-263	10	0.00333	0.00165	0.00031
Indeno[1,2,3-cd]pyrene	193-39-5	5.72	—	TX $^{Tot}Soil_{Comb}$	1.9	0.00333	0.00333	0.00059
Naphthalene	91-20-3	31.25	—	TX $^{GW}Soil_{Ing}$	10	0.00333	0.00333	0.00054
Phenanthrene	85-01-8	415.72	—	TX $^{GW}Soil_{Ing}$	140	0.00333	0.00165	0.00057
Pyrene	129-00-0	1,116.51	—	TX $^{GW}Soil_{Ing}$	370	0.00333	0.00165	0.00052

Notes:

[1] LOQ, LOD, and MDLs are provided by Gulf Coast Analytical Laboratories are targets that are achievable under optimal conditions and may vary during the course of the project. Physical characteristics, such as moisture content, will affect the actual limits achieved.

The lowest project action level, identified in the project action level source column, is used to assess the laboratory's LOQ, LOD, and MDL to meet project objectives.

HH = Human health receptors
ECO = Ecological receptors
mg/kg = Milligrams per kilogram
LOQ = Limit of quantitation; analogous with TRRP-13 definition for the Method Quantitation Limit (MQL)
LOD = Limit of detection, provided for informational purposes as TRRP-13 requires that data be reported to the LOQ (TRRP-13 MQL) and MDL.
MDL = Method detection limit
— = Screening level not available
TRRP = Texas Risk Reduction Program
TX $^{Tot}Soil_{Comb}$ = TRRP Table 1 Residential Class 1 or Class 2 groundwater ingestion, 0.5 acre area
TX $^{GW}Soil_{Ing}$ = TRRP Table 1 Residential Soil Protective Concentration Levels for total soil combined pathway, 0.5 acre area
TX Eco RG-263 = *Update to Guidance for Conducting Ecological Risk Assessments, at Remediation Sites in Texas RG-263 (Revised)*, January 2006 Version, Table 3-4

Matrix:	Soil — Synthetic Precipitation Leaching Procedure							
Analytical Group:	Polynuclear Aromatic Hydrocarbons							
Analyte	**CAS No.**	**TX CI $^{GW}GW_{Class3}$ Project Action Level µg/L)**	**Saltwater Chronic Criteria (µg/L)**	**Project Action Level Source**	**Project Quantitation Limit Goal (µg/L)**	**LOQ[1] (µg/L)**	**LOD[1] (µg/L)**	**MDL[1] (µg/L)**
2-Methylnaphthalene	91-57-6	29,200	30	SW Chronic SWRBEL	10	0.1	0.1	0.064
Acenaphthene	83-32-9	438,000	40.4	SW Chronic SWRBEL	13	0.1	0.05	0.037
Acenaphthylene	208-96-8	438,000	—	TX CI $^{GW}GW_{Class3}$	146,000	0.1	0.1	0.070
Anthracene	120-12-7	2,190,000	0.18	SW Chronic SWRBEL	0.06	0.1	0.05	0.024
Benzo[a]anthracene	56-55-3	280	—	TX CI $^{GW}GW_{Class3}$	93	0.1	0.1	0.059
Benzo[a]pyrene	50-32-8	20	—	TX CI $^{GW}GW_{Class3}$	6.7	0.1	0.05	0.022
Benzo[b]fluoranthene	205-99-2	280	—	TX CI $^{GW}GW_{Class3}$	93	0.1	0.05	0.018
Benzo[g,h,i]perylene	191-24-2	219,000	—	TX CI $^{GW}GW_{Class3}$	73,000	0.1	0.05	0.036
Benzo[k]fluoranthene	207-08-9	2,800	—	TX CI $^{GW}GW_{Class3}$	930	0.1	0.05	0.039
Chrysene	218-01-9	28,000	—	TX CI $^{GW}GW_{Class3}$	9,330	0.1	0.05	0.018
Dibenz(a,h)anthracene	53-70-3	28	—	TX CI $^{GW}GW_{Class3}$	9.3	0.1	0.05	0.034
Fluoranthene	206-44-0	292,000	2.96	SW Chronic SWRBEL	1.0	0.1	0.05	0.039
Fluorene	86-73-7	292,000	50	SW Chronic SWRBEL	17	0.1	0.1	0.097
Indeno[1,2,3-cd]pyrene	193-39-5	280	—	TX CI $^{GW}GW_{Class3}$	93.3	0.1	0.05	0.040
Naphthalene	91-20-3	146,000	125	SW Chronic SWRBEL	42	0.1	0.05	0.037
Phenanthrene	85-01-8	219,000	4.6	SW Chronic SWRBEL	1.5	0.1	0.05	0.028
Pyrene	129-00-0	219,000	0.24	SW Chronic SWRBEL	0.08	0.1	0.05	0.036

Notes:

[1] LOQ, LOD, and MDLs provided by Gulf Coast Analytical Laboratories are targets that are achievable under optimal conditions and may vary during the course of the project. Physical characteristics, such as moisture content, will affect the actual limits achieved.

The lowest project action level, identified in the project action level source column, is used to assess the laboratory's LOQ, LOD, and MDL to meet project objectives.

µg/L = Micrograms per liter
LOQ = Limit of quantitation; analogous with TRRP-13 definition for the Method Quantitation Limit (MQL)
LOD = Limit of detection, provided for informational purposes as TRRP-13 requires that data be reported to the LOQ (TRRP-13 MQL) and MDL
MDL = Method detection limit
— = Screening level not available
TRRP = Texas Risk Reduction Program

TX CI $^{GW}GW_{Class3}$ = TRRP Table 3 Commercial/Industrial Class 3 groundwater ingestion, 0.5 acre area. (June 2012)
SW Chronic SWRBEL = Surface water saltwater chronic risk-based exposure limits from Figure 30 Texas Administrative code §307.6 (c)(1) (effective 22 July 2010)

Matrix:	Soil								
Analytical Group:	Metals								
Analyte	**CAS No.**	**Texas Medium Background (mg/kg)**	**Project Action Level (HH) (mg/kg)**	**Project Action Level (ECO) (mg/kg)**	**Project Action Level Source**	**Project Quantitation Limit Goal (mg/kg)**	**LOQ[1] (mg/kg)**	**LOD[1] (mg/kg)**	**MDL[1] (mg/kg)**
Antimony	7440-36-0	1	5.411497423	5	TX Eco RG-263	1.7	0.04	0.02	0.0070
Arsenic	7440-38-2	5.9	5.019162033	18	Texas Background	2.0	0.04	0.03	0.0092
Copper	7440-50-8	15	548.1989537	61	TX Eco RG-263	20	0.04	0.04	0.0039
Lead	7439-92-1	15	3.028742515	120	TX Eco RG-263	1	0.8	0.7	0.198

Matrix:	Soil — Synthetic Precipitation Leaching Procedure							
Analytical Group:	Metals							
Analyte	**CAS No.**	**TX CI $^{GW}GW_{Class3}$ Project Action Level (µg/L)**	**Saltwater Chronic Criteria (µg/L)**	**Project Action Level Source**	**Project Quantitation Limit Goal (µg/L)**	**LOQ[1] (mg/kg)**	**LOD[1] (mg/kg)**	**MDL[1] (mg/kg)**
Antimony	7440-36-0	600	—	TX CI $^{GW}GW_{Class3}$	200	0.04	0.02	0.0070
Arsenic	7440-38-2	1,000	78	TX CI $^{GW}GW_{Class3}$	330	0.04	0.03	0.0092
Copper	7440-50-8	130,000	3.6	SW Chronic SWRBEL	20	0.04	0.04	0.0039
Lead	7439-92-1	1,500	5.3	SW Chronic SWRBEL	1	0.8	0.7	0.198

Notes:

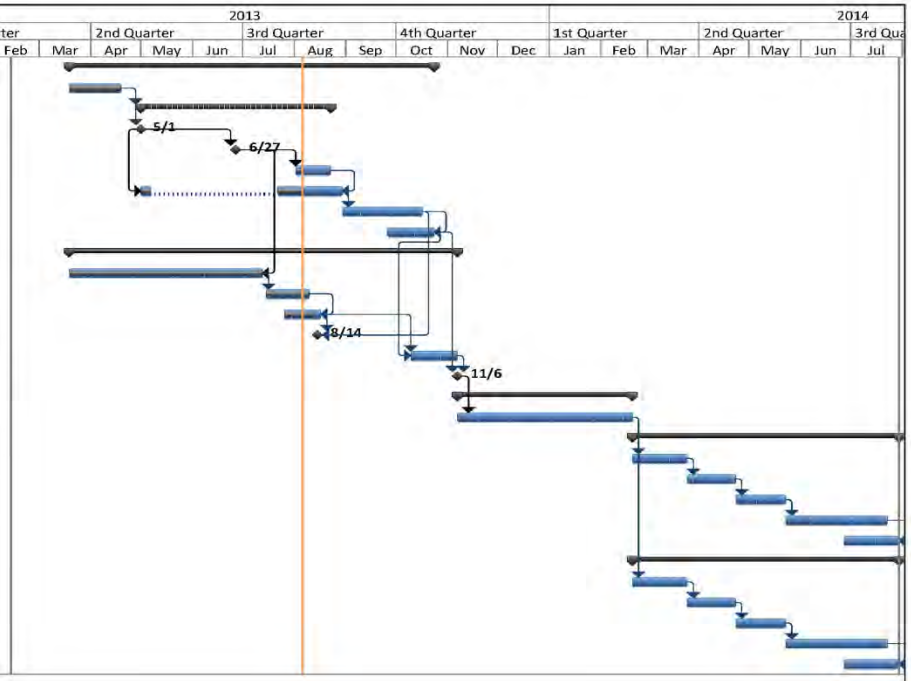
[1] LOQ, LOD, and MDLs provided by Gulf Coast Analytical Laboratories are targets that are achievable under optimal conditions and may vary during the course of the project. Physical characteristics, such as moisture content, will affect the actual limits achieved.

Metals background or the lowest project action level, identified in the project action level source column, is used to assess the laboratory's LOQ, LOD, and MDL to meet project objectives.

HH = Human health receptors
ECO = Ecological receptors
mg/kg = Milligrams per kilogram
µg/L = Micrograms per liter
LOQ = Limit of quantitation; analogous with TRRP-13 definition for the Method Quantitation Limit (MQL)
LOD = Limit of detection, provided for informational purposes as TRRP-13 requires that data be reported to the LOQ (TRRP-13 MQL) and MDL
MDL = Method detection limit
— = Screening level not available
TRRP = Texas Risk Reduction Program
TX Eco RG-263 = *Update to Guidance for Conducting Ecological Risk Assessments, at Remediation Sites in Texas RG-263 (Revised)*, January 2006 Version, Table 3-4
Texas Background = Texas Commission on Environmental Quality Chapter 350 – TRRP, Texas-Specific Soil Background Concentrations
TX CI $^{GW}GW_{Class3}$ = TRRP Table 3 Commercial/Industrial Class 3 groundwater ingestion, 0.5 acre area. (June 2012)
SW Chronic SWRBEL = Surface water saltwater chronic risk-based exposure limits from Figure 30 Texas Administrative code §307.6 (c)(1) (effective 22 July 2010)

SAP WORKSHEET #16: PROJECT SCHEDULE/TIMELINE TABLE

ID	WBS	Task Name	Duration	Start	Finish
1	**1**	**1 UFP-SAP/QAPP**	**157 days**	**Tue 3/19/13**	**Wed 10/23/13**
2	1.1	1.1 Draft UFP-SAP/QAPP	23 days	Tue 3/19/13	Thu 4/18/13
3	**1.2**	**1.2 Navy Review & Comments**	**82 days**	**Wed 5/1/13**	**Thu 8/22/13**
4	1.2.1	1.2.1 RPM Review of Worksheets 10, 11, 17	0 days	Wed 5/1/13	Wed 5/1/13
5	1.2.2	1.2.2 DQO Team Meeting (Worksheets 10, 11, 17)	0 days	Thu 6/27/13	Thu 6/27/13
6	1.2.3	1.2.3 Navy Chemist Review of Full UFP-SAP	15 days	Fri 8/2/13	Thu 8/22/13
7	1.3	1.3 Comment Response & Draft Final UFP-SAP/QAPP	33 days	Wed 5/1/13	Thu 8/29/13
8	1.4	1.4 Regulatory Review (TCEQ & USEPA)	34 days	Fri 8/30/13	Wed 10/16/13
9	1.5	1.5 Response to Comments & Final UFP-SAP/QAPP	20 days	Thu 9/26/13	Wed 10/23/13
10	**2**	**2 RI Work Plan & HASP**	**167 days**	Tue 3/19/13	Wed 11/6/13
11	2.1	2.1 Draft RI Work Plan & Draft HASP	84 days	Tue 3/19/13	Fri 7/12/13
12	2.2	2.2 Navy Review & Comments (HASP)	20 days	Mon 7/15/13	Fri 8/9/13
13	2.3	2.3 Response to Comments & Draft Final RI Work Plan & Final HASP	16 days	Fri 7/26/13	Fri 8/16/13
14	2.4	2.4 Regulatory Review RI Work Plan (TCEQ & USEPA)	0 days	Wed 8/14/13	Wed 8/14/13
15	2.5	2.5 Response to Comments & Final RI Work Plan	20 days	Thu 10/10/13	Wed 11/6/13
16	3	3 Final RI Work Plan (UFP-SAP & HASP)	0 days	Wed 11/6/13	Wed 11/6/13
17	**3**	**4 RI Field Work**	**75 days**	Thu 11/7/13	Wed 2/19/14
18	4.1	4.1 RI Field Work	**75 days**	Thu 11/7/13	Wed 2/19/14
19	**4**	**5 RI Report**	114 days	Thu 2/20/14	Tue 7/29/14
20	4.1	5.1 Draft RI Report	**23 days**	Thu 2/20/14	Mon 3/24/14
21	4.2	5.2 Navy Review & Comments	21 days	Tue 3/25/14	Tue 4/22/14
22	4.3	5.3 Response to Comments & Draft Final RI Report	22 days	Wed 4/23/14	Thu 5/22/14
23	4.4	5.4 Regulatory Review (TCEQ & USEPA)	43 days	Fri 5/23/14	Tue 7/22/14
24	4.5	5.5 Response to Comments & Final RI Report	23 days	Fri 6/27/14	Tue 7/29/14
25	**5**	**6 Feasibility Study**	114 days	Thu 2/20/14	Tue 7/29/14
26	5.1	6.1 Draft FS Report	**23 days**	Thu 2/20/14	Mon 3/24/14
27	5.2	6.2 Navy Review & Comments	21 days	Tue 3/25/14	Tue 4/22/14
28	5.3	6.3 Response to Comments & Draft Final FSReport	22 days	Wed 4/23/14	Thu 5/22/14
29	5.4	6.4 Regulatory Review (TCEQ & USEPA)	43 days	Fri 5/23/14	Tue 7/22/14
30	5.5	6.5 Response to Comments & Final FS Report	23 days	Fri 6/27/14	Tue 7/29/14



Project: JM45_RI-FS_GunneryComplex_NASCC_trackingschedule_6A
Date: Tue 8/6/13
JM45 NAS Corpus Christi Texas
RI-FS Gunnery Training Complex

Task	External Tasks	Manual Task	Finish-only		
Split	External Milestone	Duration-only	Deadline		
Milestone	Inactive Task	Manual Summary Rollup	Progress		
Summary	Inactive Milestone	Manual Summary			
Project Summary	Inactive Summary	Start-only			

Page 1

SAP WORKSHEET #17: SAMPLING DESIGN AND RATIONALE

(UFP-QAPP Manual Section 3.1.1)

17.1 General Sampling Design and Rationale

The sampling strategy for the former Gunnery Training Complex is designed to fill the data gaps identified in the Site Inspection (SI) Report to define the nature and extent of chemicals of potential concern (COPCs) in the soil at two depth intervals, 0- to 1-foot below ground surface (bgs) and 1- to 2-foot bgs. This Sampling and Analysis Plan (SAP) describes the supplemental sampling and analysis necessary to address these data gaps in four of the former ranges: Fixed Target Range (FTR), North Trap Range (NTR), South Trap Range (STR), and Closed Skeet Range (CSR). This section identifies sampling locations, quality assurance (QA)/quality control (QC) samples to be collected, analyses to be performed, and rationales for the sampling and analytical program.

Target analytes that are present in soil at the four range sites at concentrations exceeding soil Protective Concentration Levels (PCLs) were identified in the SI Report as COPCs. These contaminants have the highest potential to impact groundwater and include the following:

- Polynuclear Aromatic Hydrocarbons (PAHs): Multiple PAHs associated with clay targets were documented at elevated levels in soil within certain areas near the firing points of the CSR, which is consistent with the ranges' operational histories.

- Select Metals: Select metals (antimony, arsenic, cooper, and lead) associated with expended munitions were documented at elevated levels in soil within certain areas of all four range sites, predominantly in the target areas, which is consistent with their operational histories. Lead is typically the most significant metals contaminant because it is present in the greatest concentrations and poses the greatest risk to receptors. However, other metals that are target analytes in this investigation, based on levels detected in soil at various locations, include antimony, arsenic, and copper.

The proposed biased sampling approach is based on assumptions regarding potential contaminant distribution, knowledge of historical site activities, the conceptual site models (CSMs), and previous soil sampling investigation results. The sample locations were selected to provide sufficient data to close data gaps in site soil and to confirm the CSM of no effect on groundwater quality.

Samples will be collected using the field standard operating procedures (SOPs) identified on Worksheet #21 and will be submitted to Gulf Coast Analytical Laboratories for analysis. The analytical methods and laboratory SOPs used by Gulf Coast Analytical Laboratories are identified in Worksheet #23. The numbers of sample analyses to be performed for each target analyte or analytical group are identified in Worksheet #18. Worksheet #19 presents a summary of the sample analyses, container types and volumes, preservation requirements, and holding times for the samples to be collected. Field QC samples will be collected as part of the investigation, including field duplicates and equipment rinsate blanks. Worksheet #20 presents the field QC sample summary.

Sample locations will be marked in the field using a wooden stake or brightly colored pin flag. Coordinates of each sample location will be determined by Global Positioning System, which will allow for future reacquisition of the locations if further investigation or remedial action is necessary. All sample location markers will be removed prior to final demobilization.

Although munitions and explosives of concern (MEC) are not expected within any of the four investigation sites, if MEC are observed in or around any work area, work must be halted. The presence of MEC must be communicated to the field team leader (FTL), and the FTL will then communicate with Naval Air Station (NAS) Corpus Christi personnel so that the appropriate action may be taken. If obvious soil staining is observed in any boring, the staining will be described in the boring log, and additional samples may be collected at the discretion of the FTL to determine the nature and possibly the extent of associated site-related contamination.

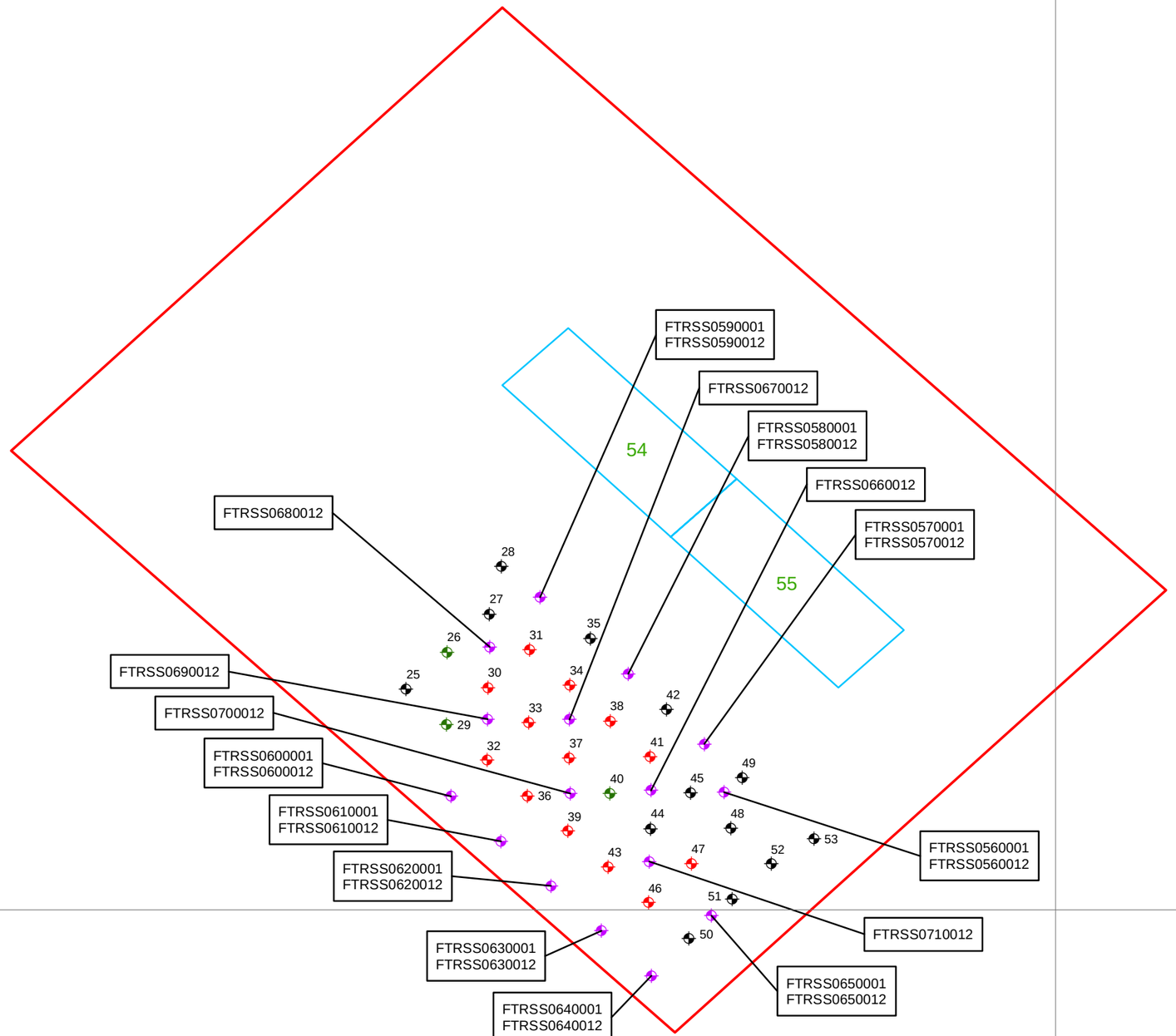
The subsequent sections describe proposed sampling locations that are shown on the following figures for each site and summarized in Table 17-1:

- Figure 17-1 Proposed Metals Soil Sampling Locations Fixed Target Range
- Figure 17-2 Proposed Metals Soil Sampling Locations North Trap Range
- Figure 17-3 Proposed Metals Soil Sampling Locations South Trap Range
- Figure 17-4 Proposed Metals Soil Sampling Locations Closed Skeet Ranges
- Figure 17-5 Proposed PAH Soil Sampling Locations Closed Skeet Ranges

97°17'50"W

97°17'45"W

27°41'5"N



Legend

- RI Sample Location
- SI Exceedance of TRRP Tier 1 Total Soil Combined PCL
- SI No Exceedance
- SI Soil Sample Location
- Former Firing Line
- Fixed Target Range Boundary
- FTRSS0540001 = Sample Identification

1 inch = 50 feet

0 50 100 Feet

N

FIGURE 17-1
PROPOSED METALS SOIL
SAMPLING LOCATIONS
FIXED TARGET RANGE
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: C. BARNETT	DATE: 7/23/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER: JM45

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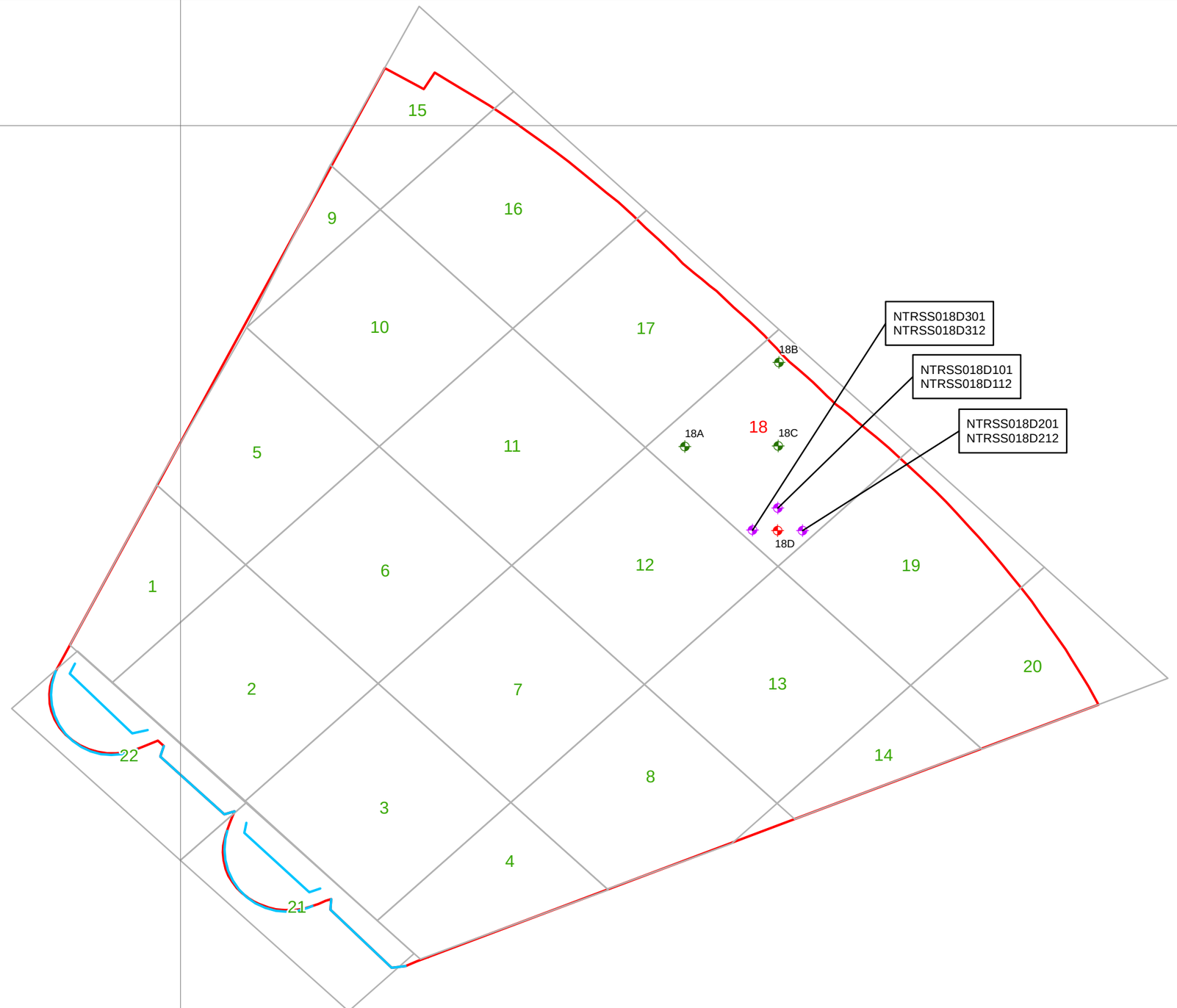
97°17'50"W

97°17'40"W

27°41'20"N



Legend

- RI Sample Location
- SI Exceedance of TRRP Tier 1 Total Soil Combined PCL
- SI No Exceedance
- SI Soil Sample Location
- Former Firing Line
- North Trap Range Boundary
- NTRSS018D301 = Sample Identification

1 inch = 100 feet

0 100 200 Feet

N

FIGURE 17-2
PROPOSED METALS SOIL
SAMPLING LOCATIONS
NORTH TRAP RANGE
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: C. BARNETT	DATE: 4/2/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER: XXXXX

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97°18'0"W

97°17'50"W

27°41'10"N

27°41'10"N

10

1

11

2

4

5

3

7

6

8

STRSS009B101
STRSS009B112

9C

STRSS009C101
STRSS009C112

9B

9

9A

STRSS009A101
STRSS009A112

Legend

- RI Sample Location
- SI Soil Sample Location
- Former Firing Line
- Installation Boundary
- South Trap Range Boundary
- STRSS009A101 = Sample Identification

1 inch = 100 feet

0 50 100 150 200 Feet

N

FIGURE 17-3
PROPOSED METALS SOIL
SAMPLING LOCATIONS
SOUTH TRAP RANGE
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: C. BARNETT	DATE: 4/2/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER: XXXXX

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97°17'40"W
97°17'30"W
97°17'20"W
27°41'10"N
27°41'0"N

CSRSS036F101
CSRSS036F112
CSRSS036I101
CSRSS036I112
CSRSS036G101
CSRSS036G112
CSRSS036H101
CSRSS036H112
CSRSS031F101
CSRSS031F112
CSRSS031I101
CSRSS031I112
CSRSS031H101
CSRSS031H112
CSRSS031G101
CSRSS031G112
CSRSS004F101
CSRSS004F112
CSRSS004G101
CSRSS004G112
CSRSS002F101
CSRSS002F112
CSRSS002G101
CSRSS002G112

Legend

- RI Sample Location
- SI Exceedance of TRRP Tier 1 Total Soil Combined PCL
- SI No Exceedance
- SI Soil Sample Location
- Former Firing Line
- Current Range
- Former Range
- Skeet Range
- Grid

Color Key:
36 = Exceedance of Tier 1 PCL
13 = No Exceedance
CSRSS002F101 = Sample Identification

1 inch = 200 feet
0 200 400 Feet

N

FIGURE 17-4
PROPOSED METALS SOIL
SAMPLING LOCATIONS
CLOSED SKEET RANGES
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: C. BARNETT	DATE: 4/2/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER: XXXXX

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97°17'40"W

97°17'30"W

97°17'20"W

27°41'10"N

27°41'0"N

CSRSS025F101
CSRSS025F112

CSRSS006F101
CSRSS006F112

Legend

- RI Sample Location
- SI Soil Sample Location
- Former Firing Line
- Skeet Range
- Current Range
- Former Range
- Grid

Color Key:
36 = Exceedance of Tier 1 PCL
13 = No Exceedance
CSRSS025F101 = Sample Identification

1 inch = 200 feet

0 200 400 Feet

N

FIGURE 17-5
PROPOSED PAH SOIL
SAMPLING LOCATIONS
CLOSED SKEET RANGES
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: C. BARNETT	DATE: 4/2/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER: XXXXX

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Table 17-1
Proposed Soil Sampling Summary

Depth	Antimony	Arsenic	Copper	Lead	PAHs	pH	TOC	SPLP[1]
Fixed Target Range								
0 — 1 ft	10	—	—	10	—	1	1	4 (antimony & lead)
1 — 2 ft	16	—	—	16	—	1	1	
North Trap Range								
0 — 1 ft	—	—	—	3	—	1	1	2 (lead)
1— 2 ft	—	—	—	3	—	1	1	
South Trap Range								
0 — 1 ft	—	3	3	3	—	1	1	2 (arsenic, copper, lead)
1 — 2 ft	—	3	3	3	—	1	1	
Closed Skeet Ranges								
0 — 1 ft	12	12	—	12	2	2	2	3 (antimony, arsenic, lead) 4 (PAHs)
1 — 2 ft	12	12	—	12	2	2	2	
Total	50	30	6	62	4	10	10	11 (select metals) 4 (PAHs)

Notes:
[1] Samples will be selected for SPLP analysis based on the highest concentrations detected at each range, regardless of sampling interval.

ft = Foot/feet
PAHs = Polynuclear aromatic hydrocarbons
TOC = Total organic carbon
SPLP = Synthetic precipitation leaching procedure

17.2 Soil Sampling Program — Fixed Target Range

Surface soil SI samples over roughly the southern half of the former target berm area in this range were found to contain lead and antimony above screening criteria. Areal extent was fairly tightly defined, as the SI sampling grid was approximately 20 feet.

