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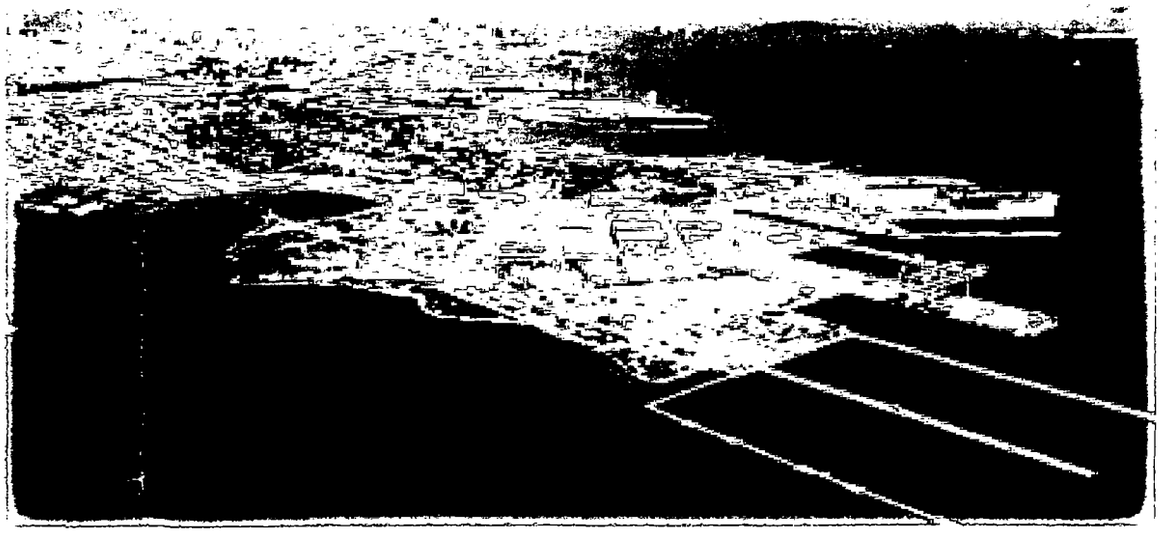

July 14, 2010

Hunters Point Shipyard
San Francisco, California
Document Control Number: SHAW-8822-0006-0148

Final Project Work Plan
Parcel D-1 Storm Drain and Sanitary Sewer Removal

DEPARTMENT OF THE NAVY
BASE REALIGNMENT AND CLOSURE
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Dear BCT Members:

Enclosure (1) is the *Final Project Work Plan Parcel D-1 Storm Drain and Sanitary Sewer Removal, Hunters Point Shipyard, San Francisco, California*, dated July 14, 2010. The document was completed in July 2010 but could not be submitted due to contractual reasons.

If you should have any concerns with this matter, please contact James Whitcomb at (619) 532-0936, or me at (619) 532-0913.

Sincerely,

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By direction of the Director

Enclosure: 1. *Final Project Work Plan Parcel D-1 Storm Drain and Sanitary Sewer Removal, Hunters Point Shipyard, San Francisco, California*, dated July 14, 2010

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FINAL
PROJECT WORK PLAN
PARCEL D-1 STORM DRAIN AND SANITARY SEWER REMOVAL HUNTERS POINT SHIPYARD SAN FRANCISCO, CALIFORNIA

Contract Number N64273-08-D-8822
Contract Task Order Number 0006

Document Control Number: SHAW-8822-0006-0148
July 14, 2010

Prepared for:

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FINAL
PROJECT WORK PLAN
PARCEL D-1 STORM DRAIN AND SANITARY SEWER REMOVAL HUNTERS POINT SHIPYARD SAN FRANCISCO, CALIFORNIA

Contract Number N64273-08-D-8822
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Document Control Number: SHAW-8822-0006-0148
July 14, 2010

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Abbreviations and Acronyms

^{3}H	tritium
^{90}Sr	strontium-90
^{137}Cs	cesium-137
^{152}Eu	europium-152
^{226}Ra	radium-226
^{232}Th	thorium-232
^{239}Pu	plutonium-239
α	alpha
β	beta
σ	sigma
μR/hr	microRoentgen per hour
AEC	Atomic Energy Commission
ALARA	as low as reasonably achievable
AM	Action Memorandum
APP	Accident Prevention Plan
ARAR	applicable or relevant and appropriate requirement
BAAQMD	Bay Area Air Quality Management District
bgs	below ground surface
BMP	best management practice
Cal-DOSH	California Department of Occupational Safety and Health
Cal/EPA	California Environmental Protection Agency
CCR	California Code of Regulations
CCSF	City and County of San Francisco
CDFG	California Department of Fish and Game
CDPH	California Department of Public Health
CEC	Civil Engineering Command
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CGS	Coast and Geodetic Survey
CIH	Certified Industrial Hygienist
cm	centimeters
cm^2	square centimeters
cpm	counts per minute
CSO	Caretaker Site Office
CSP	Certified Safety Professional
CTO	Contract Task Order
D-1 Design Plan	*Final Design Plan for the Parcel D-1 Sanitary Sewer and Storm Drain Removal*
D-1 Execution Plan	*Final Execution Plan for the Parcel D-1 Radiological Remediation and Support*
D-1 Radiological Work Plan	*Final Radiological Work Plan for Hunters Point Shipyard Parcel D-1, San Francisco, California*

D-1 Sewer Work Plan	*Final Project Work Plan, Parcel D-1 Storm Drain and Sanitary Sewer Removal, Hunters Point Shipyard, San Francisco, California*
DCGL	derived concentration guideline level
DNAPL	dense, non-aqueous phase liquid
DoD	Department of Defense
DOT	Department of Transportation
dpm	disintegrations per minute
DQO	data quality objective
DTSC	California Department of Toxic Substances Control
EMS	Environmentla Management Solutions, Inc.
EP	extraneous pipe
EPA	U.S. Environmental Protection Agency
EPP	Environmental Protection Plan
ES	excavated soil
FS	Feasibility Study
FSS	Final Status Survey
g/cm^3	grams per cubic centimeter
GPS	Global Positioning System
HDPE	high-density polyethylene
HPS	Hunters Point Shipyard
HRA	Historical Radiological Assessment
IR	Installation Restoration
IRP	Installation Restoration Program
ISO	International Organization for Standardization
ITSI	Innovative Technical Solutions, Inc.
keV	kiloelectron volt
LBGR	lower boundary of the gray region
LDR	land disposal restriction
License RSO	License Radiation Safety Officer
LFR-PRC	Levine-Fricke-Recon, Inc. and PRC Environmental Management, Inc.
LLMW	low-level mixed waste
LLRW	low-level radioactive waste
LNAPL	light non-aqueous phase liquid
m	meter
m^2	square meters
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	minimum detectable concentration
MDCR	minimal detectable count rate
MDER	minimum detectable exposure rate
MeV	megaelectron volts
min	minute

MOU	memorandum of understanding
mR/hr	milliRoentgen per hour
NaI	sodium iodide
NAVFAC SW	Naval Facilities Engineering Command, Southwest
NAVSEA	Naval Sea Systems Command
Navy	Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NIST	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NRDL	Naval Radiological Defense Laboratory
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
pCi/g	picocuries per gram
PM	Project Manager
PPE	personal protective equipment
PQCM	Project Quality Control Manager
PRSO	Project Radiation Safety Officer
QA	quality assurance
QC	quality control
RACR	Removal Action Completion Report
RASO	Radiological Affairs Support Office
RCA	radiologically-controlled area
RCRA	Resource Conservation and Recovery Act
RCS	Radiological Controls Supervisor
RCT	Radiological Control Technician
RI	Remedial Investigation
ROC	radionuclide of concern
ROICC	Resident Officer in Charge of Construction
RPM	Remedial Project Manager
RPP	Radiation Protection Plan
RSO	Radiation Safety Officer
RSY	Radiological Screening Yard
RWP	Radiological Work Permit
RWQCB	California Regional Water Quality Control Board, San Francisco Region
SAP	Sampling and Analysis Plan
SD	storm drain
SOP	standard operating procedure
SS	sanitary sewer
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan

STLC	Soluble Threshold Limit Concentration
SUPR	Survey Unit Project Report
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TCRA	time-critical removal action
TtEC	Tetra Tech EC, Inc.
TtEMI	Tetra Tech EM, Inc.
TSCA	Toxic Substances Control Act
TSDF	treatment, storage, and disposal facility
TTLC	Total Threshold Limit Concentration
USA	Underground Service Alert
USC	United States Code
VCP	vitrified clay pipe
VSP	Visual Sampling Plan
WET	Waste Extraction Test
WMP	Waste Management Plan
ZOI	zone of influence

Executive Summary

This *Project Work Plan, Parcel D-1 Storm Drain and Sanitary Sewer Removal, Hunters Point Shipyard, San Francisco, California* (D-1 Sewer Work Plan) describes the scope and approach for storm drain (SD) and sanitary sewer (SS) systems removal and radiological release of Parcel D-1 at Hunters Point Shipyard (HPS), San Francisco, California. The Department of the Navy (Navy); Naval Facilities Engineering Command, Southwest; and the Radiological Affairs Support Office (RASO) are directing this removal action under the Department of Defense Installation Restoration Program (IRP) in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan. Upon review of HPS's radiological operational history, the *Final Historical Radiological Assessment, Volume II* (HRA; Naval Sea Systems Command [NAVSEA], 2004), and site-specific investigative data, the Navy has determined that the SDs and SSs contain radioactive material, requiring a response action. This decision is documented in the *Final Basewide Radiological Removal Action, Action Memorandum-Revision 2006, Hunters Point Shipyard, San Francisco, California* (Navy, 2006), which was created to direct removal actions within areas throughout the base that contain radioactive contamination.

The Navy has initiated this removal action for the SD and SS systems basewide to substantially eliminate the potential threat posed by future migration or release of radioactive material present in the systems into the surrounding environment. Such a release could occur as a result of wastewater or storm water transport, erosion, weathering, seismic events, or biological activity.

The removal action objectives are to protect public health and welfare and the environment and to preclude potential exposure to future residents or workers by physically removing the existing SD and SS piping and disposing associated radioactive contaminants that exceed the radiological removal objectives (release limits), thus substantially eliminating potential migration of contaminated material within or outside of the systems. The HRA (NAVSEA, 2004) identified cesium-137 (^{137}Cs), radium-226 (^{226}Ra), and strontium-90 (^{90}Sr) as radionuclides of concern (ROCs) for the SD and SS systems; and plutonium-239 (^{239}Pu), thorium-232 (^{232}Th), europium-152 (^{152}Eu), and tritium (^{3}H) as ROCs for radiologically-impacted sites in Parcel D-1 that contain sewers (Table 1).. The release limits have been established by the Navy in consonance with U.S. Environmental Protection Agency, Region 9. Meeting the release limits specified in the *Final Basewide Radiological Removal Action, Action Memorandum-Revision 2006, Hunters Point Shipyard, San Francisco, California* (Navy, 2006) is the purpose of this removal action.

This D-1 Sewer Work Plan addresses remediation of ROCs (^{137}Cs, ^{226}Ra and ^{90}Sr), specified in the HRA (NAVSEA, 2004) for the SD and SS systems as well as additional ROCs that may be

present in SD and SS piping within or draining from radiologically-impacted sites within Parcel D-1 (NAVSEA, 2004).

This D-1 Sewer Work Plan is based upon and conforms to the *Final Project Work Plan, Base-wide Storm Drain and Sanitary Sewer Removal, Revision 3, Hunters Point Shipyard, San Francisco, California* (Tetra Tech EC, Inc. [TtEC], 2008), with deviations made only due to:

- Limitation of this D-1 Sewer Work Plan to Parcel D-1
- Implementation of this D-1 Sewer Work Plan by Shaw Environmental & Infrastructure, Inc. (herein referred to as Shaw)

This D-1 Sewer Work Plan presents the overall scope and approach that will be implemented within Parcel D-1 of Hunters Point Shipyard to perform the SD and SS systems removal and associated radiological screening, waste management, and site restoration activities. SD and SS systems will, to the extent practicable, be removed. A specific design plan (Shaw, 2010b) is being submitted under separate cover to supplement the information provided in this D-1 Sewer Work Plan. The design plan will include unique implementation details, including identification of specific SD and SS piping to be removed, the relationship between the removal actions and existing environmental conditions, special construction requirements (if any), area-specific technical specifications, detailed design drawings, and data quality objectives.

SD and SS piping within Parcel D-1 will be removed under this D-1 Sewer Work Plan. SD and SS piping within radiologically-impacted building sites and other areas will be addressed after the site or area has completed the Final Status Surveys (FSS) process.

SD and SS piping may be left in place under limited conditions. Piping laterals that discharged fluids from non-radiologically-impacted sites of Parcel D-1 will initially only be removed within the first 10 feet of their union with a main trunk. If radiological contamination is not present in this segment of the piping, then the exposed ends of the lateral will be capped or plugged and the remaining portions left in place. If evidence of radiological contamination is encountered, then the remainder of the lateral will be removed.

The Navy will obtain all necessary authorizations and submit all necessary notifications prior to mobilization. Because this removal action is being performed in accordance with Section 121(e) of CERCLA to support a removal action, no permits are necessary. However, all substantive requirements of those permits will be met.

Mobilization activities will include notifying tenant and other stakeholders, and preparing the site will involve moving equipment and material to the Parcel D-1 and/or Shaw's Hunters Point project office, establishing Radiological Control Areas, and installing security fencing and runoff

controls. Pre-excavation topographical and geophysical surveys may be performed to further refine the existing site conditions, if necessary.

The general approach for removing and surveying the SD and SS piping will be:

1. Remove any non-soil surface cover
2. Excavate soils
3. Remove the piping
4. Plug open pipes left in place during the removal process to prevent fluids from entering or exiting pipes
5. Conduct ex-situ radiological screening and sampling of the piping
6. Conduct FSSs of the excavated soils and excavation trenches

After the results of these activities are evaluated and any identified radiological contamination is removed, the trench excavations will be backfilled and the site restored.

Soil associated with each SD and SS piping will be removed to a minimum of 1 foot below and from the sides of piping. Soil excavated from within an identified IRP site will be screened in a Radiological Screening Yard (RSY), stockpiled, and sampled for the chemicals of concern prior to making a decision to either reuse the soil for trench backfill or dispose of the soil as waste. Excavated soil from non-IRP sites will be screened in a RSY, stockpiled separately, and used to backfill the excavations without additional chemical testing.

After the soil is excavated and removed to a RSY, all SD and SS piping will be removed. To the extent practicable, the pipingwill be removed intact. The interior surfaces of removed piping will be radiologically-characterized by hand-survey and swipe sampling. Solid/sediment samples will be collected and analyzed for radiological contamination if a sufficient quantity is found to be present within the removed section of piping. If the piping breaks into small pieces (all dimensions less than 6 inches) that can be processed within an RSY as soil, as often occurs in removal of terracotta and vitrified clay pipe (VCP), the pieces will be managed as soil and not as piping.

Excavated soil will be transported to a screening pad within an RSY for dewatering (if necessary) and radiological surveys. Excavated soil placed on the screening pads will be spread out in lifts not to exceed 6 inches in thickness and up to 1,000 square meters in surface area. As necessary, the material will be allowed to dewater prior to the performance of radiological surveys. The radiological surface survey will consist of a high-density gamma scan, using sodium iodide detectors and supported by global positioning system equipment. A minimum of 18 solid samples will be collected for each survey unit of excavated soil (up to 1,000 square

meters) placed on the screening pad. The samples will be systematically collected based on a random start point. Additional samples will be collected at locations where the investigation level is exceeded. If ^{137}Cs is identified above release limits, samples will also be analyzed for ^{90}Sr and for alpha emission by alpha spectrometry.

FSSs for every excavated piping trench section will include 100 percent scan and systematic and biased static measurements. Systematic post-excavation, in-situ soil samples will be collected after establishing a grid that will not exceed 1,000 square meters over the excavated trench surfaces. A minimum of 18 systematically located samples will be collected from each trench section after excavation is completed. The following systematic samples will be analyzed for radionuclides by gamma spectroscopy:

- 10 percent of the samples submitted to the on-site laboratory will be analyzed for ^{90}Sr per the Sampling and Analysis Plan (SAP; Appendix A)
- 10 percent of the samples submitted to the on-site laboratory will be submitted to the off-site laboratory by the on-site laboratory operator for quality assurance verification

Additional laboratory analysis for radionuclides will also be conducted as follows:

- If gamma spectroscopy indicates that ^{137}Cs is present, laboratory analysis for ^{90}Sr will be conducted
- SD and SS piping from radiologically-impacted sites will be evaluated for the radionuclides identified for the TSP from which the piping was removed

FSS procedures are described in this D-1 Sewer Work Plan. FSS results will be used for dose modeling and unrestricted release. Should radioactive material be detected within the trench, it will be removed and additional surveys/sampling will be performed. When the results of the FSS (gamma scans and samples) meet the release criteria and (RASO) concurrence is received, the excavation trenches will be backfilled. The primary source of backfill material is expected to be uncontaminated material removed from the excavations. In some areas of Parcel D-1, site restoration will consist of installing surface drainage swales to direct overland storm water runoff to outfalls along the San Francisco Bay shoreline, as appropriate. Installation of any structures or performance of any grading to control or direct storm water will be limited to that identified as necessary to properly direct storm water flows to San Francisco Bay. All installed drainage will comply with storm water discharge requirements. The locations of SD piping will be identified in the project design plan. No SS piping will be replaced.