Six soil samples will be collected in the southwest of the range to delineate the extent of antimony and lead contamination. Four soil samples will be collected along the northern perimeter of the former berm to confirm x-ray fluorescence (XRF) data. Soil will be sampled with hand augers at two depth intervals — 0-1 foot and 1-2 feet — and submitted for analysis of total antimony and lead. To complement these samples and assess potential for groundwater impacts, six additional locations will be sampled within the interior of this approximately 90-foot by 120-foot suspect area, with samples from the 1- to 2-foot interval submitted for total antimony and lead analysis.

One soil sample from each interval (specific sample location to be field-selected) will be analyzed for pH and total organic carbon (TOC). These data, along with similar data collected during the SI, will be used in the Tier 2 PCL calculations, as appropriate.

Upon receipt of the sampling data, the analytical results will be evaluated to identify the highest COPC detections. The four soil samples exhibiting the highest detected concentrations will be prepared using synthetic precipitation leaching potential (SPLP) and analyzed for antimony and lead to assess the leachability potential of soil to groundwater.

17.3 Soil Sampling Program — North Trap Range

In the SI, only one composite sample was found to exceed the screening for lead, apparently driven by contribution of lead in the "D" subsample. Three step-out sampling locations are proposed around this subsample point within the original SI sampling grid 18, results from which, will either support a conclusion that the SI result is an outlier or further delineate the contamination in support of a potential hot spot removal scenario. Soil will be sampled with hand augers at two depth intervals — 0- to 1-foot and 1- to 2-foot — and submitted for analysis of total lead.

One soil sample from each interval (specific sample location to be field-selected) will be analyzed for pH and TOC. These data, along with similar data collected during the SI, will be used in the Tier 2 PCL calculations, as appropriate.

Upon receipt of the sampling data, the analytical results will be evaluated to identify the highest lead detection. The two soil samples exhibiting the highest detected concentrations will be prepared using SPLP and analyzed for lead to assess the leachability potential of soil to groundwater.

17.4 Soil Sampling Program — South Trap Range

One composite sample analysis (from SI sample grid 9) exceeded the screening levels for arsenic, copper, and lead. Three supplemental sample locations at two depth intervals — 0- to 1-foot and 1- to 2-foot — will be established adjacent to the discrete locations sampled for the SI composite sample in grid 9. The samples will be analyzed for total arsenic, copper, and lead. These supplemental data should be sufficient either to disprove the SI indication of risk, or reduce uncertainty in the volume of potentially affected soil.

One soil sample from each interval (specific sample location to be field-selected) will be analyzed for pH and TOC. These data, along with similar data collected during the SI, will be used in the Tier 2 PCL calculations, as appropriate.

Upon receipt of the sampling data, the analytical results will be evaluated to identify the highest COPC detections. The two soil samples exhibiting the highest detected concentrations will be prepared using SPLP and analyzed for arsenic, copper, lead to assess the leachability potential of soil to groundwater.

17.5 Soil Sampling Program — Closed Skeet Range

17.5.1 Select Metals Evaluation

In the SI, some of the highest laboratory and screening results for select metals (especially lead) were found at the CSR in a nominally 300-foot by 600-foot area in the north central portion of the overall site; an apparent juxtaposition of historic shot-fall among all the layouts. Eight sampling locations along the northwest boundary are proposed to close delineation of affected area (adjacent to SI sampling grids 31 and 36). Near the firing stations from the most recently used (currently closed) range were two elevated composite results (intended to represent 150-foot square grid areas) where the lead results were not supported by discrete XRF results. These two grids (2 and 4) are proposed as locations where confirmatory discrete sampling at two stations and two shallow depths for each grid will be performed. Each location will be sampled at two depth intervals — 0- to 1-foot and 1- to 2-foot — and analyzed for total antimony, arsenic, and lead.

Two soil samples from each interval (specific sample locations to be field-selected) will be analyzed for pH and TOC. These data, along with similar data collected during the RI, will be used in the Tier 2 PCL calculations, as appropriate.

Upon receipt of the sampling data, the analytical results will be evaluated to identify the highest COPC detections. The three soil samples exhibiting the highest detected concentrations will be prepared using SPLP and analyzed for antimony, arsenic, and lead to assess the leachability potential of soil to groundwater.

17.5.2 Polynuclear Aromatic Hydrocarbons Evaluation

The CSR exhibited a pattern of slightly elevated PAH concentrations in surface soil within about 150 feet of the firing stations at all six of the former range layouts, with the exclusion of the northernmost range in this group of historical ranges. Two PAH step-out samples are proposed in the two grids where the highest concentrations were detected in the SI sampling. One sample location will be in grid node 6 between SI subsamples A and B and one sample location will be in grid node 25 between SI subsamples D and E. Two depth intervals will be sampled — 0- to 1-foot and 1- to 2-foot — to assess the potential threat posed to groundwater because these locations had the highest PAH results for the former Gunnery Training Complex.

To ensure preparation and analytical holding times will be met, the four samples will also be concurrently prepared for SPLP and analyzed for PAHs to assess the leachability potential of soil to groundwater.

SAP WORKSHEET #18: LOCATION-SPECIFIC SAMPLING METHODS/SOP REQUIREMENTS TABLE

(UFP-QAPP Manual Section 3.1.1)

Sample Matrix: Soil
Location: Fixed Target Range

Sample Location	Sample ID	Latitude	Longitude	Depth, feet bgs	Sampling Standard Operating Procedures	Antimony	Arsenic	Copper	Lead	PAHs	TOC	pH
FTRSS056	FTRSS0560001 FTRSS0560021	27.68484974	-97.29619367	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X			X			
FTRSS057	FTRSS0570001 FTRSS0570012	27.68490267	-97.29621529	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X			X			
FTRSS058	FTRSS0580001 FTRSS0580012 FTRCS0580012 (Field Duplicate)	27.68497865	-97.29629768	0-1 1-2 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X			X			
FTRSS059	FTRSS0590001 FTRSS0590012	27.68506167	-97.29639393	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X			X		X	X
FTRSS060	FTRSS0600001 FTRSS0600012 (+MS/MSD)	27.68484535	-97.29649068	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X			X			
FTRSS061	FTRSS0610001 FTRSS0610012	27.6847966	-97.2964362	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X			X			
FTRSS062	FTRSS0620001 FTRSS0620012	27.68474786	-97.29638171	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X			X			
FTRSS063	FTRSS0630001 FTRSS0630012	27.6846991	-97.29632724	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X			X			
FTRSS064	FTRSS0640001 FTRSS0640012 (+MS/MSD)	27.68465032	-97.29627275	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X			X			
FTRSS065	FTRSS0650001 FTRSS0650012	27.68471567	-97.29620748	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X			X			
FTRSS066	FTRSS0660012	27.68485195	-97.29627317	1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X			X			

Sample Matrix:	**Soil**											
Location:	**Fixed Target Range**											
Sample Location	**Sample ID**	**Latitude**	**Longitude**	**Depth, feet bgs**	**Sampling Standard Operating Procedures**	**Antimony**	**Arsenic**	**Copper**	**Lead**	**PAHs**	**TOC**	**pH**
FTRSS067	FTRSS0670012	27.68492902	-97.29636194	1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	**X**			**X**			
FTRSS068	FTRSS0680012	27.68500815	-97.29644883	1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	**X**			**X**			
FTRSS069	FTRSS0690012	27.68492937	-97.2964508	1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	**X**			**X**			
FTRSS070	FTRSS070012	27.68484863	-97.29636092	1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	**X**			**X**			
FTRSS071	FTRSS0710012 FTRCS0710012 (Field Duplicate)	27.68477437	-97.29627495	1-2 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	**X**			**X**		**X**	**X**

Notes:
bgs = Below ground surface
PAHs = Polynuclear aromatic hydrocarbons
TOC = Total organic carbon
+MS/MSD = Sample will be used for matrix spike/matrix spike duplicate analysis

Example sample identification: FTRSS0560001 = Fixed Target Range, soil sample, location 56, 0 to 1-foot sampling depth interval.

All TOC and pH samples will be collected from the 1-2 foot interval.

After receipt of analytical results, up to four soil samples exhibiting the highest concentrations will be prepared using Synthetic Precipitation Leaching Procedure and analyzed for antimony and lead to assess the leachability potential of soil to groundwater.

Sample Matrix: **Soil**
Location: **North Trap Range**

Sample Location	Sample ID	Latitude	Longitude	Depth, feet bgs	Sampling Standard Operating Procedures	Antimony	Arsenic	Copper	Lead	PAHs	TOC	pH
NTRSS018D1	NTRSS018D101 (+MS/MSD) NTRSS018D112	27.68794732	-97.29575128	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21				X			
NTRSS018D2	NTRSS018D201 NTRSS018D212 NTRCS018D212 (Field Duplicate)	27.68789179	-97.29569007	0-1 1-2 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21				X		X	X
NTRSS018D3	NTRSS018D301 NTRSS018D312	27.68789284	-97.29581366	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21				X		X	X

Notes:
bgs = Below ground surface
PAHs = Polynuclear aromatic hydrocarbons
TOC = Total organic carbon
+MS/MSD = Sample will be used for matrix spike/matrix spike duplicate analysis

Example sample identification: NTRSS018D112 = North Trap Range, soil sample, grid 18, location D1, 1 to 2-foot sampling depth interval.

All TOC and PH samples will be collected from the 1-2 foot interval.

After receipt of analytical results, up to two soil samples exhibiting the highest concentrations will be prepared using Synthetic Precipitation Leaching Procedure and analyzed for lead to assess the leachability potential of soil to groundwater.

Sample Matrix: **Soil**
Location: **South Trap Range**

Sample Location	Sample ID	Latitude	Longitude	Depth, feet bgs	Sampling Standard Operating Procedures	Antimony	Arsenic	Copper	Lead	PAHs	TOC	pH
STRSS009A	STRSS009A101 STRSS009A112 (+MS/MSD)	27.68458935	-97.29872081	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21		X	X	X			
STRSS009B	STRSS009B101 STRSS009B112	27.68473974	-97.29867322	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21		X	X	X		X	X
STRSS009C	STRSS009C101 STRCS009C101 (Field Duplicate) STRSS009C112	27.68486156	-97.29853331	0-1 0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21		X	X	X			

Notes:
bgs = Below ground surface
PAHs = Polynuclear aromatic hydrocarbons
TOC = Total organic carbon
+MS/MSD = Sample will be used for matrix spike/matrix spike duplicate analysis

Example sample identification: STRSS009A101 = South Trap Range, soil sample, grid 9, location A1, 0 to 1-foot sampling depth interval.

All TOC and PH samples will be collected from the 1-2 foot interval.

After receipt of analytical results, up to two soil samples exhibiting the highest concentrations will be prepared using Synthetic Precipitation Leaching Procedure and analyzed for arsenic, copper, and lead to assess the leachability potential of soil to groundwater.

Sample Matrix: Soil
Location: Closed Skeet Range

Sample Location	Sample ID	Latitude	Longitude	Depth, feet bgs	Sampling Standard Operating Procedures	Antimony	Arsenic	Copper	Lead	PAHs	TOC	pH
CSRSS002F	CSRSS002F101 CSRCS002F101 (Field Duplicate) CSRSS002F112	27.68476573	-97.29250384	0-1 0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X	X		X		X	X
CSRSS002G	CSRSS002G101 CSRSS002G112	27.68464438	-97.29267635	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X	X		X			
CSRSS004F	CSRSS004F101 CSRSS004F112	27.68525022	-97.2918019	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X	X		X		X	X
CSRSS004G	CSRSS004G101 CSRCS004G101 (Field Duplicate) CSRSS004G112	27.68513648	-97.29195704	0-1 0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X	X		X			
CSRSS031F	CSRSS031F101 CSRSS031F112	27.68674179	-97.29406832	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X	X		X		X	X
CSRSS031G	CSRSS031G101 CSRSS031G112	27.68664364	-97.29415636	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X	X		X			
CSRSS031H	CSRSS031H101 CSRSS031H112 (+MS/MSD)	27.68668587	-97.29425154	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X	X		X			
CSRSS031I	CSRSS031I101 CSRSS031I112	27.68677272	-97.2941748	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X	X		X			
CSRSS036F	CSRSS036F101 CSRSS036F112	27.68739574	-97.29353115	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X	X		X			
CSRSS036G	CSRSS036G101 CSRSS036G112 (+MS/MSD)	27.68727201	-97.2936412	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X	X		X		X	X
CSRSS036H	CSRSS036H101 CSRSS036H112	27.6872964	-97.29377267	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X	X		X			
CSRSS036I	CSRSS036I101 CSRSS036I112	27.68742787	-97.29366678	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21	X	X		X			
CSRSS006F	CSRSS006F101 CSRSS006F112	27.68474929	-97.29327944	0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21					X		

Sample Matrix: **Soil**
Location: **Closed Skeet Range**

Sample Location	Sample ID	Latitude	Longitude	Depth, feet bgs	Sampling Standard Operating Procedures	Antimony	Arsenic	Copper	Lead	PAHs	TOC	pH
CSRSS025F	CSRSS025F101 CSRCS025F101CSRSS025F112	27.6855494	-97.2940391	0-1 0-1 1-2	SOP-3-03A, SOP-3-04A, SOP-3-16, SOP-3-21					X		

Notes:
bgs = Below ground surface
PAHs = Polynuclear aromatic hydrocarbons
TOC = Total organic carbon
+MS/MSD = Sample will be used for matrix spike/matrix spike duplicate analysis

Example sample identification: CSRSS025F112 = Closed Skeet Range, soil sample, grid 25, location F1, 1 to 2-foot sampling depth interval.

All TOC and PH samples will be collected from the 1-2 foot interval.

After receipt of analytical results, up to three metal (antimony, arsenic, and lead) samples and up to four PAH samples exhibiting the highest concentrations will be prepared using Synthetic Precipitation Leaching Procedure to assess the leachability potential of soil to groundwater.

SAP WORKSHEET #19: FIELD SAMPLING REQUIREMENTS TABLE

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Analytical and Preparation Method/ *SOP Reference*	Containers (number, size, and type)	Sample Volume	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time[1]
Soil	PAHs via SIM	SW-846 3550C/8270D *EXT-001/GCMSSV-004*	(1) 4-ounce glass jar	30 grams	Cool to 0-6°C	14 days to preparation 40 days from preparation to analysis
Soil	PAHs via SIM SPLP	SW-846 1312/3510C/8270D *EXT-070/EXT-003/ GCMSSV-004*	(1) 4-ounce glass jar	100 grams	Cool to 0-6°C	14 days to SPLP Leach 7 days from SPLP Leach to extraction 40 days from preparation to analysis
Soil	Select Metals: Antimony, Arsenic, Copper, Lead	SW-846 3050B/6020A *MET-004/MET-021*	(1) 4-ounce glass jar	1.25 grams	None	180 days
Soil	Select Metals: Antimony, Arsenic, Copper, Lead SPLP	SW-846 1312/3010A/6020A *EXT-070/MET-021*	(1) 4-ounce glass jar	100 grams	None	180 days to SPLP Leach 180 days from SPLP Leach to analysis
Soil	Total Organic Carbon	SW-846 9060 (Modified)/Lloyd Kahn Method *WL-057*	(1) 4-ounce glass jar	0.1 gram	Cool to 0-6°C	28 days
Soil	pH	SW-846 9045D *EXT-032*		20 grams	Cool to 0-6°C	As soon as possible

Notes:

1 Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

SOP = Standard operating procedure
PAHs = Polynuclear aromatic hydrocarbons
SIM = Selective ion monitoring
°C = Degrees Celsius
SPLP = Synthetic precipitation leaching procedure

SAP WORKSHEET #20: FIELD QUALITY CONTROL SAMPLE SUMMARY TABLE

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Number of Sampling Locations	Number of Field Duplicates	Number of MS/MSDs	Number of Equipment Blanks	Total Number of Samples to Lab[1]
Soil	Antimony	50	3	3/3	1	56
Soil	Arsenic	30	2	2/2	1	34
Soil	Copper	6	1	1/1	1	8
Soil	Lead	62	4	4/4	1	70
Soil	PAHs	4	1	1/1	1	6
Soil	SPLP Antimony	7	1	1/1	0	8
Soil	SPLP Arsenic	5	1	1/1	0	6
Soil	SPLP Copper	2	1	1/1	0	3
Soil	SPLP Lead	11	1	1/1	0	13
Soil	SPLP PAHs	4	1	1/1	0	5
Soil	Total Organic Carbon	10	0	0	0	10
Soil	pH	10	0	0	0	10

Notes:

[1] Total number of samples does not include MS/MSD analysis.

MS = Matrix spike
MSD = Matrix spike duplicate
PAHs = Polynuclear aromatic hydrocarbons
SPLP = Synthetic precipitation leaching procedure

Frequency of QA/QC sample collection:

Field Duplicate = One per 10 field samples
MS/MSD = One pair per 20 field samples (including field quality control samples)
Equipment Blank = One per field-cleaned sampling equipment per week

SAP WORKSHEET #21: PROJECT SAMPLING SOP REFERENCES TABLE

(UFP-QAPP Manual Section 3.1.2)

The field standard operating procedures presented below are in Appendix A.

SOP Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Yes/No)	Comments
SOP-3-01	*Utility Clearance* Revision 0, June 2012	Resolution Consultants	None	No	None
SOP-3-02	*Field Log Books* Revision 0, May 2012	Resolution Consultants	None	No	None
SOP-3-03A	*Sample Labeling and Chain of Custody* Revision 0, August 2012	Resolution Consultants	None	No	None
SOP-3-04A	*Packaging and Shipping Procedures for Low Concentration Samples*, Revision 0, May 2012	Resolution Consultants	None	No	None
SOP-3-05-TX	*Investigative Derived Waste Management for Texas* Revision 0, May 2012	Resolution Consultants	None	No	None
SOP-3-06	*Equipment Decontamination* Revision 0, May 2012	Resolution Consultants	Buckets, brushes	No	None
SOP-3-07	*Land Surveying* Revision 0 August 2012	Resolution Consultants	Global Positioning System	No	None
SOP-3-16	*Soil Classification* Revision 0, August 2012	Resolution Consultants	None	No	None
SOP-3-21	*Surface and Subsurface Soil Sampling* Revision 0, May 2012	Resolution Consultants	Spoons, Trowel, Hand Auger	No	None
TCEQ Ecological Checklist	*Figure: 30 TAC §350.77(b) Tier I: Exclusion Criteria Checklist*	TCEQ	None	No	None

Notes:
SOP = Standard operating procedure
TCEQ = Texas Commission on Environmental Quality

SAP WORKSHEET #22: FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION TABLE

(UFP-QAPP Manual Section 3.1.2.4)

Field Equipment	Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference	Comments
Global Positioning System Trimble Geo XT (or similar)	Positioning	Beginning and end of each day used	Accuracy: sub-meter horizontal dilution of precision < 3, number of satellites must be at least six	Wait for better signal, replace unit, or choose alternate location technique	Resolution Consultants FTL or designee	SOP-3-07	None

Notes:
SOP = Standard operating procedure
FTL = Field team leader

SAP WORKSHEET #23: ANALYTICAL SOP REFERENCES TABLE

(UFP-QAPP Manual Section 3.2.1)

Laboratory Name and Address: Gulf Coast Analytical Laboratories, 7979 GSRI Road, Baton Rouge, Louisiana 70820

Laboratory Point of Contact/Project Manager: Brenda Martinez, brenda.martinez@gcal.com, 225-769-4900

SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to Quality Systems Manual	Modified for Project Work? (Yes/No)
EXT-001	*Preparation of Base/Neutral/Acid Low Level Soil/Sediment Samples,* Revision 19, 11 April 2013	Definitive	Soil Extraction PAHs via SIM	Not applicable	No	No
EXT-003	*Base/Neutral/Acid Sample Extraction Using Separatory Funnel*, Revision 23, 1 April 2013	Definitive	Soil Leach Extraction PAHs via SIM	Not applicable	No	No
GCMSSV-004	*Standard Operating Procedure for the Analysis Semi-volatile Mass Spec Samples for 8270D*, Revision 8, 25 January 2013	Definitive	Soil and SPLP Analysis PAHs via SIM	GC/MS Agilent 5973-6890N or 5975-6890N	No	No
MET-004	*Standard Operating Procedure for 3050 Metals Digestion*, Revision 15, 1 August 2012	Definitive	Soil Digestion Antimony, Arsenic, Copper, Lead	Not applicable	No	No
MET-005	*Standard Operating Procedure for ICP Water Preparation*, Revision 15, 1 August 2012	Definitive	Soil Leach Digestion Antimony, Arsenic, Copper, Lead	Not applicable	No	No
MET-021	*Standard Operating Procedure for the Analysis of Samples by ICP/MS*, 24 August 2012, Revision 3	Definitive	Soil and Leach Analysis Antimony, Arsenic, Copper, Lead	Agilent 7700 ICP/MS	No	No
EXT-070	*Standard Operating Procedure for Synthetic Precipitation Leaching Procedure — Method 1312*, Revision 3, 1 February 2010	Definitive	Soil Leach PAHs via SIM and Metals	Not applicable	No	No
WL-057	*Standard Operating Procedure for Total Organic Carbon (TOC) in Soil Samples*, Revision 3, 11 October 2010	Screening	Total Organic Carbon	Total Organic Carbon Analyzer	No	No
EXT-032	*Standard Operating Procedure for Determining pH in Solid or Waste Samples*, Revision 12, 23 May 2013	Screening	pH	pH Meter	No	No

Notes:

Laboratory standard operating procedures will be available upon request.

SOP = Standard operating procedure
PAH = Polynuclear aromatic hydrocarbons
SIM = Selective ion monitoring
SPLP = Synthetic precipitation leaching procedure
GC/MS = Gas chromatograph/mass spectrometer
ICP/MS = Inductively coupled plasma spectroscopy/mass spectrometer

SAP WORKSHEET #24: ANALYTICAL INSTRUMENT CALIBRATION TABLE

(UFP-QAPP Manual Section 3.2.2)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
GC/MS PAHs via SIM	Tuning	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method for specific ion criteria	Retune instrument and verify. Rerun affected samples. Flagging criteria are not appropriate.	Analyst, Supervisor	GCAL SOP GCMSV-004
GC/MS PAHs via SIM	Breakdown check (DDT)	At the beginning of each 12-hour period, prior to analysis of samples.	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Correct problem then repeat the breakdown check. No samples shall be run until degradation ≤ 20%.	Analyst, Supervisor	GCAL SOP GCMSSV-004
GC/MS PAHs via SIM	ICAL Minimum five-point initial calibration for all analytes	Initial calibration prior to sample analysis and after any routine maintenance (source cleaning, new column, etc.)	Average RF ≥ 0.050; %RSD ≤30% for RFs of the CCCs; Average %RSD ≤ 15% for all compounds, linear or quadratic curve fit with $r^2 \geq 0.99$	Repeat calibration if criterion is not met	Analyst, Supervisor	GCAL SOP GCMSSV-004
GC/MS PAHs via SIM	Second source ICV	Once after each ICAL	All analytes within ± 20% of expected value	Remake standard, recalibrate if necessary	Analyst, Supervisor	GCAL SOP GCMSSV-004
GC/MS PAHs via SIM	CCV	CV daily, before sample analysis, and every 12 hours of analysis time	All targets ≤ 20%D	Repeat initial calibration and reanalyze all samples analyzed since the last successful CV	Analyst, Supervisor	GCAL SOP GCMSSV-004
GC/MS PAHs via SIM	RRT Evaluation	Prior to sample analysis	Set at mid-point of ICAL; +/- 30 seconds each CCV	CCV fails, perform column maintenance, inspect pumps, and leak checks. After instrument correction, repeat ICAL	Analyst, Supervisor	GCAL SOP GCMSSV-004
ICP/MS Antimony, Arsenic, Copper, Lead	Tuning	Prior to ICAL	Mass calibration ≤ 0.1 amu from the true value; Resolution < 0.9 amu full width at 10% peak height; For stability, %RSD ≤ 5% for at least four replicate analyses.	Retune instrument then reanalyze tuning solutions.	Analyst, Supervisor	GCAL SOP MET-021
ICP/MS Antimony, Arsenic, Copper, Lead	ICAL for all analytes: minimum three standards and a calibration blank	Daily initial calibration prior to sample analysis and after any routine maintenance	$r^2 \geq 0.995$	Correct the problem; Recalibrate	Analyst, Supervisor	GCAL SOP MET-021
ICP/MS Antimony, Arsenic, Copper, Lead	Second source ICV	Once after each ICAL, prior to beginning a sample run	All analytes within ± 10% of expected value	Repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification.	Analyst, Supervisor	GCAL SOP MET-021

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
ICP/MS Antimony, Arsenic, Copper, Lead	ICS	At the beginning of an analytical run and every 12 hours.	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD ICS-AB: within 20% of true value	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze affected samples.	Analyst, Supervisor	GCAL SOP MET-021
ICP/MS Antimony, Arsenic, Copper, Lead	CCV	Every 10 analyses and end of sequence	All analytes within ± 10% of expected value	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful CCV.	Analyst, Supervisor	GCAL SOP MET-021
ICP/MS Antimony, Arsenic, Copper, Lead	Low-level calibration check standard	Daily after one-point ICAL	80-120% recovery	Correct the problem; Recalibrate	Analyst, Supervisor	GCAL SOP MET-021
ICP/MS Antimony, Arsenic, Copper, Lead	Calibration blank	Once with each ICAL, after every 10 samples and at the end of an analytical sequence.	No analytes detected > LOD	Correct problem. Re-prepare and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst, Supervisor	GCAL SOP MET-021
ICP/MS Antimony, Arsenic, Copper, Lead	Linear Dynamic range/ High level check	Every 6 months and with major maintenance	90-110% recovery	Perform maintenance and/or reanalyze at lower concentration.	Analyst, Supervisor	GCAL SOP MET-021
TOC Analyzer	ICAL Minimum 5 standards and calibration blank	Daily initial calibration prior to sample analysis and after any routine maintenance	$r \geq 0.995$	Correct the problem and repeat ICAL	Analyst, Supervisor	GCAL SOP WL-057
TOC Analyzer	ICV	Once after each ICAL, prior to beginning a sample run	±10% of the expected value	Correct problem and rerun ICV. If that fails, correct problem and repeat ICAL.	Analyst, Supervisor	GCAL SOP WL-057
TOC Analyzer	CCV	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	±10% of the expected value	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.	Analyst, Supervisor	GCAL SOP WL-057
TOC Analyzer	Calibration blank	Immediately following the ICV and CCV	No analytes detected > LOD	Correct problem. Re-prepare and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst, Supervisor	GCAL SOP WL-057
pH	ICAL 3 buffer solutions	Daily initial calibration prior to sample analysis and after any routine maintenance	Slope 92-108	Correct the problem and repeat ICAL		GCAL SOP WL-057

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
pH	Buffer Check ICV	Once after each ICAL, prior to beginning a sample run	± 0.05 pH units of the true value	Correct the problem and repeat ICAL	Analyst, Supervisor	GCAL SOP EXT-032
pH	CCV	At the end of the analysis sequence	± 0.05 pH units of the true value	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.	Analyst, Supervisor	GCAL SOP EXT-032

Notes:

SOP = Standard operating procedure
GC/MS = Gas chromatograph/mass spectrometer
PAH = Polynuclear aromatic hydrocarbons
SIM = Selective ion monitoring
ICAL = Initial calibration
DDT = 4,4'-dichlorodiphenyltrichloroethane
RF = Response factor
%RSD = Relative standard deviation
CCC = Calibration check compound
r^2 = Least squares regression coefficient/coefficient of determination
ICV = Initial calibration verification
CCV = Continuing calibration verification
%D = Percent difference
RRT = Relative retention time
ICP/MS = Inductively coupled plasma spectroscopy/mass spectrometer
amu = Atomic mass unit
ICS = Interference check solution
LOD = Limit of detection
r = Correlation coefficient
CV = Calibration verification
GCAL = Gulf Coast Analytical Laboratories
TOC = Total organic carbon

SAP WORKSHEET #25: ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION TABLE

(UFP-QAPP Manual Section 3.2.3)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC/MS	Check for leaks, replace gas line filters, replace column, clean injection port/liner, clean source, replace vacuum pump oil, replace filament, replace inlet liner, replace septa, and bake out instrument.	PAHs via SIM	Inspect vacuum pressure, monitor instrument performance via CCV	Inspect vacuum pressure daily. Instrument will be inspected prior to each ICAL and/or as needed. Clean source and replace vacuum pump oil annually or as needed. Routine maintenance as necessary.	No maintenance is required as long as instrument meets tuning criteria and QC meets DoD QSM criteria.	Replace connections, clean source, replace gas line filters, clip/replace column, clean injection port, replace injection port liner, replace Electron Multiplier. Inspect system and correct problem; re-tune instrument and perform new initial calibration after major maintenance.	Analyst, Supervisor	GCAL SOP GCMSSV-004
ICP/MS	Change pump tubing, clean nebulizer, change torch, clean sample cone/skimmer cone	Antimony, Arsenic, Copper, Lead	Monitor instrument performance via CCV and Calibration Blank	Instrument will be inspected prior to each ICAL and/or as needed. Routine maintenance as necessary.	No maintenance is required as long as instrument meets tuning criteria and QC meets DoD QSM criteria.	Change pump tubing, torch and nebulizer, clean cone; recalibrate and reanalyze affected data. Inspect system and correct problem; re-tune instrument and perform new initial calibration after major maintenance.	Analyst, Supervisor	GCAL SOP MET-021
Total Organic Carbon Analyzer	Check injection port, injection needle, Catalyst	Total Organic Carbon	Monitor instrument performance via CCV and Calibration Blank	Daily with loss of sensitivity or lack of response. Instrument will be inspected prior to each ICAL and/or as needed. Routine maintenance as necessary.	No maintenance is required as long as calibration meets SOP criteria.	Replace or clean as needed. Inspect system and correct problem; perform new initial calibration after major maintenance.	Analyst, Supervisor	GCAL SOP WL-057
pH Meter	Flush and refill the electrode as needed; When dirt or oil builds up on the electrode, clean with methanol	pH	Monitor instrument performance via CCV	Instrument will be inspected prior to each ICAL and/or as needed. Routine maintenance as necessary.	No maintenance is required as long as calibration meets SOP criteria.	Flush/Fill electrode and/or clean as needed; perform new initial calibration after major maintenance.	Analyst, Supervisor	GCAL SOP EXT-032

Notes:

SOP = Standard operating procedure
GC/MS = Gas chromatograph/mass spectrometer
PAHs = Polynuclear aromatic hydrocarbons
SIM = Selective ion monitoring
CCV = Continuing calibration verification
ICAL = Initial calibration
QC = Quality control
ICP/MS = Inductively coupled plasma spectroscopy/mass spectrometer
DoD QSM = Department of Defense Quality Systems Manual

SAP WORKSHEET #26: SAMPLE HANDLING SYSTEM

(UFP-QAPP Manual Appendix A)

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT	
Sample Collection (Personnel/Organization):	FTL/Resolution Consultants
Sample Packaging (Personnel/Organization):	FTL/Resolution Consultants
Coordination of Shipment (Personnel/Organization):	FTL/Resolution Consultants
Type of Shipment/Carrier:	Overnight via FedEx
SAMPLE RECEIPT AND ANALYSIS	
Sample Receipt (Personnel/Organization):	Sample Receiving Supervisor, Charlotte Saucier/GCAL
Sample Custody and Storage (Personnel/Organization):	Sample Receiving Supervisor, Charlotte Saucier/GCAL
Sample Preparation (Personnel/Organization):	Extractions, Prep Supervisor, Rob Martin/GCAL
Sample Determinative Analysis (Personnel/Organization):	Laboratory Manager, Scott Bailey/GCAL
SAMPLE ARCHIVING	
Field Sample Storage (No. of days from sample collection):	180 Days from Receipt of Samples
Sample Extract/Digestate Storage (No. of days from extraction/digestion):	180 Days from Receipt of Samples
SAMPLE DISPOSAL	
Personnel/Organization:	Waste Compliance Manager John Bailey/GCAL
Number of Days from Analysis:	180 Days from Receipt of Samples

Notes:

FTL = Field team leader
GCAL = Gulf Coast Analytical Laboratories

SAP WORKSHEET #27: SAMPLE CUSTODY REQUIREMENTS

(UFP-QAPP Manual Section 3.3.3)

27.1 Sample Nomenclature, Sample Collection Documentation, Handling, and Tracking Procedures

The following sections outline the procedures that will be used to document project activities and sample collection, handling, tracking, and custody procedures during the investigation. All forms must be filled in as completely as possible.