Radioactively contaminated material (SD and SS system piping, debris, excavated soils including mixed wastes, or incidental material) exhibiting concentrations above the radiological release criteria will be properly stored on site pending packaging, disposal, and transportation by a U.S. Deaprtment of the Army contractor in compliance with the Navy Low-level Radioactive

Waste Disposal Program. Soils from within IRP sites not deemed suitable for reuse as backfill will be sent for off-site disposal. Large non-radioactive debris not suitable for replacement within the excavation area also will be sent for off-site disposal.

The results of the removal action will be documented in Survey Unit Project Reports that will be provided to regulatory agencies for review and acceptance as trenches are backfilled. These Survey Unit Project Reports will also be provided as Attachments in the Removal Action Completion Report for presentation to the regulatory agencies and the Restoration Advisory Board.

1.0 Introduction

This *Project Work Plan, Parcel D-1 Storm Drain and Sanitary Sewer Removal, Hunters Point Shipyard, San Francisco, California* (D-1 Sewer Work Plan) describes the scope and approach for the removal action for the storm drain (SD) and sanitary sewer (SS) systems within Parcel D-1 of Hunters Point Shipyard (HPS) in San Francisco, California (Figure 1). The Department of the Navy (Navy), Naval Facilities Engineering Command, Southwest (NAVFAC SW), and the Radiological Affairs Support Office (RASO) are directing this removal action. This plan is being prepared under Navy contract N62473-08-D-8822, Contract Task Order (CTO) 0006.

This D-1 Sewer Work Plan is based on and conforms to the *Final Project Work Plan, Base-wide Storm Drain and Sanitary Sewer Removal, Hunters Point Shipyard, San Francisco, California,* Revision 3 (Tetra Tech EC, Inc. [TtEC], 2008), and includes Shaw Environmental & Infrastructure, Inc. (herein referred to as Shaw) procedures.

This removal action is being conducted in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The Navy will submit all necessary notifications prior to mobilization. Because this removal action is being performed in accordance with Section 121(e) of CERCLA, no permits are necessary. However, all substantive requirements of those permits will be met.

Based on HPS's radiological operational history described in the *Final HRA, Volume II* (HRA; Naval Sea Systems Command [NAVSEA], 2004) and site-specific investigative data, the Navy has determined that HPS contains radioactive contamination in soils and debris and requires a response action. This decision is documented in the *Final Basewide Radiological Removal Action, Action Memorandum - Revision 2006, Hunters Point Shipyard, San Francisco, California* (referred to hereafter as the Action Memorandum [AM]; Navy, 2006), which was created to direct removal actions within areas throughout the base that contain localized radioactive contamination.

The Navy has initiated this removal action for the extraction of SD and SS systems and soil containing radioactive contaminants that may be present in or around the SD and SS systems. This removal action will serve to eliminate the potential threat posed by future migration and/or off-site release of radioactive material present at the site to the surrounding environment. Currently, such a release could occur as a result of wastewater or storm water transport, erosion, weathering, seismic events, or biological activity.

The *Final Historical Radiological Assessment, Volume II* (HRA; Naval Sea Systems Command [NAVSEA], 2004) listed cesium-137 (^{137}Cs), radium-226 (^{226}Ra), and strontium-90 (^{90}Sr) as radionuclides of concern (ROCs) for the basewide SD and SS systems. Those SD and SS piping within the radiologically-impacted sites identified by the HRA (NAVSEA, 2004) or CTO 0006 (NAVFAC SW, 2009) will have additional ROCs. The additional ROCs for such SD and SS piping will be those identified in the HRA (NAVSEA, 2004) for each of those sites. Table 1 lists the ROCs for all of the sewers in Parcel D-1 as well as the ROCs that are specific to the portions of the sewers found within radiologically-impacted sites.

Radiologically-impacted sites within Parcel D-1 include several building sites, a building, two piers, and 14 ship berths that straddle the boundary of Parcel D-1 and Parcel F (see Section 2.7.2 of this D-1 Sewer Work Plan for further discussion). All materials with radioactivity levels higher than the release criteria that are encountered during the removal action will be remediated by disposal as low level radioactive waste. The radiological surveying and characterization sampling will be conducted in accordance with this D-1 Sewer Work Plan and *Final Radiological Work Plan for Parcel D-1, Hunters Point Shipyard, San Francisco, California,* (D-1 Radiological Work Plan, Shaw, 2010a).

This D-1 Sewer Work Plan describes the overall scope and approach to the removal action and details the specific activities involved in implementation of the planned removal action. The *Final Design Plan for the Parcel D-1 Sanitary Sewer and Storm Drain Removal* (D-1 Design Plan) (Shaw, 2010b) includes site and detail design drawings and specifications for each work area.

1.1 Release Criteria

The release criteria (Table 2) are intended to meet the radiological removal objectives to protect public health and welfare and the environment by physically removing and disposing of radioactive contaminants that exceed the release criteria, thus substantially eliminating potential migration of contaminated material within or outside of the systems. The release criteria have been established by the Navy in consonance with U.S. Environmental Protection Agency (EPA), Region 9. Meeting the specified release criteria for unrestricted radiological release for the area is the purpose of this removal action.

1.2 Scope of Work

The scope of the removal action includes preparation of and updating this work plan, preparation of parcel or area-specific design plans, performance of construction activities, preparation of Survey Unit Project Reports (SUPRs) for each backfilled trench section, and preparation of a Removal Action Completion Report (RACR). This D-1 Sewer Work Plan will define the work at

a summary level, and the design plan will provide the details for the removal and construction process.

Prior to invasive work, notifications will be issued, procurements completed, and equipment and personnel mobilized. The major field activities associated with the removal action include:

- Establishing radiologically controlled areas (RCAs) and procedures
- Implementing traffic control and other safety procedures
- Clearing vegetation
- Removing pavement
- Conducting geophysical investigations and utility clearance of excavation areas
- Establishing soil and debris stockpile areas and stockpile and transfer areas for handing potentially radiologically-impacted materials
- Hauling potentially radiologically-impacted soils to Radiological Screening Yards (RSYs) for screening and analysis by TtEC, the Navy basewide radiological contractor
- Excavating impacted SD and SS piping. Piping includes pipe and all components (manholes, drop inlets, clean-outs, lift stations, etc.)
- Ex-situ surveying excavated SD and SS piping
- Sampling, segregation, and stockpiling of contaminated soil materials (trench bedding fill and non-trench soil materials and debris
- Conducting in-situ surveys of soils that constitute trench sides and bottoms
- Post-excavation radiological sampling
- Backfill and compaction with non-impacted excavated soils (ESs) or clean import material
- Establishing new storm drainage system/site restoration
- Arranging waste transportation and disposal

Field activities will be completed upon decontamination and demobilization of project equipment and personnel.

The SD and SS trenches will be backfilled upon completion of excavation, radiological surveys and testing of soil and trenches, and RASO's evaluation of data and concurrence. Following completion of all work, a RACR will be prepared. The RACR will document that the fieldwork has resulted in completion of the release criteria and will include all SUPRs, documenting the

radiological evaluation and release of trench and backfill soils. The report will be provided to the Navy, regulatory agencies and the Restoration Advisory Board.

1.3 Site Safety

The Occupational Safety and Health Administration (OSHA) and California Department of Occupational Safety and Health (Cal-DOSH) regulations and permit requirements for excavations and other work will be followed. All excavations will be conducted in accordance with California Health and Safety Code, California Code of Regulations (CCR) Title 8, Sections 1539 through 1541, and 29 Code of Federal Regulations (CFR), Parts 1910 and 1926. All field activities will be conducted in accordance with the Shaw *Draft Execution Plan for the Parcel D-1 Radiological Remediation and Support* (D-1 Execution Plan; Shaw, 2010c), which includes the *Draft Accident Prevention Plan/Site Safety and Health Plan/Radiation Protection Plan* (APP/SSHP/RPP; Shaw, 2010d). The APP/SSHP/RPP has been prepared as a stand-alone document and appended to the D-1 Execution Plan.

1.4 Radiological Control Practices

Shaw has a Nuclear Regulatory Commission (NRC) Materials License (No. 20-31340-01, valid through 2019). Shaw will implement radiological control measures and this D-1 Sewer Work Plan in accordance with the license and acceptable industry standards.

Other NRC-licensed contractors are performing work for the Navy at HPS. Shaw will coordinate radiological work and related activities with two other NRC-licensed contractors, namely TtEC, and Environmental Management Solutions, Inc. (EMS), under a Memorandum of Understanding (MOU). TtEC is the HPS Navy basewide radiological contractor, and EMS is the HPS Navy basewide radiological waste disposal contractor. The MOU identifies specific responsibilities of Shaw, TtEC, and EMS for the conduct of radiological operations at HPS. Shaw's implementation of the MOU will be concurrent with mobilization.

1.5 Project Organization

Mr. James Whitcomb will be the Navy Remedial Project Manager (RPM) for this project. He is responsible for project management, budget control, and schedule maintenance, as well as coordinating project survey plans, reports, and negotiations with regulatory agencies. Mr. Whitcomb is also responsible for community relations and ensuring that the field and remedial activities comply with the applicable rules and regulations. Mr. Mike Mentink and Mr. Doug Delong of the Caretaker Site Office (CSO) will be responsible for coordination of field activities. Ms. Shirley Ng of the Resident Officer in Charge of Construction (ROICC) will be responsible for technical oversight and quality assurance (QA). Ms. Laurie Lowman and Mr. Matthew Slack will be the technical leads for the RASO and are responsible for the technical oversight and review of the project documents and all issues related to radiological activities.

The RASO acts as the lead interface with regulatory agencies on radiological issues, survey plans and reports, and radiological release criteria.

Shaw's Parcel D-1/CTO 0006 Project Manager (PM) will be responsible for general project administration. The PM oversees budget, schedule, and document preparation, and ensures the quality of all project-related activities and deliverables.

Shaw's Parcel D-1/CTO 0006 Construction Manager will manage the fieldwork, provide oversight to subcontractors, and will be responsible for managing the on-site technical aspects of the project and coordination with the CSO, ROICC, Site Safety and Health Officer (SSHO), RASO, and PM.

Shaw's Project Quality Control Manager (PQCM) will coordinate with Shaw's PM, Shaw's Program Quality Control (QC) Manager, and the NAVFAC SW QA Officer to ensure that all field activities comply with the project specifications. The SSHO will be on site during field activities and will be responsible for ensuring that field activities are conducted in compliance with the APP/SSHP/RPP (Shaw, 2010d). The SSHO will coordinate with Shaw's Program Certified Industrial Hygienist (CIH).

An on-site Project Radiation Safety Officer (RSO) (PRSO) will manage all project radiological personnel and will ensure implementation of both the D-1 Radiological Work Plan and RPP under the direction of the Shaw License Radiation Safety Officer (License RSO). The PRSO and Radiological Controls Supervisor (RCS) will be responsible for ensuring that all radiological operations are performed in compliance with Shaw's NRC license, the radiological work permits (RWP), the RPP, and Shaw policies and procedures. Additional support will be provided by other engineering and technical resources. Figure 2 provides a project organization chart that shows the relationship among select team members.

The following is a list of the key project contacts:

Agency	Contact	Project Title
NAVFAC SW 1455 Frazee Road, Suite 900 San Diego, CA 92108-4310	James Whitcomb (619) 532-0936 james.whitcomb@navy.mil	Navy RPM
Naval Sea Systems Command (NAVSEA) Detachment (DET) RASO Building 1971 NWS P.O. Box Drawer 260 Yorktown, VA 23691-0260	Laurie Lowman (757) 887-7650 laurie.lowman@navy.mil	Navy Radiological Site Manager

NAVSEA DET RASO Building 1971 NWS P.O. Box Drawer 260 Yorktown, VA 23691-0260	Matthew Slack (757) 887-4212 matthew.slack@navy.mil	Navy Assistant Radiological Site Manager
NAVFAC SW 1220 Pacific Highway San Diego, CA 92132-5190	Narciso Ancog (619) 532-3046 narciso.ancog@navy.mil	Navy QA Officer
NAVFAC SW ROICC San Francisco Bay Area 2450 Saratoga Avenue, Building 110, Suite 200 Alameda, CA 94501-7545	Shirley Ng (510) 755-5878 shirley.ng@navy.mil	ROICC Project Engineer
NAVFAC ROICC San Francisco Bay Area 2450 Saratoga Avenue, Building 110, Suite 200 Alameda, CA 94501	Andy Uehisa (510) 755-5875 andrew.uehisa@navy.mil	ROICC Construction Management Technician
CSO HPS 410 Avenue of the Palms, Suite 161 San Francisco, CA 94130	Mike Mentink (415) 743-4729 mike.mentink@navy.mil	CSO
CSO HPS 410 Avenue of the Palms, Suite 161 San Francisco, CA 94130	Doug Delong (415) 743-4713 doug.delong@navy.mil	CSO
EPA, Region IX 75 Hawthorne Street (SFD-8-1) San Francisco, CA 94105-	Mark Ripperda (415) 972-3028 ripperda.mark@epamail.epa.gov	U.S. EPA RPM
California Environmental Protection Agency (Cal/EPA) Department of Toxic Substances Control (DTSC) Office of Military Facilities 700 Heinz Ave., Building F, Suite 200 Berkeley, CA 94710	Ryan Miya (510) 540-3775 rmiya@dtsc.ca.gov	Cal/EPA DTSC RPM
Regional Water Quality Control Board 1515 Clay Street, Suite 1400 Oakland, CA 94312	Ross Steenson (510) 622-2445 rsteenson@waterboards.ca.gov	California Regional Water Quality Control Board, San Francisco Region (RWQCB) RPM

Shaw 4005 Port Chicago Highway Concord, CA 94502	Frank Hackett (925) 288-2135 Cell (925) 200-7207 Frank.hackett@shawgrp.com	PM
Shaw 1230 Columbia Street, Suite 1200 San Diego, CA 92101	Steve Massey (619) 446-4522 Stephen.massey@shawgrp.com	Program QC Manager
Shaw 3347 Michelson Drive, Suite 200 Irvine, CA 92612	Fred Mlakar, CIH, CSP (949) 660-5413 Cell (949) 981-1450 Fred.mlakar@shawgrp.com	Program Health & Safety Manager
Shaw Portland, ME	Tom Peterson Cell (631) 245-3672	License RSO
Shaw 4005 Port Chicago Highway Concord, CA 94520	John Hamm (925) 288-2012 Cell (505) 259-1232 John.hamm@shawgrp.com	Radiological Program Manager
Shaw 4005 Port Chicago Highway Concord, CA 94520	Rose Condit (925) 288-2151 Rose.condit@shawgrp.com	Program Chemist
Shaw 4005 Port Chicago Higway Concord, CA 94520	Ray Schul (925) 288-9898 Cell (518) 496-5533 Raymond.schul@shawgrp.com	PRSO
Shaw 4005 Port Chicago Highway Concord, CA 94520	Jeff Sumlin (505) 506-0205 Jeff.sumlin@shawgrp.com	RCS
Shaw 4005 Port Chicago Highway Concord, CA 94520	Mark Egan (925) 288-2279 Cell (925) 321-6169 Mark.egan@shawgrp.com	SSHO
Shaw 4005 Port Chicago Highway Concord, CA 94520	Dave Peet Cell (707) 761-0972 Dave.peet@shawgrp.com	PQCM

Shaw 4005 Port Chicago Highway Concord, CA 94520	Owen Chao, PE (925) 288-2137 Cell (510) 673-2539 Owen.chao@shawgrp.com	Project Engineer
Shaw 4005 Port Chicago Highway Concord, CA 94520	Jim Click Cell (303) 345-8998	Construction Manager
Shaw 4005 Port Chicago Highway Concord, CA 94520	Dan Wynne, PG, CEG, CHG (925) 288-2031 Cell (530) 220-3401 Dan.wynne@shawgrp.com	Project Technical Manager

1.6 Project Work Plan Organization

This D-1 Sewer Work Plan includes the following sections and appendices:

- **Section 1.0: Introduction** provides the release criteria of the project, the scope of work, and the organization of the D-1 Sewer Work Plan.
- **Section 2.0: Site Description and Background** includes a description of Parcel D-1, including environmentally sensitive areas, background on the SD and SS systems, and previous work relevant to the project.
- **Section 3.0: Regulatory Framework** describes the regulatory process, release criteria, regulated site activities, anticipated waste streams, and potential federal and state applicable or relevant and appropriate requirements (ARARs).
- **Section 4.0: Radiological Control Plan** outlines the radiological procedures relevant to this removal action.
- **Section 5.0: Final Status Surveys** outlines the FSS design relevant to this removal action.
- **Section 6.0: System Description** provides a general description of the SD and SS systems.
- **Section 7.0: Field Implementation** describes the actions and methods for removing SD and SS piping.
- **Section 8.0: Waste Management Plan** presents the waste management practices and procedures to be followed for the types and quantities of waste expected to be generated during the field activities associated with the removal activities during the SD and SS systems radiological characterization and remediation.
- **Section 9.0: Environmental Protection Plan** presents information, regarding the environmental management program for the SD and SS systems radiological

characterization and remediation. The purpose of this Environmental Protection Plan (EPP) is to detail the means of compliance with the ARARs for the remediation effort.

- **Section 10.0: References** includes the documents used to prepare this D-1 Sewer Work Plan.
- **Appendix A** – Sampling and Analysis Plan (SAP)
- **Appendix B** –Buried Drums, Bottles, Jars, and Containers with Unknown Content Procedure

2.0 Site Description and Background

This section discusses site description and land uses, site hydrogeology, site history, and previous environmental investigations conducted in Parcel D-1.

2.1 Site Description

2.1.1 Hunters Point Shipyard

HPS is located in the City and County of San Francisco (CCSF), California. HPS occupies land that extends eastward into San Francisco Bay (Figure 3). The land adjoining HPS is part of the CCSF, and designated by the CCSF Planning Department as South Bayshore as "Bayview-Hunters Point." Predominant land uses in Bayview-Hunters Point are industrial and residential. More than half of the land is devoted to industrial use. Approximately 50 percent of the residents in Bayview-Hunters Point own their homes.

HPS was operated as a Navy shipyard from approximately 1940 to 1974, and as a private shipyard under lease from the Navy between 1976 and 1986. The Navy resumed active management in 1985. Hazardous materials from shipyard operations were left on-site, so HPS was placed on the National Priorities List pursuant to CERCLA. In 1991, HPS was designated for closure pursuant to the Defense Base Realignment and Closure Act of 1990. Additional details on HPS history are provided in the *Final Revised Feasibility Study for Parcel D* (SulTech, 2007) and the *Draft Record of Decision for Parcels D-1 and UC-1* (Navy, 2009).

HPS consists of 420 acres of upland areas and 446 acres underlying water of San Francisco Bay. The 420 upland acres were initially divided into parcels A, B, C, D, and E to focus on future use and environmental investigation and cleanup activities. Parcel D was subsequently subdivided into Parcels D-1, D-2, G, and UC-1. Parcel F is comprised of immediately adjacent submerged land at the bottom of San Francisco Bay that is within Navy control. Figure 3 shows the HPS parcel boundaries.

2.1.2 Overview of Parcel D-1

Parcel D-1 is located in the southeastern portion of the former Parcel D (Figure 3). Almost all of Parcel D-1 was created by placing fill during World War II. A small portion of the parcel may have been pre-existing land that was significantly graded, during the construction of the parcel.

Parcel D-1 has an average elevation of approximately 9 feet above sea level and approximately 7085 lineal feet of constructed, vertical-walled shoreline that is effectively all ship berth (Naval Civil Engineering Command [CEC], 1949). Approximately two-thirds of the parcel surface is concrete or asphalt. Buildings and compacted gravel-sand fill constitute the remaining parcel surface. The Gun Mole and South Piers extend southeastward into San Francisco Bay and are

located by the South Slip (Naval CEC, 1949). Fourteen ship berths (Berths 10 through 22 and Berth 29) are located along the seaward margin of Parcel D-1 (Naval CEC, 1949; NAVSEA, 2004). These 14 berths (Figure 1) transition below water to Parcel F.

According to the CCSF's redevelopment plan, Parcel D-1 is to be zoned for the industrial and maritime industrial uses. Most of Parcel D-1 was formerly part of the industrial support area and used for shipping, ship repair, and office and commercial activities.

The Gun Mole Pier, and possibly South Pier, were used for berthing contaminated ships, following atomic weapons testing, radioactive waste management activities, and decontamination tests performed by the Navy Radiological Defense Laboratory (NRDL) and other maritime use.

2.1.3 Construction of Parcel D-1

Most of the land of Parcel D-1 was constructed during World War II. Prior to that time all or nearly all of what is now Parcel D-1 lay beneath the San Francisco Bay.

2.1.3.1 Former Shoreline and Filling

Century-old U.S. Coast and Geodetic Survey (CGS) and U.S. Geological Survey historic documents do not agree about whether any portion of what is now Parcel D-1 was supratidal or intertidal land prior to the build-out of the parcel. A 1998 cultural resource assessment (Par Environmental Services, 1998) suggests that a narrow area of Parcel D-1, which was approximately 700 feet long and 100 feet wide along E Street, was above water. However, ENGEO (2009) reproduced and interpreted a 1903 U.S. CGS map to indicate that all of Parcel D-1 was underwater and that a very steep shoreline existed approximately 50 feet northeast of E Street, dropping off quickly to a depth of 3 to 6 fathoms. The Navy and Shaw's provisions for evaluating and protecting cultural and historical resources within Parcel D-1 (D-1 Execution Plan) have assumed that the shoreline lay within Parcel D-1.

The entire surface of Parcel D-1 is fill. The fill is up to 110 feet below existing grade (CGS, 1903; ENGEO, 2009). The fill is significantly shallower north toward E Street and south toward Mahan Street and H Street, where the seastack Shag Rock protruded above the water (CGS, 1903).

2.1.3.2 Construction of Piers and Berths

A detailed construction history of Parcel D-1 is not available. The Gun Mole Pier was constructed from sheet steel cells that were emplaced and filled primarily with sediment materials dredged from San Francisco Bay. The South Pier was constructed of concrete-faced timer cribs and filled (ENGEO, 2009). The origin and placement of fills in the adjacent (land) areas of Parcel D-1 are not known. A more detailed description of the pier and berth construction

is found in Table II-14 of the *Candlestick-Hunters Point Shipyard Draft Environmental Impact Report* (CCSF Planning Department, 2009).

Earthen Materials of Parcel D-1

For the purpose of this D-1 Sewer Work Plan, all of Parcel D-1 is considered semi-engineered earthen fill. The fill may be primarily granular (sand and gravel-sized) that is largely derived from nearby onshore quarry sources during the expansion of HPS. It may locally include debris or sediments dredged from nearby locations. Younger fills are present within Parcel D-1 and are primarily trench bedding and backfill of SD and SS and other underground utility trenches.

The Parcel D-1 earthen fill sometimes contains clasts of the rock serpentinite, derived primarily from nearby highlands during construction of HPS. Serpentinite sometimes contains mineral types in sufficient abundances to constitute naturally-occurring asbestos. Modern regulations concerning asbestos and naturally-occurring asbestos did not exist when HPS was constructed, and the extent, size and abundance of serpentinite clasts within the Parcel D-1 fill are not known.

The thickness of fill within Parcel D-1 is inferred to vary from approximately 12 feet to 110 feet, based upon comparison of elevations on modern map (Shaw, 2010b) and a 1903 U.S. CGS bathymetry map (ENGEO, 2009). The fill placed to construct the parcel in the 1940s was mostly derived from San Francisco Bay and generally placed over Bay Muds; however, near E Street and near Mahan and H Streets, the fill may have been placed against steep, shallow bottoms rising toward the mainland and Shag Stack, respectively (ENGEO, 2009). Several boring logs made near Mahan Street and Hussey Street claim that sands encountered as shallow as 3 feet were part of the (native) Undifferentiated Upper Sand deposits. These deposits typically occur more deeply at HPS and it is unclear if those sands were correctly identified or if the material was fill.

2.1.4 Current Remediation Activities Within Parcel D-1

Radiological Screening of Soils

Some ES materials generated within HPS are radiologically-screened within RSY 2, located within the west-central portion of Parcel D-1 (Figure 1). The yard is operated by TtEC, the HPS Navy basewide radiological contractor. SD and SS removal within the RSY 2 RCA will not be implemented until the RSY has been relocated and the at-grade surface radiologically released.

Groundwater Monitoring

Navy contractor CE2-Kleinfelder administers a program to monitor all groundwater within HPS. Groundwater monitoring wells within Parcel D-1 are included in the monitoring program, and CE2-Kleinfelder periodically accesses the wells. Shaw will be implementing RCAs over nearly all of Parcel D-1and informed CE2-Kleinfelder so that CE2-Kleinfelder may perform its mission effectively and in accordance with Shaw's NRC license requirements, the MOU, and other safety

considerations. Shaw will not remove any groundwater monitoring wells during implementation of this D-1 Sewer Work Plan.

2.2 Hydrology

2.2.1 Groundwater

A general discussion of the groundwater hydrology of Parcel D-1 is not germane, because it was constructed of fills and has no appreciable relief, and the proposed work is shallow earthwork and no groundwater removal is planned. Therefore, following discussion is focused upon Parcel D-1 and the proposed work.

The planned removal action is expected to be accomplished without intersecting groundwater and that with a few excavations the groundwater table or other seeps will be encountered.

Shallowest groundwater in Parcel D-1 is unconfined and classified as part of the HPS A-aquifer (SulTech, 2007). The depth to groundwater within Parcel D-1 reportedly ranges from 6 to 10 feet below ground surface (bgs). The A-aquifer in Parcel D-1 exists primarily within fill materials and is reported to be 10 to 40 feet thick. All the SD and SS excavation and related work proposed in this D-1 Sewer Work Plan is expected to terminate above the water table or within the uppermost feet of the A-aquifer.

The direction of groundwater flow within Parcel D-1 varies and is not significant to the implementation of this D-1 Sewer Work Plan. The hydraulic conductivity of the A-aquifer within the original Parcel D reportedly ranged from 0.025 to 580 feet per day based on data from slug and pumping tests (Sultech, 2007). The wide range of reported hydraulic conductivities indicates that the aquifer consisted of very heterogeneous materials. Parcel D includes areas that are inland from Parcel D-1 and not composed of fill, and so Parcel D discussions of groundwater and aquifer characteristics may not apply to Parcel D-1, which is constructed largely of fill.

Estimated Parcel D groundwater velocities are defined as the average linear velocity at which groundwater moves through the pore spaces in the aquifer. The velocities were calculated using an average hydraulic gradient of 0.001 foot per foot, and an assumed typical A-aquifer effective porosity of 0.25. Average linear velocities in the A-aquifer within original Parcel D ranged from approximately 1.5 to 31 feet per year.

2.2.2 San Francisco Bay Dynamics

The 24-hour tidal range within San Francisco Bay generally ranges from 5 to 8 feet. The highest measured tide at San Francisco Bay has been 8.1 feet above mean low low water.

HPS groundwater close to San Francisco Bay fluctuates vertically in a muted response to tidal fluctuations. The inland extents of tidally-induced fluctuations in groundwater elevation are

reported to be approximately 400 feet in the vicinity of former Buildings 313 and 368 and approximately 250 feet beneath most of Parcel D-1 (SulTech, 2007).

2.3 Environmentally Sensitive Areas

Environmentally sensitive areas are located within and in the vicinity of HPS. Two types of wetland habitat, saline-emergent wetland (coastal salt marsh) and small seasonal freshwater wetland, are found in the several small wetland areas along the undeveloped southern HPS shoreline in Parcel E. These areas provide the greatest ecological diversity of any habitat at HPS. Several small areas of saline-emergent wetland are located within the intertidal zone along the Bay shoreline edges. Plant species observed in these areas during a February 1997 field survey included pickleweed (*Salicornia virginica*), salt grass (*Distichlis spicata*), and cordgrass (*spartina foliosa*).

A small freshwater emergent wetland area, supported by a small intermittent freshwater source, is located on approximately one acre in Installation Restoration (IR) Site 01/21 (IR-01/21). Observed plant species in this wetland include the toad rush (*Juncus* sp.), umbrella sedge (*Cyperus laevigatus*), Pacific Coast bulrush (*Scirpus robustus*), and rabbit's-foot grass (*Polypogon monspeliensis*).

Waterfowl, shorebirds, and wading birds may use wetland habitats as a source of food, cover, and water. The following animal species were observed at HPS during the February 1997 field survey: the common snipe (*Gallinago gallinago*), greater yellowlegs (*Tringa melanoleuca*), killdeer (*Charadrius vociferus*), mallard (*Anas platyrhynchos*), great blue heron (*Ardea herodias*), and great egret (*Casmerodius albus*). The abundance of shorebirds may serve as prey for raptors, such as the endangered peregrine falcon (*Falco peregrinus*). Small animals, such as the raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), and the burrowing owl (*Athene cunicularia*), may forage in or along the edges of wetland habitat. Harbor seals (*Phoca vitulina richardsi)* are known to feed in the waters off HPS. Environmental protections that will be implemented during the radiological removal work are discussed in Section 9.0.

2.4 Land Usage Near HPS

The CCSF Planning Department's *Candlestick-HPS Draft Environmental Impact Report* summarized existing land uses (CCSF Planning Department, 2009). Several CCSF Housing Authority public housing facilities (Hunters Point A-West, E-West, Hunters View, and Westbrook) are located in the immediate vicinity of HPS. These communities form a large housing area, part of which is adjacent to the HPS entrance gate. Other nearby areas include a mixture of light and heavy industries, including automobile recycling, repair shops, and food manufacturers. Retail ventures, including stores and restaurants, are also located within one mile of HPS.

The *Final Design Plan for the Parcel D-1 Sanitary Sewer and Storm Drain Removal* (D-1 Design Plan; Shaw, 2010b) will include an evaluation of the removal action in relation to facilities with sensitive receptors such as schools or day care centers. If these sites are within one mile of the removal action and could be potentially impacted, they will be identified in the design plan.

2.5 Current and Future HPS Usage

For more than 20 years, the Navy has leased many HPS buildings to private tenants and Navy-related entities for industrial and artistic uses, including storage space, art studios, machine workshops, woodworking shops, automobile restoration garages, recreational vehicle parking, and for filming movies.

Non-licensed radioactive material is in use at HPS in thoriated welding rods, building smoke detectors, and radiation survey instrument check sources used by remediation contractors.

Most HPS tenants have been notified that they must leave HPS prior to the start of activities under this D-1 Sewer Work Plan to ensure that operations can be performed safely. Those tenants that will remain at HPS during the SD and SS piping removal actions will be required to temporarily relocate outside of active work areas.

After this removal action and other remedial activities are completed, portions of HPS will be transferred to the CCSF for conversion to non-defense reuse. The CCSF's reuse plan identifies a wide range of planned reuse opportunities across HPS, including residential, commercial, mixed use (residential/commercial), industrial, maritime, and open space.

2.6 Storm Drain and Sanitary Sewer Systems Background

The SD and SS systems have been modified since being built. Designed and built in the 1940s as a combined SD/SS system, it used the same conveyance piping and 40 separate discharge outfalls into San Francisco Bay. This combined system was enlarged in sections from the 1940s to its maximum size in 1958, when it underwent the first in a series of separation projects. The Building 819 pump station was constructed to transport much of the sanitary sewage from HPS to the City of San Francisco treatment works, and separating the systems took place in the industrial areas and the southwest area of HPS. Separating the systems involved installation of dedicated SS collection piping or diversion structures within the combined system. Twenty-eight outfalls to the San Francisco Bay were converted for exclusive use for SD outlets, but 12 continued to serve as combined SD/SS outlets. In 1973, the second segregation project was undertaken. This project removed some of the SD outfalls from the South Basin Area, which is just offshore from the Parcel E shoreline. The last of the separation projects performed in 1976 involved the installation of additional dedicated SS piping. Complete separation of the combined

systems was never achieved. Due to the nature of the separation process, radiological contamination from the same source could have impacted piping of both systems.

2.7 Previous Investigations and Remediations

2.7.1 Chemical Contamination

The Navy completed initial investigation of former Parcel D in 1990 with a Preliminary Assessment (PA). The PA focused on record searches, interviews, and limited field investigations. The PA report concluded that portions of former Parcel D warranted further investigation because of the potential of soil and groundwater contamination. The Navy completed a Remedial Investigation (RI) in 1996. The RI included collection of soil and groundwater data and the hydrogeologic characterization of former Parcel D. The RI was followed by the original Feasibility Study (FS) in 1997, Risk Management Review in 1999, Revised FS in 2007, and Proposed Plan in 2008. Parcel D was subdivided following the completion and publication of most of these studies. Hence, some information in those studies may not apply to Parcel D-1.

The Navy has conducted the following focused removal and cleanup actions within Parcel D:

- 1988: Polychlorinated Biphenyl Transformer Removal – 199 transformers located throughout HPS were removed
- 1991 to 1993: Underground Storage Tanks Removal – 10 underground storage tanks at former Parcel D were removed or closed in place
- 1991 to 1995: Sandblast Grit Cleanup Action – Approximately 90 tons of sandblast grit was removed and recycled from IR Site 44 in former Parcel D
- 1994 to 1996: Pickling and Plate Yard Removal Action at IR Site 09 – The removal action included (1) removing and disposing of pickling sumps, including brick linings; (2) securing the containment vault; (3) removing and disposing of zinc chromate residue; and (4) demolishing and disposing of various structures, including three acid storage aboveground storage tanks, and the plate storage and drying racks
- 1996 to 2001: Removal of more than 2,500 cubic yards of soil from 10 soil excavation areas; removal or closure of fuel and stream piping
- 2004 to present: Routine monitoring of groundwater

Minor contamination may remain within areas of former Parcel D, including Parcel D-1. Industrial activities have resulted in elevated concentrations of polycyclic aromatic hydrocarbons and lead in soil. Elevated concentrations of metals other than lead, such as arsenic and manganese, may be related to the bedrock fill quarried to build HPS in the 1940s. The fill also included construction debris and waste materials (such as sandblast grit) that may have contained

elevated concentrations of select metals. The Navy has worked with the regulatory agencies to identify remedial alternatives that address metals in soil, regardless of their source.

The Navy identified the former Pickling and Plate Yard as the source of elevated concentrations of chromium (VI) and possibly nickel in nearby shallow groundwater. Use of solvents during industrial operations also released volatile organic compounds into groundwater.

This D-1 Sewer Work Plan addresses radiological contamination. Previous radiological evaluations and removals are discussed in the following section.

2.7.2 Radiological Contamination

The Navy identified radiologically-impacted areas, buildings, equipment, and infrastructure at former Parcel D associated with the former use of general radioactive materials and decontamination of ships used, during atomic weapons testing in the South Pacific Operation Crossroads in the HRA (NAVSEA, 2004). Table 1 lists the ROCs for Parcel D-1 and Figure 4 shows the locations of the radiologically-impacted areas. The Navy continues to investigate and clean up radiological contamination at HPS as part of an ongoing time-critical removal action (TCRA). A TCRA is an expedited CERCLA response action with an abbreviated planning period. An AM was prepared to document the decision to undertake a TCRA (Navy, 2006), and the Record of Decision documented the decisions for the final cleanup remedy.