27.1.1 Sample Nomenclature

Sample labeling will be conducted in general accordance with the procedures outlined in Worksheet #18. Sample nomenclature put forth for this field event has been selected to be consistent with the identifiers used during the Site Inspection. Nomenclature for soil samples includes the site being investigated, matrix code, soil boring identification number, and depth interval.

Sample type codes planned for this event will include N for normal samples, FD for field duplicates, and EB for equipment blanks. Field duplicates will be labeled so they will be "blind" to the laboratory; they will use the same sample identification as the parent sample but the differentiator will be the fourth character, which will be changed to a C. For example, a soil duplicate of FTRSS0560001 would be indicated using FTRCS0560001. Equipment blanks will be labeled sequentially followed by the date (i.e., EB07222013). Samples to be used for matrix spike (MS) and matrix spike duplicate (MSD) will be labeled MS/MSD on the container label and noted on the chain-of-custody; however, "MS/MSD" will not be part of the unique sample identifier in order to maintain consistency with the project database. Worksheet #18 provides anticipated sample identifiers for this scope of work.

27.1.2 Sample Collection Documentation

Documentation of field observations will be recorded in a field logbook(s) and/or field log sheets including sample collection logs, boring logs, and monitoring well construction logs. The field logbook utilized on this project will consist of a bound, water-resistant logbook. All pages of the logbook will be numbered sequentially and observations will be recorded with indelible ink.

Field sample log sheets will be used to document sample collection details and other observations and activities will be recorded in the field logbook. Instrument calibration logs will be used to record the daily instrument calibration.

For sampling and field activities, the following types of information will be recorded in the field logbook as appropriate:

- Site name and location
- Date and time of logbook entries
- Personnel and their affiliations
- Weather conditions
- Activities involved with the sampling
- Subcontractor activity summary
- Site observations including site entry and exit times
- Site sketches made onsite
- Visitor names, affiliations, arrival and departure times
- Health and safety issues, including personal protective equipment

27.1.3 Sample Handling and Tracking System

Following collection, all samples will be immediately placed on ice in a cooler. The glass sample containers will be enclosed in bubble-wrap in order to protect the bottleware during shipment. The cooler will be secured using strapping tape along with a signed custody seal. Sample coolers will be delivered to a local courier location for priority overnight delivery to the selected laboratory for analysis. Samples will be preserved as appropriate based on the analytical method. The laboratories will provide pre-preserved sample containers for sample collection. Samples will be maintained at 0 to 6 degrees Celsius until delivery to the laboratory. Proper custody procedures will be followed throughout all phases of sample collection and handling.

After collection, each sample will be maintained in the sampler's custody until formally transferred to another party (e.g., FedEx). For all samples collected, chain-of-custody forms will document the date and time of sample collection, the sampler's name, and the names of all others who subsequently held custody of the sample. Specifications for chemical analyses will also be documented on the chain-of-custody form. Further details on chain-of-custody procedures are provided in SOP-3-03A.

The following subsections outline the procedures that will be used by field and laboratory personnel to document project activities and sample-collection procedures. All forms must be filled in as completely as possible.

Resolution Consultants personnel will collect the samples. The samplers will take care not to contaminate samples through improper handling. Samples will be sealed in appropriate containers, packaged by Resolution Consultants personnel and placed into sealed coolers under chain-of-custody in accordance with the applicable standard operating procedure (SOP). All coolers will contain a temperature blank. Samples will be transferred under chain-of-custody to a courier as described below. Once received by the laboratory, receipt will be documented on the chain-of-custody form and the samples will be checked in. The samples will remain under chain-of-custody throughout the analysis period to ensure their integrity is preserved. Details are provided below.

Samples to be delivered to the laboratory(s) will be made by a public courier (i.e., FedEx). After samples have been collected, they will be sent to the laboratory(s) within 24 hours.

27.2 Field Sample Custody Procedures

Chain-of-custody protocols will be used throughout sample handling to establish the evidentiary integrity of sample containers. These protocols will be used to demonstrate that the samples were handled and transferred in a manner that would eliminate possible tampering. Samples for the laboratory will be packaged and shipped in accordance with Resolution Consultants SOP-3-04A.

A sample is under custody if:

- The sample is in the physical possession of an authorized person
- The sample is in view of an authorized person after being in his/her possession
- The sample is placed in a secure area by an authorized person after being in his/her possession
- The sample is in a secure area, restricted to authorized personnel only

Custody documentation is designed to provide documentation of preparation, handling, storage, and shipping of all samples collected. A multi-part form is used with each page of the form signed and dated by the recipient of a sample or portion of sample. The person releasing the sample and the person receiving the sample each will retain a copy of the form each time a sample transfer occurs.

Integrity of the samples collected will be the responsibility of identified persons from the time the samples are collected until the samples, or their derived data, are incorporated into the final report.

The Resolution Consultants Field Team Leader is responsible for the care and custody of the samples collected until they are delivered to the laboratory or are entrusted to a carrier. When transferring samples, the individuals relinquishing and receiving them will sign, date, and note the time on the chain-of-custody form. This record documents the sample custody transfer from the sampler to the laboratory, often through another person or agency (common carrier). Upon arrival at the laboratory, internal sample custody procedures will be followed as defined in the laboratory SOPs.

27.3 Laboratory Chain-of-Custody

Laboratory sample custody procedures (receipt of samples, archiving, and disposal) will be used in accordance with laboratory SOPs. Coolers are received and checked for proper temperature. A sample cooler receipt form will be filled out to note conditions and any discrepancies. The chain-of-custody form will be checked against the sample containers for accuracy. Samples will be logged into the laboratory information management system and given a unique log number which can be tracked through processing. The laboratory project manager will notify the Resolution Consultants Field Team Leader verbally or via e-mail immediately if any problems are identified. Discrepancies and resolutions will be documented on the sample receiving checklist.

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE

(UFP-QAPP Manual Section 3.4)

Matrix:	Soil and SPLP Leach
Analytical Group:	PAHs via SIM
Analytical Method/SOP Reference:	SW-846 8270D via SIM/GCAL SOP GCMSSV-004

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples per matrix	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ. (See Box D-1 in QSM V4.2.)	Correct problem; re-prepare and/or reanalyze any sample associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	See Method/SOP QC Acceptance Limit Column
Surrogates	All field and QC samples	**DoD QSM Surrogate Limits** / **Soil %R** / **Water (Soil Leach) %R** 2-Fluorobiphenyl: 45-105 / 50-110 Terphenyl-d14: 30-125 / 50-135 2,4,6-Tribromophenol: 35-125 / 40-125 2-Fluorophenol: 35-105 / 20-110 Phenol-d5/d6: 40-100 / * Nitrobenzene-d5: 35-100 / 40-110 * Laboratory limit is used; %R not listed in DoD QSM.	Re-prepare and/or reanalyze if sufficient sample is available. If reanalysis confirms failing recoveries, report and narrate.	Analyst, Supervisor, QA Manager	Accuracy Bias	QC acceptance criteria specified in DoD QSM Version 4.2 See Method/SOP QC Acceptance Limit Column
LCS	One per batch of 20 or fewer samples per matrix	QC acceptance criteria specified in Table G-6 of DoD QSM Version 4.2	Correct problem. If the LCS recoveries are high but the sample results are <LOQ narrate. Otherwise, re-prepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Analyst, Supervisor, QA Manager	Accuracy Bias	QC acceptance criteria specified in Table G-6 of DoD QSM Version 4.2
Internal Standards	In all field samples and standards	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within 50% to +100% of ICAL midpoint standard	Inspect MS or GC for malfunctions. Reanalyze all samples with internal standard failures. If reanalysis confirms matrix interference, report sample and narrate.	Analyst, Supervisor, QA Manager	Accuracy Bias	See Method/SOP QC Acceptance Limit Column

Matrix:	Soil and SPLP Leach
Analytical Group:	PAHs via SIM
Analytical Method/SOP Reference:	SW-846 8270D via SIM/GCAL SOP GCMSSV-004

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
MS/MSD	One per batch of 20 or fewer samples per matrix	For matrix accuracy evaluation, use LCS recovery criteria; RPD $\leq$30%.	Contact the client to determine if additional measures are required.	Analyst, Supervisor, QA Manager	Accuracy Bias Precision	See Method/SOP QC Acceptance Limit Column

Notes:

SPLP	=	Synthetic precipitation leaching procedure
PAHs	=	Polynuclear aromatic hydrocarbons
SIM	=	Selective ion monitoring
GCAL	=	Gulf Coast Analytical Laboratories
SOP	=	Standard operating procedure
QC	=	Quality control
LOQ	=	Limit of quantitation
DoD QSM	=	Department of Defense Quality Systems Manual
QA	=	Quality assurance
%R	=	Percent recovery
LCS	=	Laboratory control sample
ICAL	=	Initial calibration
EICP	=	Extracted ion current profile
MS	=	Mass Spectrometer
GC	=	Gas chromatograph
MS/MSD	=	Matrix spike/matrix spike duplicate
RPD	=	Relative percent difference

Matrix:	Soil and SPLP Leach
Analytical Group:	Antimony, Arsenic, Copper, and Lead
Analytical Method/SOP Reference:	SW-846 Method 6020A/GCAL SOP MET-21

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples per matrix	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ. (See Box D-1 in QSM V4.2.)	Correct problem; re-prepare and/or reanalyze any sample associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	See Method/SOP QC Acceptance Limit Column
LCS	One LCS per preparatory batch (20 or fewer samples per matrix)	**DoD QSM LCS Limits** / **Soil %R** / **Water (Soil Leach) %R** Antimony 75-120 80-120 Arsenic 80-120 80-120 Copper 80-120 80-120 Lead 80-120 80-120	Re-prepare and/or reanalyze all associated samples.	Analyst, Supervisor, QA Manager	Accuracy Bias	QC acceptance criteria specified in DoD QSM Version 4.2 See Method/SOP QC Acceptance Limit Column
Internal Standards	In all field samples and standards	Internal standard intensity within 30-120% of intensity of the internal standard in the ICAL.	Reanalyze all samples with internal standard failures. If reanalysis confirms matrix interference, report sample and narrate.	Analyst, Supervisor, QA Manager	Accuracy, Bias	See Method/SOP QC Acceptance Limit Column
Sample Duplicate or MSD	One per batch of 20 or fewer samples per matrix	RPD ≤ 20%	Contact the client to determine if additional measures are required.	Analyst, Supervisor, QA Manager	Precision	See Method/SOP QC Acceptance Limit Column
Matrix Spike	One per batch of 20 or fewer samples per matrix	For matrix accuracy evaluation, use LCS recovery criteria	Contact the client to determine if additional measures are required.	Analyst, Supervisor, QA Manager	Accuracy, Bias	See Method/SOP QC Acceptance Limit Column
Dilution Test	One per batch of 20 or fewer samples per matrix if MS or MSD fails	If the analyte concentration is sufficiently high (minimally, a factor of 10 above the lower limit of quantitation after dilution), an analysis of a 1:5 dilution should agree within ± 10% of the original measurement.	Perform Post Digestion Spike	Analyst, Supervisor, QA Manager	Accuracy, Bias	See Method/SOP QC Acceptance Limit Column

Matrix:	Soil and SPLP Leach
Analytical Group:	Antimony, Arsenic, Copper, and Lead
Analytical Method/SOP Reference:	SW-846 Method 6020A/GCAL SOP MET-21

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Post Digestion Spike	One per batch of 20 or fewer samples per matrix if MS or MSD fails	%R — 80-120%	Contact the client to determine if additional measures are required.	Analyst, Supervisor, QA Manager	Accuracy, Bias	See Method/SOP QC Acceptance Limit Column

Notes:

SPLP	=	Synthetic precipitation leaching procedure
SOP	=	Standard operating procedure
GCAL	=	Gulf Coast Analytical Laboratories
QC	=	Quality control
LOQ	=	Limit of quantitation
DoD QSM	=	Department of Defense Quality Systems Manual
QA	=	Quality assurance
LCS	=	Laboratory control sample
%R	=	Percent recovery
ICAL	=	Initial calibration
MSD	=	Matrix spike duplicate
RPD	=	Relative percent difference
MS	=	Matrix spike

Matrix:	Soil
Analytical Group:	Total Organic Carbon
Analytical Method:	SW-846 9060 (Modified), Lloyd Kahn Method
SOP Reference:	GCAL SOP WL-057

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method blank	One per batch of 20 or fewer samples	No analytes detected > ½ LOQ	Correct problem; reanalyze any sample associated with a blank that fails criteria, except when the sample analysis resulted in a non-detect.	Analyst, Supervisor, QA Manager	Bias Contamination	See Method/SOP QC Acceptance Limit Column
LCS	One per batch of 20 or fewer samples	%R — 69-128%	Correct problem; reanalyze any sample associated with an LCS that fails criteria.	Analyst, Supervisor, QA Manager	Accuracy Bias	See Method/SOP QC Acceptance Limit Column
MS/MSD	One per batch of 20 or fewer samples	%R — 69-128%	Report data with a narrative stating the sample is affected by matrix interference.	Analyst, Supervisor, QA Manager	Accuracy Bias	See Method/SOP QC Acceptance Limit Column
Sample Duplicate	One per batch of 20 or fewer samples, Sample duplicate is not required if MSD is performed.	RPD $\leq$25% for concentrations > 5 times the LOQ	Correct problem and reanalyze sample and duplicate.	Analyst, Supervisor, QA Manager	Precision	See Method/SOP QC Acceptance Limit Column

Notes:

GCAL = Gulf Coast Analytical Laboratories
SOP = Standard operating procedure
QC = Quality control
LOQ = Limit of quantitation
QA = Quality assurance
LCS = Laboratory control sample
%R = Percent recovery
MS/MSD = Matrix spike/matrix spike duplicate
RPD = Relative percent difference

Matrix:	Soil
Analytical Group:	pH
Analytical Method:	SW-846 9045D
SOP Reference:	GCAL SOP EXT-032

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Sample Duplicate	One per batch of 20 or fewer samples	RPD $\leq$25% for concentrations > 5 times the LOQ	Correct problem and reanalyze sample and duplicate.	Analyst, Supervisor, QA Manager	Precision	See Method/SOP QC Acceptance Limit Column

Notes:

GCAL = Gulf Coast Analytical Laboratories
SOP = Standard operating procedure
QC = Quality control
RPD = Relative percent difference
QA = Quality assurance
LOQ = Limit of quantitation

SAP WORKSHEET #29: PROJECT DOCUMENTS AND RECORDS TABLE

(*UFP-QAPP Manual Section 3.5.1*)

Document	Where Maintained
Sample Collection Documents and Records Project personnel sign-off record Field logbook (and sampling notes) Field sample forms (e.g., sample log sheets, drilling logs, etc.) Chain-of-custody records Sample shipment air bills Equipment calibration logs Photographs Sampling and Analysis Plans including field sampling standard operating procedures Safe work permit forms	Sample collection documents and records (may include printed copy as well as electronic information) will be maintained at the Resolution Consultants office at 5724 Summer Trees Drive, Memphis, Tennessee 38134. These records will be transferred to the Federal Records Center (FRC) accordance with in the NAVFAC *Environmental Restoration Recordkeeping Manual* where they will be retained for 50 years after the last decision document is signed.
Analytical Results Documents and Records Sample receipt/log-in forms Sample preparation logs Equipment calibration logs Sample analysis run logs Reported field sample results Reported results for standards, quality control checks Reported results for standards, quality control samples Data completeness checklists Data validation memoranda	Analytical results, documents and records will be provided by the laboratory in printed and electronic formats. Printed copies of laboratory data will be stored at Resolution Consultants office at 5724 Summer Trees Drive, Memphis, Tennessee 38134 until transfer to the FRC. The records will be retained by the FRC for 50 years after the last decision document is signed. Electronic analytical results will also be verified, entered, and maintained in a database on a password protected Structured Query Language server. Data qualifiers will be added to the database during data validation. After validation, the validated data files will be transferred to the Navy's NIRIS data management system.

Document	Where Maintained
Other Documents Personnel training records Health and Safety certifications Health and Safety Plan Letter reports, Investigation Reports, etc. Analytical Audit Checklist	Personnel training records and health and safety certificates will be stored in personnel records and electronically in the Resolution Consultants training database located at project file at 5724 Summer Trees Drive, Memphis, Tennessee 38134. Plans and reports will be stored in printed version and electronically in the Administrative Record file. Printed copies will be stored at Resolution Consultants office at 5724 Summer Trees Drive, Memphis, Tennessee 38134 transfer to the FRC. The records will be retained by the FRC for 50 years after the last decision document is signed. Analytical Audit Checklists will be retained by the respective accreditation authorities.
Final Document/Records Repository Administrative Record files Site files Post decision Files Analytical data Spatial data Maps	All final documents/Records repositories will be stored in accordance with in the NAVFAC *Environmental Restoration Recordkeeping Manual*. Printed copies will be stored at Resolution Consultants office at 5724 Summer Trees Drive, Memphis, Tennessee 38134 until transfer to the FRC, and electronic copies will be maintained, verified, and stored on the Navy's NIRIS data management system. These files will be retained by the FRC for 50 years after the last decision document is signed.

Notes:
FRC = Federal Records Center
NIRIS = Naval Installation Restoration Information Solution
NAVFAC = Naval Facilities Engineering Command

SAP WORKSHEET #30: ANALYTICAL SERVICES TABLE

(*UFP-QAPP Manual Section 3.5.2.3*)

Matrix	Analytical Group	Sample Locations/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization[1] (name and address, contact person and telephone number)	Backup Laboratory/ Organization
Soil	PAHs via SIM	See Worksheet #18	GCAL GCMSSV-004	21 Days	Gulf Coast Analytical Laboratories 7979 GSRI Road, Baton Rouge, Louisiana 70820 Brenda Martinez, brenda.martinez@gcal.com, 225-769-4900	None
Soil	Antimony, Arsenic, Copper, Lead	See Worksheet #18	GCAL MET-021	21 Days	Gulf Coast Analytical Laboratories 7979 GSRI Road, Baton Rouge, Louisiana 70820 Brenda Martinez, brenda.martinez@gcal.com, 225-769-4900	None
Soil	SPLP PAHs via SIM	See Worksheet #18	GCAL EXT-070/ GCMSSV-004	21 Days	Gulf Coast Analytical Laboratories 7979 GSRI Road, Baton Rouge, Louisiana 70820 Brenda Martinez, brenda.martinez@gcal.com, 225-769-4900	None
Soil	SPLP Antimony, Arsenic, Copper, Lead	See Worksheet #18	GCAL EXT-070/ MET-021	21 Days	Gulf Coast Analytical Laboratories 7979 GSRI Road, Baton Rouge, Louisiana 70820 Brenda Martinez, brenda.martinez@gcal.com, 225-769-4900	None
Soil	Total Organic Carbon	See Worksheet #18	GCAL WL-057	21 Days	Gulf Coast Analytical Laboratories 7979 GSRI Road, Baton Rouge, Louisiana 70820 Brenda Martinez, brenda.martinez@gcal.com, 225-769-4900	None
Soil	pH	See Worksheet #18	GCAL EXT-032	21 Days	Gulf Coast Analytical Laboratories 7979 GSRI Road, Baton Rouge, Louisiana 70820 Brenda Martinez, brenda.martinez@gcal.com, 225-769-4900	None

Notes:

1 Laboratory meets accreditation requirements to support project needs.

PAHs = Polynuclear aromatic hydrocarbons
SIM = Selective ion monitoring
SPLP = Synthetic Precipitation Leaching Procedure
GCAL = Gulf Coast Analytical Laboratories

SAP WORKSHEET #31: PLANNED PROJECT ASSESSMENTS TABLE

(UFP-QAPP Manual Section 4.1.1)

Worksheet is not applicable; no project-specific assessments are planned.

SAP WORKSHEET #32: ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES TABLE

(UFP-QAPP Manual Section 4.1.2)

Worksheet is not applicable; no project-specific assessments are planned.

SAP WORKSHEET #33: QUALITY ASSURANCE MANAGEMENT REPORTS TABLE

(UFP QAPP Manual Section 4.2)

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Data Validation	Report per data package	Within 4 weeks of receipt of laboratory data	Resolution Consultants project chemist or designee	TOM, project file, Resolution Consultants
Major Analysis Problem Identification (Internal Resolution Consultants Memorandum)	When persistent analysis problems are detected by Resolution Consultants that may impact data usability	Immediately upon detection of problem (same day)	Resolution Consultants quality assurance officer or project chemist	TOM, program manager, contracts department, project file, Resolution Consultants
Progress Report	Monthly for duration of the project	Monthly	TOM, Resolution Consultants	Navy RPM, program manager, project file, Resolution Consultants
Laboratory Quality Assurance Report	When significant plan deviations result from unanticipated circumstances	Immediately upon detection of problem (same day)	Laboratory quality assurance manager or project manager	TOM, project chemist, project file, Resolution Consultants

Notes:
TOM = Task order manager
RPM = Remedial project manager

SAP WORKSHEETS #34-36: DATA VERIFICATION AND VALIDATION (STEPS I AND IIA/IIB) PROCESS TABLE

(UFP-QAPP Manual Section 5.2.1), (UFP-QAPP Manual Section 5.2.2), (Figure 37 UFP-QAPP Manual), (Table 9 UFP-QAPP Manual)

Data Review Input	Description	Responsible for Verification (name, organization)	Step I/ IIa/IIb [1]	Internal/ External
Verification Chain-of-custody forms Sample Login/Receipt	Review the sample shipment for completeness, integrity, and sign accepting the shipment. All sample labels will be checked against the chain-of-custody form, and any discrepancies will be identified, investigated, and corrected. The samples will be logged in at every storage area and work station required by the designated analyses. Individual analysts will verify the completeness and accuracy of the data recorded on the forms. Verification of sample login/receipt and chain-of-custody forms will be documented on the laboratory sample receipt form.	Laboratory sample custodians and analysts, Gulf Coast Analytical Laboratories	I	Internal
Verification Chain-of-custody forms	Check that the chain-of-custody form was signed/dated by the sampler relinquishing the samples and by the laboratory sample custodian receiving the samples for analyses. Verification of chain-of-custody forms will be documented in the DVA workbook.	Project chemist or data validators, Resolution Consultants	I	External
Verification SAP sample tables	Verify that all proposed samples listed in the SAP tables have been collected. Sample completeness will be documented in the DVA workbook and Data Usability Summary Report in accordance with TCEQ TRRP-13.	FTL or designee, Resolution Consultants	I	External
Verification Sample log sheets and field notes	Verify that information recorded in the log sheets and field notes are accurate and complete. Sample log sheet verification will be documented by dated signature on the last page or page immediately following the review material.	FTL or designee, Resolution Consultants	I	External
Verification Field QC samples	Check that field QC samples, described in Worksheet #12 and listed in Worksheet #20, were collected as required. QC sample completeness will be documented in the DVA workbook and Data Usability Summary Report in accordance with TCEQ TRRP-13.	FTL or designee, Resolution Consultants	I	External
Verification Analytical data package	Verify all analytical data packages will be verified internally for completeness by the laboratory performing the work. The laboratory project manager (or designee) will sign the case narrative for each data package. All laboratory data package reviews will be documented on the laboratory review checklists and exception reports that accompany the data in accordance with TCEQ TRRP-13.	Laboratory project manager, Gulf Coast Analytical Laboratories	I	Internal
Verification Analytical data package	Verify the data package for completeness. Missing information will be requested from the laboratory and validation (if performed) will be suspended until missing data are received. Data package completeness will be documented in the DVA workbook.	FTL, Project chemist or data validators, Resolution Consultants	I	External
Verification Electronic data deliverables	Verify the electronic data against the chain-of-custody and hard copy data package for accuracy and completeness. Electronic data deliverable verification will be documented in the DVA workbook.	Data manager and/or validator, Resolution Consultants	I	External
Validation Chain-of-custody	Examine the traceability of the data from time of sample collection until reporting of data. Ensure that the custody and integrity of the samples were maintained from collection to analysis and the custody records are complete and any deviations are recorded. Chain-of-custody verification will be documented in the DVA workbook.	Project chemist or data validators, Resolution Consultants	IIa	External

Data Review Input	Description	Responsible for Verification (name, organization)	Step I/ IIa/IIb [1]	Internal/ External
Validation Holding Times	Review that the samples were shipped and stored at the required temperature and sample pH for chemically-preserved samples meet the requirements listed in Worksheet #19. Ensure that the analyses were performed within the holding times. If holding times were not met, confirm that deviations were documented. Holding time examination will be documented in the DVA workbook and in the Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa	External
Validation Sample results for representativeness	Check that the laboratory recorded the temperature at sample receipt and the pH of the chemically preserved samples to ensure sample integrity from sample collection to analysis. Sample receipt and preservation will be documented in the DVA workbook and in the Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Laboratory data results for accuracy	Ensure that the laboratory QC samples were analyzed and that the measurement performance criteria, listed in Worksheet #28, were met for all field samples and QC analyses. Check that specified field QC samples were collected and analyzed, as listed in Worksheet #12, and that the analytical QC criteria were met. Accuracy will be documented in the DVA workbook and in the Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Field and laboratory duplicate analyses for precision	Check the field sampling precision by calculating the RPD for field duplicate samples. Check the laboratory precision by reviewing the RPD or percent difference values from laboratory duplicate analyses; MS/MSDs; and LCS/LCSDs. Ensure compliance with the precision goals listed in Worksheet #12 and 28. Precision will be documented in the DVA workbook and in the Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Project action limits	Assess and document the impact on matrix interferences or sample dilutions performed because of the high concentration of one or more contaminant, on the other target compounds reported as undetected. Project action limit achievement will be documented in the DVA workbook and in the Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Data quality assessment report	Summarize deviations from methods, procedures, or contracts. Qualify data results based on method or QC deviation and explain all the data qualifications. Present tabular qualified data and data qualifier codes and summarize data qualification outliers. Determine if the data met the measurement performance criteria and determine the impact of any deviations on the technical usability of the data. Result qualification will be documented in the in the DVA workbook and in the Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation SAP QC sample documentation	Ensure that all QC samples specified in the SAP were collected and analyzed and that the associated results were within acceptance limits. QC sample completeness and assessment will be documented in the DVA workbook and Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Analytical data deviations	Determine the impact of any deviation from sampling or analytical methods and laboratory SOP requirements and matrix interferences effect on the analytical results. Data deviations will be documented in the DVA workbook and Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIb	External

Data Review Input	Description	Responsible for Verification (name, organization)	Step I/ IIa/IIb [1]	Internal/ External
Validation Project quantitation limits for sensitivity	Ensure that the project detection limits were achieved. Project quantitation limit achievement will be documented in the DVA workbook and in the Data Usability Summary Report in accordance with TCEQ TRRP-13	Project chemist or data validators, Resolution Consultants	IIb	External
Validation Soil and SPLP Leach PAHs via SIM	Validate PAH via SIM data using TCEQ TRRP-13 and MPC identified in Worksheets #12, #19, #24, and #28. All data will be validated and raw instrument outputs assessed and recalculated for 10% of the reported results. *U.S. EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review*, (June 2008) will be used as a guidance on applying qualifiers when MPC identified in Worksheets #12, #19, #24, and #28 are not met, including identifying when samples will be qualified estimated or rejected and when individual or all samples in a batch will be qualified. All data validation finding will be documented in a Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Soil and SPLP Leach Antimony, Arsenic, Copper, Lead	Validate metals data using TCEQ TRRP-13 and MPC identified in Worksheets #12, #19, #24, and #28. All data will be validated and raw instrument outputs assessed and recalculated for 10% of the reported results. *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review*, (January 2010) will be used as a guidance on applying qualifiers when MPC identified in Worksheets #12, #19, #24, and #28 are not met, including identifying when samples will be qualified estimated or rejected and when individual or all samples in a batch will be qualified. All data validation finding will be documented in a Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Total Organic Carbon and pH	Validate total organic carbon and pH data using TCEQ TRRP-13 and MPC identified in Worksheets #12, #19, #24, and #28. *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review*, (January 2010) will be used as a guidance on applying qualifiers when MPC identified in Worksheets #12, #19, #24, and #28 are not met. The end use of the data will be to assess soil physical properties; therefore, validation for total organic carbon and pH data will be limited to the following elements: holding times, blank analyses, laboratory control samples, and laboratory duplicates. All data validation finding will be documented in a Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External

<table>
<tr><th>Data Review Input</th><th>Description</th><th>Responsible for Verification (name, organization)</th><th>Step I/ IIa/IIb [1]</th><th>Internal/ External</th></tr>
<tr><td>Validation
Data qualifiers</td><td>Qualifiers that will be applied during the data validation process are summarized below and, as indicated, results will be considered usable for interpretation unless the results are rejected when extreme data quality indicator failures are noted.
<table>
<tr><th>Data Qualifier</th><th>Qualifier Definition</th><th>Interpret Result As a Detection?</th><th>Result Usable?</th><th>Potential Result Bias</th></tr>
<tr><td>no qualifier</td><td>Acceptable</td><td>Yes</td><td>Yes</td><td>None expected</td></tr>
<tr><td>J</td><td>Estimated</td><td>Yes</td><td>Yes</td><td>High or Low</td></tr>
<tr><td>JH</td><td>Estimated and Biased High</td><td>Yes</td><td>Yes</td><td>High</td></tr>
<tr><td>JL</td><td>Estimated and Biased Low</td><td>Yes</td><td>Yes</td><td>Low</td></tr>
<tr><td>U</td><td>Undetected</td><td>No</td><td>Yes</td><td>None expected</td></tr>
<tr><td>UJ</td><td>Undetected and Estimated</td><td>No</td><td>Yes</td><td>High or Low</td></tr>
<tr><td>UJL</td><td>Undetected and Estimated Biased Low</td><td>No</td><td>Yes</td><td>Low</td></tr>
<tr><td>UR</td><td>Undetected and Rejected</td><td>No</td><td>No</td><td>Unspecified</td></tr>
<tr><td>R</td><td>Rejected</td><td>No</td><td>No</td><td>Unspecified</td></tr>
</table></td><td>Project chemist or data validators, Resolution Consultants</td><td>IIa/IIb</td><td>External</td></tr>
</table>

Notes:

[1] IIa = compliance with methods, procedures, and contracts [see Table 10, page 117, UFP-QAPP manual, V.1, March 2005].
IIb = comparison with measurement performance criteria in the SAP [see Table 11, page 118, UFP-QAPP manual, V.1, March 2005].

SAP = Sampling and analysis plan
DVA = Data validation assistant
FTL = Field team leader
QC = Quality control
RPD = Relative percent difference
MS/MSD = Matrix spike/Matrix Spike duplicate
LCS/LCSD = Laboratory control sample/laboratory control sample duplicate
SOP = Standard operating procedure
SPLP = Synthetic precipitation leaching procedure
PAH = Polynuclear aromatic hydrocarbons
SIM = Selective ion monitoring
TCEQ = Texas Commission on Environmental Quality
TRRP-13 = Texas Risk Reduction Program *Review and Reporting of Chemical of Concern (COC) Concentration Data under TRRP*, RG-366/TRRP-13, Revised May 2010
MPC = Measurement performance criteria
U.S. EPA = U.S Environmental Protection Agency

SAP WORKSHEET #37: USABILITY ASSESSMENT

(UFP-QAPP Manual Section 5.2.3)

Data Review

The usability of the data directly affects whether project objectives can be achieved and the following characteristics will be evaluated at a minimum. The results of these evaluations will be included in the project report. The characteristics will be evaluated for multiple concentration levels if the evaluator determines that this is necessary. To the extent required by the type of data being reviewed, the assessors will consult with other technically competent individuals to render sound technical assessments of these data characteristics:

- Completeness — Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected to be obtained under correct normal conditions. It is expected that 100% of the planned sampling points will be collected. The completeness goal for field measurements will be greater than 90%. Laboratory analysis for this project will have a completeness goal greater than 95% to account for unanticipated results that may be rejected during data validation. Completeness can be calculated using the following equation.

$$\%Completeness = \frac{No.\ of\ Valid\ Tests}{Total\ Tests\ Taken} x100$$

  The Field Team Leader (FTL), acting on behalf of the Project Team, will determine whether deviations from the scheduled sample collection or analyses occurred. If they have occurred and the Resolution Consultants Task Order Manager (TOM) determines that the deviations compromise the ability to meet project objectives she will consult with the Navy Remedial Project Manager (RPM) and other project team members, as necessary (determined by the Navy RPM), to develop appropriate corrective actions.

- Precision — Precision measures the reproducibility of measurements and methods and is defined for qualitative data as a group of values' variability compared with its average value. To assess the precision of the measurement systems used in this project, field duplicates will be obtained and analyzed with the samples collected. Precision of laboratory analysis will be assessed by comparing the relative percent difference (RPD) of analytical results between matrix spike (MS) and matrix spike duplicates (MSDs), or sample duplicates, and the measurement quality objectives will be those cited in Worksheets #12 and #28.

The RPD will be calculated for each pair of duplicate analysis using the following equation:

$$RPD = \frac{(S \quad D)}{(S + D)/2} x100$$

Where:

S = sample result
D = duplicate result

The project chemist, acting on behalf of the Project Team, will determine whether precision goals for field duplicates and laboratory duplicates were met. This will be accomplished by comparing duplicate results to precision goals identified in Worksheets #12 and #28. This also will include a comparison of field and laboratory precision with the expectation that laboratory duplicate results will be no less precise than field duplicate results. If the goals are not met or data have been flagged as estimated (J qualifier), limitations on the use of the data will be described in the project report.

- Accuracy — Accuracy is the degree to which a given result agrees with the true value. The accuracy of an entire measurement system is an indication of any bias that exists. Spiked sample results provide information needed to assess the accuracy of analyses. Specifically, surrogate spike, MS/MSD, and laboratory control sample (LCS) percent recoveries (%Rs) are used to assess accuracy. Every organic sample is spiked with known quantities of non-target surrogate compounds. Five percent of all samples analyzed are spiked with target chemicals for the MS/MSD (or sample duplicates). If the calculated %Rs for the known spike concentrations is within defined control limits set by each method, the reported sample concentrations are considered accurate. The accuracy measurement quality objectives will be those cited in Worksheets #12 and #28. Accuracy is calculated using the following equation:

$$\%R = \frac{(SSR \quad SR)}{SA} x100$$

Where:

SSR = spike sample recovery
SR = sample recovery
SA = concentration of spike added

The project chemist, acting on behalf of the Project Team, will determine whether the accuracy/bias goals were met for project data. This assessment will include an evaluation of field and laboratory contamination; instrument calibration variability; and analyte recoveries for surrogates, MS, MSD, and LCS against the goals identified in Worksheets #24 and #28. If the goals are not met, limitations on the use of the data will be described in the project report. Bias of the qualified results and a description of the impact of identified non-compliances on a specific data package or on the overall project data will be described in the project report.

- Representativeness — A project scientist, identified by the Resolution Consultants TOM, and acting on behalf of the Project Team, will determine whether the data are adequately representative of intended populations, both spatially and temporally. This will be accomplished by verifying that samples were collected and analyzed in accordance with this Sampling and Analysis Plan, by reviewing spatial and temporal data variations, and by comparing these characteristics to expectations. The usability report will describe the representativeness of the data for each matrix and analytical fraction. This will not require quantitative comparisons unless professional judgment of the project scientist indicates that a quantitative analysis is required.

- Comparability — The project chemist, acting on behalf of the Project Team, will determine whether the data generated under this project are sufficiently comparable to historical property data generated by different methods and for samples collected using different procedures and under different property conditions. This will be accomplished by comparing overall precision and bias among data sets for each matrix and analytical fraction. This will not require quantitative comparisons unless the project chemist indicates that such quantitative analysis is required.

- Sensitivity — The project chemist, acting on behalf of the Project Team, will determine whether project sensitivity goals listed in Worksheet #15 are achieved. The overall sensitivity and quantitation limits from multiple data sets for each matrix and analysis will be compared. If sensitivity goals are not achieved, the limitations on the data will be described.

Describe the evaluative procedures used to assess overall measurement error associated with the project:

After completion of the data validation, the data and data quality will be reviewed to determine whether sufficient data of acceptable quality are available for decision making. In addition to the evaluations described above, a series of inspections and statistical analyses will be performed to estimate these characteristics. The statistical evaluations will include simple summary statistics for target analytes, such as maximum concentration, minimum concentration, number of samples exhibiting non-detected results, number of samples exhibiting positive results, and the proportion of samples with detected and non-detected results. The Project Team members, identified by the Resolution Consultants TOM, will assess whether the data collectively support the attainment of project objectives. They will consider whether any missing or rejected data have compromised the ability to make decisions or to make the decisions with the desired level of confidence. The data will be evaluated to determine whether missing or rejected data can be compensated by other data.

Identify the personnel responsible for performing the usability assessment:

The Resolution Consultants TOM, project chemist, and FTL will be responsible for conducting the listed data usability assessments. The data usability assessment will be reviewed with the Project Team. If deficiencies affecting the attainment of project objectives are identified, the review will take place either in a face to face meeting or a teleconference depending on the extent of identified deficiencies. If no significant deficiencies are identified, the data usability assessment will simply be documented in the project report and reviewed during the normal document review cycle.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

The data will be presented in tabular format, including data qualifications such as estimation (J, UJ) or rejection (R). The project report will identify and describe the data usability limitations and suggest re-sampling or other corrective actions, if necessary. Graphical presentations of the data such as concentration tag maps will be generated as part of the overall data evaluation process.

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Appendix A
Field Standard Operating Procedures

Utility Clearance

Procedure 3-01

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the process for determining the presence of subsurface utilities and other cultural features at locations where planned site activities involve the physical disturbance of subsurface materials.

1.2 This procedure is the Program-approved professional guidance for work performed by Resolution Consultants under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract (Contract Number N62470-11-D-8013).

1.3 The procedure applies to the following activities: soil gas surveying, excavating, trenching, drilling of borings and installation of monitoring and extraction wells, use of soil recovery or slide-hammer hand augers, and all other intrusive sampling activities.

1.4 The primary purpose of the procedure is to minimize the potential for damage to underground utilities and other subsurface features, which could result in physical injury, disruption of utility service, or disturbance of other subsurface cultural features.

1.5 If there are procedures, whether it be from Resolution Consultants, state, and/or federal, that are not addressed in this SOP and are applicable to utility clearance, those procedures should be added as an appendix to the project specific SAP.

1.6 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

2.1 Field and subcontractor personnel shall adhere to a site-specific health and safety plan (HASP).

3.0 Terms and Definitions

3.1 **Utility**

For the proposes of this SOP, a utility is defined as a manmade underground line or conduit, cable, pipe, vault or tank that is, or was, used for the transmission of material or energy (e.g., gas, electrical, telephone, steam, water or sewage, product transfer lines, or underground storage tanks).

3.2 **As-Built Plans**

As-built plans are plans or blueprints depicting the locations of structures and associated utilities on a property.

3.3 **One-Call**

The Utility Notification Center is the one-call agency for nationwide call before you dig. The Utility Notification Center is open 24 hours a day, and accepts calls from anyone planning to dig. The phone number 811 is the designated call before you dig phone number that directly connects you to your local one-call center. Additional information can be found at www.call811.com.

Calling before you dig ensures that any publicly owned underground lines will be marked so that you can dig around them safely. Having the utility lines marked not only prevents accidental damage to the lines, but prevents property damage and personal injuries that could result in breaking a line.

The following information will need to be provided when a call is placed to One-Call:

- Your name, phone number, company name (if applicable), and mailing address.
- What type or work is being done.
- Who the work is being done for.
- The county and city the work is taking place in.
- The address or the street where the work is taking place.
- Marking instructions, (specific instructions as to where the work is taking place).

Under normal circumstances it takes between 2 to 5 days from the time you call (not counting weekends or holidays) to have the underground lines marked. Because these laws vary from state to state, exactly how long it will take depends on where your worksite is located. You will be given an exact start time and date when your locate request is completed, which will comply with the laws in your area.

In the event of an emergency (any situation causing damage to life or property, or a service outage), lines can be marked sooner than the original given time if requested.

3.4 **Toning**

Toning is the process of surveying an area utilizing one or more surface geophysical methods to determine the presence or absence of underground utilities. Typically, toning is conducted after identifying the general location of utilities and carefully examining all available site utility plans. Each location is marked according to the type of utility being identified. In addition, areas cleared by toning are flagged or staked to indicate that all identified utilities in a given area have been toned.

4.0 Training and Qualifications

4.1 The **Contract Task Order (CTO) Manager** is responsible for verifying that these utility locating procedures are performed prior to the initiation of active subsurface exploration.

4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.3 The **Field Manager** is responsible for ensuring that all utility locating activities are performed in accordance with this procedure.

4.4 All **Field Personnel** are responsible for the implementation of this procedure.

5.0 Equipment and Supplies

5.1 Equipment and supplies necessary for locating subsurface utilities will be provided by the subcontractor; however, the project **Field Manager/Field Personnel** will provide any additional equipment and supplies as needed as well as maintain information regarding the utility clearance activities in the field logbook.

6.0 Procedure

Proceed wtih the following steps where subsurface exploration will include excavations, drilling, or any other subsurface investigative method that could damage utilities at a site. In addition to the steps outlined below, always exercise caution while conducting subsurface exploratory work.

6.1 **Prepare Preliminary Site Plan**

- Prepare a preliminary, scaled site plan depicting the proposed exploratory locations as part of the project specific Sampling and Analysis Plan (SAP) or Work Plan. Include as many of the cultural and natural features as practical in this plan.

6.2 **Review Background Information**

- Search existing plan files to review the as-built plans to identify the known location of utilities at the site. Plot the locations of utilities identified onto a preliminary, scaled site plan. Inform the CTO Manager if utilities lie within close proximity to a proposed exploration or excavation location. The CTO Manager will determine if it is necessary to relocate proposed sampling or excavation locations.
- Include the utility location information gathered during previous investigations (e.g., remedial investigation or remedial site evaluation) in the project design documents for removal or remedial actions. In this manner, information regarding utility locations collected during implementation of a CTO can be shared with the subcontractor during implementation of a particular task order. In many instances, this will help to reduce the amount of additional geophysical surveying work the subcontractor may have to perform.
- Conduct interviews with onsite and facility personnel familiar with the site to obtain additional information regarding the known and suspected locations of underground utilities. In addition, if appropriate, contact shall be made with local utility companies to request their help in locating underground lines. Pencil in the dimensions, orientation, and depth of utilities, other than those identified on the as-built plans, at their approximate locations on the preliminary plans. Enter the type of utility, the personnel who provided the information, and the date the information was provided into the field log.
- During the pre-field work interviewing process, the interviewer will determine which site personnel should be notified in the event of an incident involving damage to existing utilities. Record this information in the field logbook with the corresponding telephone numbers and addresses.

6.3 **Site Visit/Locate Utilities/Toning**

- Prior to the initiation of field activities, the Field Task Manager or similarly qualified field personnel shall visit the site and note existing structures and evidence of associated utilities, such as fire hydrants, irrigation systems, manhole and vault box covers, standpipes, telephone switch boxes, free-standing light poles, gas or electric meters, pavement cuts, and linear depression. Compare notes of the actual site configuration to the preliminary site plan. Note deviations in the field logbook and on the preliminary site plan. Accurately locate or survey and clearly mark with stakes, pins, flags, paint, or other suitable devices all areas where subsurface exploration is proposed. These areas shall correspond with the locations drawn on the preliminary site plan.
- Following the initial site visit by the Field Task Manager, a trained utility locating subcontractor will locate, identify, and tone all utilities depicted on the preliminary site plan. The Field Task Manager or similarly qualified field personnel shall visit the site and identify the areas of subsurface disturbance with white spray paint, chalk, white pin flags or some other easily identifiable marking. The utility locator should utilize appropriate sensing equipment to attempt to locate utilities that might not have appeared on the as-built plans. At a minimum, the utility subcontractor should utilize a metal detector and/or magnetometer; however, it is important to consider the possibility that non-metallic utilities or tanks might be present at the site. Use other appropriate surface geophysical methods such as Ground Penetrating Radar, Radiodetection, etc. as appropriate. Clear proposed exploration areas of all utilities in the immediate area where subsurface exploration is proposed. Clearly tone all anomalous areas. Clearly identify all toned areas on the preliminary site plan. All utilities near the area of subsurface disturbance should also be marked out by the utility subcontractor using the universal colors for subsurface utilities (i.e., red – electric; blue – water; green – sewer; yellow – gas; etc.). After toning the site and plotting all known or suspected buried utilities on the preliminary site plan, the utility locator shall provide the Field Task Manager with a copy of the completed preliminary

site plan. Alternatively, the Field Task Manager or designee shall document the results of the survey on the preliminary site plan.

- Report to the Field Task Manager anomalous areas detected and toned that are in close proximity to the exploration or excavation areas. The Field Task Manager shall determine the safe distance to maintain from the known or suspected utility. It may be necessary to relocate the proposed exploration or excavation areas. If this is required, the Field Task Manager or designee shall relocate them and clearly mark them using the methods described above. Completely remove the markings at the prior location. Plot the new locations on the site plan and delete the prior locations from the plan. In some instances, such as in areas extremely congested with subsurface utilities, it may be necessary to dig by hand or use techniques such as air knife to determine the location of the utilities.

6.4 **Prepare Site Plan**

- Prior to the initiation of field activities, draft a final site plan that indicates the location of subsurface exploration areas and all known or suspected utilities present at the site. Provide copies of this site plan to the Navy Technical Representative (NTR), the CTO Manager, and the subcontractor who is to conduct the subsurface exploration/excavation work. Review the site plan with the NTR to verify its accuracy prior to initiating subsurface sampling activities.

7.0 Quality Control and Assurance

7.1 Utility locating must incorporate quality control measures to ensure conformance to these and the project requirements.

8.0 Records, Data Analysis, Calculations

8.1 A bound field logbook will be kept detailing all activities conducted during the utility locating procedure.

8.2 The logbook will describe any changes and modifications made to the original exploration plan. The trained utility locator shall prepare a report and keep it in the project file. Also, a copy of the final site plan will be kept in the project file.

9.0 Attachments or References

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Author	Reviewer	Revisions (Technical or Editorial)
Caryn DeJesus Senior Scientist	Bob Shoemaker Senior Scientist	Rev 0 – Initial Issue (June 2012)

Logbooks

Procedure 3-02

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the activities and responsibilities pertaining to the identification, use, and control of logbooks and associated field data records.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

2.1 In order to keep the logbook clean, store it in a clean location and use it only when outer gloves used for PPE have been removed.

3.0 Terms and Definitions

3.1 **Logbook**

A logbook is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the relevant activity, the person assigned responsibility for maintenance of the logbook, and the beginning and ending dates of the entries.

3.2 **Data Form**

A data form is a predetermined format utilized for recording field data that may become, by reference, a part of the logbook (e.g., soil boring logs, trenching logs, surface soil sampling logs, groundwater sample logs, and well construction logs are data forms).

4.0 Training and Qualifications

4.1 The **Contract Task Order (CTO) Manager** or **designee** is responsible for determining which team members shall record information in field logbooks and for obtaining and maintaining control of the required logbooks. The **CTO Manager** shall review the field logbook on at least a monthly basis. The **CTO Manager** or **designee** is responsible for reviewing logbook entries to determine compliance with this procedure and to ensure that the entries meet the project requirements.

4.2 A knowledgeable individual such as the **Field Manager**, **CTO Manager**, or **Program Quality Manager** shall perform a technical review of each logbook at a frequency commensurate with the level of activity (weekly is suggested, or, at a minimum, monthly). Document these reviews by the dated signature of the reviewer on the last page or page immediately following the material reviewed.

4.3 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.4 The **Field Manager** is responsible for ensuring that all **field personnel** follow these procedures and that the logbook is completed properly and daily. The **Field Manager** is also responsible for submitting copies to the **CTO Manager**, who is responsible for filing them and submitting a copy (if required by the CTO Statement of Work).

4.5 The **logbook user** is responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature. The **logbook user** is also responsible for safeguarding the logbook while having custody of it.

4.6 All **field personnel** are responsible for the implementation of this procedure.

5.0 Equipment and Supplies

5.1 Field logbooks shall be bound field notebooks with water-repellent pages.

5.2 Pens shall have indelible black ink.

6.0 Procedure

6.1 The field logbook serves as the primary record of field activities. Make entries chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct the applicable events. Store the logbook in a clean location and use it only when outer gloves used for personal protective equipment (PPE) have been removed.

6.2 Individual data forms may be generated to provide systematic data collection documentation. Entries on these forms shall meet the same requirements as entries in the logbook and shall be referenced in the applicable logbook entry. Individual data forms shall reference the applicable logbook and page number. At a minimum, include names of all samples collected in the logbook even if they are recorded elsewhere.

6.3 Enter field descriptions and observations into the logbook, as described in Attachment 1, using indelible black ink.

6.4 Typical information to be entered includes the following:

- Dates (month/day/year) and times (military) of all on-site activities and entries made in logbooks/forms;
- Site name and description;
- Site location by longitude and latitude, if known;
- Weather conditions, including temperature and relative humidity;
- Fieldwork documentation, including site entry and exit times;
- Descriptions of, and rationale for, approved deviations from the work plan (WP) or field sampling plan;
- Field instrumentation readings;
- Names, job functions, and organizational affiliations of on-site personnel;
- Photograph references;
- Site sketches and diagrams made on site;
- Identification and description of sample morphology, collection locations, and sample numbers;
- Sample collection information, including dates (month/day/year) and times (military) of sample collections, sample collection methods and devices, station location numbers, sample collection depths/heights, sample preservation information, sample pH (if applicable), analysis requested (analytical groups), etc., as well as chain-of-custody (COC) information such as sample identification numbers cross-referenced to COC sample numbers;
- Sample naming convention;
- Field quality control (QC) sample information;
- Site observations, field descriptions, equipment used, and field activities accomplished to reconstruct field operations;

- Meeting information;
- Important times and dates of telephone conversations, correspondence, or deliverables;
- Field calculations;
- PPE level;
- Calibration records;
- Contractor and subcontractor information (address, names of personnel, job functions, organizational affiliations, contract number, contract name, and work assignment number);
- Equipment decontamination procedures and effectiveness;
- Laboratories receiving samples and shipping information, such as carrier, shipment time, number of sample containers shipped, and analyses requested; and
- User signatures.

6.5 The logbook shall reference data maintained in other logs, forms, etc. Correct entry errors by drawing a single line through the incorrect entry, then initialing and dating this change. Enter an explanation for the correction if the correction is more than for a mistake.

6.6 At least at the end of each day, the person making the entry shall sign or initial each entry or group of entries.

6.7 Enter logbook page numbers on each page to facilitate identification of photocopies.

6.8 If a person's initials are used for identification, or if uncommon acronyms are used, identify these on a page at the beginning of the logbook.

6.9 At least weekly and preferably daily, the **preparer** shall photocopy and retain the pages completed during that session for backup. This will prevent loss of a large amount of information if the logbook is lost.

7.0 Quality Control and Assurance

7.1 Review per Section 4.2 shall be recorded.

8.0 Records, Data Analysis, Calculations

8.1 Retain the field logbook as a permanent project record. If a particular CTO requires submittal of photocopies of logbooks, perform this as required.

8.2 Deviations from this procedure shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

9.0 Attachments or References

9.1 Attachment 1 – Description of Logbook Entries

9.2 Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue

Attachment 1
Description of Logbook Entries

Logbook entries shall be consistent with Section A.1.4 *Field Documentation SOPs* of the UFP-QAPP Manual (DoD 2005) and contain the following information, as applicable, for each activity recorded. Some of these details may be entered on data forms, as described previously.

Name of Activity	For example, Asbestos Bulk Sampling, Charcoal Canister Sampling, Aquifer Testing.
Task Team Members and Equipment	Name all members on the field team involved in the specified activity. List equipment used by serial number or other unique identification, including calibration information.
Activity Location	Indicate location of sampling area as indicated in the field sampling plan.
Weather	Indicate general weather and precipitation conditions.
Level of PPE	Record the level of PPE (e.g., Level D).
Methods	Indicate method or procedure number employed for the activity.
Sample Numbers	Indicate the unique numbers associated with the physical samples. Identify QC samples.
Sample Type and Volume	Indicate the medium, container type, preservative, and the volume for each sample.
Time and Date	Record the time and date when the activity was performed (e.g., 0830/08/OCT/89). Use the 24-hour clock for recording the time and two digits for recording the day of the month and the year.
Analyses	Indicate the appropriate code for analyses to be performed on each sample, as specified in the WP.
Field Measurements	Indicate measurements and field instrument readings taken during the activity.
Chain of Custody and Distribution	Indicate chain-of-custody for each sample collected and indicate to whom the samples are transferred and the destination.
References	If appropriate, indicate references to other logs or forms, drawings, or photographs employed in the activity.
Narrative (including time and location)	Create a factual, chronological record of the team's activities throughout the day including the time and location of each activity. Include descriptions of general problems encountered and their resolution. Provide the names and affiliations of non-field team personnel who visit the site, request changes in activity, impact the work schedule, request information, or observe team activities. Record any visual or other observations relevant to the activity, the contamination source, or the sample itself. It should be emphasized that logbook entries are for recording data and chronologies of events. The logbook author must include observations and descriptive notations, taking care to be objective and recording no opinions or subjective comments unless appropriate.
Recorded by	Include the signature of the individual responsible for the entries contained in the logbook and referenced forms.
Checked by	Include the signature of the individual who performs the review of the completed entries.

Sample Labeling and Chain of Custody Procedures
Procedure 3-03A

1.0 Purpose and Scope

1.1 The purpose of this standard operating procedure is to establish standard protocols for all field personnel for use in maintaining field and sampling activity records, labeling samples, ensuring that proper sample custody procedures are utilized, and completing chain-of-custody/analytical request forms.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

Not applicable

3.0 Definitions

3.1 **Logbook**

A logbook is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the relevant activity, the person responsible for maintenance of the logbook, and the beginning and ending dates of the entries.

3.2 **Chain-of-Custody**

Chain-of-custody (COC) is documentation of the process of custody control. Custody control includes possession of a sample from the time of its collection in the field to its receipt by the analytical laboratory, and through analysis and storage prior to disposal.

4.0 Training and Qualifications

4.1 The **CTO Manager**, or designee, is responsible for determining which team members shall record information in the field logbook and for checking sample logbooks and COC forms to ensure compliance with these procedures. The **CTO Manager**, or designee, shall review COC forms at the completion of each sampling event.

4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.3 The **Field Manager** is responsible for ensuring that all field equipment is decontaminated according to this procedure.

4.4 The **Project Chemist**, or designee, is responsible for verifying that the COC/analytical request forms have been completed properly and match the sampling and analytical plan. The **Project Chemist**, or designee, is responsible for notifying the laboratory, data managers, and data validators in writing if analytical request changes are required as a corrective action. These small changes are different from change orders, which involve changes to the scope of the subcontract with the laboratory and must be made in accordance with a respective contract.

4.5 All **Field Personnel** are are responsible for recording pertinent data onto the COC forms to satisfy project requirements and for attesting to the accuracy of the entries by dated signature.

5.0 Procedure

This procedure provides standards for labeling the samples, documenting sample custody, and completing COC/analytical request forms. The standards presented in this section shall be followed to ensure that samples collected are maintained for their intended purpose and that the conditions encountered during field activities are documented.

5.1 Sample Labeling

Affix a waterproof sample label with adhesive backing to each individual sample container. Record the following information with a waterproof marker on each label:

- Project name or number (optional)
- COC sample number
- Date and time of collection
- Sampler's initials
- Matrix (optional)
- Sample preservatives (if applicable)
- Analysis to be performed on sample (This shall be identified by the method number or name identified in the subcontract with the laboratory)

These labels may be obtained from the analytical laboratory or printed from a computer file onto adhesive labels.

5.2 Custody Procedures

For samples intended for chemical analysis, sample custody procedures shall be followed through collection, transfer, analysis, and disposal to ensure that the integrity of the samples is maintained. A description of sample custody procedures is provided below.

Sample Collection Custody Procedures

According to the EPA guidelines, a sample is considered to be in custody if one of the following conditions is met:

- It is in one's actual physical possession or view
- It is in one's physical possession and has not been tampered with (i.e., it is under lock or official seal)
- It is retained in a secured area with restricted access
- It is placed in a container and secured with an official seal such that the sample cannot be reached without breaking the seal

Place custody seals on shipping coolers (and sample jars, if required) if the cooler/container is to be removed from the sampler's custody. Place a minimum of two custody seals in such a manner that they must be broken to open the containers or coolers. Label the custody seals with the following information:

- Sampler's name or initials
- Date and time that the sample/cooler was sealed

These seals are designed to enable detection of sample tampering. An example of a custody seal is shown in Attachment 1.