Radiological Evaluation of Storm Drain and Sanitary Sewers

The HRA (NAVSEA, 2004) determined that all SD and SS systems at HPS were potentially radiologically-impacted. This D-1 Sewer Work Plan will guide the implementation of radiological surveying, removal, waste management, and restoration associated with decommissioning and obtaining radiological release of the SD and SS systems within Parcel D-1. It will also guide the removal of SD and SS piping from within radiologically-impacted sites of Parcel D-1 identified by the HRA (NAVSEA, 2004) or CTO 0006 (NAVFAC SW, 2009) (Table 1).

Radiological Survey at Gun Mole Pier

In 2001, Tetra Tech EM, Inc. radiologically surveyed a portion of the Gun Mole Pier in the vicinity of Berth 19. Surface measurements of gamma and beta radiation were obtained to determine whether elevated radioactivity remained. The locations of the sampling points were determined based on the former locations of the concrete test pad and NRDL barge on the pier. A portable detection instrument equipped with a sodium iodide (NaI) scintillation probe was used to measure the gamma levels around the pier. The measurements were made both in a systematic grid pattern and specific locations over drains, surface cracks, and other unusual features. Beta levels were also measured at selected locations using a Geiger-Mueller detector. This investigation indicated that only background radioactivity existed in the areas surveyed.

Final Historical Radiological Assessment

The HRA (NAVSEA, 2004) was conducted to evaluate all previous uses of radioactive materials at HPS and to assess their potential impacts. The HRA designated 84 HPS sites as radiologically impacted. Seven of the sites lay within the area later defined as Parcel D-1: Building 274; Building 313, 313A and 322 Sites; Building 383 area; the NRDL Site on Mahan Street; and the Gun Mole Pier (Figure 4). The HRA also identified all of the ship berths that straddle the boundary of Parcels D-1 and F as radiologically impacted. The basewide SD and SS systems were also identified as radiologically impacted in the HRA (NAVSEA, 2004). An estimated three to four miles of SD and SS piping lie within Parcel D-1 (NAVFAC SW, 2009) and 14 berths adjoin it at the boundary with Parcel F. Radiological survey and remediation for free release of the South Pier was required by the Navy in soliciting and awarding CTO 0006 (NAVFAC SW, 2009). This D-1 Sewer Work Plan addresses only the radiological surveying and remediation of the SD and SS systems within Parcel D-1.

3.0 Regulatory Framework

Environmental investigation and remediation activities are being conducted at HPS under the Department of Defense (DoD) IRP in accordance with CERCLA and Section 300.415(b) of the NCP. Under Executive Order 12580 from the Office of the President of the United States, the Navy is the lead agency responsible for implementation of this removal action. The EPA is the lead regulatory agency. The DTSC and RWQCB will provide state regulatory oversight. The RASO and the California Department of Public Health (CDPH) will provide specialized oversight, because this work involves radiological processes and remediation.

3.1 Regulatory Process

The Navy is directing this removal action under the IRP in accordance with requirements of CERCLA and the NCP. This removal action is being conducted in accordance with the AM (Navy, 2006).

The EPA, DTSC, RWQCB, and the CDPH have all provided input to the Navy. Input is provided through the Base Cleanup Team meetings, as well as through comments to this D-1 Sewer Work Plan. The agencies are responsible for ensuring that the cleanup proceeds according to the substantive requirements of the applicable regulations.

3.2 Removal Action Objectives

The removal action objectives for this removal action are to implement the AM (Navy, 2006) and protect public health and welfare and the environment, which are consistent with the NCP requirements in Title 40 CFR, Part 300.415(b)(2). This removal action requires physically removing and disposing of radioactive contamination that exceed the release criteria presented in Table 2. Most of the radiologically-impacted sites within Parcel D-1 have more ROCs than the sewers (Table 1). The release criteria for the SD and SS systems and the Parcel D-1 radiologically-impacted sites are included in Table 2, because SD and SS piping are present within those sites. SD and SS laterals that drain from those sites may impact the main drainage piping. This D-1 Sewer Work Plan addresses additional ROCs that may be present.

3.3 Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA 1980 (CERCLA, 42 United States Code [USC], Section 9621[d]), as amended, states that remedial actions at CERCLA sites must attain (or the decision document must justify the waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations determined to be legally applicable or relevant and appropriate. Although Section 121 of CERCLA does not itself expressly require that CERCLA removal actions comply with ARARs, the EPA has promulgated a requirement in the NCP

mandating that CERCLA removal actions "shall, to the extent practicable considering the exigencies of the situation, attain ARARs under federal environmental or state environmental or facility siting laws" (Title 40 CFR, Part 300.415[j]). It is Navy policy to follow this requirement. Certain specified waivers may be used for removal actions, as is the case with remedial actions.

The NCP defines applicable requirements as cleanup standards, standards of control, and other substantive environmental protection requirements, criteria or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstances at a CERCLA site (40 CFR 300.5).

The NCP defines relevant and appropriate requirements as cleanup standards, standards of control and other substantive requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that, while not expressly stated as applicable to a hazardous substance, pollutant or contaminant, remedial action, location, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site and are well-suited to the particular site (40 CFR 300.5).

In accordance with the NCP requirements, the ARARs are presented in the AM (Navy, 2006). The chemical-specific, location-specific, and action-specific ARARs presented in the AM (Navy, 2006) and identified as applicable to this removal action are presented as follows:

Chemical-specific ARARs

- Resource Conservation and Recovery Act (RCRA) hazardous waste identification requirements (42 USC, Chapter 82, 6901-6991[I], CCR, Title 22, 66261.21, 66261.22 [a][1], 66261.23, 66261.24[a][1], and 66261.100)
- Standards Applicable to Generators of Hazardous Waste (CCR, Title 22, Division 4.5, Chapter 12, Article 1)

Location-specific ARARs

- Federal Coastal Zone Management Act (16 USC 1451–1464)
- Executive Order No. 11990, Protection of Wetlands
- Clean Water Act of 1977, as amended, Section 404 (33 USC 1344)
- Porter-Cologne Water Quality Control Act, California Water Code Division 7
- San Francisco Bay Water Quality Control Plan (RWQCB, 1995)
- Endangered Species Act of 1973 (16 USC 1531–1543)

Action-specific ARARs

- Requirements under RCRA for disposal of hazardous waste on land (Title 22 CCR 66268.7). This ARAR was originally listed as chemical-specific in the AM (Navy, 2006).

- Storage and Control of Licensed Material (10 CFR Part 20 Subpart I, 20.1801)
- Clean Air Act excavation requirements (42 USC 7401 et seq., Bay Area Air Quality Management District [BAAQMD] Regulations 6-301, 6-302, and 6-305, Regulation 8-40)
- Requirements under RCRA for disposal of hazardous waste on land (Title 22 CCR 66268.7)
- State Water Resources Control Board (SWRCB) Order 99-08 adopted pursuant to Title 40 CFR Part 122, Subpart G
- Federal Hazardous Materials Transportation Law hazardous materials transportation requirements (49 USC 5101-5127, 49 CFR 171.2[g], 172.300-172.304, 17.312, 172.400, 172.504)

Summaries of the potential chemical-specific, location-specific, and action-specific ARARs are included in Tables 3, 4, and 5.

3.4 Release Criteria

The HRA (NAVSEA, 2004) identified ^{226}Ra, ^{137}Cs, and ^{90}Sr as ROCs for the basewide SD and SS systems; and plutonium-239 (^{239}Pu), thorium-232 (^{232}Th), europium-152 (^{152}Eu), and tritium (^{3}H) as ROCs for radiologically-impacted sites in parcel D-1 that contain sewers. Prior radiological investigations have confirmed the presence of ^{226}Ra and ^{137}Cs within portions of the SD and SS systems.

All of the ROCs are listed in Table 1, including the specific locations within Parcel D-1. Release criteria for each ROC are contained in Table 2. If additional radionuclides are encountered, the cleanup goals established in the AM (Navy, 2006) will be adopted. Any remaining contamination at the site will be addressed though the IRP process, consistent with CERCLA and NCP.

4.0 Radiological Control Plan

All general provisions of the D-1 Radiological Work Plan (Shaw, 2010a) shall be applied during implementation of this work. This includes the requirement for work plans, RWPs, and work being conducted under the limitations of Shaw's NRC license when applicable.

4.1 Radiological Health and Safety

The D-1 Execution Plan (Shaw, 2010c) contains the APP/SSHP/RPP and standard operating procedures (SOPs) that will be used to address controls necessary for radiologically-safe operations. A Project SSHO will be present at all active work areas to ensure that work is conducted in a safe manner.

Personnel assigned to site work will be required to understand the requirements and sign a RWP prior to beginning work. The Shaw PRSO will manage implementation of the radiological aspects of work plans. The PRSO will monitor compliance with the RWP. The PRSO or an Authorized User designated by the License RSO will be present during all radiological work activities. NRC license compliance shall be ensured by the PRSO.

Dose rate, contamination, and air monitoring will be performed as necessary. Personal protective equipment (PPE) levels, dictated by radiological considerations and physical and chemical safety issues identified at each work location, will be assigned or modified, according to the approved RWP, APP/SSHP/RPP, and the SSHO in consultation with the PRSO.

Shaw's policy states that radiological work must be performed to maintain exposures as low as reasonably achievable (ALARA). The ALARA concept of radiation protection specifies that exposures to ionizing radiation and releases of radioactive material should be managed to reduce collective doses to workers and the general public ALARA.

The RPP for Parcel D-1 details the training requirements for project personnel, exposure monitoring requirements, and the radiological control procedures for this project.

4.2 Investigation Levels

Investigation levels are specific levels of radioactivity used to indicate when additional investigation may be necessary. Investigation levels also serve as a QC check. For example, in addition to indicating potential contamination, a measurement that exceeds the investigation level may indicate a failing instrument.

When determining an investigation level using a statistical-based parameter (for example, standard deviation), the following may be considered: survey objectives, underlying radionuclide

distributions (for example, normal, log normal, non-parametric), data population descriptors (for example, standard deviation, mean, median), and prior survey and historical information.

When an investigation level is exceeded, the measurement will be confirmed to ensure that the initial measurement/sample actually exceeds the particular investigation level. This process will involve taking further measurements to confirm the initial result, and as appropriate, to quantify the area of elevated residual radioactivity.

4.2.1 Investigation Levels for Gamma Radiation Surveys

For gamma surveys, the investigation level will normally be established at the reference area mean + 3 sigma (σ), where σ is the standard deviation of the gamma readings in the reference area.

4.2.2 Investigation Levels for Alpha and Beta Radiation Surveys

For alpha and beta surveys, the investigation level will be the release criteria or a statistically-based parameter (e.g., reference area mean + 3σ), if used.

4.3 Radiation Detection Instrumentation

Various instruments will be used to detect the radioactive material known or suspected to be present within the SD and SS systems. Instrument calibration, performance checks, and operation shall be done, as applicable, with Shaw SOP(s), governing preparation of portable radiation and contamination survey meters and instruments for field use, and in accordance with any additional instructions specified in the design plans. The instruments selected shall be able to detect the ROCs and, in relation to the survey or analytical technique, be capable of measuring levels sufficient to support the data quality objectives (DQOs) presented in the SAP (Appendix A). Table 6 identifies the instrumentation that may be used for radiological surveys.

Radiation detection instrumentation used during the survey will be maintained and calibrated to operate within manufacturers' specifications so that the required sensitivity and precision will be maintained. Specific calibration and maintenance will be conducted by personnel familiar with the equipment or by manufacturers' technical representatives.

Operational procedures have been developed for all field equipment to verify that the equipment is operating properly and that the data will be valid with instrument-traceable calibrations. These procedures include functional operational checks, routine maintenance, calibration procedures, and operational instructions.

Instrumentation used during the FSS will be field-checked prior to starting work and at the end of the day. All of the instruments are required to be within the $\pm$ 3 σ criteria established when initial performance parameters were determined for each instrument. If an instrument does not

meet the criteria, it will be removed from service and returned to the manufacturer for maintenance.

4.3.1 Instruments for Static and Scan Surveys for Alpha and Beta Activity

Alpha and beta radiation measurements will be performed using either a Ludlum Model 2360 data logger (or equivalent) equipped with either a Ludlum Model 43-68 gas-proportional probe or a Ludlum Model 43-93 zinc sulfide plastic scintillation detector (or equivalent).

4.3.2 Instruments for Static and Scan Surveys for Gamma Activity

Direct measurement and scan surveys for gamma radiation will be performed using a Ludlum Model 2221 (or equivalent) equipped with a Ludlum Model 44-10 2-inch by 2-inch NaI scintillation detector (or equivalent).

4.3.3 Instruments for Direct Measurement Surveys for Beta and Gamma Activity

Direct measurement surveys for beta and gamma radiation will be performed using Ludlum Model 3 (or equivalent) with a Model 44-9 Geiger-Mueller pancake probe (or equivalent). These instruments will be used for routine surveys associated with operational aspects of decommissioning activities such as monitoring personnel and equipment exiting a RCA.

4.3.4 Instrument for Exposure Rate Surveys

Exposure rate surveys are conducted with a Ludlum Model 19 MicroR meter (or equivalent). Compatible with anticipated exposure rates, the instrument is equipped with an internally mounted 1-inch by 1-inch NaI scintillation detector that is integral to the meter housing.

4.4 HPS Navy Radiological Laboratory Instrumentation

Operation of the HPS radiological laboratory is managed by TtEC, the Navy basewide radiological contractor.

Shaw will provide soil samples under chain-of-custody to TtEC. TtEC will test those samples in the on-site radiological laboratory at HPS. On-site laboratory equipment will be used to analyze most radiological samples collected in the field. Table 7 lists the types of measurements and laboratory equipment to be used on site, during survey activities for the SD and SS systems removal action. Chemical analyses of selected alpha, beta, and gamma analyses for QC purposes will be analyzed by TtEC at off-site laboratories in accordance with the SAP (Appendix A).

4.4.1 Quality Assurance Checks

QA checks shall be performed on laboratory instrumentation to ensure proper operation and to maintain calibration. The quality checks shall be documented, reviewed, and maintained. Data trends outside the tolerance limits shall be investigated to determine the cause and potential effect on measurement results.

4.4.2 Gross Alpha and Beta/Gamma Removable Surface Contamination Surveys

Swipe samples will be processed by Shaw, using a Ludlum Model 2929 alpha and beta/gamma radiation counter (or equivalent). Data is reported in units of disintegrations per minute (dpm) per 100 square centimeters (cm; cm^2).

4.4.3 Gamma Spectroscopy

Gamma spectroscopy analysis will be performed, using hardware features that include a high-purity germanium gamma photon detector supported by software. Instrument hardware is calibrated using a multi-energy National Institute of Standards and Technology (NIST)-traceable source ranging from 10 kiloelectron volts (keV) to 2 megaelectron volts (MeV). Data results will be reviewed for QA and reported in units of picocurie per gram (pCi/g). Analysis and review processes will address count integration, efficiency, and background corrections, as well as the processing of overlapping peaks. Gamma spectroscopy focuses on energetic photons emitted from ROCs. A spectral region of interest results around a specified energy range allows for identification and quantification of associated nuclides and daughter products.

4.4.4 ^{90}Sr Analysis

A minimum of 10 percent of samples sent to the on-site laboratory will be randomly chosen for ^{90}Sr analysis by TtEC, the on-site laboratory operator, and shipped to an off-site laboratory. An approved procedure describes a method for separation and superscript measurement of ^{90}Sr in various media through the use of a specialized cation resin. The extraction system in the proprietary specialized resin is 1.0 molar 4,4'(5')-di-*t*-butylcyclohexano 18-crown-6 (crown ether) in 1-octanol. A 40 percent solution is loaded onto an inert chromatographic support. The bed density of strontium resin is approximately 0.35 grams per milliliter. The radioactive ^{90}Sr is separated using the specialized resin prior to gas proportional counting. Small amounts of ^{90}Sr tracer are used to monitor method yields and correct results to improve precision and accuracy.

4.4.5 Alpha Spectroscopy

The Nayv basewide radiological contractor, TtEC, will perform alpha spectroscopy via subcontract at an off-site laboratory.

Alpha-emitting radioisotopes spontaneously produce alpha particles (also known as helium-4 nuclei) at characteristic energies usually between about 3 and 6 MeV. Alpha particles are heavily charged particles. Because they are large and slow, alpha particles readily lose energy in materials. Any physical medium between the alpha-emitting radionuclide and the active portion of the detector will absorb some of the alpha particle's energy.

The alpha particle energies of many isotopes differ by as little as 10 to 20 keV. Because this is near the resolution of the silicon detectors used in alpha spectrometers, such elements must be

chemically separated before analysis. This chemical separation is intended to isolate specific elements in the sample to minimize interferences between multiple alpha-emitting nuclides. To account for the inevitable loss of the sample during separation, a known quantity of a specific isotope or tracer is added to the sample. These NIST-traceable tracers are isotopes of one of the elements under study; i.e., uranium-232 for uranium quantification. Because all isotopes of an element behave alike chemically, the percent of tracer lost in the chemical processes is equal to the percent of sample lost, assuming the tracer is homogeneously mixed with the sample and is brought into chemical equilibrium with the sample.

Samples must be properly mounted on a chromatographic support to obtain the thinnest sample possible, thereby minimizing self-attenuation. After the sample is placed into the chamber and the chamber evacuated, data are acquired from the sample for a preset period of time. Because of the low activities involved, acquisitions are often very long to achieve the desired minimum detectable activity. After data is acquired, analysis software processes the spectrum and quantifies the results for the isotopes of interest.

Analysis can consist of simple count integration and efficiency correction and may also involve extensive background corrections, compensation for various chemical process characteristics, and processing of overlapping peaks. Analysis will be performed by chemical separation, using subcontractor-approved SOPs. An EG&G Ortec® Octête Alpha Spectroscopy system, combined with Alpha-Vision® software will be used. The results of alpha spectroscopy analysis are reported in pCi/g, picocuries per milliliter, or picocuries per liter, depending on the medium analyzed.