Field personnel shall also log individual samples onto COC forms (carbon copy or computer generated) when a sample is collected. These forms may also serve as the request for analyses. Procedures for completing these forms are discussed in Section 0, indicating sample identification number, matrix, date and time of collection, number of containers, analytical methods to be performed on the sample, and preservatives added (if any). The samplers will also sign the COC form signifying that they were the personnel who collected the samples. The COC form shall accompany the samples from the field to the laboratory. When a cooler is ready for shipment to the analytical laboratory, the person delivering the samples for transport will sign and indicate the date and time on the accompanying COC form. One copy of the COC form will be retained by the sampler and the remaining copies of the COC form shall be placed inside a self-sealing bag and taped to the inside of the cooler. Each cooler must be associated with a unique COC form. Whenever a transfer of custody takes place, both parties shall sign and date the accompanying carbon copy COC forms, and the individual relinquishing the samples shall retain a copy of each form. One exception is when the samples are shipped; the delivery service personnel will not sign or receive a copy because they do not open the coolers. The laboratory shall attach copies of the completed COC forms to the reports containing the results of the analytical tests. An example COC form is provided in Attachment 2.

5.3 Completing COC/Analytical Request Forms

COC form/analytical request form completion procedures are crucial in properly transferring the custody and responsibility of samples from field personnel to the laboratory. This form is important for accurately and concisely requesting analyses for each sample; it is essentially a release order from the analysis subcontract.

Attachment 2 is an example of a completed COC/analytical request form that may be used by field personnel, with box numbers identified and discussed in text below. Multiple copies may be tailored to each project so that much of the information described below need not be handwritten each time. Each record on the form (Attachment 2) is identified with a bold number corresponding to the instructions given below.

1. Record the project name, site location.
2. Record the site location, including the state.
3. Record the Contract Task Order number
4. Record the Resolution Consultants Task Order Manager
5. Record the sampler/site phone or cell number (if applicable).
6. Record the laboratory name where the samples were sent.
7. Record the requested turnaround time, in days. If a specific turnaround time is required to meet project objectives, but was not indicated on the laboratory service request form submitted to the purchasing department, the sampler, project manager, or site manager should contact the purchasing department so the laboratory contract can be modified.
8. Record the COC number that is defined by the sampler and should be unique throughout the project's history. An example would be to use the sampler's initials followed by the data. If multiple custodies are generated on a given day, use a unique sequential identifier. Example: CRC040105A, CRC040105B
9. Record the purchase order number provided by the purchasing department.
10. Record the page and total number of COC forms used in a shipment.
11. Record the project, and phase applicable to the sampling task.
12. Record the two-character code corresponding to the *chemical* preservation type, which is found on the bottom of the COC form. If no chemical preservation was added to the sample, the field should be left blank. Temperature preservation need not be documented at this location, but will be indicated elsewhere on the COC form (see 33).

13. List the requested analysis. Whenever possible, list the corresponding analytical method. (e.g., VOCs, 8260).

14. For Lab identification use only.

15. Record the full *unique* sample identification as detailed in the Site's Sampling and Analysis Plan.

16. Record the location identification, which is a shortened ID used for presentation and mapping, as detailed in the Site's Sampling and Analysis Plan.

17. Record the sample date using the format mm/dd/yy.

18. Record the sample time using the military format of hhmm.

19. Record the matrix code of the sample, which is located at the bottom of the COC form. The matrix code is a crucial element of the Navy's data management system. For simplicity, only typical matrix codes are listed on the bottom COC form, but below is a complete listing of all applicable Navy matrix codes:

Table 1
Navy Matrix Codes

Matrix Code	Matrix Code Description	Matrix Code	Matrix Code Description
AA	Ambient air	RK	Rock
AC	Composite air sample	SB	Bentonite
AD	Air - Drilling	SBS	Sub-surface soil (> 6")
AIN	Integrated air sample (under sample form of gas)	SC	Cement/Concrete
AQ	Air quality control matrix	SD	Drill cuttings — solid matrix
AQS	Aqueous	SE	Sediment
ASB	Asbestos	SEEP	SEEP
ASBF	Asbestos-Fibrous	SF	Filter sand pack
ASBNF	Asbestos-Non-Fibrous	SJ	Sand
AVE	Air-Vapor extraction, effluent	SK	Asphalt
AX	Air sample from unknown origin	SL	Sludge
BK	Brick	SM	Water filter (solid material used to filter water)
BS	Brackish sediment	SN	Miscellaneous solid/building materials
CA	Cinder ash	SO	Soil
CK	Caulk	SP	Casing (PVC, stainless steel, cast iron, iron pipe
CN	Container	SQ	Soil/Solid quality control matrix
CR	Carbon (usually for a remediation system)	SS	Scrapings
DF	Dust/Fallout	SSD	Subsurface sediment
DR	Debris/rubble	STKG	Stack gas
DS	Storm drain sediment	STPM	Stripper Tower Packing Media
DT	Trapped debris	SU	Surface soil (less than 6 inches)
EF	Emissions flux	SW	Swab or wipe
EW	Elutriate water	SZ	Wood
FB	Fibers	TA	Animal tissue
FL	Forest litter	TP	Plant tissue
GE	Soil gas effluent — stack gas (from system)	TQ	Tissue QC
GI	Soil gas influent (into system)	TX	Tissue
GL	Headspace of liquid sample	UNK	Unknown
GQ	Gaseous or Headspace QC	W	Water (not groundwater, unspecified)
GR	Gravel	WA	Drill cuttings - aqueous mix
GS	Soil gas	WB	Brackish Water

Table 1
Navy Matrix Codes

Matrix Code	Matrix Code Description	Matrix Code	Matrix Code Description
GT	Grit	WC	Drilling water (used for well construction)
IC	IDW Concrete	WD	Well development water
IDD	IDW Solid	WF	Freshwater (not groundwater)
IDS	IDW soil	WG	Ground water
IDW	IDW Water	WH	Equipment wash water
IW	Interstitial water	WI	Ground water influent (into system)
LA	Aqueous phase of a multiphase liquid/soil	WL	Leachate
LF	Product (floating or free)	WM	Marine water
LQ	Organic liquid quality control matrix	WN	Pore water
MA	Mastic	WO	Ocean water
MO	Mortar	WP	Drinking water
MR	Marine sediment	WQ	Water for QC samples
MS	Metal shavings	WR	Ground water effluent (from system)
NS	Near-surface soil	WS	Surface water
PA	Paper	WT	Composite groundwater sample
PC	Paint Chips	WU	Storm water
PP	Precipitate	WW	Waste water
RE	Residue		

Field QC blanks will require matrix codes that identify the type of blank associated with parent sample. Aqueous field QC blanks are not automatically identified with a matrix code of "WQ," indicating a water quality control blank; they are only identified with a matrix code of "WQ" if the associated samples are also aqueous. Trip blanks, field blanks, and equipment rinsate blanks collected in association with ***soil*** samples will be identified with a matrix code of "SQ," even though the actual matrix is aqueous, because the blanks were collected to assess potential contamination imparted during decontamination activities or transport of ***soil*** samples.

20. Record the sample type code, which is located at the bottom of the COC form. The sample type is a crucial element of the EQuIS data management system. For simplicity, only typical sample type codes are listed on the bottom of the COC form, but below is a list of all applicable Navy field sample type codes:

Table 2
Navy Sample Type Codes

Sample Type Code	Sample Type Code Description
AB	Ambient condition blank
BIOCON	Bioassay control sample
BS	Blank spike
BSD	Blank spike duplicate
EB	Equipment blank
EBD	Equipment blank/rinsate duplicate
FB	Field blank
FD	Field duplicate
FS	Field spike
IDW	Purge and rinsate water
LB	Lab Blank

Table 2
Navy Sample Type Codes

Sample Type Code	Sample Type Code Description
LR	Lab Replicate
MB	Material blank
MIS	Multi-Incremental Sample
MS	Matrix spike
N	Normal (Regular)
PE	Performance evaluation
PURGE	Purge water sample
RD	Regulatory duplicate
SB	Source blank
SBD	Source blank duplicate
SCREEN	Screening Sample
SD	Matrix spike duplicate
SPLIT	Sample split
SRM	Standard reference material
TB	Trip Blank
TBD	Trip blank duplicate
TBR	Trip blank replicate

Field duplicate samples — Field duplicates will be identified using the format detailed in the Site's Sampling and Analysis Plan. However, field duplicates will also be differentiated from the parent sample on the chain-of-custody form. The parent sample will have a sample type code of "N," for normal environmental sample; while its duplicate will have a sample type code of "FD."

21. Record whether the sample is field filtered with a "Y" or not field filtered with an "N." If a project requires collecting samples for both total and dissolved constituents, the same sample and location ID is used for both (see 15 and 16); however, the sampler will indicate whether the sample is field filtered at this location on the COC form. This field must always be filled out; even when soil samples are collected (where "N" appropriately applies, in most cases).

22. Record the total number of containers that are submitted for all of the tests. This must add up to the total number of containers listed for each individual test in 23.

23. Record the number of containers for each test. Do not use Xs, rather indicate the number of containers submitted for each test listed in 14. For example, Sample 010MW007002 requires analysis for VOCs (8260), and SVOCs (8270). Record 3 under the VOC analysis and 2 under the SVOC (assuming 3 containers were submitted for VOCs and 2 were submitted for SVOCs). The total number of containers in this example is 5, which should be the total number of containers listed in 22. Extra containers submitted for matrix spike/matrix spike duplicates (MS/MSDs) will be appropriately recorded.

24. Indicate if extra sample volume was included for MS/MSD analysis using an "X." Samples to be used for MS/MSDs will use the same sample ID and location ID (see 15 and 16), but will be collected in triplicate, particularly for liquid samples, to ensure the analytical laboratory receives sufficient volume for the analyses.

25. Indicate if the samples should be held by the laboratory for future testing using an "X."

26. Record any field comments.

27. Reserved for laboratory comments.

28. Indicate the total number of coolers in each shipment. *Note*: When multiple coolers are submitted, each should contain a COC form.

29. Signature(s) of the person(s) relinquishing sample custody.

30. Signature(s) of the person(s) receiving sample custody.

31. Indicate whether the samples are iced, by checking the appropriate response.

32. Indicate the method of shipment (e.g., FedEx, hand-delivered, laboratory courier).

33. Record the airbill number when a commercial courier is used. This is particularly important when multiple coolers are sent in the same shipment or when the laboratory is sent the COC form in advance of receiving samples because it aids in tracking lost coolers.

34. Record the date the coolers were shipped.

COC forms tailored to each CTO can be drafted and printed onto multiple forms. This eliminates the need to rewrite the analytical methods column headers each time. It also eliminates the need to write the project manager, name, and number; QC Level; turnaround time; and the same general comments each time.

Complete one COC form per cooler. Whenever possible, place all volatile organic analyte vials into one cooler in order to reduce the number of trip blanks. Complete all sections and be sure to sign and date the COC form. One copy of the COC form must remain with the field personnel.

6.0 Records

The COC/analytical request form shall be faxed or emailed approximately daily to the Project Chemist, or designee for verification of accuracy. Following the completion of sampling activities, the sample logbook and COC forms will be transmitted to the CTO Manager for storage in project files. The original COC/analytical request form shall be submitted by the laboratory along with the data delivered. Any changes to the analytical requests that are required shall be made in writing to the laboratory. A copy of this written change shall be sent to the data validators and placed in the project files. The reason for the change shall be included in the project files so that recurring problems can be easily identified.

7.0 References and Attachments

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/-fedfac/pdf/ufp_qapp_v1_0305.pdf.

Attachment 1: Chain-of-Custody Seal

Attachment 2: Generic Chain-of-Custody/Analytical Request Form

Author	Reviewer	Revisions (Technical or Editorial)
Tina Cantwell QA Officer	Ben Brantley Project Manager	Rev 0 — Initial Issue

Attachment 1
Chain-of-Custody Seal

EXAMPLE CHAIN-OF-CUSTODY SEAL

[LABORATORY]	SAMPLE NO.	DATE	SEAL BROKEN BY
	SIGNATURE		DATE
	PRINT NAME AND TITLE *(Inspector, Analyst or Technician*		

Attachment 2
Example Chain-of-Custody/Analytical Request Form

RESOLUTION CONSULTANTS

CHAIN OF CUSTODY AND ANALYTICAL REQUEST RECORD

Project Name: 1		COC No. 7	Page of 9
Site Location: 2		PO No. 8	Project No. 10
Contract Task Order No. 3			Lab Name 11

Sampler/Site Phone# 4

Send Results To: 5

Data Shipping Address: 6

Sample Analysis Requested (Enter number of containers for each test)

Lab ID	Sample ID (sys_samp_code)	Location ID (sys_loc_code)	Date (mm/dd/yy)	Time (Military) (hhmm)	Matrix Code (1)	Sample Type (2)	Field Filtered (Y/N)	Total No. of Containers 12 / 13										Extra Volumen for MS/MSD	HOLD
14	15	16	17	18	19	20	21	22	23									24	25

Turnaround Time(specify): 26 **Final** _____ days **Email** (if applicable) _____ days

Deliverable(check): 27 Level 2_____ Level 3_____ Full/Level 4_____ TX TRRP-13_____

Field **Comments:** 28

Lab **Comments:** 29

Sample Shipment and Delivery Details

Number of coolers in shipment: 30

Relinquished by (signature)	Date	Time
1 31		
2		
3		

Received by (signature)	Date	Time
1 32		
2		
3		

Samples Iced?(check) 33 Yes___ No___

Method of Shipment: 34

Airbill No: 35

Date Shipped: 36

(1) AA=Ambient air, **AQ**=Air quality control, **ASB**=Asbestos, **CK**=Caulk, **DS**=Storm drain sediment, **GS**=Soil gas, **IC**=IDW Concrete, **IDD**=IDW Solid, **IDS**=IDW soil, **IDW**=IDW Water, **LF**=Free Product, **MA**=Mastic, **PC**=Paint Chips, **SC**=Cement/Concrete, **SE**=Sediment, **SL**=Sludge, **SO**=Soil, **SQ**=Soil/Solid quality control, **SSD**=Subsurface sediment, **SU**=Surface soil (<6 in), **SW**=Swab or wipe, **TA**=Animal tissue, **TP**=Plant tissue, **TQ**=Tissue quality control, **WG**=Ground water, **WL**=Leachate, **WO**=Ocean water, **WP**=Drinking water, **WQ**=Water quality control, **WR**=Ground water effluent, **WS**=Surface water, **WU**=Storm water, **WW**=Waste water

(2) Sample Type: AB=Ambient Blk, **EB**=Equipment Blk, **FB**=Field Blk, **FD**=Field Duplicate Sample, **IDW**=Investigative-Derived Waste, **MIS**=Incremental Sampling Methodology, **N**=Normal Environmental Sample, **PE**=Performance Eval., **TB**=Trip Blk

(3) Preservative added: HA=Hydrochloric Acid, **NI**=Nitric Acid, **SH**=Sodium Hydroxide, **SA**=Sulfuric Acid, **AA**=Ascorbic Acid, **HX**=Hexane, **ME**=Methanol, **SB**=sodium bisulfate, **ST**=Sodium Thiosulfate, If **NO preservative** added leave blank

Sample Handling, Storage, and Shipping of Low Level Environmental Samples

Procedure 3-04A

1.0 Purpose and Scope

1.1 This Standard Operating Procedure (SOP) sets forth the methods for use by personnel engaged in handling, storing, and transporting low level environmental samples.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

2.1 To avoid lifting injuries associated with heavy coolers, use the large muscles of the legs, not the back. Use dollies if possible.

2.2 When using tools for cutting purposes, cut away from yourself. The use of appropriate, task specific cutting tools is recommended.

2.3 Wear proper gloves, such as blue nitrile and latex, as defined in the site-specific project health and safety plan, when handling sample containers to avoid contacting any materials that may have spilled out of the sample containers.

3.0 Terms and Definitions

DOT — Department of Transportation

4.0 Training and Qualifications

4.1 The **Contract Task Order** (CTO) **Manager** is responsible for verifying that these procedures are performed prior to the initiation of active subsurface exploration.

4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.3 The **Field Manager** is responsible for ensuring that sample handling, storage, and shipping are performed in accordance with this procedure.

4.4 All **Field Personnel** are responsible for the implementation of this procedure.

5.0 Procedures

5.1 Handling and Packaging

Environmental samples should be packaged prior to shipment using the following procedures:

1. Allow sufficient headspace in all bottles (except volatile organic analysis containers with a septum seal) to compensate for any pressure and temperature changes (approximately 1 percent of the volume of the container).

2. Ensure that the lids on all bottles are tight (will not leak).

3. Glass bottles should be wrapped in bubble wrap — preferably sealable bubble wrap sample bags, if available. Place bottles in separate and appropriately-sized polyethylene bags and seal the bags.

4. Select a sturdy cooler in good repair. Secure and tape the drain plug with fiber or duct tape inside and outside. Line the cooler with a large heavy-duty plastic bag.

5. Place cushioning/absorbent material in the bottom of the cooler, if available, and then place the containers in the cooler with sufficient space to allow for the addition of cushioning between the containers.

6. Put "blue ice" (or ice that has been "double bagged" in heavy-duty polyethylene bags and properly sealed) on top of and/or between the containers. Fill all remaining space between the containers with bubble wrap or other suitable absorbent material.

7. Securely fasten the top of the large garbage bag with packaging tape.

8. Place the completed Chain-of-Custody (COC) Record into a sealed plastic bag, and tape the bag to the inner side of the cooler lid.

9. Close the cooler and securely tape (preferably with fiber tape) the top of the cooler shut. COC seals should be affixed to opposing sides of the cooler within the securing tape so that the cooler cannot be opened without breaking the seal.

5.2 Shipping

Follow all appropriate DOT regulations (e.g., 49 Code of Federal Regulations, Parts 171-179) for shipment of air, soil, water, and other samples. Elements of these procedures are summarized in the following subsections.

5.2.1 Non-hazardous Materials Shipment

If the samples are suspected to be non-hazardous based on previous site sample results, field screening results, or visual observations, if applicable, then samples may be shipped as non-hazardous.

When a cooler is ready for shipment to the laboratory, prepare standard air bill paperwork for shipment of the samples to the laboratory. Write the shippers tracking/airbill number on the COC form. Place two copies of the COC form inside a self-sealing bag and tape it to the inside of the cooler. Seal the cooler with waterproof tape and label it with “Fragile,” “This-End-Up” (or directional arrows pointing up), or other appropriate notices. Affix a label stating the destination (laboratory address) to each cooler. Personnel should be aware of carrier weight or other policy restrictions.

5.2.2 Hazardous Materials Shipment

Shipment of Hazardous Material is not covered in this SOP; all samples handled under this SOP are anticipated to be non-hazardous or not dangerous goods. The CTO Manager, or designee, is responsible for determining if samples collected during a specific field investigation meet the definitions for dangerous goods. If a sample is collected of a material that is listed in the Dangerous Goods List, Section 4.2, of International Air Transport Authority (IATA), then that sample must be identified, packaged, marked,

labeled, and shipped according to the instructions given for that material. If the composition of the collected sample(s) is unknown, and the project leader knows or suspects that it is a regulated material (dangerous goods), the sample may not be offered for air transport. If the composition and properties of a waste sample or a highly contaminated soil, sediment, or water sample are unknown, or only partially known, the sample may not be offered for air transport.

6.0 Records

Maintain all copies of chain of custodies and air bills with the project file. .

7.0 Attachments or References

International Air Transport Authority (IATA). Dangerous Goods Regulations

http://www.iata.org/whatwedo/cargo/dangerous_goods/Documents/DGR52-significant-changes.pdf

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Author	Reviewer	Revisions (Technical or Editorial)
Ben Brantley	Tina Cantwell	Rev 0 — Initial Issue
Program Manager	QA Officer	

1.0 PURPOSE

This standard operating procedure (SOP) describes the activities regarding the management of investigation-derived waste (IDW) at project sites in the state of Texas. The purpose of this procedure is to provide guidance for the minimization, handling, labeling, temporary storage, inventory, classification, and disposal of IDW. This procedure will also apply to personal protective equipment (PPE), sampling equipment, decontamination fluids, non-IDW trash, non-indigenous IDW, and hazardous waste generated during implementation of remedial actions. If there are procedures whether it is from Resolution Consultants, state and/or federal, that are not addressed in this SOP and are applicable to IDW, then those procedures may be added as an appendix to the project-specific Sampling and Analysis Plan.

2.0 SCOPE

This procedure shall serve as management-approved professional guidance for and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by both the Contract Task Order (CTO) Manager and the Quality Assurance (QA) Manager.

This procedure was developed to serve as management-approved professional guidance for the management of IDW in the state of Texas. It focuses on the requirements for minimizing, segregating, handling, labeling, storing, and inventorying IDW in the field. Certain drum inventory requirements related to the screening, sampling, classification, and disposal of IDW are also noted in this procedure. This procedure was developed based on the rules promulgated in Title 30, Texas Administrative Code (TAC), Chapter 335, and Title 40 Code of Federal Regulations (CFR), Subchapter I.

3.0 DEFINITIONS

3.1 Logbook

A logbook is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the relevant activity, the person assigned responsibility for maintenance of the logbook, and the beginning and ending dates of the entries.

3.2 Hazardous Waste

A waste is defined as hazardous by the U.S. Environmental Protection Agency (USEPA) if it is one of over 400 wastes listed in the CFR as hazardous or if it exhibits one or more of four hazardous characteristics; i.e., it is ignitable, corrosive, reactive or toxic. (40 CFR 261.3)

3.3 Class 1 Industrial Waste

A waste that, because of its concentration or physical or chemical characteristics, is toxic; corrosive; flammable; a strong sensitizer or irritant; a generator of sudden pressure by decomposition, heat or other means; or may pose a substantial present or potential danger to human health or the environment when improperly processed, stored , transported, disposed of or otherwise managed. (30 TAC 335.1[14])

A waste that contains specific constituents which equal or exceed the levels listed in 335.521(a)(1) is a Class 1 waste. Generators should document that a waste with significant concentrations of Table 2 constituents is not Class 1 (335.521 Table 2). A waste is classified as Class 1 if a liquid has a flash point of less than 65.6 degrees Celsius (150 degrees Fahrenheit), or is a solid or semi-solid capable of causing fires through friction, or retained heat from process, or ignited readily and burns vigorously and persistently, creating serious hazard. A waste is classified as Class 1 if it is a semi-solid or solid which when mixed with distilled water produces a solution with pH less than 2 or greater than 12.5; if total recoverable cyanides are greater than 20 parts per million; if absence of analytical data and/or process knowledge which proves waste is Class 2 or Class 3; if identified as Class 1 in 335.508 (Specific Wastes); or if not a hazardous waste and generator chooses to classify as Class 1.

3.4 Class 2 Industrial Waste

Any waste that cannot be described as a hazardous waste or as a non-hazardous Class 1 or Class 3 waste. (30 TAC 335.1[15]) A generator can choose not to classify waste as Class 3.

3.5 Class 3 Industrial Waste

A waste that is inert and essentially insoluble, usually including materials such as rock, brick, glass, dirt, certain plastics, rubber, and similar materials that are not readily decomposable. (30 TAC 335.1[16])

4.0 RESPONSIBILITIES

The CTO Manager is responsible for identifying instances of non-compliance with this procedure and ensuring that IDW is properly handled and managed in accordance with this SOP and any site-specific or project-specific planning documents. The CTO Manager is responsible for ensuring that all personnel involved in IDW management shall have the appropriate education, experience, and training to perform their assigned tasks. The QA Manager or CTO Manager is responsible for ensuring overall compliance with this procedure. The Field Manager is responsible for ensuring that all IDW is managed according to this procedure. Field personnel are responsible for the implementation of this procedure and will be accountable for the comprehension and implementation of this SOP during all field activities, as well as obtaining the appropriate field logbooks, forms, labels, records and equipment needed to complete the field activities.

5.0 PROCEDURE

5.1 Equipment/Supplies

The equipment and supplies required for implementation of this SOP include the following:

- Containers for waste (e.g., U.S. Department of Transportation (DOT) approved 55-gallon open or closed top drums) and material to cover waste to protect it from weather (e.g., plastic covering)
- Equipment (i.e., pumps, generators, water/interface level indicators, safety monitoring equipment, drum sampling equipment, wrenches to secure drum bungs or lids)
- Hazardous/non-hazardous waste drum labels (weatherproof)
- Permanent marking pens
- Inventory forms for project file
- Plastic garbage bags, zip lock storage bags, rolls of plastic sheeting
- Steel-toed boots, chemical resistant gloves, coveralls, safety glasses, and any other PPE required in the site-specific Site Health and Safety Plan (SHSP).

5.2 Drum Handling

IDW shall be containerized using DOT-approved drums. The drums shall be made of steel or plastic, have a 55-gallon capacity, be completely painted or opaque, and have removable lids or bungs (i.e., United Nations Code 1A2 or 1H2). Typically, 55-gallon drums are used; however, smaller drums may be used depending on the amount of waste generated. New steel drums are preferred over recycled drums.

Recycled drums should not be used for hazardous waste, polychlorinated biphenyl compounds or other regulated shipments. For sites where large quantities of liquids will be generated, double-walled bulk steel or plastic storage tanks may be used. For this scenario, consider the scheduling and cost-effectiveness of this type of bulk storage, treatment, and discharge system or offsite disposal versus longer-term drum storage.

When DOT-approved drums with removable lids are used, verify the integrity of any foam or rubber sealing ring located on the underside the drum lids prior to sealing drums containing IDW liquids. If the ring is only partially attached to the drum lid, or if a portion of the ring is missing, select another drum lid with a sealing ring that is in sound condition.

To prepare IDW drums for labeling, wipe clean the outer wall surfaces and drum lids of all material that might prevent legible and permanent labeling. If potentially contaminated material adheres to the outer surface of a drum, wipe that material from the drum and segregate the paper towel or rag used to remove the material with visibly soiled PPE and disposable sampling equipment. Label all IDW drums and place them on pallets or within secondary containment in the designated storage area.

5.3 Labeling

Containers used to store IDW must be properly labeled. Two general conditions exist: 1) waste characteristics are known to be either hazardous or nonhazardous from previous studies or onsite data; or 2) waste characteristics are unknown until additional data are obtained.

For situations where the waste characteristics are known, the waste containers should be packaged and labeled in accordance with appropriate state and federal regulations that may govern the labeling of waste.

The following information shall be placed on all non-hazardous waste labels:

- Description and source of waste (i.e., purge water from MW-1, soil cuttings from HA-2)
- Contact information, including name and telephone number
- Date when the container becomes full

The following information shall be placed on all hazardous waste labels:

- Description and source of waste (i.e., purge water from MW-1, soil cuttings from HA-2)
- Generator information (i.e., name, address, contact telephone number)
- USEPA identification number and Texas Solid Waste Registration number (supplied by onsite client representative)
- Date when the container becomes full

When the final characterization of a waste is unknown, a notification label should be placed on the drum with the words "waste characterization pending analysis" and the following information included on the label:

- Description and source of waste (i.e., purge water from MW-1, soil cuttings from HA-2)
- Contact information, including name and telephone number
- Date when the container becomes full

Once the waste has been characterized, the label should be changed as appropriate for a non-hazardous or hazardous waste.

Waste labels should be constructed of a weatherproof material and filled out with a permanent marker to prevent being washed off or becoming faded by sunlight. It is recommended that waste labels be placed on the side of the container, since the top is more subject to weathering. However, when multiple containers are accumulated together, it also may be helpful to include labels on the top of the containers to facilitate organization and disposal.

Each container of waste generated shall be recorded in the logbook used by the person responsible for labeling the waste. After the waste is disposed, either by transportation offsite or disposal onsite in an approved disposal area, an appropriate record shall be made in the same logbook to document proper disposition of IDW.

5.4 Types of Site Investigation Waste

Several types of waste are generated during site investigations that may require special handling. These include soil and drilling fluids, groundwater, decontamination water, and used PPE, as discussed further in the following subsections.

5.4.1 Soil and Drilling Fluids

Soil cuttings from boreholes can be shoveled back into the borehole after drilling is complete, if feasible. If all of the soil cuttings cannot be returned to the borehole, soil cutting should be placed in an open-top 55-gallon drum. Drilling mud generated during investigation activities shall be collected in 55-gallon drums as well. Containers must remain closed at all times unless waste is being added. The containers shall be labeled in accordance with this SOP. An inventory containing the source, volume, and description of material put in the containers shall be logged on prescribed forms and kept in the project file.

5.4.2 Groundwater or Decontamination Water

Groundwater generated during monitoring well development, purging, and sampling can be collected in truck-mounted containers and/or other transportable containers (i.e., 55-gallon drums). Wastewater generated during decontamination of field and sampling equipment will be collected and containerized in drums. Using bung style drums helps prevent leaks when drums are moved. Lids or bungs on drums must be secured at all times and only open during filling or pumping activities. The containers shall be labeled in accordance with this SOP.

5.4.3 Personal Protective Equipment

PPE that is generated throughout investigation activities shall be placed in plastic garbage bags. If the solid or liquid waste that was being handled is characterized as hazardous waste, then the corresponding PPE should also be disposed as hazardous waste. If not, all PPE should be disposed as Texas Class 2 non-hazardous waste in municipal sanitary landfill. Trash that is generated as part of field activities may be disposed in a municipal sanitary landfill as long as the trash was not exposed to hazardous media.

5.5 Waste Accumulation Onsite

IDW generated during investigation activities may be subject to storage times dictated by the site's hazardous waste generator status. Hazardous waste can either be stored in the designated waste management unit either 90 days (large quantity generator), 180 days (small quantity generator), or 12 months (conditionally exempt small quantity generator). This information can be obtained from the site or client point of contact. Until final offsite disposal, such containers should be inventoried, stored as securely as possible, and inspected weekly, as a general good practice.

The following requirements for the hazardous waste storage area must be implemented:

- Proper hazardous waste signs shall be posted as required by any state or federal statutes that may govern the labeling of waste
- Secondary containment to contain spills
- Spill containment equipment must be available
- Fire extinguisher
- Adequate aisle space for unobstructed movement of personnel

More requirements may be enforced by the client or site point of contact based on generator status. Weekly storage area inspections shall be performed and documented to ensure compliance with these requirements. Throughout the project, an inventory shall be maintained to itemize the type and quantity of the waste generated.

5.6 Waste Disposal

IDW will be characterized for disposal through the use of client knowledge, laboratory analytical data created from soil or groundwater samples gathered during the field activities, and/or composite samples from individual containers.

All waste generated during field activities will be stored, transported, and disposed according to applicable state, federal, and local regulations. In Texas, IDW will be classified as hazardous, Industrial Class 1, Industrial Class 2, or Industrial Class 3 based on the waste

determination process. Hazardous waste must be handled and disposed offsite at an approved hazardous waste disposal facility. Class 1 non-hazardous waste must be disposed at a facility permitted to accept Class 1 waste. Class 2 waste can be disposed at a municipal landfill, Class 1 landfill, or hazardous waste facility. All wastes classified as industrial Class 3 or general rubbish will be disposed at a municipal sanitary landfill, or in the case of construction and demolition (C&D) debris, must be disposed of at a facility that can accept C&D material.

In general, waste disposal should be carefully coordinated with the client or site point of contact, which would be considered the "generator" of the waste. Waste profiles should be carefully reviewed to ensure accuracy, as well as waste manifests prior to transportation offsite for disposal. In addition, facilities receiving waste have specific requirements that vary even for non-hazardous waste, so characterization should be conducted to support both applicable regulations and facility requirements during the profile approval process.

5.7 Regulatory Requirements

The following federal and state regulations shall be used as resources for determining waste characteristics and requirements for waste storage, transportation, and disposal:

- CFR, Title 40, Part 261
- CFR, Title 49, Parts 172, 173, 178, and 179
- 30 TAC, Title 30, Chapter 335

5.8 Waste Transport

A state-licensed and DOT-registered hazardous waste hauler shall transport all wastes classified as hazardous, or DOT hazardous. Typically, the facility receiving any waste can coordinate a hauler to transport the waste. Shipped hazardous waste shall be disposed in accordance with all Resource Conservation and Recovery Act (RCRA)/USEPA requirements. All waste manifests or bills of lading will be signed either by the client or the client's designee.

6.0 RECORDS

Describe all IDW management activities in the field logbook. This should include all handling activities from when a container becomes full until it is transported offsite for disposal. Tracking of IDW will include applicable dates and weekly inspections.

7.0 HEALTH AND SAFETY

The CTO Manager or designee shall prepare a site-specific health and safety plan. All onsite personnel shall adhere to the site-specific SHSP.

8.0 REFERENCES

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U.S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/-fedfac/pdf/ufp_qapp_v1_0305.pdf.

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— 1992b. Guide to Management of Investigative-Derived Wastes. Quick reference fact sheet. OSWER Dir. 9345.3-03FS. Office of Solid Waste and Emergency Response. January.

— 1997a. Sending Wastes Off Site? OSC and RPM Responsibilities under the Off-Site Rule. EPA/540-F-97-006, Office of Solid Waste and Emergency Response. September.

— 1997b. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846. 3rd ed., Final Update IIIA. Office of Solid Waste. Updates available: www.epa.gov/epaoswer/hazwaste/test/new-meth.htm.

— 1998. Management of Remediation Waste under RCRA. EPA/530-F-98-026. Office of Solid Waste and Emergency Response. October.

— (No Date). Compliance with the Off-Site Rule During Removal Actions. Office of Regional Counsel (Region 3). Hendershot, Michael.

9.0 ATTACHMENTS

None.

Equipment Decontamination

Procedure 3-06

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes methods of equipment decontamination, to be used for activities where samples for chemical analysis are collected or where equipment will need to be cleaned before leaving the site or before use in subsequent activities.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

It is the responsibility of the **Site Safety Officer (SSO)** to set up the site zones (i.e., exclusion, transition, and clean) and decontamination areas. Generally the decontamination area is located within the transition zone, upwind of intrusive activities, and serves as the washing area for both personnel and equipment to minimize the spread of contamination into the clean zone. Typically, for equipment, a series of buckets are set up on a visqueen-lined bermed area. Separate spray bottles containing cleaning solvents as described in this procedure or the Contract Task Order (CTO) Work Plan (WP) and distilled water are used for final rinsing of equipment. Depending on the nature of the hazards and the site location, decontamination of heavy equipment, such as augers, pump drop pipe, and vehicles, may be accomplished using a variety of techniques.

All **Field Personnel** responsible for equipment decontamination must adhere to the site-specific health and safety plan (HSP) and must wear the personal protective equipment (PPE) specified in the site-specific HSP. Generally this includes, at a minimum, Tyvek® coveralls, steel-toed boots with boot covers or steel-toed rubber boots, safety glasses, American National Standards Institute-standard hard hats, and hearing protection (if heavy equipment is in operation). Air monitoring by the **SSO** may result in an upgrade to the use of respirators and cartridges in the decontamination area; therefore, this equipment must be available on site. If safe alternatives are not achievable, discontinue site activities immediately.

In addition to the aforementioned precautions, the following sections describe safe work practices that will be employed.

2.1 **Chemical Hazards associated with Equipment Decontamination**

- Avoid skin contact with and/or incidental ingestion of decontamination solutions and water.
- Utilize PPE as specified in the site-specific HSP to maximize splash protection.
- Refer to material safety data sheets, safety personnel, and/or consult sampling personnel regarding appropriate safety measures (i.e., handling, PPE including skin and respiratory).
- Take the necessary precautions when handling detergents and reagents.

2.2 **Physical Hazards associated with Equipment Decontamination**

- To avoid possible back strain, it is recommended to raise the decontamination area 1 to 2 feet above ground level.
- To avoid heat stress, over exertion, and exhaustion, it is recommended to rotate equipment decontamination among all site personnel.

- Take necessary precautions when handling field sampling equipment.

3.0 Terms and Definitions

None.

4.0 Training and Qualifications

4.1 The **CTO Manager** is responsible for ensuring that decontamination activities comply with this procedure. The **CTO Manager** is responsible for ensuring that all personnel involved in equipment decontamination shall have the appropriate education, experience, and training to perform their assigned tasks.

4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.3 The **Field Manager** is responsible for ensuring that all field equipment is decontaminated according to this procedure.

4.4 All **Field Personnel** are responsible for the implementation of this procedure.

5.0 Procedure

Decontamination of equipment used in soil/sediment sampling, groundwater monitoring, well drilling and well development, as well as equipment used to sample groundwater, surface water, sediment, waste, wipe, asbestos, and unsaturated zone, is necessary to prevent cross-contamination and to maintain the highest integrity possible in collected samples. Planning a decontamination program requires consideration of the following factors:

- Location where the decontamination procedures will be conducted
- Types of equipment requiring decontamination
- Frequency of equipment decontamination
- Cleaning technique and types of cleaning solutions appropriate to the contaminants of concern
- Method for containing the residual contaminants and wash water from the decontamination process
- Use of a quality control measure to determine the effectiveness of the decontamination procedure

The following subsections describe standards for decontamination, including the frequency of decontamination, cleaning solutions and techniques, containment of residual contaminants and cleaning solutions, and effectiveness.

5.1 Decontamination Area

Select an appropriate location for the decontamination area at a site based on the ability to control access to the area, the ability to control residual material removed from equipment, the need to store clean equipment, and the ability to restrict access to the area being investigated. Locate the decontamination area an adequate distance away and upwind from potential contaminant sources to avoid contamination of clean equipment.

5.2 Types of Equipment

Drilling equipment that must be decontaminated includes drill bits, auger sections, drill-string tools, drill rods, split barrel samplers, tremie pipes, clamps, hand tools, and steel cable. Decontamination of monitoring well development and groundwater sampling equipment includes submersible pumps, bailers, interface probes, water level meters, bladder pumps, airlift pumps, peristaltic pumps, and lysimeters. Other sampling equipment that requires decontamination includes, but is not limited to, hand trowels,

hand augers, slide hammer samplers, shovels, stainless-steel spoons and bowls, soil sample liners and caps, wipe sampling templates, composite liquid waste samplers, and dippers. Equipment with a porous surface, such as rope, cloth hoses, and wooden blocks, cannot be thoroughly decontaminated and shall be properly disposed of after one use.

5.3 Frequency of Equipment Decontamination

Decontaminate down-hole drilling equipment and equipment used in monitoring well development and purging prior to initial use and between each borehole or well. Down-hole drilling equipment, however, may require more frequent cleaning to prevent cross-contamination between vertical zones within a single borehole. When drilling through a shallow contaminated zone and installing a surface casing to seal off the contaminated zone, decontaminate the drilling tools prior to drilling deeper. Initiate groundwater sampling by sampling groundwater from the monitoring well where the least contamination is suspected. Decontaminate groundwater, surface water, and soil sampling devices prior to initial use and between collection of each sample to prevent the possible introduction of contaminants into successive samples.

5.4 Cleaning Solutions and Techniques

Decontamination can be accomplished using a variety of techniques and fluids. The preferred method of decontaminating major equipment, such as drill bits, augers, drill string, and pump drop-pipe, is steam cleaning. To steam clean, use a portable, high-pressure steam cleaner equipped with a pressure hose and fittings. For this method, thoroughly steam wash equipment and rinse it with potable tap water to remove particulates and contaminants.

A rinse decontamination procedure is acceptable for equipment such as bailers, water level meters, new and re-used soil sample liners, and hand tools. The decontamination procedure shall consist of the following: (1) wash with a non-phosphate detergent (Alconox®, Liquinox®, or other suitable detergent) and potable water solution; (2) rinse with potable water; (3) spray with laboratory-grade isopropyl alcohol; (4) rinse with deionized or distilled water; and (5) spray with deionized or distilled water. If possible, disassemble equipment prior to cleaning. Add a second wash at the beginning of the process if equipment is very soiled.

Decontaminating submersible pumps requires additional effort because internal surfaces become contaminated during usage. Decontaminate these pumps by washing and rinsing the outside surfaces using the procedure described for small equipment or by steam cleaning. Decontaminate the internal surfaces by recirculating fluids through the pump while it is operating. This recirculation may be done using a relatively long (typically 4 feet) large-diameter pipe (4-inch or greater) equipped with a bottom cap. Fill the pipe with the decontamination fluids, place the pump within the capped pipe, and operate the pump while recirculating the fluids back into the pipe. The decontamination sequence shall include: (1) detergent and potable water; (2) potable water rinse; (3) potable water rinse; and (4) deionized water rinse. Change the decontamination fluids after each decontamination cycle.

Solvents other than isopropyl alcohol may be used, depending upon the contaminants involved. For example, if polychlorinated biphenyls or chlorinated pesticides are contaminants of concern, hexane may be used as the decontamination solvent; however, if samples are also to be analyzed for volatile organics, hexane shall not be used. In addition, some decontamination solvents have health effects that must be considered. Decontamination water shall consist of distilled or deionized water. Steam-distilled water shall not be used in the decontamination process as this type of water usually contains elevated concentrations of metals. Decontamination solvents to be used during field activities will be specified in the CTO WP.

Rinse equipment used for measuring field parameters, such as pH (indicates the hydrogen ion concentration – acidity or basicity), temperature, specific conductivity, and turbidity with deionized or distilled water after each measurement. Also wash new, unused soil sample liners and caps with a fresh

detergent solution and rinse them with potable water followed by distilled or deionized water to remove any dirt or cutting oils that might be on them prior to use.

5.5 **Containment of Residual Contaminants and Cleaning Solutions**

A decontamination program for equipment exposed to potentially hazardous materials requires a provision for catchment and disposal of the contaminated material, cleaning solution, and wash water.

When contaminated material and cleaning fluids must be contained from heavy equipment, such as drill rigs and support vehicles, the area must be properly floored, preferably with a concrete pad that slopes toward a sump pit. If a concrete pad is impractical, planking can be used to construct solid flooring that is then covered by a nonporous surface and sloped toward a collection sump. If the decontamination area lacks a collection sump, use plastic sheeting and blocks or other objects to create a bermed area for collection of equipment decontamination water. Situate items, such as auger flights, which can be placed on metal stands or other similar equipment, on this equipment during decontamination to prevent contact with fluids generated by previous equipment decontamination. Store clean equipment in a separate location to prevent recontamination. Collect decontamination fluids contained within the bermed area and store them in secured containers as described below.

Use wash buckets or tubs to catch fluids from the decontamination of lighter-weight drilling equipment and hand-held sampling devices. Collect the decontamination fluids and store them on site in secured containers, such as U.S. Department of Transportation-approved drums, until their disposition is determined by laboratory analytical results. Label containers in accordance with Procedure 3-05, *IDW Management*.

6.0 Quality Control and Assurance

A decontamination program must incorporate quality control measures to determine the effectiveness of cleaning methods. Quality control measures typically include collection of equipment blank samples or wipe testing. Equipment blanks consist of analyte-free water that has been poured over or through the sample collection equipment after its final decontamination rinse. Wipe testing is performed by wiping a cloth over the surface of the equipment after cleaning. These quality control measures provide "after-the fact" information that may be useful in determining whether or not cleaning methods were effective in removing the contaminants of concern.

7.0 Records, Data Analysis, Calculations

Any project where sampling and analysis is performed shall be executed in accordance with an approved sampling and analysis plan. This procedure may be incorporated by reference or may be incorporated with modifications described in the plan.

Deviations from this procedure or the sampling and analysis plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

8.0 Attachments or References

8.1 ASTM Standard D5088. 2008. *Standard Practice for Decontamination of Field Equipment Used at Waste Sites.* ASTM International, West Conshohocken, PA. 2008. DOI: 10.1520/D5088-02R08. www.astm.org.

8.2 NAVSEA T0300-AZ-PRO-010. *Navy Environmental Compliance Sampling and Field Testing Procedures Manual*. August 2009.

8.3 Procedure 3-05, *IDW Management*.

Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue

Land Surveying

Procedure 3-07

1.0 Purpose and Scope

1.1 The purpose of this document is to define the standard operating procedure (SOP) for acquiring land surveying data to facilitate the location and mapping of geologic, hydrologic, geotechnical data, and analytical sampling points and to establish topographic control over project sites.

1.2 This procedure is the Program-approved professional guidance for work performed by Resolution Consultants under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract (Contract Number N62470-11-D-8013).

1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review. If there are procedures whether it be from Resolution Consultants, state and/or federal that are not addressed in this SOP and are applicable to surface water sampling then those procedures may be added as an appendix to the project specific SAP.

1.4 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Program Quality Manager. Deviations to this SOP will be documented in the field records.

1.5 If there are procedures, whether it be from Resolution Consultants, state and/or federal, that are not addressed in this SOP and are applicable to land surveying then those procedures may be added as an appendix to the project specific Sampling and Analysis Plan (SAP).

2.0 Safety

2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to conducting fieldwork. All **field sampling personnel** must review the project-specific health and safety plan (HASP) paying particular attention to the control measures planned for the specific field tasks. Conduct preliminary area monitoring to determine the potential hazard to field sampling personnel. If significant contamination is observed, minimize contact with potential contaminants in both the vapor and liquid phase through the use of respirators and disposable clothing.

2.2 In addition, observe standard health and safety practices according to the project-specific HASP. Suggested minimum protection includes inner disposable vinyl gloves, outer chemical-protective nitrile gloves, rubberized steel-toed boots, and an American National Standards Institute-standard hard hat. Half-face respirators and cartridges and Tyvek® suits may be necessary depending on the contaminant concentrations, and shall always be available on site.

2.3 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the **Site Safety Officer (SSO)** or designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

2.4 The health and safety considerations for the work associated with land surveying include:

- Slip, trips and falls associated with work in the field;

- Biological hazards associated with work in the field; and,
- Potential hazards associated with contaminants of concern (COC) that may be located in the survey area,

3.0 Terms and Definitions

3.1 Boundary Survey

Boundary surveys are conducted by Certified Land Surveyors in order to delineate a legal property line for a site or section of a site.

3.2 Global Positioning System (GPS)

A system of satellites, computers, and receivers that is able to determine the latitude and longitude of a receiver on Earth by calculating the time difference for signals from different satellites to reach the receiver.

4.0 Interferences

4.1 Commercially available GPS units typically have a level of precision of (±) 3 to 5 meters. Field corrections can be made as described in Section 8.3 below.

5.0 Training and Qualifications

5.1 Qualifications and Training

5.1.1 The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

5.2.1 The **Contract Task Order (CTO) Manager** is responsible for ensuring that land surveying activities comply with this procedure. The CTO Manager is responsible for ensuring that all field sampling personnel involved in land surveying shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Field Manager (FM)** is responsible for ensuring that all field personnel follow these procedures. In virtually all cases, subcontractors will conduct these procedures. The FM or designee is responsible for overseeing the activities of the subcontractor and ensuring that sampling points and topographic features are properly surveyed.

6.0 Equipment and Supplies

6.1 The following equipment list contains materials that may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Personal protective equipment (PPE) and other safety equipment, as required by the HASP;
- Commercially available GPS unit; and,
- Field Logbook.

7.0 Calibration or Standardization

7.1 An authorized manufacturer's representative shall inspect and calibrate survey instruments in accordance with the manufacturer's specifications regarding procedures and frequencies. At a minimum, instruments shall be calibrated no more than six months prior to the start of the survey work.

7.2 Standards for all survey work shall be in accordance with National Oceanic and Atmospheric Administration standards and, at a minimum, with accuracy standards set forth below. The horizontal accuracy for the location of all grid intersection and planimetric features shall be (±) 0.1 feet. The horizontal accuracy for boundary surveys shall be 1 in 10,000 feet (1:10,000). The vertical accuracy for ground surface elevations shall be (±) 0.1 feet. Benchmark elevation accuracy and elevation of other permanent features, including monitoring wellheads, shall be (±) 0.01 feet.

8.0 Procedure

8.1 Theodolite/Electronic Distance Measurement (EDM)

Follow the procedures listed below during theodolite/EDM land surveying conducted under the NAVFAC CLEAN Program:

- A land surveyor registered in the state or territory in which the work is being performed shall directly supervise all surveying work.
- Reference surveys to the local established coordinate systems and base all elevations and benchmarks established on U.S. Geological Survey datum, 1929 general adjustment.
- Reference surveyed points to Mean Sea Level (Lower Low Water Level).
- Jointly determine appropriate horizontal and vertical control points prior to the start of survey activities. If discrepancies in the survey (e.g., anomalous water level elevations) are observed, the surveyor may be required to verify the survey by comparison to a known survey mark. If necessary, a verification survey may be conducted by a qualified third party.
- All field notes, sketches, and drawings shall clearly identify the horizontal and vertical control points by number designation, description, coordinates, and elevations. Map all surveyed locations using a base map or other site mapping, as specified by the project Work Plan or SAP.
- Begin and end all surveys at the designated horizontal and vertical control points to determine the degree of accuracy of the surveys.
- Iron pins used to mark control points shall be made of reinforcement steel or an equivalent material and shall be 18 inches long with a minimum diameter of 5/8 inch. Drive pins to a depth of 18 inches into the soil.
- Stakes used to mark survey lines and points shall be made from 3-foot lengths of 2-inch by 2-inch lumber and pointed at one end. Clearly mark them with brightly colored weatherproof flagging and paint.
- Clearly mark the point on a monitoring well casing or well riser that is surveyed by filing grooves into the casing/riser on either side of the surveyed point, or by marking the riser with a permanent ink marker.

8.2 Global Positioning System (GPS) to Conduct Land Survey

Follow the procedures listed below during land surveying using GPS:

- A land surveyor registered in the state or territory in which the work is being performed shall directly supervise all surveying work.
- Reference surveys to the local established coordinate systems and base all elevations and benchmarks established on U.S. Geological Survey datum, 1929 general adjustment.

- All field notes, sketches, and drawings shall clearly identify the horizontal and vertical control points by number designation, description, coordinates, and elevations. Map all surveyed locations using a base map or other site mapping, as specified in the project Work Plan or SAP.
- Begin and end all surveys at the designated horizontal and vertical control points (as applicable) to determine the degree of accuracy of the surveys.
- Iron pins used to mark control points shall be made of reinforcement steel or an equivalent material and shall be 18 inches long with a minimum diameter of 5/8 inch. Drive pins to a depth of 18 inches into the soil.
- Stakes used to mark survey lines and points shall be made from 3-foot lengths of 2-inch by 2-inch lumber and pointed at one end. Clearly mark them with brightly colored weatherproof flagging and paint.
- Clearly mark the point on a monitoring well casing that is surveyed by filing grooves into the casing on either side of the surveyed point.

8.3 Global Positioning System (GPS) to Position Sample Locations or Locate Site Features

Experienced field personnel may use a GPS system unit to position sample locations (e.g. grid positioned samples, soil boring locations) at a site. The decision to use field personnel or a licensed land surveyor will depend on the objectives of the survey (e.g. vertical elevation is not required) and the levels of precision required. Typically when a level of precision greater than (±) 3 to 5 meters is required, a licensed surveyor will be required. When a level of precision of (±) 3 to 5 meters is sufficient to meet project requirements (i.e. when laying sampling grids, identifying significant site features, or locating features identified in GIS figures) experienced field personnel may use commercially available, consumer-grade GPS units. Follow the procedures listed below to locate samples or site features using GPS:

- A commercially available GPS unit with Wide Angle Averaging System (WAAS), topographic map display, and waypoint storage capabilities should be used.
- If waypoints are to be imported into a GIS database, the same grid projection system should be used.
- If a permanent reference point near the site is available, it is recommended that a waypoint at this location be taken every day waypoints are stored.
- When laying out a sampling grid from a GIS map, upload the coordinates from GIS to the GPS unit, including coordinates for an easily identified, permanent, nearby feature (i.e. building corner, roadway intersection, or USGS benchmark).
- If during the initial site walk, the permanent feature identified does not overlay within (±) 5 meters as identified in the GPS unit, field corrections of the waypoints should be made.
- Field corrections can be made by adding/subtracting the difference in x,y coordinates between the field measurement of the permanent site feature and the anticipated x,y coordinates. This correction should then be applied to the x,y coordinates for each sampling location to be marked. Corrected x,y coordinates can then be uploaded into the GPS unit.
- Sampling points and site features can then be located in the field using the GPS units “Go To” function. When the distance to the sampling point or feature remains close to zero, the location can be marked.
- If no field corrections to the sampling location need to be made, or if sampling locations are to be surveyed by a licensed surveyor at a later date, no additional waypoints need to be taken. If significant changes to the sampling location are made, GPS coordinates at the corrected location shall be stored and labeled.

- It is recommended that GPS coordinates be uploaded to a storage device such as PC at the end of each day.
- Field logs shall indicate manufacturer and model number for GPS unit used, map datum and projection used, and any field corrections made. If the GPS unit cannot lock onto a WAAS system at the site, this should also be noted.

9.0 Quality Control and Assurance

None.

10.0 Data and Records Management

The surveyor shall record field notes daily using generally accepted practices. The data shall be neat, legible, in indelible ink, and easily reproducible. Copies of the surveyor's field notes and calculation forms generated during the work shall be obtained and placed in the project files.

Surveyor's field notes shall, at a minimum, clearly indicate:

- The date of the survey;
- General weather conditions;
- The name of the surveying firm;
- The names and job titles of personnel performing the survey work;
- Equipment used, including serial numbers; and,
- Field book designations, including page numbers.

A land surveyor registered in the state or territory in which the work was done shall sign, seal, and certify the drawings and calculations submitted by the surveyor.

Dated records of land surveying equipment calibration shall be provided by the surveyor and placed in the project files. Equipment serial numbers shall be provided in the calibration records.

11.0 Attachments or References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Author	*Reviewer*	*Revisions (Technical or Editorial)*
Robert Shoemaker Senior Scientist	Naomi Ouellette, Project Manager	Rev 0 – Initial Issue

Soil and Rock Classification

Procedure 3-16

1.0 Purpose and Scope

1.1 The purpose of this document is to define the standard operating procedure (SOP) to thoroughly describe the physical characteristics of the sample and classify it according to the Unified Soil Classification System (USCS).

1.2 This procedure is the Program-approved professional guidance for work performed by Resolution Consultants under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract (Contract Number N62470-11-D-8013).

1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review. If there are procedures whether it be from Resolution Consultants, state and/or federal that are not addressed in this SOP and are applicable to surface water sampling then those procedures may be added as an appendix to the project specific SAP.

1.4 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Program Quality Manager. Deviations to this SOP will be documented in the field records.

2.0 Safety

2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling. All **field sampling personnel** responsible for sampling activities must review the project-specific health and safety plan (HASP) paying particular attention to the control measures planned for the sampling tasks. Conduct preliminary area monitoring to determine the potential hazard to field sampling personnel. If significant contamination is observed, minimize contact with potential contaminants in both the vapor and liquid phase through the use of respirators and disposable clothing.

2.2 In addition, observe standard health and safety practices according to the project-specific HASP. Suggested minimum protection during well sampling activities includes inner disposable vinyl gloves, outer chemical-protective nitrile gloves, rubberized steel-toed boots, and an American National Standards Institute-standard hard hat. Half-face respirators and cartridges and Tyvek® suits may be necessary depending on the contaminant concentrations, and shall always be available on site.

2.3 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the **Site Safety Officer (SSO)** or designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

2.4 The health and safety considerations for the work associated with soil classification include:

- At no time during classification activities are personnel to reach for debris near machinery that is in operation, place any samples in their mouth, or come in contact with the soils/rocks without the use of gloves.
- Stay clear of all moving equipment and be aware of pinch points on machinery. Avoid wearing loose fitting clothing.
- When using cutting tools, cut away from yourself. The use of appropriate, task specific cutting tools is recommended.
- To avoid heat/cold stress as a results of exposure to extreme temperatures and PPE, drink electrolyte replacement fluids (1 to 2 cups per hour is recommended) and in case of extreme cold, wear insulating clothing.

3.0 Terms and Definitions

None.

4.0 Interference

None.

5.0 Training and Qualifications

5.1 The **Contract Task Order (CTO) Manager** is responsible for ensuring that the soil and rock classification procedures comply with this procedure. The **CTO Manager** is responsible for ensuring that all personnel involved in soil and rock classification shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.3 The **Field Manager** is responsible for ensuring that all project **field personnel** follow these procedures.

5.4 Field personnel are responsible for the implementation of this procedure. Minimum qualifications for **field sampling personnel** require that one individual on the field team shall have a minimum of 6 months of experience with soil and rock classification.

5.5 The **project geologist** and/or **task manager** is responsible for directly supervising the soil and rock classification procedures to ensure that they are conducted according to this procedure, and for recording all pertinent data collected. If deviations from the procedure are required because of anomalous field conditions, they must first be approved by the **Program Quality Manager** and then documented in the field logbook and associated report or equivalent document.

6.0 Equipment and Supplies

6.1 The following equipment list contains materials which may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Personal protective equipment (PPE) and other safety equipment, as required by the HASP
- Field log book and pen with indelible ink
- Boring log

- Munsell Soil Color Chart
- Scoopula, spatula, and/or other small hand tools
- California Sampler
- Hand-held penetrometer

7.0 Calibration or Standardization

None.

8.0 Procedure

8.1 Soil Classification

The basic purpose of the classification of soil is to thoroughly describe the physical characteristics of the sample and to classify it according to an appropriate soil classification system. The USCS was developed so that soils could be described on a common basis by different investigators and serve as a "shorthand" description of soil. A classification of a soil in accordance with the USCS includes not only a group symbol and name, but also a complete word description.

Describing soil on a common basis is essential so that soil described by different site qualified personnel is comparable. Site individuals describing soil as part of site activities *must* use the classification system described herein to provide the most useful geologic database for all present and future subsurface investigations and remedial activities.

The site geologist or other qualified individual shall describe the soil and record the description in a boring log, logbook, and/or electronic field data collection device. The essential items in any written soil description are as follows:

- Classification group name (e.g., silty sand)
- Color, moisture, and odor
- Range of particle sizes and maximum particle size
- Approximate percentage of boulders, cobbles, gravel, sand, and fines
- Plasticity characteristics of the fines
- In-place conditions, such as consistency, density, and structure
- USCS classification symbol

The USCS serves as ”shorthand“ for classifying soil into 15 basic groups:

GW[1] Well graded (poorly sorted) gravel (>50 percent gravel, <5percent fines)

GP[1] Poorly graded (well sorted) gravel (>50percent gravel, <5percent fines)

GM[1] Silty gravel (>50 percent gravel, >15 percent silt)

GC[1] Clayey gravel (>50 percent gravel, >15 percent clay)

SW[1] Well graded (poorly sorted) sand (>50 percent sand, <5 percent fines)

SP[1] Poorly graded (well sorted) sand (>50 percent sand, <5 percent fines)

[1] If percentage of fine is 5 percent to 15 percent, a dual identification shall be given (e.g., a soil with more than 50 percent poorly sorted gravel and 10 percent clay is designated GW-GC.

SM[1] Silty sand (>50 percent sand, >15 percent silt)

SC[1] Clayey sand (>50 percent sand, >15 percent clay)

ML[2] Inorganic, low plasticity silt (slow to rapid dilatancy, low toughness, and plasticity)

CL[2] Inorganic, low plasticity (lean) clay (no or slow dilatancy, medium toughness and plasticity)

MH[2] Inorganic elastic silt (no to slow dilatancy, low to medium toughness and plasticity)

CH[2] Inorganic, high plasticity (fat) clay (no dilatancy, high toughness, and plasticity)

OL Organic low plasticity silt or organic silty clay

OH Organic high plasticity clay or silt

PT Peat and other highly organic soil

Figure8-1 defines the terminology of the USCS. Flow charts presented in Figure 8-2 and indicate the process for describing soil. The particle size distribution and the plasticity of the fines are the two properties of soil used for classification. In some cases, it may be appropriate to use a borderline classification (e.g., SC/CL) if the soil has been identified as having properties that do not distinctly place the soil into one group.