4.5 Instrument Equations

The following equations are used to calculate efficiencies, minimum detectable concentrations (MDCs) and minimum detectable count rates (MDCRs). These equations are presented in the D-1 Radiological Work Plan (Shaw, 2010a). The D-1 Radiological Work Plan conforms to a standardized *Multi-Agency Radiation Site Survey Investigation Manual* (MARSSIM)-compliant approach (DoD et al., 2000) for radiological surveys and remediation.

4.5.1 Instrument Efficiency

The instrument efficiency (ε_i) is defined as the ratio between the net count rate, in counts per minute (cpm), of the instrument and the surface emission rate of the calibration source for a specified geometry. The surface emission rate is the 2π particle fluence affected by both the attenuation and backscatter of the radiation emitted from the calibration source.

Equation 7-1 from the D-1 Radiological Work Plan (Shaw, 2010a) will be used to calculate the instrument efficiency in counts per particle. However, efficiency is typically reported as having no units or being unitless.

***Equation 7-1 from the* D-1 Radiological Work Plan (Shaw, 2010a)**

$$\varepsilon_i = \frac{R_{S+B} - R_B}{q_{2\pi}\left(\frac{W_A}{S_A}\right)}$$

Where:

ε_i	=	instrument efficiency (count per particle)
R_{S+B}	=	the gross count rate of the calibration measurement (cpm)
R_B	=	the background count rate in cpm
$q_{2\pi}$	=	surface emission rate of the calibration source (NIST-traceable) (particles per minute [min])
W_A	=	active area of the detector window (cm^2)
S_A	=	area of the source (cm^2)

The instrument efficiency is determined by obtaining static counts with the detector over a calibration source that has a NIST-traceable surface emission rate. The 2π particle fluence rate is corrected for decay, attenuation, and scatter. Then the surface emission rate of the source must be corrected for the area subtended by the probe. Factors that can also affect the instrument's efficiency are discussed as follows:

- Efficiency Check Sources – Efficiency check sources that emit alpha or beta radiation with energies similar to those expected from the contaminant in the field (similar to the expected ROCs) will be selected.
- Source Geometry Factors – Instrument efficiency will usually be determined with an efficiency check source equal to or greater than the area of the probe. If a source that is smaller than the probe is used, a conversion factor is applied to the MDC to account for the active region of the probe.
- Source-to-detector Distance – The detector efficiency will be calculated at a source-to-detector distance the same as the detector-to-surface distance used in the field.

4.5.2 Minimum Detectable Concentration for Static Alpha and Beta Counts

The static MDC is the level of radioactivity practically achievable by the overall measurement process. The conventional equation, Equation 7-7 from the D-1 Radiological Work Plan (Shaw, 2010a), shown below is used to calculate instrument MDC in units of dpm per 100 cm^2:

***Equation 7-7 from the* D-1 Radiological Work Plan (Shaw, 2010a)**

$$MDC = \frac{3 + 4.65\sqrt{R_B T_B}}{\varepsilon_s \varepsilon_i \frac{W_A}{100} T_B}$$

Where:

3+4.65	=	constant factor provided in MARSSIM
R_B	=	background count rate (cpm)
T_B	=	background counting time (min)
ε_i	=	instrument efficiency (count per particle)
ε_s	=	contaminated surface efficiency (particle per disintegration)
W_A	=	active area of the detector window (cm^2)

In Equation 7-7, W_A is the size of the "active" area of the detector window. If the area of the detector window (cm^2) does not equal 100 cm^2, it is necessary to convert the detector response to units of dpm per 100 cm^2.

If the background and sample are counted for different time intervals, Equation 7-8, which is from the D-1 Radiological Work Plan (Shaw, 2010a) is used to calculate the MDC in dpm per 100 cm^2.

***Equation 7-8 from* the D-1 Radiological Work Plan (Shaw, 2010a)**

$$MDC = \frac{3 + 3.29\sqrt{R_B T_{S+B}\left(1 + \frac{T_{S+B}}{T_B}\right)}}{\varepsilon_i \varepsilon_s \frac{W_A}{100\ cm^2} T_{S+B}}$$

Where:

3+3.29	=	constant factor provided in MARSSIM
R_B	=	background count rate (cpm)
T_B	=	background counting time (min)
T_{S+B}	=	sample counting time (min)
ε_i	=	instrument efficiency (count per particle)
ε_s	=	contaminated surface efficiency (particle per disintegration)
W_A	=	active area of the detector window (cm^2)

4.5.3 Surface Efficiency (ε_s) for Surface Activity Measurements

The surface efficiency term in the preceding equations is used to determine the 4π total efficiency for a particular surface and condition. Suitable values are based on the radiation and radiation energy, and are primarily impacted by the backscatter and self-absorption characteristics of the surface on which the contamination exists in the field. Backscatter is most affected by the energy of the radiation and the density of the surface material. Self-absorption characteristics or attenuation are also a function of the radiation's energy and surface condition. In the absence of experimentally determined surface efficiencies, two standards provide conservative recommendations for surface efficiencies. The standards are ISO-7503-1

(International Organization for Standardization [ISO], 1988) and NUREG-1507 (NRC, 1998). ISO-7503-1 recommends a surface efficiency of 0.5 for maximum beta energies exceeding 0.5 MeV and to use a surface efficiency of 0.25 for beta energies between 0.15 and 0.4 MeV and for alpha emitters (ISO, 1988; NRC, 1998). NUREG-1507 provides surface efficiencies based on studies performed for the NRC. In general, NUREG-1507 indicates that the ISO rule-of-thumb for surface efficiencies is conservative, particularly for beta-emitting radionuclides with end-point energies between 0.25 MeV and 0.4 MeV.

At HPS, a surface efficiency of 0.25 will be used for alpha and beta emitters.

4.5.4 Minimum Detectable Count Rate and Minimum Detectable Concentration for Beta and Gamma Scans

The minimum detectable number of net source counts in the scan interval can be arrived at by multiplying the square root of the number of background counts (in the scan interval) by the detectability value associated with the desired performance (as reflected in d') as shown in Equation 7-5, which is from the D-1 Radiological Work Plan (Shaw, 2010a).

***Equation 7-5 from the* D-1 Radiological Work Plan (Shaw, 2010a)**

$$MDCR = d'\sqrt{b_i}\left(\frac{60}{i}\right)$$

Where:

d' = index of sensitivity (alpha [α] and beta [β] errors [performance criteria])
b_i = number of background counts in scan time interval (count)
i = scan or observation interval (s)

The required rate of true positives will be 95 percent, and the false positives will be 60 percent. From Table 6.5 of MARSSIM (DoD et al., 2000), the value of d', representing this performance goal, is 1.38.

The scan MDC is determined from the MDCR by applying conversion factors that account for detector and surface characteristics and surveyor efficiency. As discussed below, the MDCR accounts for the background level, performance criteria (d'), and observation interval. The observation interval during scanning is the actual time that the detector can respond to the contamination source. This interval depends on the scan speed, detector size in the direction of the scan, and area of elevated activity.

The scan MDC for beta surveys of structure surfaces is calculated using Equation 7-6, which is from the D-1 Radiological Work Plan (Shaw, 2010a).

***Equation 7-6 from the* D-1 Radiological Work Plan (Shaw, 2010)**

$$Scan\ MDC = \frac{MDCR}{\sqrt{p}\ \varepsilon_i \varepsilon_s \frac{W_A}{100\ cm^2}}$$

Where:

$MDCR$ is previously discussed
p = surveyor efficiency factor
ε_i = instrument efficiency (count per particle)
ε_s = contaminated surface efficiency (particle per disintegration)
W_A = area of the detector window (cm^2)

4.5.5 MDC for Gamma Scans of Surface Areas (2-inch by 2-inch NaI Probe)

The scan MDC (in pCi/g) for land areas is based on the area of elevated activity, depth of contamination, and the radionuclide (energy and yield of gamma emissions.) To establish the scan MDC, the relationship between the detector's net count rate to net exposure rate must be established first. The relationship is established by determining the MDCR and then applying a surveyor efficiency factor. In this example, the MDCR is calculated using Equation 7-5 with the following values:

d' = 1.38 (from Table 6.5 in MARSSIM)
b_i = 5,510 cpm / (60 seconds per minute/6-second observation) = 551 cpm
i = 6 seconds

Therefore, MDCR equals 324 cpm. Actual MDCR values will be determined for each instrument employed for field activities.

To get the $MDCR_{Surveyor}$, a surveyor efficiency factor p is applied as shown in Equation 7-9, which is from the D-1 Radiological Work Plan (Shaw, 2010a):

Equation 7-9 from the D-1 Radiological Work Plan (Shaw, 2010a)

$$MDCR_{Surveyor} = MDCR / \sqrt{p}$$

The $MDCR_{Surveyor}$ can then be calculated, assuming a surveyor efficiency (p) of 0.7 and the example background count rate of 5,510 cpm and assuming a 6-second scan observation interval as follows:

$$MDCR_{Surveyor} = \frac{MDCR}{\sqrt{p}} = \frac{324}{\sqrt{0.7}} = 387\ cpm$$

The $MDCR_{Surveyor}$ is then converted into the corresponding minimum detectable exposure rate (MDER) by use of a calibration constant specific to the detector being used and the ROC. For example, when used with the Ludlum Model 2221, the calibration records for the Ludlum Model 44-10 2-inch by 2-inch NaI scintillation detector provide a calibration constant that can be used to determine the ratio of cpm to microRoentgen per hour (μR/hr). As shown in Equation 7-10, which is from the D-1 Radiological Work Plan (Shaw, 2010a) a dose rate can be calculated for a given count rate and vice versa.

***Equation 7-10 from the* D-1 Radiological Work Plan (Shaw, 2010a)**

$$MDER\,(\mu R/hr) = \frac{MDCR_{Surveyor} * 6\times10^{7}}{cc}$$

Where:

$MDCR_{Surveyor}$ = 387 cpm (calculated in Equation 7-9)

cc = calibration constant = 5.4×10^{10} counts/R (average)

6×10^{7} = a conversion factor accounting for differences in time and activity units (microRoentgen per minute/Roentgen per hour)

$MDER$ = 0.43 μR/hr

Next, the relationship between the radionuclide concentration and exposure rate is established with modeling. Modeling (using MicroShield™ software [Grove Engineering, 1995-2009]) is used to determine the net exposure rate produced by the radionuclide at a distance above ground. The factors considered in modeling include:

- The dose point of 10 cm (4 inches) above the soil
- The density of material in grams per cubic centimeter (g/cm^3)
- Derived concentration guideline level (DCGL) of the ROC in pCi/g
- The depth of detection for the DCGL
- The circular dimension of the cylindrical area of detector capability (square meters [m; m^2])

The concentration of the ROC (Scan MDC) necessary to yield the MDER may be calculated by taking the ratio of the MDER to the exposure rate calculated by MicroShield™ (Grove Engineering, 1995-2009) as shown in Equation 7-10 using the following input parameters:

- The dose point of 4 inches above the soil was used.
- The density of 1.6 g/cm^3 was used for soil.

- The ^{226}Ra concentration of 1.0 pCi/g was used.
- The depth of the area of elevated activity was 15 cm.
- The circular dimension of the cylindrical area of elevated activity was 0.25 m^2.

MicroShield™ software (Grove Engineering, 1995-2009) calculates the exposure rate to be 0.7384 μR/hr for ^{226}Ra (which accounts for buildup). The radionuclide concentration of ^{226}Ra (scan MDC) necessary to yield the MDER calculated in Equation 7-10 (0.43 μR/hr) may be calculated by taking the ratio of the MDER to the exposure rate calculated by MicroShield™ software, as shown in Equation 7-11, which comes from the D-1 Radiological Work Plan (Shaw, 2010a).

***Equation 7-11 from the* D-1 Radiological Work Plan (Shaw, 2010a)**

$$Scan\ MDC(pCi/g) = \frac{DCGL\ pCi/g * MDER\mu R/hr}{Microshield\ Exposure\ Rate\mu R/hr} = 0.58\ pCi/g$$

Where:

DCGL = 1.0 pCi/g (from Table 3-1)

MDER = 0.43 μR/hr (from Equation 7-10 from the D-1 Radiological Work Plan (Shaw, 2010a)

MicroShield Exposure Rate = 0.7384 μR/hr

Microshield™ Version 5.05 calculates the exposure rate to be 0.0295 μR/hr for ^{137}Cs (which accounts for buildup). The radionuclide concentration of ^{137}Cs (scan MDC) necessary to yield the MDER calculated in Equation 7-10 (0.43 μR/hr) may be calculated by taking the ratio of the MDER to the exposure rate calculated by Microshield™, as shown in Equation 7-11 from the D-1 Radiological Work Plan (Shaw, 2010a). Values presented here are examples and actual values will be determined specific to each instrument used to support field work activities.

***Equation 7-11 from the* D-1 Radiological Work Plan (Shaw, 2010a)**

$$Scan\ MDC(pCi/g) = \frac{DCGL\ pCi/g * MDER\mu R/hr}{Microshield\ Exposure\ Rate\mu R/hr} = 1.647\ pCi/g$$

Where:

DCGL = 0.113 pCi/g (from Table 3-1)

MDER = 0.43 μR/hr (from Equation 7-10 from the D-1 Radiological Work Plan (Shaw, 2010a)

Microshield Exposure Rate = 0.0295 μR/hr

4.5.6 MDC for Static Gamma Measurements

For gamma surveys, MDC is calculated in cpm. Equation 7-12 from the D-1 Radiological Work Plan (Shaw, 2010a) is used to calculate the MDC.

***Equation 7-12 from the* D-1 Radiological Work Plan (Shaw, 2010a)**

$$MDC = \frac{3 + 4.65\sqrt{R_B T_B}}{T_B}$$

Where:

3+4.65	=	constant factor provided in MARSSIM
R_B	=	background count rate (cpm)
T_B	=	background counting time (min)

The inputs observed in the reference area will be used in Equation 7-12 to calculate the MDC for the Ludlum Model 2221-1 for ^{226}Ra and ^{137}Cs.

4.6 Survey Implementation

Radiological control procedures will be implemented to support remediation activities for the SD and SS systems. These procedures are intended to protect the health and safety of project personnel and the general public, to comply with the NRC license requirements under which the work is to be performed, and to comply with ALARA principles. Shaw SOPs provide specific direction for instrument calibration and the collection of survey data. The following subsections describe the survey procedures that will be performed during implementation of this D-1 Sewer Work Plan.

4.6.1 Reference (Background) Areas

An average background level will be determined by performing a minimum of 18 measurements at systematic or random locations within a designated background area. The detector probe will be held approximately 10 cm (4 inches) from the surface area for gamma and 0.6 cm (0.25 inch) from the surface area for alpha/beta radiation. Instrumentation will be allowed to stabilize before background readings are taken. The average of the readings taken will determine the background for each energy emission. Background exposure rates will also be collected for reference data. Some solid samples will need to be collected in the background area for comparative analyses of post-excavation sample analyses. The same survey methodology and instruments used to collect the background data will be used to perform measurements within survey units.

Data collected in reference areas will be statistically evaluated using a graphical format, such as a frequency distribution chart. The purpose of the evaluation is to ensure that the data collected in the reference area are consistent with a normal distribution and that the variability of the background is not too high.

4.6.2 Scan Surveys

Scan surveys are an evaluation technique performed by moving a detection device over a surface at a specified speed and distance above the surface to detect radiation. The device will be used to identify areas that may require additional survey measurements.

TtEC will perform scan surveys for gamma radiation ES on the RSY pads.

Scans of removed SD and SS piping and trench sidewalls and bottoms will be performed as described in the following subsections.

4.6.2.1 Scan Surveys for Alpha/Beta Radiation

Surface scan surveys for alpha and beta radiation will be performed by moving the detector over the surface being surveyed at a rate of approximately 2.5 cm (1 inch) per second. The detector will be held approximately 0.6 cm (0.25 inch) above the surface being surveyed.

4.6.2.2 Scan Surveys for Gamma Radiation

Surface scan surveys for gamma radiation will be performed by traversing a path at a maximum speed (scan rate) of approximately 0.08 meter per second, while maintaining the detector approximately 10 cm (4 inches) above the area being surveyed.

4.6.3 Static Surveys

Static surveys are used to determine contamination levels on surface areas. The surveys are an evaluation technique performed by holding a detection device over a surface for a specified time at a set distance to detect radiation.

4.6.3.1 Static Surveys for Alpha/Beta Radiation

Static alpha/beta measurements will be conducted with the detector approximately 0.6 cm (0.25 inch) above the surface. Count time for conducting the measurement is dependent upon the isotope of concern. When the alpha/beta static measurements are used to release equipment and materials, a 2-minute count time will be sufficient to measure the appropriate release criteria.

Materials that will be surveyed for alpha and beta contamination will be done so as to determine the disposition of the material. In such cases, the Atomic Energy Commission's (AEC, 1974) *Regulatory Guide 1.86* limits (identified in Table 8) will be used.

4.6.3.2 Static Surveys for Gamma Radiation

Static gamma measurements require positioning the detector assembly approximately 10 cm (4 inches) above the surface and completing a stationary 60-second survey.

4.6.4 Exposure Rate Measurements

Exposure rate surveys will be performed to measure ambient gamma radiation levels. Exposure rate measurements are obtained by holding the detection device approximately 1 meter from the surface being surveyed. Instrumentation will be allowed to stabilize for approximately 30 seconds before taking the measurement.