8.1.1 Estimation of Particle Size Distribution

One of the most important factors in classifying a soil is the estimated percentage of soil constituents in each particle size range. Being proficient in estimating this factor requires extensive practice and frequent checking. The steps involved in determining particle size distribution are listed below:

1. Select a representative sample (approximately 1/2 of a 6-inch long by 2.5-inch diameter sample liner).
2. Remove all particles larger than 3 inches from the sample. Estimate and record the percent by volume of these particles. Only the fraction of the sample smaller than 3 inches is classified.
3. Estimate and record the percentage of dry mass of gravel (less than 3 inches and greater than 1/4 inch).
4. Considering the rest of the sample, estimate, and record the percentage of dry mass of sand particles (about the smallest particle visible to the unaided eye).
5. Estimate and record the percentage of dry mass of fines in the sample (do not attempt to separate silts from clays).
6. Estimate percentages to the nearest 5 percent. If one of the components is present in a quantity considered less than 5 percent, indicate its presence by the term “trace”.
7. The percentages of gravel, sand, and fines must add up to 100 percent. “Trace” is not included in the 100 percent total.

8.1.2 Soil Dilatancy, Toughness, and Plasticity

8.1.2.1 Dilatancy

To evaluate dilatancy, follow these procedures:

[2] If the soil is estimated to have 15 percent to 25 percent sand or gravel, or both, the words “with sand” or “with gravel” (whichever predominates) shall be added to the group name (e.g., clay with sand, CL; or silt with gravel, ML). If the soil is estimated to have 30 percent or more sand or gravel, or both, the words “sandy” or “gravely” (whichever predominates) shall be added to the group name (e.g., sandy clay, CL). If the percentage of sand is equal to the percent gravel, use “sandy.”

1. From the specimen, select enough material to mold into a ball about 1/2 inch (12 millimeters [mm]) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.
2. Smooth the soil ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other hand several times. Note the reaction of water appearing on the surface of the soil. Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the reaction as none, slow, or rapid in accordance with the criteria in Table 8-1. The reaction is the speed with which water appears while shaking, and disappears while squeezing.

Table 8-1: Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in specimen.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

8.1.2.2 Toughness

Following the completion of the dilatancy test, shape the test specimen into an elongated pat and roll it by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. (If the sample is too wet to roll easily, spread it into a thin layer and allow it to lose some water by evaporation.) Fold the sample threads and re-roll repeatedly until the thread crumbles at a diameter of about 1/8 inch. The thread will crumble at a diameter of 1/8 inch when the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread. After the thread crumbles, lump the pieces together and knead it until the lump crumbles. Note the toughness of the material during kneading. Describe the toughness of the thread and lump as low, medium, or high in accordance with the criteria in Table 8-2.

Table 8-2: Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread near the plastic limit. The thread and the lump have medium stiffness.
High	Considerable pressure is required to roll the thread near the plastic limit. The thread and the lump have very high stiffness.

DEFINITION OF TERMS

MAJOR DIVISIONS			SYMBOLS	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More Than Half of Material is Larger Than No. 200 Sieve Size	GRAVELS More Than Half of Coarse Fraction is Smaller Than No. 4 Sieve	CLEAN GRAVELS (Less than 6% Fines)	GW	Well graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		GRAVELS With Fines	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	SANDS More Than Half of Coarse Fraction is Smaller Than No. 4 Sieve	CLEAN SANDS (Less than 6% Fines)	SW	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands, gravelly sands, little or no fines
		SANDS With Fines	SM	Silty sands, sand-silt mixtures, non-plastic fines
			SC	Clayey sands, sand-clay mixtures, plastic fines
FINE GRAINED SOILS More Than Half of Material is Smaller Than No. 200 Sieve Size	SILTS AND CLAYS Liquid Limit is Less Than 50%		ML	Inorganic silts, rock flour, fine sandy silts or clays, and clayey silts with non- or slightly-plastic fines
			CL	Inorganic clays of low to medium plasticity, gravelly clays, silty clays, sandy clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid Limit is Greater Than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts, clayey silt
			CH	inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils

GRAIN SIZES

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		
200	40	10	4	3/4"	3"	12"	
U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENINGS			

Figure8-1: Unclassified Soil Classification System (USCS)

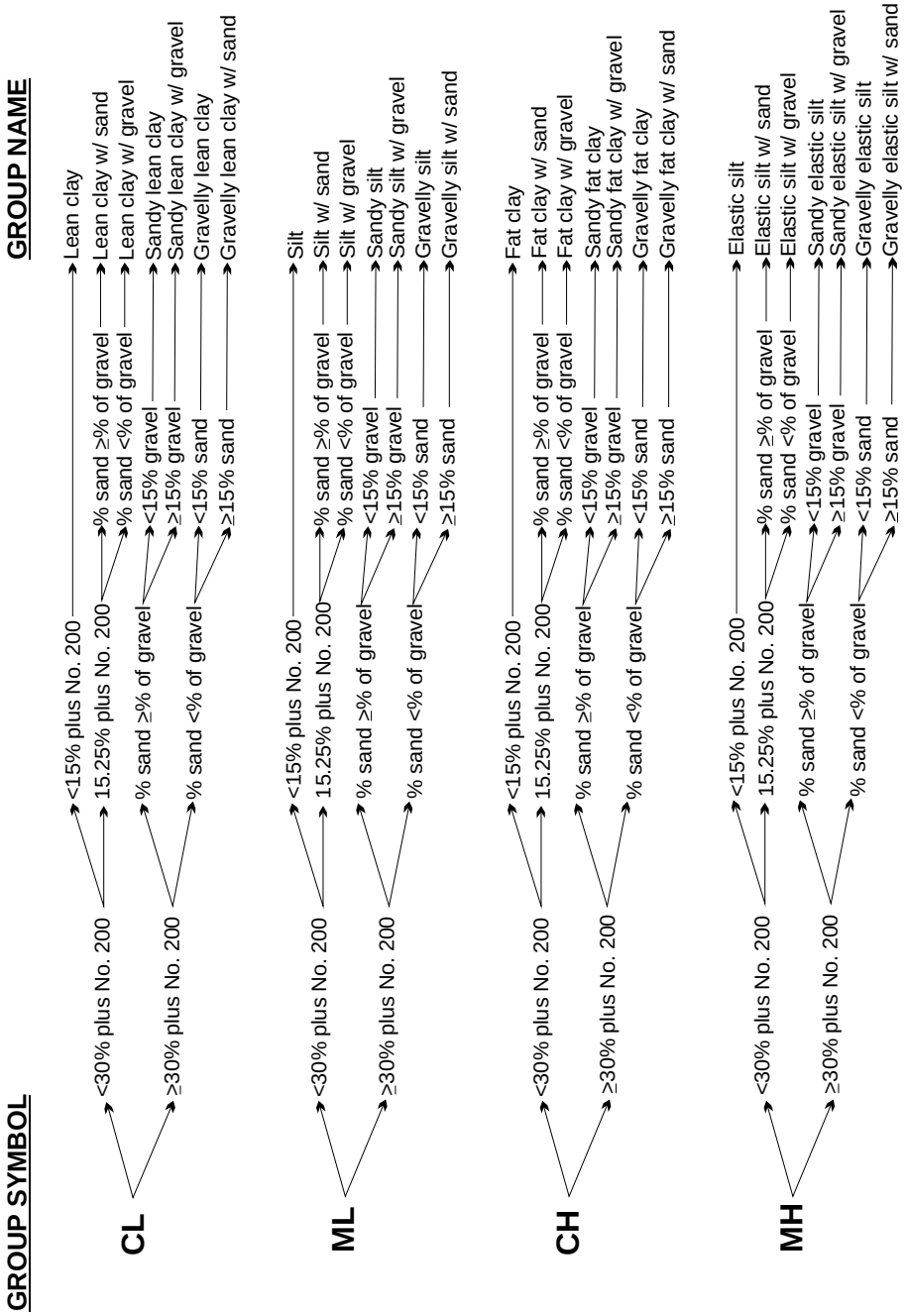


Figure 8-2: Flow Chart for Fine Grain Soil Classification

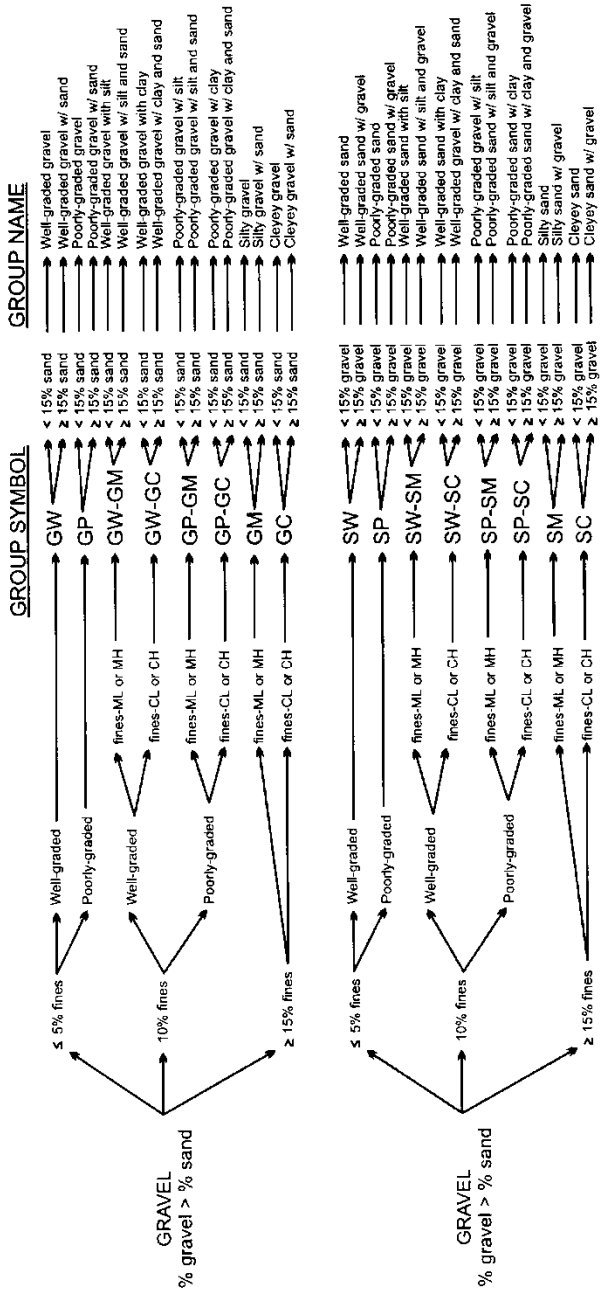


Figure 8-3: Flow Chart for Soil with Gravel

8.1.2.3 Plasticity

The plasticity of a soil is defined by the ability of the soil to deform without cracking, the range of moisture content over which the soil remains in a plastic state, and the degree of cohesiveness at the plastic limit. The plasticity characteristic of clays and other cohesive materials is defined by the liquid limit and plastic limit. The liquid limit is defined as the soil moisture content at which soil passes from the liquid to the plastic state as moisture is removed. The test for the liquid limit is a laboratory, not a field, analysis.

The plastic limit is the soil moisture content at which a soil passes from the plastic to the semi-solid state as moisture is removed. The plastic limit test can be performed in the field and is indicated by the ability to roll a 1/8-inch (0.125-inch) diameter thread of fines, the time required to roll the thread, and the number of times the thread can be re-rolled when approaching the plastic limit.

The plasticity tests are not based on natural soil moisture content, but on soil that has been thoroughly mixed with water. If a soil sample is too dry in the field, add water prior to performing classification. If a soil sample is too sticky, spread the sample thin and allow it to lose some soil moisture.

Table 8-3 presents the criteria for describing plasticity in the field using the rolled thread method.

Table 8-3: Criteria for Describing Plasticity

Description	Criteria
Non-Plastic	A 1/8-inch thread cannot be rolled.
Low Plasticity	The thread can barely be rolled.
Medium Plasticity	The thread is easy to roll and not much time is required to reach the plastic limit.
High Plasticity	It takes considerable time rolling the thread to reach the plastic limit.

8.1.3 **Angularity**

The following criteria describe the angularity of the coarse sand and gravel particles:

- **Rounded** particles have smoothly-curved sides and no edges.
- **Subrounded** particles have nearly plane sides, but have well-rounded corners and edges.
- **Subangular** particles are similar to angular, but have somewhat rounded or smooth edges.
- **Angular** particles have sharp edges and relatively plane sides with unpolished surfaces. Freshly broken or crushed rock would be described as angular.

8.1.4 **Color, Moisture, and Odor**

The natural moisture content of soil is very important. Table **8-4** shows the terms for describing the moisture condition and the criteria for each.

Table 8-4: Soil Moisture Content Qualifiers

Qualifier	Criteria
Dry	Absence of moisture, dry to the touch
Moist	Damp but no visible water
Wet	Visible water, usually soil is below water table

Color is described by hue and chroma using the Munsell Soil Color Chart (Munsell 2000). For uniformity, all site geologists shall utilize this chart for soil classification. Doing so will facilitate correlation of geologic units between boreholes logged by different geologists. The Munsell Color Chart is a small booklet of numbered color chips with names like “5YR 5/6, yellowish-red.” Note mottling or banding of colors. It is particularly important to note and describe staining because it may indicate contamination.

In general, wear a respirator if strong organic odors are present. If odors are noted, describe them if they are unusual or suspected to result from contamination. An organic odor may have the distinctive smell of decaying vegetation. Unusual odors may be related to hydrocarbons, solvents, or other chemicals in the subsurface. An organic vapor analyzer may be used to detect the presence of volatile organic contaminants.

8.1.5 In-Place Conditions

Describe the conditions of undisturbed soil samples in terms of their density/consistency (i.e., compactness), cementation, and structure utilizing the following guidelines:

8.1.5.1 Density/Consistency

Density and consistency describe a physical property that reflects the relative resistance of a soil to penetration. The term “density” is commonly applied to coarse to medium-grained sediments (i.e., gravels, sands), whereas the term “consistency” is normally applied to fine-grained sediments (i.e., silts, clays). There are separate standards of measure for both density and consistency that are used to describe the properties of a soil.

The density or consistency of a soil is determined by observing the number of blows required to drive a 1 3/8-inch (35 mm) diameter split barrel sampler 18 inches using a drive hammer weighing 140 lbs (63.5 kilograms [kg]) dropped over a distance of 30 inches (0.76 meters). Record the number of blows required to penetrate each 6 inches of soil in the field boring log during sampling. The first 6 inches of penetration is considered to be a seating drive; therefore, the blow count associated with this seating drive is recorded, but not used in determining the soil density/consistency. The sum of the number of blows required for the second and third 6 inches of penetration is termed the “standard penetration resistance,” or the “N-value.” The observed number of blow counts must be corrected by an appropriate factor if a different type of sampling device (e.g., Modified California Sampler with liners) is used. For a 2 3/8-inch inner diameter (I.D.) Modified California Sampler equipped with brass or stainless steel liners and penetrating a cohesionless soil (sand/gravel), the N-value from the Modified California Sampler must be divided by 1.43 to provide data that can be compared to the 1 3/8-inch diameter sampler data.

For a cohesive soil (silt/clay), the N-value for the Modified California Sampler should be divided by a factor of 1.13 for comparison with 1 3/8-inch diameter sampler data.

Drive the sampler and record blow counts for each 6-inch increment of penetration until one of the following occurs:

- A total of 50 blows have been applied during any one of the three 6-inch increments; a 50-blow count occurrence shall be termed “refusal” and noted as such on the boring log.
- A total of 150 blows have been applied.
- The sampler is advanced the complete 18 inches without the limiting blow counts occurring, as described above.

If the sampler is driven less than 18 inches, record the number of blows per partial increment on the boring log. If refusal occurs during the first 6 inches of penetration, the number of blows will represent the N-value for this sampling interval. Table 8-5 and Table 8-6 present representative descriptions of soil density/consistency vs. N-values.

Table 8-5: Measuring Soil Density with a California Sampler – Relative Density (Sands, Gravels)

Description	Field Criteria (N-Value)	
	1 3/8 in. ID Sampler	2 in. ID Sampler using 1.43 factor
Very Loose	0–4	0–6
Loose	4–10	6–14
Medium Dense	10–30	14–43
Dense	30–50	43–71
Very Dense	> 50	> 71

Table 8-6: Measuring Soil Density with a California Sampler – Fine Grained Cohesive Soil

Description	Field Criteria (N-Value)	
	1 3/8 in. ID Sampler	2 in. ID Sampler using 1.13 factor
Very Soft	0–2	0–2
Soft	2–4	2–4
Medium Stiff	4–8	4–9
Stiff	8–16	9–18
Very Stiff	16–32	18–36
Hard	> 32	> 36

For undisturbed fine-grained soil samples, it is also possible to measure consistency with a hand-held penetrometer. The measurement is made by placing the tip of the penetrometer against the surface of the soil contained within the sampling liner or shelby tube, pushing the penetrometer into the soil a distance specified by the penetrometer manufacturer, and recording the pressure resistance reading in pounds per square foot (psf). The values are as follows (Table 8-7):

Table 8-7: Measuring Soil Consistency with a Hand-Held Penetrometer

Description	Pocket Penetrometer Reading (psf)
Very Soft	0–250
Soft	250–500
Medium Stiff	500–1000
Stiff	1000–2000
Very Stiff	2000–4000
Hard	>4000

Consistency can also be estimated using thumb pressure using Table 8-8.

Table 8-8: Measuring Soil Consistency Using Thumb Pressure

Description	Criteria
Very Soft	Thumb will penetrate soil more than 1 inch (25 mm)
Soft	Thumb will penetrate soil about 1 inch (25 mm)
Firm	Thumb will penetrate soil about 1/4 inch (6 mm)
Hard	Thumb will not indent soil but readily indented with thumbnail
Very Hard	Thumbnail will not indent soil

8.1.5.2 *Cementation*

Cementation is used to describe the friability of a soil. Cements are chemical precipitates that provide important information as to conditions that prevailed at the time of deposition, or conversely, diagenetic effects that occurred following deposition. Seven types of chemical cements are recognized by Folk (1980). They are as follows:

- Quartz – siliceous
- Chert – chert-cemented or chalcedonic
- Opal – opaline
- Carbonate – calcitic, dolomitic, sideritic (if in doubt, calcareous should be used)
- Iron oxides – hematitic, limonitic (if in doubt, ferruginous should be used)
- Clay minerals – if the clay minerals are detrital or have formed by recrystallization of a previous clay matrix, they are not considered to be a cement. Only if they are chemical precipitates, filling previous pore space (usually in the form of accordion-like stacks or fringing radial crusts) should they be included as “kaolin-cemented,” “chlorite-cemented,” etc.
- Miscellaneous minerals – pyritic, collophane-cemented, glauconite-cemented, gypsiferous, anhydrite-cemented, baritic, feldspar-cemented, etc.

The degree of cementation of a soil is determined qualitatively by utilizing finger pressure on the soil in one of the sample liners to disrupt the gross soil fabric. The three cementation descriptors are as follows:

- Weak – friable; crumbles or breaks with handling or slight finger pressure
- Moderate – friable; crumbles or breaks with considerable finger pressure
- Strong – not friable; will not crumble or break with finger pressure

8.1.5.3 *Structure*

This variable is used to qualitatively describe physical characteristics of soil that are important to incorporate into hydrogeological and/or geotechnical descriptions of soil at a site. Appropriate soil structure descriptors are as follows:

- Granular – spherically shaped aggregates with faces that do not accommodate adjoining faces
- Stratified – alternating layers of varying material or color with layers at least 6 mm (1/4 inch) thick; note thickness
- Laminated – alternating layers of varying material or color with layers less than 6 mm (1/4 inch) thick; note thickness
- Blocky – cohesive soil that can be broken down into small angular or subangular lumps that resist further breakdown
- Lensed – inclusion of a small pocket of different soil, such as small lenses of sand, should be described as homogeneous if it is not stratified, laminated, fissured, or blocky. If lenses of different soil are present, the soil being described can be termed homogeneous if the description of the lenses is included
- Prismatic or Columnar – particles arranged about a vertical line, ped is bounded by planar, vertical faces that accommodate adjoining faces; prismatic has a flat top; columnar has a rounded top
- Platy – particles are arranged about a horizontal plane

8.1.5.4 Other Features

- Mottled – soil that appears to consist of material of two or more colors in blotchy distribution
- Fissured – breaks along definite planes of fracture with little resistance to fracturing (determined by applying moderate pressure to sample using thumb and index finger)
- Slickensided – fracture planes appear polished or glossy, sometimes striated (parallel grooves or scratches)

8.1.6 **Development of Soil Description**

Develop standard soil descriptions according to the following examples. There are three principal categories under which all soil can be classified. They are described below.

8.1.6.1 Coarse-grained Soil

Coarse-grained soil is divided into sands and gravels. A soil is classified as a sand if over 50 percent of the coarse fraction is "sand-sized." It is classified as a gravel if over 50 percent of the coarse fraction is composed of "gravel-sized" particles.

The written description of a coarse-grained soil shall contain, in order of appearance: Typical name including the second highest percentage constituent as an adjective, if applicable (underlined); grain size of coarse fraction; Munsell color and color number; moisture content; relative density; sorting; angularity; other features, such as stratification (sedimentary structures) and cementation, possible formational name, primary USCS classification, secondary USCS classification (when necessary), and approximate percentages of minor constituents (i.e., sand, gravel, shell fragments, rip-up clasts) in parentheses.

Example: POORLY-SORTED SAND WITH SILT, medium- to coarse-grained, light olive gray, 5Y 6/2, saturated, loose, poorly sorted, subrounded clasts, SW/SM (minor silt with approximately 20 percent coarse-grained sand-sized shell fragments, and 80 percent medium-grained quartz sand, and 5 percent to 15 percent ML).

8.1.6.2 Fine-grained Soil

Fine-grained soil is further subdivided into clays and silts according to its plasticity. Clays are rather plastic, while silts have little or no plasticity.

The written description of a fine-grained soil should contain, in order of appearance: Typical name including the second highest percentage constituent as an adjective, if applicable (underlined); Munsell color; moisture content; consistency; plasticity; other features, such as stratification, possible formation name, primary USCS classification, secondary USCS classification (when necessary), and the percentage of minor constituents in parentheses.

Example: SANDY LEAN CLAY, dusky red, 2.5 YR 3/2, moist, firm, moderately plastic, thinly laminated, CL (70 percent fines, 30 percent sand, with minor amounts of disarticulated bivalves [about 5 percent]).

8.1.6.3 Organic Soil

For highly organic soil, describe the types of organic materials present as well as the type of soil constituents present using the methods described above. Identify the soil as an organic soil, OL/OH, if the soil contains enough organic particles to influence the soil properties. Organic soil usually has a dark brown to black color and may have an organic odor. Often, organic soils will change color, (e.g., from black to brown) when exposed to air. Some organic soils will lighten in color significantly when air-dried. Organic soils normally will not have a high toughness or plasticity. The thread for the toughness test will be spongy.

8.2 Example: ORGANIC CLAY, black, 2.5Y, 2.5/1, wet, soft, low plasticity, organic odor, OL (100 percent fines), weak reaction to HCl.

8.3 Rock Classification

The purpose of rock classification is to thoroughly describe the physical and mineralogical characteristics of a specimen and to classify it according to an established system. The generalized rock classification system described below was developed because, unlike the USCS for soils, there is no universally accepted rock classification system. In some instances, a more detailed and thorough rock classification system may be appropriate. Any modifications to this classification system, or the use of an alternate classification system should be considered during preparation of the site work plan. Both the CTO Manager and the QA Manager or Technical Director must approve any modifications to this classification system, or the use of another classification system.

Describing rock specimens on a common basis is essential so that rocks described by different site geologists are comparable. Site geologists describing rock specimens as a part of investigative activities must use the classification system described herein, or if necessary, another more detailed classification system. Use of a common classification system provides the most useful geologic database for all present and future subsurface investigations and remedial activities.

In order to provide a more consistent rock classification between geologists, a rock classification template has been designated as shown in **Error! Reference source not found.**. The template includes classification of rocks by origin and mineralogical composition. When classifying rocks, all site geologists shall use this template.

The site geologist shall describe the rock specimen and record the description in a boring log or logbook. The items essential for classification include (i.e., metamorphic foliated):

- Classification Name (i.e., schist)
- Color
- Mineralogical composition and percent
- Texture/Grain size (i.e., fine-grained, pegmatitic, aphlitic, glassy)
- Structure (i.e., foliated, fractured, lenticular)
- Rock Quality Designation (sum of all core pieces greater than two times the diameter of the core divided by the total length of the core run, expressed as a percentage)
- Classification symbol (i.e., MF)

Example: Metamorphic foliated schist: Olive gray, 5Y, 3/2, Garnet 25 percent, Quartz 45 percent, Chlorite 15 percent, Tourmaline 15 percent, Fine-grained with Pegmatite garnet, highly foliated, slightly wavy, MF.

9.0 Quality Control and Assurance

None

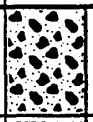
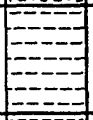
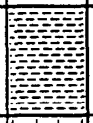
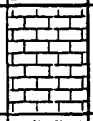
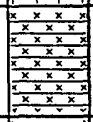
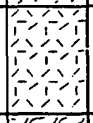
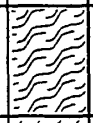
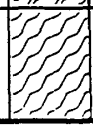
DEFINITION OF TERMS					
PRIMARY DIVISIONS			SYMBOLS		SECONDARY DIVISIONS
SEDIMENTARY ROCKS	Clastic Sediments	CONGLOMERATE		CG	Coarse-grained Clastic Sedimentary Rock types including: Conglomerates and Breccias
		SANDSTONE		SS	Clastic Sedimentary Rock types including: Sandstone, Arkose and Greywacke
		SHALE		SH	Fine-grained Clastic Sedimentary Rock types including: Shale, Siltstone, Mudstone and Claystone
	Chemical Precipitates	CARBONATES		LS	Chemical Precipitates including: Limestone, Crystalline Limestone, Fossiliferous Limestone Micrite and Dolomite
		EVAPORITES		EV	Evaporites including: Anhydrite, Gypsum, Halite, Travertine and Caliche
IGNEOUS ROCKS		EXTRUSIVE (Volcanic)		IE	Volcanic Rock types including: Basalt, Andesite, Rhyolite, Volcanic Tuff, and Volcanic Breccia
		INTRUSIVE (Plutonic)		II	Plutonic Rock types including: Granite, Diorite and Gabbro
METAMORPHIC ROCKS		FOLIATED		MF	Foliated Rock types including: Slate, Phyllite, Schist and Gneiss
		NON-FOLIATED		MN	Non-foliated Rock types including: Metaconglomerate, Quartzite and Marble

Figure 8-4: Rock Classification System

10.0 Data and Records Management

10.1 Document soil classification information collected during soil sampling onto the field boring logs, field trench logs, and into the field notebook. Copies of this information shall be sent to the **CTO Manager** for the project files.

10.2 Field notes will be kept during coring activities in accordance with SOP 3-03 – Recordkeeping, Sample Labeling, and Chain of Custody. The information pertinent to soil classification activities includes chronology of events, sample locations (x,y,z), time/date, sampler name, methods (including type of core liner/barrel, if applicable), sampler penetration and acceptability, sample observations, and the times and type of equipment decontamination. Deviations to the procedures detailed in the SOP should be recorded in the field logbook.

11.0 Attachments or References

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Author	*Reviewer*	*Revisions (Technical or Editorial)*
Robert Shoemaker Senior Scientist	Naomi Ouellette, Project Manager	Rev 0 – Initial Issue

Surface and Subsurface Soil Sampling Procedures

Procedure 3-21

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the procedures for soil sampling. The procedure includes surface and subsurface sampling by various methods using hand auguring, test pit, direct-push, and split-spoon equipment.

1.2 The procedure includes soil sampling for volatile organic compounds (VOCs). For project specific information (e.g. sampling depths, equipment to be used, and frequency of sampling), refer to the Sampling and Analysis Plan (SAP), which takes precedence over these procedures. Surface soil sampling, typically considered to be up to two feet below ground surface by EPA standards, is typically accomplished using hand tools such as shovels or hand augers. Test pit samples are considered subsurface samples, although normally collected via hand tools similar to surface soil sampling or by excavation machinery. Direct-push and split-spoon sampling offer the benefit of collecting soil samples from a discrete or isolated subsurface interval, without the need of extracting excess material above the target depth. These methods dramatically reduce time and cost associated with disposal of material from soil cuttings when compared to test pit sampling. In addition, direct-push and split-spoon sampling methods can obtain samples at targeted intervals greater than 15 feet in depth, allowing for discrete depth soil sampling while speeding up the sampling process. Direct-push methods work best in medium to fine-grained cohesive materials such as medium to fine sands, silts, and silty clay soils. Split-spoon sampling works well in all types of soil, but is somewhat slower than direct-push methods. Samples are composited so that each sample contains a homogenized representative portion of the sample interval. Due to potential loss of analytes, samples for volatile analysis are not composited. Samples for chemical analysis can be collected by any of the above-mentioned sampling methods, as disturbed soil samples. Undisturbed samples are collected, sealed, and sent directly to the laboratory for analysis. For undisturbed samples, the samples are not homogenized.

2.0 Safety

2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project Health and Safety Plan (HASP). In the absence of a HASP, work will be conducted according to the Contract Task Order (CTO) Work Plan (WP) and/or direction from the **Site Safety Officer (SSO)**.

2.2 Before soil sampling commences, appropriate entities (e.g. DigSafe, local public works departments, company facilities) must be contacted to assure the anticipated soil sampling locations are marked for utilities, including electrical, telecommunications, water, sewer, and gas.

3.0 Terms and Definitions

None.

4.0 Interferences

4.1 Low recovery of soil from sampling equipment will prevent an adequate representation of the soil profile and sufficient amount of soil sample. If low recovery is a problem, the hole may be offset and re-advanced, terminated, or continued using a larger diameter sampler.

4.2 Asphalt in soil samples can cause false positive results for hydrocarbons. To ensure samples are free of asphalt, do not collect samples that may contain asphalt. If the collection of samples potentially containing asphalt is unavoidable, note the sampling depths at which the presence of asphalt are suspected.

4.3 Instrumentation interferences addressed in SOPs for Calibration of the Photoionization Detector (PID), Headspace Screening for Total Volatile Organics, and Equipment Decontamination must also be considered.

4.4 Cross contamination from sampling equipment must be prevented by using sampling equipment constructed of stainless steel that is adequately decontaminated between samples.

5.0 Training and Qualifications

5.1 **Qualifications and Training**

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 **Responsibilities**

5.2.1 The CTO Manager is responsible for ensuring that soil sampling activities comply with this procedure. The CTO Manager is responsible for ensuring that all personnel involved in soil sampling shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The Program Quality Manager is responsible for ensuring overall compliance with this procedure.