4.6.5 Swipe Sample Measurements

Shaw will perform wipe sampling to assess the presence of radioactive contamination readily removed from a surface. Swipe samples will be used to evaluate the presence of alpha and beta/gamma surface activity.

4.6.6 Equipment and Material Surveys

Equipment and material surveys will be performed, following the methods in Shaw SOP T-RA-002. Table 8 provides acceptable levels of contamination based on the *Regulatory Guide 1.86* limits (AEC, 1974). In the event that survey results indicate that levels of contamination exceed the limits listed in Table 8, appropriate decontamination methods may be performed to minimize waste. If decontamination methods are unsuccessful, the material will be disposed of as radioactive waste.

Before being put into service or leaving a radiological work area, equipment and/or materials will be surveyed in an area of low-background concentrations to ensure that the equipment and materials release criteria are not exceeded. New equipment that has not been used elsewhere and new materials in original packaging are exempt from the survey requirement prior to use on site.

Equipment and/or materials being put into service in a radiological work area at HPS that exceed the release criteria will be returned to the supplier for replacement or decontamination. Equipment and/or materials that do not meet the release criteria will be decontaminated before leaving the radiological work area or stored for disposal.

4.6.7 Personnel Surveys

Properly trained staff will self-perform personnel surveys in a pre-designated, low-background area, before leaving a RCA as specified in the RWP or when deemed necessary by the RCS. Personnel not qualified to administer a self-survey will be monitored by a qualified technician.

4.6.8 Media Sampling

Various samples may be collected for radiological analysis, including soil, sediment, and water. The SAP (Appendix A) describes the methods for collecting samples, sample numbering, sample labeling, sample shipment, and completion of the associated chain-of-custody and other required documentation. Media samples for gamma spectroscopy and removable surface contamination will be analyzed on site using instrumentation described in Sections 7.3.3 and 7.3.2, respectively, and Table 7 of the D-1 Radiological Work Plan (Shaw, 2010a). Samples for gross alpha and beta analysis will be analyzed on-site by Shaw. In addition, 10 percent of the media samples analyzed by the on-site laboratory for gamma spectroscopy will also be analyzed at an off-site laboratory, as described in the SAP.

4.6.9 Air Sampling

As specified in the D-1 Radiological Work Plan (Shaw, 2010a), airborne activity monitoring (continuous or grab samples) will be used during the course of work. Monitoring and trending for airborne radioactive material will be performed as necessary to control occupational exposures, establish PPE, and determine respiratory protection requirements. Engineered controls, with concurrence from the RASO, will be implemented if required to maintain airborne concentrations below 10 percent of the applicable derived airborne concentration value for the ROCs (Table 9). At a minimum, air sampling for radionuclides will be performed upwind, downwind, and at the excavation location.

4.7 Sampling Protocol

In support of this D-1 Sewer Work Plan, numerous SD and SS trench soil samples will be collected and tested to determine their radionuclide concentrations. Direct surface radiation measurements will be performed at each sample collection location before initiating sampling to identify any presence of gross contamination. If elevated radiation levels are present, samples and equipment will be treated as radioactive and handled accordingly. The SAP (Appendix A) provides a more detailed discussion of the sampling and analysis procedures for the scope of this work. Section 7.0 of this D-1 Sewer Work Plan also discusses the various types and quantities of samples that will be collected during the performance of this work.

4.8 Post-Work Area Surveillance

At the conclusion of each workday, the assigned radiological control technicians (RCTs) will complete necessary paperwork associated with the daily radiological surveys. Air samples will be collected and analyzed to ensure that exposure to radioactive particulates is maintained below the designated levels.

4.9 Decontamination Procedures

Shaw Radiological SOPs, (D-1 Radiological Work Plan [Shaw, 2010a]) will be followed in decontaminating equipment and materials. Equipment or materials that cannot be easily or cost-effectively decontaminated will be evaluated for possible limited use in radioactive material use areas, or disposed of as radioactive waste. Decontamination water will be collected and sampled before it is disposed properly.

5.0 Final Status Surveys

The MARSSIM (DoD et al., 2000), the *Nonparametric Statistical Methodology for the Design and Analysis of the Final Status Decommissioning Survey Guide* (NUREG-1505; NRC, 1998), and the *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions Guide* (NRC, 1998 and 1998) were used as guidance in designing the FSSs. Sample methods, field QC requirements, analytical methods, laboratory QC requirements, and sample quantities are provided in the SAP (Appendix A).

5.1 Objective of the Final Status Survey

MARSSIM (DoD, et al., 2000), NUREG-1505 (NRC, 1998), and NUREG-1507 (NRC, 1998) were used as guidance documents in the design of this D-1 Sewer Work Plan. The objective of the FSS is to demonstrate that identified residual radioactivity levels inside the excavated trench and ES to be used as backfill meet the release criterion. In demonstrating that this objective is met, the null hypothesis is tested for residual contamination that exceeds the release criterion; the alternative hypothesis is then tested for residual contamination that meets the release criterion.

5.2 Survey Grids

A reference coordinate system will be laid out for each survey unit. A triangular grid system will be used for the ES and the trenches. The length, L, of a side of the square grid is determined by the total number of samples or measurements to be taken. The length of the square will determine the distance between survey data points. The length or sample spacing of the grids will be calculated for each of the survey units using Equation 4-2 from the D-1 Radiological Work Plan (Shaw, 2010a)

***Equation 4-2 from the* D-1 Radiological Work Plan (Shaw, 2010a)**

$$L = \sqrt{\frac{A}{0.866 * N}}$$

Where:

L	=	length of sample spacing (m)
A	=	surface area of the survey unit (m^2)
0.866	=	constant factor from MARSSIM
N	=	statistically calculated number of samples

5.3 Survey Units

Initial surveys will consist of two different types of survey units: trench units and ES units. The combination of the trench unit and the associated ES units used for backfill will compose a single

survey unit. Each ES unit and trench unit must stand up to individual scrutiny as a single survey unit. The concentrations of radioactive material in each of the survey units are not expected to vary significantly from one survey unit to the other. Although the size of each survey unit may vary, each will receive the same survey and sampling frequency coverage.

5.3.1 Trench Survey Units

Trench survey units will encompass an excavated trench section not to exceed 1,000 m^2 in excavation surface area (walls and bottom of trench). Each excavated trench survey unit will undergo a 100 percent scan survey for gamma radiation. A minimum of 18 discrete surveillance points will be spaced, using the triangular grid pattern per Equation 4-2 from the D-1 Radiological Work Plan (Shaw, 2010a) and the most current version of Visual Sampling Plan (VSP) software.

5.3.2 Excavated Soil Survey Units

ES survey units will be comprised of up to 1,000 m^2 of surface area or 100 linear feet of excavated trench soils spread out in lifts not to exceed 6 inches in height. Each ES survey unit will undergo a 100 percent scan survey for gamma radiation. A minimum of 18 discrete surveillance points will be spaced using the triangular grid pattern in Equation 4-2 from the D-1 Radiological Work Plan (Shaw, 2010a), using the most current version of VSP software. The TtEC RSY operator will perform these activities.

5.4 Survey Unit Classification

The classification of areas for the FSS is a critical step in the survey design process so that each site area receives adequate survey coverage. The working hypothesis of MARSSIM (DoD, et al., 2000) is that all impacted areas being evaluated for release have a potential for radioactive contamination above the DCGL. This initial assumption means that all areas are initially considered Class 1 areas, unless some basis for reclassification as non-impacted, Class 3, or Class 2 is provided. Class 1 areas have the greatest potential for contamination, and therefore receive the highest degree of survey effort, followed by Class 2 and then Class 3 areas.

The survey units will be limited in size based on classification and site-specific conditions. MARSSIM (DoD et al., 2000) recommends areas for survey units according to the following:

Classification	Suggested Area
Class 1 Land Areas	up to 2,000 m^2

The limitation on survey unit size ensures that each area is assigned an adequate number of data points.

5.5 Data Quality Objectives

The DQO process is a series of planning steps for establishing criteria for data quality and survey design development. The level of planning will be based on the complexity of the areas to be surveyed.

5.5.1 State the Problem

It must be determined if the site-specific release guideline has been met or if remediation is warranted. Therefore, the decision to be made can be stated as, "Do the survey results meet the soil release criteria for the radionuclides of concern?"

It is anticipated that successful completion of activities described in this D-1 Sewer Work Plan will provide sufficient data for the unrestricted release of the SD and SS trenches and ES. Resources available to provide the necessary data include the following:

- Activities outlined in this D-1 Sewer Work Plan
- MARSSIM guidance (DoD et al., 2000) for ensuring statistically valid data
- Trained and experienced workers

5.5.2 Identify the Decision

The need to provide data for the unrestricted release of the SD and SS trenches and ES requires performing radiological surveys and sampling as specified in this D-1 Sewer Work Plan.

The primary uses of the data expected to result from completion of this D-1 Sewer Work Plan is to provide information and statistical verification of data obtained to support the unrestricted release of the SD and SS trenches and ES.

5.5.3 Inputs to the Decision

Radiological surveys supporting the unrestricted release of the SD and SS trenches and ES will include:

- 100 percent gamma scan surveys of each of the survey units with 2-inch by 2-inch NaI detectors or equivalent – results less than background $+3\sigma$ levels are considered acceptable
- Systematic soil sampling of the Class 1 survey units – results below the release criteria for soil contamination are considered acceptable
- Statistical analysis of collected radiological data

5.5.4 Definition of Study Boundaries

The spatial boundaries for this FSS effort are confined to the radiologically-impacted SD and SS systems. Each survey unit will be 100-percent gamma-scan surveyed. Solid samples will be collected from systematic locations in each of the survey units.

5.5.5 Development of a Decision Rule

5.5.5.1 Release Criteria

The release criteria for this survey are listed in Table 2.

5.5.5.2 Alternative Actions

Readings greater than the mean background $+3\sigma$ or sample results that exceed the release limits will be further investigated to identify the extent of the contamination.

5.5.6 Limits on Decision Errors

Actions to minimize errors will be instituted during the data collection phase of the radiological survey. Qualified radiation survey personnel will perform the survey and record the data. Automated recording of survey data will be used where possible to minimize errors. Data transcribing is the second phase where errors may arise. To avoid data errors for manual surveys, experienced personnel will record and transcribe data.

The ongoing on-site analyses and evaluation of survey results provides a final check for errors, which if detected, can be corrected.

A knowledgeable individual who is not involved in the direct data collection process (the RCS or a designated senior RCT) will review the survey data on a daily basis. This ongoing independent review will ensure consistency of all survey data collected.

There are two types of decision errors that can be made when performing the statistical tests described in this D-1 Sewer Work Plan. The first type of decision error, called a Type I error, occurs when the null hypothesis is rejected when it is actually true. A Type I error is sometimes called a "false positive." The probability of a Type I error is usually denoted by α. The Type I error rate is often referred to as the significance level or size of the test.

The second type of decision error, called a Type II error, occurs when the null hypothesis is not rejected when it is actually false. A Type II error is sometimes called a "false negative." The probability of a Type II error is usually denoted by β . The power of a statistical test is defined as the probability of rejecting the null hypotheses when it is false. It is numerically equal to $1-\beta$, where β is the Type II error rate.

This FSS is designed to limit Type I and Type II errors to 5 percent. It is important to minimize the chances that area grids exceeding the release limits will be missed (Type I Error) and area grids meeting the release limits will be rejected as too high (Type II Error). The probability of either of these occurring will be set at a maximum of 5 percent. However, in the event that double sampling is used, the Type I error will be set at a maximum of 2.5 percent, as discussed in Section 5.5.6.1.

In demonstrating that this objective is met, the null hypothesis will be tested to see if residual contamination exceeds the release criterion; the alternative hypothesis (H_a) is then tested that residual contamination meets the release criterion.

5.5.6.1 Double Sampling

When determined to be appropriate, and when the retrospective power of the test, using the first set of samples does not meet the design objectives, double sampling may be used with the concurrence of the PRSO. Double sampling will be avoided by proper survey design, and only used when determined to be absolutely necessary. The procedure is discussed in Appendix C of NUREG-1757 Volume 2 (DoD et al., 2000) as follows:

> Such allowance for double sampling should be specifically mentioned in preparing the DQOs and in advance of any sampling and analysis. During the DQO process, double sampling could be considered as an option when setting the Type I error rates. Double sampling should not be used as a substitute for adequate planning. If it is to be allowed, this should be agreed upon with NRC staff, and DTSC and EPA for HPS as part of the DQO process. The procedure for double sampling, i.e., the size of the second set of samples, should be specified, recognizing that the Type I error rate could be up to twice that specified for the Sign test when only one set of samples is taken. Similar considerations apply for the Wilcoxon Rank Sum (WRS) test; however, the calculation of the exact effect on the Type I error rate is considerably more complex.

The difference between the number of samples collected and the amount of samples required (when using the updated Type I error rate in calculations) will be doubled, and these additional samples will be collected randomly and added to initial sample data. The Type I error rate for such events will be revised and limited to a maximum of 2.5 percent.

5.5.7 Optimizing Data Collection

5.5.7.1 Review Outputs and Existing Data for Consistency

Radioactive source readings will be used to check instruments for consistency prior to use in each daily shift. The instrument will only be used after readings are compared and agree within ± 20 percent or ± 3σ (as applicable) of predetermined responses. The on-site RCS will review the information each day to verify that equipment is operating satisfactorily.

A knowledgeable individual not involved in the direct data collection process will review the FSS data on a daily basis. This ongoing independent review will ensure consistency of all survey data collected.

5.5.7.2 Develop Data Collection Design Alternatives

The MARSSIM guidelines (DoD et al., 2000) will be used and a 95 percent confidence level for detecting radioactivity above the release levels will be assumed with Type I and Type II errors limited to 5 percent.

5.5.7.3 Data Collection Design Alternatives

The data collection design alternatives may change slightly if assumptions are revised based on conditions in the field being different than the furnished information derived from historical research and current knowledge of the survey unit.

5.5.7.4 Select Most Resource-Effective Survey Design

As previously discussed, the survey design specified for use in this D-1 Sewer Work Plan was developed to perform radiological FSSs. Combined with the use of qualified and experienced personnel, this design is considered to be both efficient and resource-effective.

5.5.7.5 Document Operational Details and Theoretical Assumptions

Operational details for the radiological survey process have been developed for and are included as part of this D-1 Sewer Work Plan. The theoretical assumptions are based on guidelines contained in MARSSIM (DoD et al., 2000). Specific assumptions regarding types of radiation measurements, instrument detection capabilities, quantities and locations of data to be collected, and investigation levels are contained in this D-1 Sewer Work Plan.

5.6 Statistical Tests

Regulatory guidance, as identified in MARSSIM (DoD et al., 2000), recommends use of the WRS test to conservatively evaluate surveillance results that will be obtained from this FSS.

5.6.1 Determining the Numbers of Data Points for the WRS Test

Because the ROCs are present in background, N is calculated in the manner specified for the WRS test, according to Equation 5-2 from the D-1 Radiological Work Plan (Shaw, 2010a).

***Equation 5-2 from the* D-1 Radiological Work Plan (Shaw, 2010a)**

$$N = \frac{\left(Z_{1-\alpha} + Z_{1-\beta}\right)^2}{3\left(P_r - 0.5\right)^2}(1.2)$$

Where:

$Z_{1-\alpha}$ = 1.645 Type I decision error level (or 1.960 if double sampling is used)
$Z_{1-\beta}$ = 1.645 Type II decision level
P_r = 0.997658 random measurement probability (from Table 5.1 in MARSSIM [DoD et al., 2000])
(1.2) = 20 percent increase in number of samples over the minimum

The variable used to calculate N not already specified in the D-1 Radiological Work Plan (Shaw, 2010a) is the random measurement probability P_r. P_r in Equation 5-1 from the D-1 Radiological Work Plan (Shaw, 2010a) is based on the relative shift. The relative shift is equal to Δ/σ, where Δ is equal to DCGL-lower boundary of the gray region (LBGR) and σ is an estimate of the standard deviation of the measured values in a survey unit. The LBGR is the net median concentration of the contaminant in the survey unit. When this value is unknown, MARSSIM (DoD et al., 2000) suggests using a value for the LBGR of half the DCGL, which was used. Likewise, σ was assigned the value of the standard deviation of the measurement values in the reference area.

The values used for these parameters to determine an example P_r were 332 cpm (half of the DCGL) for Δ and 74.2 cpm for σ. The value for Δ was derived by converting the DCGL from pCi/g to cpm and dividing by 2. To perform this conversion, an arbitrary concentration of ^{226}Ra is divided by the associated exposure rate produced by this concentration of ^{226}Ra (as identified in Section 7.2.8 of the D-1 Radiological Work Plan [Shaw, 2010a]). The resulting number is then divided by the average net cpm per µR/hr for the detector. Once this number is derived, the release criteria of 1.0 pCi/g for ^{226}Ra is divided by this number, as shown in Equation 6-9 of the D-1 Radiological Work Plan (Shaw, 2010a):

***Equation 6-9 from the* D-1 Radiological Work Plan (Shaw, 2010a)**

$$665 = \frac{1.0}{1/0.7384 * 1/900}$$

Where:

1.0 = release criteria (pCi/g)
1 = arbitrary concentration of ^{226}Ra (pCi/g)
0.7384 = exposure rate for 1 pCi/g ^{226}Ra calculated by Microshield™
900 = counts per minute per µR/hr for the detector

The value for σ is based on the standard deviation from the background samples collected at the site. Using Equation 5-2 from the D-1 Radiological Work Plan (Shaw, 2010a), N is calculated as 9 samples for this example. Actual sample quantities will be determined using data specific for the actual instrument deployed in the field.