5.2.3 The Field Manager is responsible for ensuring that all soil sampling activities are conducted according to this procedure.

5.2.4 All Field Personnel are responsible for the implementation of this procedure.

6.0 Equipment and Supplies

The depth at which samples will be collected and the anticipated method of sample collection (direct-push, split-spoon, hand auger, shovel, or test pits) will be presented in the SAP. The following details equipment typically needed for soil sampling, based on the various methods. See the SAP for specific detail of equipment and supply needs.

6.1 Depending on the nature of suspected contamination, field screening instrumentation may be used for direct sampling. Appropriate instrumentation and calibration standards should be available. If volatile organic contaminants are suspected and a PID will be used, refer to the equipment and instrumentation listed in SOP 3-20 Operation and Calibration of a Photoionization Detector. Equipment in this SOP includes but is not limited to:

- PID/FID;
- Calibration gas; and
- Tedlar® gas bags (for calibration).

6.2 If field screening methods include jar headspace screening for volatile organics, refer to the equipment and procedure in SOP 3-19 Headspace Screening for Total VOCs. Equipment in this SOP includes but is not limited to:

- Clean soil (“drillers jars”) jars; and
- Aluminium foil.

6.3 Appropriate decontamination procedures must be followed for sampling equipment. Refer to SOP 3-06 Equipment Decontamination. Equipment in this SOP includes but is not limited to:

- Phosphate-free detergent;
- Isopropyl Alcohol;
- Tap water;
- Deionized Ultra-Filtered (DIUF) Water;
- Plastic buckets or washbasins;
- Brushes; and
- Polyethylene sheeting.

6.4 The following general equipment is needed for all soil sampling, regardless of method:

- Stainless steel bowls;
- Stainless steel trowels;
- Appropriate sample containers for laboratory analysis;
- Personal Protective Equipment (PPE);
- Logbook;
- Cooler and ice for preservation; and
- Stakes and flagging to document sampling location.

6.5 The following additional equipment is needed for volatile organic sampling:

- Electronic pan scale and weights for calibration; and
- Syringes or other discrete soil core samplers.

6.6 The following additional equipment may be needed for surface and test pit soil sampling:

- Hand Auger

6.7 The following additional equipment may be needed for soil sampling from direct push and/or split-spoon equipment:

- Tape measure or folding carpenter's rule for recording the length of soil recovered.

Note: All subsurface drilling equipment will be provided and maintained by the subcontractor.

7.0 Procedure

7.1 **General Soil Sampling Procedure for All Soil Sampling Methods**

7.1.1 Record the weather conditions and other relevant on-site conditions.

7.1.2 Select the soil sampling location, clear vegetation if necessary, and record the sampling location identification number and pertinent location details.

7.1.3 Verify that the sampling equipment is properly decontaminated, in working order, and situated at the intended sampling location.

7.1.4 Place polyethylene sheeting on the ground and assemble all necessary sampling equipment on top of it. Cover surfaces onto which soils or sampling equipment will be placed (i.e. tables with polyethylene sheeting).

7.1.5 Follow the appropriate procedures listed below for either surface, split-spoon, direct push, or test pit sample collection (7.2, 7.3, 7.4, and 7.5 respectively).

7.1.6 Collect soil samples according to procedures listed in Section 7.6 depending on project specific analyses.

7.1.7 Record date/time, sample ID, and sample descriptions in the field logbook or field form. A sketch or description of the location may also be recorded so the sample location can be re-constructed, especially if the location will not be recorded using global positioning satellite (GPS) equipment.

7.1.8 Immediately label the sample containers and place them on ice, if required for preservation. Complete the chain-of-custody form(s) as soon as possible.

7.1.9 Dispose of all excess excavated soil in accordance with the SAP.

7.1.10 If required, mark the sample location with a clearly labelled wooden stake or pin flag. If the location is on a paved surface, the location may be marked with spray paint.

7.1.11 Decontaminate the sampling equipment according to SOP 3-06 Equipment Decontamination.

7.2 Surface Sampling

7.2.1 The criteria used for selecting surface soil locations for sampling may include the following:

- Visual observations (soil staining, fill materials);
- Other relevant soil characteristics;
- Site features;
- Screening results;
- Predetermined sampling approach (i.e. grid or random); and
- Sampling objectives as provided in the SAP.

7.2.2 The following procedures are to be used to collect surface soil samples. Surface soils are considered to be soils that are up to two feet below ground surface, though state regulations and project objectives may define surface soils differently; therefore, the SAP should be consulted for direction on the depth from which to collect the surface soil samples. Sampling and other pertinent data and information will be recorded in the field logbook and/or on field forms. Photographs may be taken as needed or as specified in the SAP.

1. Gently scrape any vegetative covering until soil is exposed. Completely remove any pavement.
2. Remove soil from the exposed sampling area with a trowel, hand auger, or shovel. Put soils within the sampling interval in a stainless steel bowl for homogenizing. Monitor the breathing zone and sampling area as required in the HASP.
3. For VOC analyses, collect representative soil samples directly from the recently-exposed soil using a syringe or other soil coring device (e.g., TerraCore®, EnCore®). Follow procedures in Section 7.6.1 for VOC sampling.
4. Collect sufficient soil to fill all remaining sample jars into a stainless steel bowl. Homogenize the soil samples to obtain a uniform soil composition which is representative of the total soil sample collected according to the following procedure:

    a) Remove all rocks and non-soil objects using a stainless steel spoon or scoop.

b) Form a cone shaped mound with the sample material, then flatten the cone and split the sample into quarters.

c) Use the stainless steel spoon/scoop to mix the quarter samples that are opposite.

d) After mixing the opposite quarters, reform the cone shaped mound.

e) Repeat this procedure a minimum of five (5) times, removing any non-soil objects and breaking apart any clumps.

7.3 Split-Spoon Sampling

7.3.1 At each boring location, the frequency and depth of split-spoon samples will be determined from the SAP. Split-spoon samples may be collected continuously, intermittently, or from predetermined depths.

7.3.2 Split-spoon samplers shall be driven into undisturbed soil by driving the spoon ahead of the drill augers/casing. In cohesive soils, or soils where the borehole remains open (does not collapse), two split-spoon samples may be taken prior to advancing the augers/casing.

7.3.3 After split-spoons are retrieved, open the split-spoon and measure the recovery of soil. If a PID will be used for screening, immediately scan the recovered sample for VOCs using the PID. Scan the recovered soil boring by making a hole in the soil with a decontaminated trowel and placing the PID inlet very close to the hole. Be very careful not to get soil on the tip of the PID. Take PID readings every 6 inches along the split-spoon and/or in any areas of stained or disturbed soil. Record the highest PID reading and the depth at which it was observed along with all other pertinent observations. If required in the SAP, VOC and headspace samples should be collected (see Section 7.6.1) prior to logging the sample.

7.3.4 If headspace screening for VOCs is required in the SAP, collect a soil sample (as defined in the SAP) and perform headspace screening according to SOP 3-19 Headspace Screening for Total VOCs.

7.3.5 Soils collected using the split-spoon sampler will be logged by the field representative using the procedure required in the SAP.

7.3.6 Collect the remainder of the sample volume required into a stainless steel bowl. Homogenize the soil so the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in Section 7.2.

7.3.7 The SAP may specify that intervals to be sent to the laboratory be determined by visual observation and/or highest PID screening or headspace results, which can only be determined once the boring is complete. In this instance, a VOC sample should be collected at each interval. The remainder of the soil from that interval will be set aside in a clearly labelled stainless steel bowl covered with aluminium foil. Once the boring has been completed and the sample interval has been determined, the remainder of the soil can be homogenized according to Section 7.2 and submitted for laboratory analysis.

7.3.8 Once a boring is complete and all required samples have been collected, the boring must be completed as specified in the SAP (e.g., completed as a monitoring well, backfilled with bentonite, etc).

7.4 Direct Push Sampling

At each boring location, the frequency of direct-push samples will be determined from the SAP. Typically, samples with direct-push equipment are collected in 4 foot (ft) intervals, but smaller (e.g., 2 ft) and larger (e.g., 5 ft) intervals are also possible.

1. Sample using Macro-Core samplers with acetate liners to obtain discrete soil samples at the depths specified in the SAP.

2. Cut open the acetate liner. If required in the SAP, immediately scan the recovered soil boring for VOCs using a PID by making a hole in the soil with a decontaminated trowel and placing the PID inlet very close to the hole. Be very careful not to get soil on the tip of the PID. Take PID readings every 6 inches along the split-spoon and/or in any areas of stained or disturbed soil. Record the

highest PID reading and the depth at which it was observed along with all other pertinent observations. VOC and headspace samples, if required in the SAP should be collected (see Section 7.6.1) prior to logging the sample.

3. If required in the SAP, collect a soil sample (as defined in the SAP) and perform headspace screening according to SOP 3-19 Headspace Screening for Total VOCs.

4. Soils collected using the direct-push sampler will be logged by the by the field representative using the procedure required in the SAP.

5. Collect the remainder of the sample into a stainless steel bowl. Homogenize the soil collected so that the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in Section 7.2.

6. Once a boring is complete and all required samples have been collected, the boring must be completed as specified in the SAP (e.g., completed as a monitoring well, backfilled with bentonite, etc).

7.5 Test Pit Sampling

7.5.1 Excavate the test pit to the desired depth.

7.5.2 Using the excavator bucket, collect soil samples as specified in the SAP. Collect a sample and perform screening analyses as required by the SAP. If VOCs contamination is suspected, perform headspace screening according to SOP 3-19 Headspace Screening for Total VOCs.

7.5.3 Collect the sample from center of the bucket to avoid potential contamination from the bucket.

7.5.4 VOC samples should also be collected from an undisturbed section soil in the excavator bucket. The top layer of exposed soil should be scraped away just prior to collecting the VOC samples.

7.5.5 Collect the remainder of the sample volume required into a stainless steel bowl. Homogenize the soil so the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in Section 7.2.

7.5.6 Dispose of all excavated soil according to the SAP.

7.6 Sample Collection Methods

7.6.1 Volatile Organics Sampling

For soils collected for analyses of volatile organics, including Volatile Petroleum Hydrocarbons (VPH) or other purgable compounds, a closed system is maintained. From collection through analysis, the sample bottles are not opened. The bottle kit for a routine field sample for these analyses will typically include three 40-mL VOA vials and one soil jar. Two 40-mL VOA vials will contain either 5 mL reagent water or 5 mL sodium bisulfate and magnetic stir bars (i.e., low level vials). The third VOA vial will contain 15 mL methanol with no magnetic stir bar (i.e., high level vial). These vials are usually provided by the laboratory and are pre-weighed, with the tare weight recorded on the affixed sample label. No additional sample labels are affixed to the VOA vials, as addition of a label would alter the vial weight. All information is recorded directly on the sample label using an indelible marker. The soil jar is provided for percent solids determination. For VOC or VPH analyses, samples are collected prior to sample homogenization. Collect the VOC sample in accordance with the procedure described below.

1. Determine the soil volume necessary for the required sample weight, typically 5 grams:

   a) Prepare a 5 mL sampling corer (e.g., Terra Core®) or cut-off plastic syringe.

   b) Tare the sampler by placing it on the scale, and zeroing the scale.

   c) Draw back the plunger to the 5 gram mark or 5mL (5cc) mark on cut-off syringe, and insert the open end of the sampler into an undisturbed area of soil with a twisting motion, filling the

sampler with soil. Note the location of the plunger with respect to the milliliter (cc) or other graduation printed on the sampler.

d) Weigh the filled sampler, and remove or add soil until the desired weight is obtained. Note the location of the plunger which corresponds to this weight. Do not use this sample for laboratory analysis.

2. Once the required soil volume has been determined, pull the plunger back to this mark and hold it there while filling the syringe for each sample.

3. Collect 5 grams of soil using the cut-off syringe or Terra Core® sample device. Extrude the 5-grams of soil into one of the low level 40-mL VOA vials. Quickly wipe any soil from the threads of the VOA vial with a clean Kimwipe® and immediately close the vial. It is imperative that the threads be free from soil or other debris prior to replacing the cap on the vial in order to maintain the closed system necessary for the analysis.

4. Gently swirl the vial so that all of the soil is fully wetted with the preservative.

5. Fill the other low level 40 mL VOA vial in this manner.

6. Repeat the process for the high level VOA vials, only for the high level VOA vial three 5 gram aliquots (i.e., 15 grams total) should be extruded into the high level VOA vial.

   NOTE: Depending on the laboratory, some high level VOA vials only contain 5 mL or 10 mL of methanol. If this is the case, either 5 grams total or 10 grams total, respectively, should be extruded into the high level VOA vial. In other words, the mass of soil in grams should be identical to the volume of methanol in mL (i.e., 1:1 ratio of soil to methanol).

7. Collect any additional QC sample collected (e.g., field duplicate, MS, and MSD) in the same manner as above.

8. Fill the 4-oz glass jar with soil from the same area for percent moisture determination.

7.6.2 Soil Sampling Method (All other analyses except VOC/VPH)

When all the required soil for a sampling location has been obtained, the soil can be homogenized as described in section 7.2. Collect sufficient volume to fill all of the remaining sample containers at least ¾ full for all other analyses. Homogenize the soil in a decontaminated stainless steel bowl, removing rocks, sticks, or other non-soil objects and breaking apart any lumps of soil prior to filling the remaining sample containers.

NOTE: Soil samples must contain greater than 30% solids for the data to be considered valid.

8.0 Quality Control and Assurance

8.1 Sampling personnel should follow specific quality assurance guidelines as outlined in the SAP. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the SAP typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.

8.2 Quality control requirements are dependent on project-specific sampling objectives. The SAP will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

9.0 Records, Data Analysis, Calculations

All data and information (e.g., sample collection method used) must be documented on field data sheets, boring logs, or within site logbooks with permanent ink. Data recorded may include the following:

- Weather conditions;
- Arrival and departure time of persons on site;
- Instrument type, lamp (PID), make, model and serial number;
- Calibration gas used;
- Date, time and results of instrument calibration and calibration checks;
- Sampling date and time;
- Sampling location;
- Samples collected;
- Sampling depth and soil type;
- Deviations from the procedure as written; and
- Readings obtained.

10.0 Attachments or References

SOP 3-06, *Equipment Decontamination*

SOP 3-19, *Headspace Screening for Total VOCs*

SOP 3-20, *Operation and Calibration of a Photoionization Detector*

Author	Reviewer	Revisions (Technical or Editorial)
Robert Shoemaker Senior Scientist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (May 2012)

Figure: 30 TAC §350.77(b)

TIER 1: EXCLUSION CRITERIA CHECKLIST

This exclusion criteria checklist is intended to aid the person and the TCEQ in determining whether or not further ecological evaluation is necessary at an affected property where a response action is being pursued under the Texas Risk Reduction Program (TRRP). Exclusion criteria refer to those conditions at an affected property which preclude the need for a formal ecological risk assessment (ERA) because there are **incomplete or insignificant ecological exposure pathways** due to the nature of the affected property setting and/or the condition of the affected property media. This checklist (and/or a Tier 2 or 3 ERA or the equivalent) must be completed by the person for all affected property subject to the TRRP. The person should be familiar with the affected property but need not be a professional scientist in order to respond, although some questions will likely require contacting a wildlife management agency (i.e., Texas Parks and Wildlife Department or U.S. Fish and Wildlife Service). The checklist is designed for general applicability to all affected property; however, there may be unusual circumstances which require professional judgement in order to determine the need for further ecological evaluation (e.g., cave-dwelling receptors). In these cases, the person is strongly encouraged to contact TCEQ before proceeding.

Besides some preliminary information, the checklist consists of three major parts, **each of which must be completed unless otherwise instructed.** PART I requests affected property identification and background information. PART II contains the actual exclusion criteria and supportive information. PART III is a qualitative summary statement and a certification of the information provided by the person. **Answers should reflect existing conditions and should not consider future remedial actions at the affected property.** Completion of the checklist should lead to a logical conclusion as to whether further evaluation is warranted. Definitions of terms used in the checklist have been provided and users are strongly encouraged to familiarize themselves with these definitions before beginning the checklist.

Name of Facility:

Affected Property Location:

Mailing Address:

TCEQ Case Tracking #s:

Solid Waste Registration #s:

Voluntary Cleanup Program #:

EPA I.D. #s:

Definitions[1]

Affected property - The entire area (i.e., on-site and off-site; including all environmental media) which contains releases of chemicals of concern at concentrations equal to or greater than the assessment level applicable for residential land use and groundwater classification.

Assessment level - A critical protective concentration level for a chemical of concern used for affected property assessments where the human health protective concentration level is established under a Tier 1 evaluation as described in §350.75(b) of this title (relating to Tiered Human Health Protective Concentration Level Evaluation), except for the protective concentration level for the soil-to-groundwater exposure pathway which may be established under Tier 1, 2, or 3 as described in §350.75(i)(7) of this title, and ecological protective concentration levels which are developed, when necessary, under Tier 2 and/or 3 in accordance with §350.77(c) and/or (d), respectively, of this title (relating to Ecological Risk Assessment and Development of Ecological Protective Concentration Levels).

Bedrock - The solid rock (i.e., consolidated, coherent, and relatively hard naturally formed material that cannot normally be excavated by manual methods alone) that underlies gravel, soil or other surficial material.

Chemical of concern - Any chemical that has the potential to adversely affect ecological or human receptors due to its concentration, distribution, and mode of toxicity. Depending on the program area, chemicals of concern may include the following: solid waste, industrial solid waste, municipal solid waste, and hazardous waste as defined in Texas Health and Safety Code, §361.003, as amended; hazardous constituents as listed in 40 Code of Federal Regulations Part 261, Appendix VIII, as amended; constituents on the groundwater monitoring list in 40 Code of Federal Regulations Part 264, Appendix IX, as amended; constituents as listed in 40 CFR Part 258 Appendices I and II, as amended; pollutant as defined in Texas Water Code, §26.001, as amended; hazardous substance as defined in Texas Health and Safety Code, §361.003, as amended, and the Texas Water Code, §26.263, as amended; other substances as defined in Texas Water Code, §26.039(a), as amended; and daughter products of the aforementioned constituents.

Community - An assemblage of plant and animal populations occupying the same habitat in which the various species interact via spatial and trophic relationships (e.g., a desert community or a pond community).

Complete exposure pathway - An exposure pathway where a human or ecological receptor is exposed to a chemical of concern via an exposure route (e.g., incidental soil ingestion, inhalation of volatiles and particulates, consumption of prey, etc).

De minimus **-** The description of an area of affected property comprised of one acre or less where the ecological risk is considered to be insignificant because of the small extent of contamination, the absence of protected species, the availability of similar unimpacted habitat nearby, and the lack of adjacent sensitive environmental areas.

Ecological protective concentration level - The concentration of a chemical of concern at the point of exposure within an exposure medium (e.g., soil, sediment, groundwater, or surface water) which is determined in accordance with §350.77(c) or (d) of this title (relating to Ecological Risk Assessment and Development of Ecological Protective Concentration Levels) to be protective for ecological receptors. These concentration levels are primarily intended to be protective for more mobile or wide-ranging ecological receptors and, where appropriate, benthic invertebrate communities within the waters in the state. These concentration levels are not intended to be directly protective of receptors with limited mobility or range (e.g., plants, soil invertebrates, and small rodents), particularly those residing within active areas of a facility, unless these receptors are threatened/endangered species or unless impacts to these receptors result in disruption of the ecosystem or other unacceptable consequences for the more mobile or wide-ranging receptors (e.g., impacts to an off-site grassland habitat eliminate rodents which causes a desirable owl population to leave the area).

Ecological risk assessment - The process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors; however, as used in this context, only chemical stressors (i.e., COCs) are evaluated.

Environmental medium - A material found in the natural environment such as soil (including non-waste fill materials), groundwater, air, surface water, and sediments, or a mixture of such materials with liquids, sludges, gases, or solids, including hazardous waste which is inseparable by simple mechanical removal processes, and is made up primarily of natural environmental material.

Exclusion criteria - Those conditions at an affected property which preclude the need to establish a protective concentration level for an ecological exposure pathway because the exposure pathway between the chemical of concern and the ecological receptors is not complete or is insignificant.

Exposure medium - The environmental medium or biologic tissue in which or by which exposure to chemicals of concern by ecological or human receptors occurs.

Facility - The installation associated with the affected property where the release of chemicals of concern occurred.

Functioning cap - A low permeability layer or other approved cover meeting its design specifications to minimize water infiltration and chemical of concern migration, and prevent ecological or human receptor exposure to chemicals of concern, and whose design requirements are routinely maintained.

Landscaped area - An area of ornamental, or introduced, or commercially installed, or manicured vegetation which is routinely maintained.

Off-site property (off-site) - All environmental media which is outside of the legal boundaries of the on-site property.

On-site property (on-site) - All environmental media within the legal boundaries of a property owned or leased by a person who has filed a self-implementation notice or a response action plan for that property or who has become subject to such action through one of the agency's program areas for that property.

Physical barrier - Any structure or system, natural or manmade, that prevents exposure or prevents migration of chemicals of concern to the points of exposure.

Point of exposure - The location within an environmental medium where a receptor will be assumed to have a reasonable potential to come into contact with chemicals of concern. The point of exposure may be a discrete point, plane, or an area within or beyond some location.

Protective concentration level - The concentration of a chemical of concern which can remain within the source medium and not result in levels which exceed the applicable human health risk-based exposure limit or ecological protective concentration level at the point of exposure for that exposure pathway.

Release - Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment, with the exception of:

> (A) A release that results in an exposure to a person solely within a workplace, concerning a claim that the person may assert against the person's employer;

(B) An emission from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel, or pipeline pumping station engine;

(C) A release of source, by-product, or special nuclear material from a nuclear incident, as those terms are defined by the Atomic Energy Act of 1954, as amended (42 U.S.C. §2011 *et seq*.), if the release is subject to requirements concerning financial protection established by the Nuclear Regulatory Commission under §170 of that Act;

(D) For the purposes of the environmental response law §104, as amended, or other response action, a release of source, by-product, or special nuclear material from a processing site designated under §102(a)(1) or §302(a) of the Uranium Mill Tailings Radiation Control Act of 1978 (42 U.S.C. §7912 and §7942), as amended; and

(E) The normal application of fertilizer.

Sediment - Non-suspended particulate material lying below surface waters such as bays, the ocean, rivers, streams, lakes, ponds, or other similar surface water body (including intermittent streams). Dredged sediments which have been removed from below surface water bodies and placed on land shall be considered soils.

Sensitive environmental areas - Areas that provide unique and often protected habitat for wildlife species. These areas are typically used during critical life stages such as breeding, hatching, rearing of young, and overwintering. Examples include critical habitat for threatened and endangered species, wilderness areas, parks, and wildlife refuges.

Source medium - An environmental medium containing chemicals of concern which must be removed, decontaminated and/or controlled in order to protect human health and the environment. The source medium may be the exposure medium for some exposure pathways.

Stressor - Any physical, chemical, or biological entity that can induce an adverse response; however, as used in this context, only chemical entities apply.

Subsurface soil - For human health exposure pathways, the portion of the soil zone between the base of surface soil and the top of the groundwater-bearing unit(s). For ecological exposure pathways, the portion of the soil zone between 0.5 feet and 5 feet in depth.

Surface cover - A layer of artificially placed utility material (e.g., shell, gravel).

Surface soil - For human health exposure pathways, the soil zone extending from ground surface to 15 feet in depth for residential land use and from ground surface to 5 feet in depth for commercial/industrial land use; or to the top of the uppermost groundwater-bearing unit or bedrock, whichever is less in depth. For ecological exposure pathways, the soil zone extending from ground surface to 0.5 feet in depth.

Surface water - Any water meeting the definition of surface water in the state as defined in §307.3 of this title (relating to Abbreviations and Definitions), as amended.

PART I. Affected Property Identification and Background Information

1) Provide a description of the specific area of the response action and the nature of the release. Include estimated acreage of the affected property and the facility property, and a description of the type of facility and/or operation associated with the affected property. Also describe the location of the affected property with respect to the facility property boundaries and public roadways.

Attach available USGS topographic maps and/or aerial or other affected property photographs to this form to depict the affected property and surrounding area. Indicate attachments:

□ Topo map □ Aerial photo □ Other

2) Identify environmental media known or suspected to contain chemicals of concern (COCs) at the present time. Check all that apply:

Known/Suspected COC Location	Based on sampling data?
□ Soil ≤5 ft below ground surface	□ Yes □ No
□ Soil >5 ft below ground surface	□ Yes □ No
□ Groundwater	□ Yes □ No
□ Surface Water/Sediments	□ Yes □ No

Explain (previously submitted information may be referenced):

3) Provide the information below for the nearest surface water body which has become or has the potential to become impacted from migrating COCs via surface water runoff, air deposition, groundwater seepage, etc. Exclude wastewater treatment facilities and storm water conveyances/impoundments authorized by permit. Also exclude conveyances, decorative ponds, and those portions of process facilities which are:

a. Not in contact with surface waters in the State or other surface waters which are ultimately in contact with surface waters in the State; and

b. Not consistently or routinely utilized as valuable habitat for natural communities including birds, mammals, reptiles, etc.

The nearest surface water body is _____ feet/miles from the affected property and is named _____. The water body is best described as a:

□ freshwater stream: _____ perennial (has water all year)
_____ intermittent (dries up completely for at least 1 week a year)
_____ intermittent with perennial pools
□ freshwater swamp/marsh/wetland
□ saltwater or brackish marsh/swamp/wetland
□ reservoir, lake, or pond; approximate surface acres:
□ drainage ditch
□ tidal stream □ bay □ estuary
□ other; specify

Is the water body listed as a State classified segment in Appendix C of the current Texas Surface Water Quality Standards; §§307.1 - 307.10?

□ Yes Segment # _____ Use Classification:

□ No

If the water body is not a State classified segment, identify the first downstream classified segment.

Name:

Segment #:

Use Classification:

As necessary, provide further description of surface waters in the vicinity of the affected property:

PART II. Exclusion Criteria and Supportive Information
Subpart A. Surface Water/Sediment Exposure

1) Regarding the affected property where a response action is being pursued under the TRRP, have COCs migrated and resulted in a release or imminent threat of release to either surface waters or to their associated sediments via surface water runoff, air deposition, groundwater seepage, etc.? Exclude wastewater treatment facilities and storm water conveyances/impoundments authorized by permit. Also exclude conveyances, decorative ponds, and those portions of process facilities which are:

a. Not in contact with surface waters in the State or other surface waters which are ultimately in contact with surface waters in the State; and

b. Not consistently or routinely utilized as valuable habitat for natural communities including birds, mammals, reptiles, etc.

□ Yes □ No

Explain:

If the answer is Yes to Subpart A above, the affected property does not meet the exclusion criteria. However, complete the remainder of Part II to determine if there is a complete and/or significant soil exposure pathway, then complete PART III - Qualitative Summary and Certification. If the answer is No, go to Subpart B.

Subpart B. Affected Property Setting

In answering "Yes" to the following question, it is understood that the affected property is not attractive to wildlife or livestock, including threatened or endangered species (i.e., the affected property does not serve as valuable habitat, foraging area, or refuge for ecological communities). (May require consultation with wildlife management agencies.)

1) Is the affected property wholly contained within contiguous land characterized by: pavement, buildings, landscaped area, functioning cap, roadways, equipment storage area, manufacturing or process area, other surface cover or structure, or otherwise disturbed ground?

□ Yes □ No

Explain:

If the answer to Subpart B above is Yes, the affected property meets the exclusion criteria, assuming the answer to Subpart A was No. Skip Subparts C and D and complete PART III - Qualitative Summary and Certification. If the answer to Subpart B above is No, go to Subpart C.

Subpart C. Soil Exposure

1) Are COCs which are in the soil of the affected property solely below the first 5 feet beneath ground surface **or** does the affected property have a physical barrier present to prevent exposure of receptors to COCs in surface soil?

□ Yes □ No

Explain:

If the answer to Subpart C above is Yes, the affected property meets the exclusion criteria, assuming the answer to Subpart A was No. Skip Subpart D and complete PART III - Qualitative Summary and Certification. If the answer to Subpart C above is No, proceed to Subpart D.

Subpart D. *De Minimus* Land Area

In answering "Yes" to the question below, it is understood that all of the following conditions apply:

The affected property is not known to serve as habitat, foraging area, or refuge to threatened/endangered or otherwise protected species. (Will likely require consultation with wildlife management agencies.)

Similar but unimpacted habitat exists within a half-mile radius.

The affected property is not known to be located within one-quarter mile of sensitive environmental areas (e.g., rookeries, wildlife management areas, preserves). (Will likely require consultation with wildlife management agencies.)

There is no reason to suspect that the COCs associated with the affected property will migrate such that the affected property will become larger than one acre.

1) Using human health protective concentration levels as a basis to determine the extent of the COCs, does the affected property consist of one acre or less and does it meet all of the conditions above?

□ Yes □ No

Explain how conditions are met/not met:

If the answer to Subpart D above is Yes, then no further ecological evaluation is needed at this affected property, assuming the answer to Subpart A was No. Complete PART III - Qualitative Summary and Certification. If the answer to Subpart D above is No, proceed to Tier 2 or 3 or comparable ERA.

PART III. Qualitative Summary and Certification (Complete in all cases.)

Attach a brief statement (not to exceed 1 page) summarizing the information you have provided in this form. This summary should include sufficient information to verify that the affected property meets or does not meet the exclusion criteria. The person should make the initial decision regarding the need for further ecological evaluation (i.e., Tier 2 or 3) based upon the results of this checklist. After review, TCEQ will make a final determination on the need for further assessment. **Note that the person has the continuing obligation to re-enter the ERA process if changing circumstances result in the affected property not meeting the Tier 1 exclusion criteria.**

Completed by: _____ (Typed/Printed Name)

_____ (Title)

_____ *(Date)*

I believe that the information submitted is true, accurate, and complete, to the best of my knowledge.

_____ *(Typed/Printed Name of Person)*

_____ *(Title of Person)*

_____ *(Signature of Person)*

_____ *(Date Signed)*

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1 These definitions were taken from 30 TAC §350.4 and may have both ecological and human health applications. For the purpose of this checklist, it is understood that only the ecological applications are of concern.