5.6.2 Determining Data Points for Small Areas of Elevated Activity

The statistical test previously described evaluates whether or not the residual radioactivity in an area exceeds the DCGL for contamination conditions approximately uniform across the survey unit. To obtain reasonable assurance that any small areas of elevated residual radioactivity are not missed during the FSS, the total number of samples is increased. Equation 4-2 from the D-1 Radiological Work Plan (Shaw, 2010a) will be used to determine the number of samples. The required number of samples, n_{EA}, was developed for an elevated area based on a survey unit size of 1,000 m^2 and a triangular spacing of L equal to 8 m. Substituting these values into Equation 4-2 from the D-1 Radiological Work Plan (Shaw, 2010a), n_{EA} is calculated to be 18.

***Equation 4-2 from the* D-1 Radiological Work Plan (Shaw, 2010a)**

$$L = \sqrt{\frac{A}{0.866\, n_{EA}}}$$

Where:

L = length of sample spacing (8 m)

A = surface area of the survey unit (1,000 m^2)

n_{EA} = statistically calculated number of samples

6.0 System Description

6.1 Background

Until 1958, HPS had a combined SD and SS system. In 1958, the first of three separation projects was completed. The last of these projects was completed in 1976. These separation projects installed dedicated SS piping, including pump stations that discharged SS effluent off site to the San Francisco treatment plant. In spite of these separation projects, inspections of the systems indicate that some cross-connection of the two systems still exists.

All piping of the SD and SS systems in Parcels B, C, D, E, and E-2 were identified as radiologically impacted (NAVSEA, 2004). This was supported by the following rationale:

- The nature of the original combined SD/SS system design
- The potential existence of cross-connections
- The uncertainty that radiological contamination from sources within impacted buildings and/or areas may have affected the new SS piping after the separation had been completed
- Identification of radioactive contamination in SD and SS piping, during previous radiological investigations

The HRA (NAVSEA, 2004) identifies three ROCs for the SD and SS systems at HPS: ^{137}Cs, ^{226}Ra and ^{90}Sr. Shaw's implementation of this D-1 Sewer Work Plan will include removal of all SD and SS piping from within radiologically-impacted sites under this plan. Within the radiologically-impacted sites, the SD and SS removal will also consider any additional ROCs specific to those sites. Table 1 cross-lists the features of work for this D-1 Sewer Work Plan and the ROCs indicated by the HRA (NAVSEA, 2004).

Navy-provided utility sheets indicate there are an estimated 3 to 4 total miles of SD and SS piping within Parcel D-1.

6.2 Types, Sizes, and Designations of System

Utility drawings in the design plan identify type of piping (SD or SS), diameter, and type of material. Manholes, drop inlets, lift stations and clean-outs are also shown. Approximately one-third of the SD and SS piping has unknown diameter and/or material/constructions. The descriptions may not accurately represent as-built or current conditions. Actual conditions will be verified in the field as the removal is performed.

6.2.1 Storm Drain System

Figure 1 illustrates the known SD routing. Typically, the major conveyance piping run under streets and diameter increases as the drainage area increases in size. This system starts as small as 6 inches and increases to 42 inches or larger. The parcel-specific design drawings (Shaw, 2010b) illustrate the existing system routing and piping size from the historical data available.

Secondary collection systems occur through much of Parcel D-1 and vary from 4 to 12 inch diameters. The secondary systems connect with the major conveyance piping or directly to outfalls.

Where information is available, the SD system is indicated to be constructed of VCP, cast iron pipe, and corrugated metal pipe. Similar materials are likely present in portions of the SD system where information is not available.

6.2.2 Sanitary Sewer System

Figure 1 illustrates the known SS routing. Typically, the major conveyance piping run under streets and have diameters from 2 inches to 33 inches. Secondary SS piping drain or connect buildings and other features to major conveyance piping and may be as small as 2 inches diameter.

Where information is available, the SS system is indicated to be primarily concrete, VCP, and concrete inverted pipe; however, other piping types may also be present.

7.0 Field Implementation

This section describes the specific activities and procedures involved in preparing and removing existing SD and SS piping within Parcel D-1 of HPS. It will include restoration of the disturbed areas to a stable, safe condition including matching to grade changes that are expected to be made along the boundary between Parcels G and D-1, to control storm water runoff. The planned activities include:

- Permitting and notifications
- Mobilization and establishing radiological controls
- Preparatory activities and meetings
- Environmental resources surveying
- Clearing vegetation
- Initial geophysical surveying
- Topographic surveying
- Mobilization
- Traffic Control Plan implementation
- Removal of surface pavements
- Excavation of soil materials
- Removal of SD and SS piping
- Storm water, sediment, and erosion control
- Radiological surveys and sampling
- FSSs
- Backfill placement and compaction
- Limited grading for control of storm water runoff
- Site restoration for storm water runoff control
- Free-release survey and decontamination of equipment
- Waste classification, storage, and disposal
- Demobilization

7.1 Permitting and Notification

There are no permit requirements for cleanup operations conducted at HPS per the CERCLA exemption. Shaw will obtain any other necessary authorizations for completing the work from the HPS CSO.

Shaw will maintain a current annual excavation permit from Cal-DOSH. The required five-day notification will be provided before excavation begins. Invasive work will be preceded by notification to Underground Service Alert (USA) (1-800-227-2600). All excavations will be conducted in accordance with CCR Title 8, Sections 1539–1543, and 29 CFR, Parts 1910 and

1926 requirements. A competent person will conduct daily inspections of trenches and any other excavations to assess slope stability and authorize personnel to work in and near the trenches.

The Navy has a general permit for storm water discharges at HPS. The removal of the Parcel D-1 SD and SS network will not materially change the existing drainage flows and will not alter the outfalls at HPS. The Navy will notify the RWQCB in advance of any changes to the system that will result in new outfalls being installed. Other changes to the storm water system will be noted via updates to the Navy's storm water discharge reporting and permitting.

7.2 Preparatory Activities and Meetings

7.2.1 Pre-construction Meeting

A pre-construction meeting will be held at the site. The meeting will include Shaw personnel (PM, Construction Manager, SSHO, PRSO and PQCM) and Navy representatives (RASO, RPM, CSO, and ROICC). The purpose of the meeting will be to develop a shared vision of the planned work and specifically:

- Coordination between Shaw, Navy, CCSF, TtEC, EMS, and other parties
- Safety and health requirements, including physical safety, dust control, traffic controls, and radiological controls
- Review of roles of Shaw, TtEC, and EMS under the RASO-approved MOU
- Storm water controls and protection of San Francisco Bay and other environmental resources
- QC requirements and submittals
- Mark-out of known utilities, notification of USA, reviews of utility plans, and walk work areas for indications of additional or unmarked underground utilities, structures, or hazards
- Removal and management of pavement
- Excavation of soils and removals of all SD and SS piping
- Radiological surveys and sampling performed by Shaw
- Handling of wastes within Shaw RCAs within Parcel D-1
- Conveyance of excavated soils to TtEC-operated HPS RSYs for radiological screening and sampling
- Data coordination and tracking of excavated soils between Shaw, TtEC, and EMS
- Radiological screening and waste classification of all removed SS piping

- Transfer of radioactive and released SS piping to EMS, and Innovative Technical Solutions, Inc. (ITSI), the Navy basewide radiological and non-radiological waste disposal contractors, respectively
- Re-use of some screened pavement and soil materials as backfill or surface materials within Parcel D-1
- Installation of storm water drainage

Navy site-specific protocol, as applicable to this work, will also be discussed. Minutes of the meeting will be prepared by Shaw and submitted to the Navy RPM.

7.2.2 Design Plan

The D-1 Design Plan (Shaw, 2010b) will include drawings and specifications for the removal of the existing SD and SS systems, backfilling of excavations, and restoration of a storm water surface drainage system. The design plan addresses:

- Specific layouts of work areas
- Limits of excavations
- Infiltration control during outfall removal and/or replacement (none expected)
- Specifications for replacement piping (none expected)
- Backfilling standards
- Completion of grading and restoration
- Construction schedule

7.3 Environmental Resources Survey

Prior to mobilization, a qualified wildlife biologist will perform an environmental resources survey to ensure that no special-status species are residing within the limits of the work for each parcel. As appropriate, the EPP, included as Section 9.0 of this D-1 Sewer Work Plan, will be implemented for protecting wildlife and biota and following substantive ARARs.

7.4 Clearing of Vegetation

The excavation, access, and work areas will be kept as small as practicable to allow for the effective and safe execution of the work. Prior to any intrusive work, vegetation will be cleared from the work areas using mechanical means.

7.5 Geophysical Surveying for Utilities

Geophysical utility location surveys may be performed following a review of existing utility drawings of the affected areas. The geophysical surveys would be conducted over the known or suspect areas where underground utilities may exist, using ground-penetrating radar and/or electromagnetic instrumentation. The results of the geophysical survey will be compared to the

available historical drawings and combined with USA markings (if any) to identify locations of underground utilities. Appropriately colored paints (and/or stakes and flags) will be used to mark the identified utilities within the limits of the proposed excavation area. Prior to invasive work, all active utility systems that will be encountered during the project work will be isolated, locked out, and de-energized in accordance with Navy, Shaw, OSHA, and Cal-DOSH procedures and protocols.

7.6 Topographic Land Surveying

Topographic data is available in the HPS Base Map [Gahagan and Brian, 1993]). This document will be used as a baseline.

All topographic land surveys will be performed under the direction of a land surveyor registered in the State of California. All surveys will use horizontal and vertical control tied to the grid system established for HPS. All equipment used will be in good condition, calibrated, and certified in accordance with the requirements of the State of California for survey equipment and available for review. The surveyor shall provide Shaw with copies of all logbooks recording the work performed at HPS. All drawings produced by the surveyor shall be reviewed, approved, and sealed by the registered land surveyor supervising the work. These drawings and logs will be submitted in the RACR, or sooner if requested.

7.7 Mobilization

Mobilization activities will include site preparation, movement of excavation equipment and material to the site, establishment of radiological and other site controls, and orientation and training of field personnel. Prior to mobilization, the appropriate Navy personnel, including the RPM, RASO, ROICC, and CSO, will be notified regarding the planned schedule for mobilization and removal activities. To arrange for authorized entry badges, field personnel will be provided with a letter to present to the CCSF Redevelopment Agency.

Upon receipt of the appropriate records and authorizations, Shaw field personnel, temporary facilities, and required construction equipment and material will be mobilized to HPS. The temporary facilities will include restrooms, security fencing, runoff controls, and one or more secure storage (Conex) boxes for short- and long-term storage of material, if needed. Construction material mobilized to the site will allow for construction of temporary laydown areas for screening, sorting and loading, waste stockpile areas for non-radiological wastes, and decontamination facilities.

Equipment mobilization will be initiated with site preparation activities. Dedicated laydown areas will be used for short-term storage of equipment and material. Laydown areas will be constructed and managed to prevent generation of dusts and prevent contamination of storm

water. In general, equipment and material will not be staged or stored in an RCA. Only necessary items will be transported for use in the RCA.

Prior to excavation, construction best management practices will be instituted around the work areas per the *Storm Water Pollution Prevention Plan* (SWPPP) found in the D-1 Execution Plan (Shaw, 2010c).

In addition to the radiological controls set forth in Section 4.0 of this D-1 Sewer Work Plan, incoming equipment and material will be subject to radiological surveys for existing contamination levels prior to being placed into service. One hundred percent scan of accessible areas for alpha/beta contaminants. Swipes will be taken to ensure that no removable contaminants are present. Should any survey results exceed the contamination limits listed in Table 8, the equipment and materials will not be placed into service and will be returned to the shipment point of origin.

7.8 Excavation of Soils and Removal of Piping and Systems

7.8.1 Scope of Pipe Removal

The term "piping" includes all SD and SS pipe and system components (manholes, drop inlets, clean-outs, lifts stations, etc.) that may be encountered during this removal action. It is expected that all SD and SS piping within Parcel D-1 will be removed under this D-1 Sewer Work Plan.

Pipe laterals originating at non-radiologically impacted buildings and other features and located outside of radiologically-impacted sites will initially only be removed within the first 10 feet of their union (discharge) into a main or trunk. If no radiological contamination is present in this 10-foot segment of the piping, then the exposed end(s) of the lateral will be capped or plugged and the remaining portion(s) left in place. If evidence of radiological contamination is encountered, the remaining lateral will be removed in 10-foot sections until the piping has been determined to be free of radioactive contamination or to the face of an existing building if encountered, whichever comes first.

7.8.2 Excavation Approach

The general approach to removing the SD and SS piping will be to remove the overlying pavement, excavate the soil materials, and remove the SD or SS piping. Soil materials will be excavated to a minimum of 1-foot from above, around, and below the piping location.

Radiological evaluation will be performed ex-situ on SD and SS piping.

Open SD or SS piping left in place during the removal process will be plugged to prevent water from entering or exiting the in-situ piping.

FSSs will be performed on ES (soil survey units) and exposed excavated trench surfaces (trench survey units). After the survey results are evaluated and any identified radiological contamination is removed, the trenches will be backfilled with concurrence from the RASO and the site restored.

Excavation activities include the removal of overlying surface pavement (where present) from the limits of the excavation. Such material will be segregated and evaluated for potential reuse as granular surface material, subject to determination that it is not radiologically impacted.

After the removal of the surface paving, the newly-exposed soil overlying each SD and SS piping will be removed and transported to an HPS RSY operated by the basewide radiological contractor TtEC for survey and sampling.

Soil from each IRP site will be tracked separately from other soil. If concurred for release by RASO and approved for re-use based on chemistry outlined in SAP (Appendix A), the soil will be returned to the IRP site of origin for use as backfill. Soil from non-IRP sites that is concurred for release by RASO will generally be used as backfill in the same area that it was originally excavated under this D-1 Sewer Work Plan.

Shaw will coordinate its work with the Navy basewide radiological contractor, TtEC. Shaw will deliver soil to the RSYs. Shaw will use the same nomenclature as TtEC for ES and trenches to ensure consistent tracking and management of ES. Following removal of overlying ES, the SD and SS pipelines will be removed. To the extent practicable, the pipes will be removed and stockpiled separately from ES. If the piping is broken into pieces too small to effectively gather and are also less than 6 inches in any dimension that would not hinder RSY soil size requirements, it will be handled, sampled, surveyed, and managed as ES.

Where practicable, piping shall be removed intact. Pipes will be placed in designated laydown areas within the RCA from which they were removed. Radiological characterization of piping and sampling (if required) will be performed in the laydown areas. Excavated piping will be considered radiologically contaminated until survey and sampling data prove otherwise, and the piping shall be controlled as radioactively-contaminated material and handled accordingly.

Effort will be taken to contain silts and debris that may be inside any removed piping. If sufficient sediment is present within removed piping, a minimum of one representative sample will be collected for radiological analysis.

Open SD or SS piping left in place during the removal process will be plugged to prevent water from entering or exiting pipes and to substantially eliminate the release of any contamination that may be present in the piping. It is expected that piping will be truncated along the borders of

Parcel D-1 that coincide with Mahan, Hussey, Manseau, Morrell, and E Streets (Figure 1). In no case will sediments from removal or installation work be allowed to enter San Francisco Bay.

An initial surface radiological survey will be performed in radiologically-impacted areas to identify surface and near-surface (less than 12 inches bgs) radioactive anomalies. Identified anomalies will be removed for disposal through the Navy Low-level Radioactive Waste (LLRW) Disposal Program.

7.8.3 Removal and Management of Pavement

The majority of Parcel D-1 is surfaced in asphalt or concrete pavement and the remainder is packed earthen soil material. This section addresses the management of pavement that will be cleared out in order to remove all SD and SS piping.

Asphalt and concrete pavement over any SD and SS piping in roadways and non-impacted areas will be removed and processed for re-use.

Asphalt and concrete pavement removed to access any SD and SS piping in radiologically-impacted sites will be placed in a Shaw-controlled laydown area within Shaw RCAs pending either release or classification as LLRW. Shaw will track the pavement waste from excavation such that the material in each laydown area can be traced via clear written record to one or more specifically-identified survey units. If there is any indication that the soils underlying the asphalt or concrete are radiologically impacted, the removed pavement will be classified as LLRW.

If there is no radiological contamination at the location where the pavement was removed, Shaw will maintain the removed pavement in a laydown area, pending notification about the disposition of the ES screened for release within the TtEC-operated HPS RSYs. If RASO concurs with release of the ES, the corresponding pavement will be released for recycle or other re-use.

Shaw will initiate the transfer of any removed pavement designated as LLRW to bins or other containers furnished by EMS, the HPS Navy basewide radiological waste disposal contractor, within Parcel D-1. EMS will then be notified to remove the bins from Parcel D-1 and dispose the material in them.

7.8.4 Radiological Evaluation of Piping

Procedures for radiological screening and surveying are found in the D-1 Radiological Work Plan (Shaw, 2010a). This section presents the expected variables for removed piping that will be considered during the screening, surveying, and waste classification of SD and SS piping.

Crushing and Breakage

If the piping is extensively crushed and broken into pieces less than 6 inches nominal diameter, the piping will be handled as ES and delivered with other ES to a RSY for screening as soil. VCP is very brittle and commonly breaks during removal; it is expected that some broken VCP require handling as ES.

Small-Diameter Piping

Piping with a diameter smaller than approximately 10-inches cannot be radiologically scanned with sufficient reliability to ensure defensible release. The width of the active area of the portable survey instrument is too wide for piping of that diameter and cannot lie flat against curved surfaces to measure activity at or below the release criteria. Small diameter piping will be evaluated by swipe sampling.

Piping with Corrugated or other Highly Irregular Surfaces

Piping with high surface topography such as deep corrugations may be difficult or infeasible to radiologically scan with sufficient reliability to ensure defensible release. The width of the active area of the portable survey instrument may be too great to lie flat enough against piping surface to reliably measure activity at or below the release criteria. Corrugated or other irregularly-surfaced piping will prospectively be evaluated by swipe sampling.

Piping with Porous Interior Surface

Piping with porous interior surface (e.g., concrete, transite or Orangeberg piping) has the potential to have become infiltrated with water carrying ROCs. Direct measurement methods are insufficient to assess volume and contamination. These piping may prospectively be classified as follows:

- Stained, concrete-interior piping: prospectively classified as LLRW
- Transite piping: prospectively classified as LLRW with asbestos
- Orangeberg piping: prospectively classified as RCRA mixed waste

The PRSO will review the available information including visual inspection, sediment sample results when available, and any usable survey data to make disposition recommendations for small diameter piping, corrugated piping, and piping with porous interior surfaces.

Piping that has nominal diameter more than 10 inches, is uncorrugated, and does not have a porous interior surface will be surveyed for potential release, to be recycled, or disposed as general construction debris.

Laydown Pads

All SD and SS piping may be placed on laydown pads for temporary management to facilitate visual inspection, radiological scanning, radiological swipe or sediment sampling necessary prior to classification as LLRW, other radioactive waste or release as nonradioactive waste. The pads are not RSYs for the purpose of achieving FSS on ES survey units and are not intended to support evaluation for free release of soil materials.

Laydown pads will be constructed and operated within RCAs and posted as exclusion areas when in use, in accordance with the SOPs and the D-1 Radiological Work Plan (Shaw, 2010a).

Laydown pads will be constructed of high-density polyethylene (HDPE) or equivalent liner material laid directly on the ground, following removal of any rocks or other items that could puncture liner material. In accordance with the SWPPP (D-1 Execution Plan, Shaw, 2010c) the pads will be enclosed by a berm to prevent surface water runoff from outside the pad from contacting the stockpiled material, in accordance with the RCRA staging pile regulations of 40 CFR, Part 264.554, and Section 25123.3 of the California Health and Safety Code provision for stockpiling of non-RCRA hazardous soil. The liners will be draped over the berms to ensure that material placed on each pad is contained and that no waters run into or out of the laydown pads. Appropriate dust controls will also be used to ensure that dusts are not generated from laydown pads.

Any water collected from laydown pads will be characterized for chemical and radiological constituents before being disposed of properly. Sampling will be conducted according to the procedures detailed in the SAP (Appendix A).

7.8.5 Other Considerations

Odiferous or Stained Soil

Throughout the excavation process, soil and piping shall be visually inspected for staining or odors. Material that emits odors or is stained shall be segregated for further sampling and analysis per the SAP. If gross visual or olfactory contamination is identified in ES from outside the bounds of an IR site, up to the first 500 cubic yards of material excavated from an area of a non-IR site adjacent to the IR site will be segregated, sampled, and analyzed for chemical analyses as described in the SAP. This approach will be considered on a case-by-case basis. The need to collect samples will be based on professional field judgments and observations.

Layback/Shoring of Trench Sidewalls

During trenching and piping removal operations, sidewall slopes may be left unsloped (near-vertical cut). The sidewalls may be sloped to facilitate piping removal or for safety, as directed by the Competent Person. For excavations greater than 5 feet in depth or where sloping is impractical, alternative methods such as shoring must be approved by a State of California-

registered engineer and overseen by the Competent Person. The engineer or the designated Competent Person will discuss any shoring to be performed with the SSHO, PRSO, and appropriate RCTs to ensure that shoring will not interfere with sampling and gaining acceptance for radiological clearance.

Grab Sampling at Piping Breaks

A grab soil sample will be collected for radiological testing from the bottom of any trench section where evidence exists that a breach was present within the SD or SS piping. A breach will be defined as any of the following: 1) gap/crack/break in the piping segments, 2) an open-ended piping termination, 3) missing section of piping/conduit, or 4) other visible signs of piping/conduit failure/leakage. The sample will be analyzed for radioactive materials and the chemicals of concern associated with up-gradient sources.

Trench Safety

Open trench will be maintained as practical for safety, compliance with all components of the D-1 Execution Plan (Shwa, 2010c), including guidelines of the SWPPP.

Personnel shall not enter any trench unless proper sloping/benching is in place and the Shaw SSHO has approved the entry. Sloping/benching must be approved by a California-state registered engineer or his/her designated competent person as designated in the APP/SSHP/RPP. CAL-DOSH rules and regulations for stabilizing (sloping or benching) trenches to enable people to enter will continue to apply.

Sandblast Grit

Sandblast grit encountered during excavation will be handled in accordance with a TtEC work instruction, approved byRASO, specifically written to govern this material. In addition, a spotter will be used at all times during excavation activities. The spotter will be trained in recognizing sandblast grit, as well as underground utilities. Any sandblast waste will be segregated and properly disposed.

Direct Loading

In cases where the excavation is located in an area of known radiological contamination, the soils may be directly loaded into EMS-provided bins as LLRW.

Discovery of Containers

If buried drums, bottles, jars, and/or other unidentified containers are located during removal actions, they will be handled in accordance with the *Buried Drums, Bottles, Jars, and Containers with Unknown Content Procedure* (Appendix B). The procedure addresses the identification and inspection of buried containers, their recovery and removal from the excavation, hazardous

categorization, waste categorization sampling, temporary staging on site, and disposal that will be followed once a container is encountered during the excavation activities.

7.8.6 Well Destruction

Wells located in Parcel D-1 will be preserved if possible. If preservation is not possible or deemed unnecessary by the Navy, wells may be abandoned. When it is known that abandonment of a well is necessary prior to excavation, well destruction permit requirements will be met prior to abandoning existing wells. Because the project is being completed under CERCLA authority, permits and inspections are not required.

Regardless of whether or not the well abandonments are anticipated, the groundwater extraction wells and piezometers will be abandoned when necessary:

- Well construction logs and/or boring logs will be reviewed for location of any confining layer. In addition, historic groundwater monitoring data, if available, will be reviewed.
- The depth of the well or piezometer will be measured using a water level sounder to confirm the required depth for overdrilling and to estimate the amount of sealing material required.
- The well monument and wellhead will be removed prior to overdrilling the well or piezometer. The well monument and wellhead will be surveyed for radioactive contamination and disposed of based on survey results (for example, with the debris from the fill area as clean waste or as segregated radioactive waste).
- Based on historic data review, if light non-aqueous phase liquid (LNAPL) or dense non-aqueous phase liquid (DNAPL) are suspected, the borehole volume of groundwater in the well will be purged and containerized for characterization and disposal.
- The well or piezometer will be overdrilled to a depth of no more than 6 inches below the end cap, using hollow-stem auger methods. In addition, care will be taken so that confining units are not penetrated during overdrilling. The overdrilling auger diameter will be at least 2 inches larger than the existing well or piezometer diameter. Wells suspected of having LNAPL or DNAPL will be overdrilled after purging to minimize the possibility of mobilizing LNAPL or DNAPL to the surrounding environment. The components used inside the wells, such as the drilling auger, will be surveyed for radioactive contamination.
- If radioactive contamination is found, the boring will be documented for a future removal action, and the borehole will be backfilled with a mixture of bentonite and cement slurry to a depth 1 foot below the anticipated bottom well or piezometer. Bentonite will be used to seal the remainder of the borehole. Bentonite pellets used in the vadose zone will be hydrated as each 1.5- to 2-foot section is placed in the

borehole. The planned cement/bentonite mixture for the well borehole backfill will contain 5 to 10 percent bentonite.

- If no radioactive contamination is found, the borehole will be backfilled with a mixture of bentonite and cement slurry to a depth 1 foot below the anticipated bottom of the borehole. Bentonite will be used to seal the remainder of the borehole. Bentonite pellets used in the vadose zone will be hydrated as each 1.5- to 2-foot section is placed in the borehole. The planned cement/bentonite mixture for the well borehole backfill will contain 5 to 10 percent bentonite.
- To prevent bridging during backfilling, the sealing material will be placed via a tremie pipe, proceeding upward from the bottom of the borehole. The sealing material will be placed in one continuous operation (or "pour") and allowed sufficient time to settle.
- Records will be kept of the volume of sealing material placed during destruction operations to ensure that it is consistent with the calculated borehole volume. This action will ensure that the well or piezometer has been properly destroyed and that no bridging of backfill material has occurred.
- Waste materials resulting from overdrilling each well or piezometer, such as soil cuttings and well casing remnants, will be placed on a lined stockpile area, pending screening and sampling for the presence of radioactive material. Radioactive materials identified in the drill cuttings will be removed and disposed of appropriately in accordance with the Waste Management Plan (WMP) requirements. If radiologically cleared, the soil cuttings, well monuments, casings, and other debris resulting from well or piezometer abandonment will be hauled off site for disposal at an approved disposal facility.
- The auger flights will be surveyed for radioactive contamination and subsequently cleaned prior to overdrilling each well or piezometer. Auger decontamination will be performed within a self-contained decontamination trailer. If such a trailer is unavailable, a temporary equipment decontamination pad that consists of a bermed polyethylene liner will be constructed to facilitate collection of any generated wastewater. Decontamination wastewater will be collected in an on-site temporary storage tank pending sampling, analysis, and off-site disposal. Waste profiling will be performed in accordance with the SAP (Appendix A).

7.9 Storm Water, Sediment, and Erosion Control

A SWPPP, which is provided with the D-1 Execution Plan (Shaw, 2010c), addresses specific installation and maintenance of appropriate best management practices (BMPs) for controlling storm water and sediment from mobilization to demobilization. The SWPPP was prepared in accordance with SWRCB and Navy requirements. A general National Pollutant Discharge Elimination System (NPDES) storm water construction permit is not required because site activities are being conducted under Section 121(e) of CERCLA.

Releases to water and land will be prevented through the implementation of the BMPs presented in the *Erosion Control Field Manual* (Friends of the Estuary, 1998) and the *California Stormwater Best Management Practices Handbook* (Camp, Dresser, and McKee, 1993).

7.10 Radiologically-Impacted Sites

Where SD and SS piping are present within a radiologically-impacted site, the site surface or structures (where applicable) will be surveyed and remediated for free-release prior to initiating SD and SS removal within the site.

7.10.1 Initial Surface Scans

Initial radiological surface scans will be performed if piping is to be removed from a radiologically-impacted site. The initial surface survey will encompass an area that extends beyond the excavation boundaries, including soil and SD piping laydown areas. The survey will be performed using Ludlum Model 2221 survey meters coupled to Trimble Global Positioning System (GPS) data loggers with Ludlum Model 44-10 NaI probes. This survey will be completed and the results accepted prior to beginning invasive activities. Vegetation will be cleared prior to the surface scan.

7.10.2 Removal of Radioactive Material

If an artifact or radioactive point source is identified and confirmed, its coordinates will be determined and recorded and the location will be marked or flagged. Field personnel will notify the Shaw PRSO. The PRSO will notify the Navy, RASO, and the Shaw PM. Radiological support personnel under the supervision of an RCT will remove the radioactive material as directed by the PRSO.

Areas known or suspected to contain radioactive material will be isolated pending removal of the material. The assigned RCT will ensure that the removal is first evaluated by the PRSO for radiological impacts and controls.

Typical removals will involve an area within a radius of 1 foot around the coordinates of the suspected radioactive material. Under RCT oversight, the location of the elevated radiation level will then be excavated and placed directly into a waste bin. Soil removal will continue until the source of the elevated gamma activity is removed, based on survey results. Following removal of the source of elevated gamma activity, an additional foot of soil in all directions from the source will be removed and disposed of as radioactive waste. After the radioactive material and surrounding soil is excavated, the resulting pit will be resurveyed by the assigned RCT. If elevated gamma emitters persist, further examination of the soil will be made until the source of high gamma radiation is found and removed.

If the source of elevated radioactivity cannot be readily identified as a point source and removed, the material will be sampled and placed into a waste bin for disposal. If the radioactive material is a point source, it will be given a unique identification number and recorded in a logbook and on the drum inventory sheet. Radioactive point sources will be placed in plastic bags within metal drums and stored in a designated and posted radioactive material storage area pending packaging and disposal by EMS, the HPS basewide Navy waste disposal contractor under the direction of the Navy LLRW Disposal Program.

7.11 Radiological Surveys and Sampling of Excavated Material

Soil overlying every SD and SS piping will be removed. This soil will be surveyed and sampled for unrestricted use as backfill by TtEC, the HPS Navy basewide radiological contractor. The SD and SS piping will be removed separately. Additional soils may be removed if sample and survey data confirm the presence of radioactive material above the release criteria.

7.11.1 Piping

Excavated piping and large debris will be screened manually for alpha and beta/gamma emitters. When present, samples of sediment will be collected from the interior surfaces of extracted piping and analyzed by gamma spectroscopy. Swipe samples will also be collected from interior and exterior surfaces to identify the presence of removable surface contamination. Swipe samples will be analyzed on site using a dual-channel alpha and beta sample counter. The piping will be surveyed to preclude release of radioactive materials that may be affixed to the exterior and interior surface areas of the piping. The release criteria for piping can be found in Table 8.

Where surveys cannot be performed, such as with highly broken and crushed piping or very narrow diameter piping (such that the interior cannot be accessed for radiological survey), the piping will be managed as ES or LLRW. Radiologically contaminated piping material will be stored at a laydown area within an RCA pending placement in designated bin, or direct-loaded into a designated bin. Broken and crushed piping will only be managed as ES if it is in sufficiently small pieces (less than 6 inches in any dimension) so as to not impede radiological surveys as performed by TtEC, the HPS Navy basewide radiological contractor.

Additional samples will be analyzed for ^{90}Sr if ^{137}Cs activity above the release criteria is identified during field laboratory gamma spectroscopy analysis.

Excavated debris and piping that are not radiologically contaminated may be transported to temporary laydown areas or may be directly loaded into Department of Transportation (DOT)-approved containers. The wastes will be transferred to ITSI, Inc., the HPS Navy basewide non-radiological waste disposal contractor, for disposal at a CERCLA off-site, rule-approved landfill. Trucks transporting these non-radiological wastes will pass through a portal monitor prior to exiting HPS.

Trench segment piping confirmed as having radioactive contamination present above the release criteria may require further trench sampling if there is no evidence of leakage out of the piping, as directed by the Shaw PRSO.

7.11.2 Extraneous Piping

Non-SD or non-SS piping may be encountered during excavation. Such piping may or may not be classified as extraneous piping (EP). If classified as EP, the piping will be subject to certain safety, screening, and possible removal procedures as described in this subsection.

7.11.2.1 Definition of Extraneous Piping

EP shall be any non-SD/non-SS piping that has the potential to contain liquids. The following will not be EP:

- Any SD and SS piping
- Any piping that was not intended to carry or transfer liquids
- Concrete-encased piping not associated with the SD or SS systems

Treatment of Extraneous Piping

If EP is encountered during excavation its presence will be recorded on logs and field drawings.

A unique EP identification number will be assigned to each section of EP as it is identified. A written description of the EP will be made under direction of the Shaw Project Engineer. To the extent practicable, EP will not be breached and will be left intact. The EP will be marked with the appropriate EP identification number at the time it is identified as EP. Broken EP will be removed and placed on plastic in a special laydown area separate from SD and SS piping, and the EP identification number will be written on it and the EP remaining in the trench.

If there is a sufficient quantity of sediment in a broken or open EP, a sediment sample will be collected from the removed portion of an EP for analysis by the Navy's HPS radiological laboratory using gamma spectroscopy. In addition, an interior and an exterior swipe sample will be collected from the EP and analyzed by Shaw. If radiological contamination is identified, excavation activities will continue along the EP to remove the contaminated piping.

EP neither removed nor broken at the time of excavation will be labeled with the appropriate identification number. The Shaw Construction Manager will schedule a "hot tap" on the pipe to identify any potential liquid or gas in the EP. Once the "hot tap" is completed, the Shaw SSHO or designee will perform the appropriate checks for hazardous gasses or liquids and evaluated appropriately for other potential hazards. The EP will then be cut and swipe samples collected from the interior of the piping remaining in the trench, and will be analyzed by Shaw. If no

contamination is identified, the EP will be backfilled along with the trench. If contamination is identified, the EP will be excavated and treated in the same manner as SD or SS piping and the associated ES.

7.11.3 Excavated Soils

ES will be transported to an HPS RSY for subsequent dewatering (if necessary) and radiological surveys. ES placed on the screening pads will be spread out in lifts not to exceed 6 inches in height and up to 1,000 m^2 in surface area. As necessary, the material will be allowed to dewater prior to performing radiological surveys. The radiological surface survey will consist of a high-density gamma scan performed with the use of NaI detectors and supported by GPS equipment. The high-density survey process will result in a 100 percent scan survey, as detailed in Section 4.0 of this D-1 Sewer Work Plan. Radioactive material identified during screening activities will be collected, segregated, and stored in appropriate containers for subsequent packaging and disposal by EMS, the HPS Navy basewide radiological waste disposal contractor. The collection, handling and storage of radioactive materials in Shaw's control will be under the direction of the Shaw PRSO.

Collected field data will be logged and survey points plotted on survey unit grid maps to document survey results. These data will be used to directly tie the locations of any elevated radiation measurements to the corresponding grid coordinates, which will be established during the development of the systematic sampling plan. Data analysis will be performed as it is received, and questionable areas will be flagged in the field for resurvey/verification. Locations where surface radiation levels appear to be greater than 3σ of the mean background level will be noted on a subcontractor-provided grid map. Hand-held equipment featuring NaI detectors will then be used to perform static readings and verify the elevated measurements. Areas confirmed as having radiation levels greater than the established 3σ of the mean background area level will be evaluated further for the presence of radioactive material and may include additional biased sampling. If radioactive material is confirmed, the area will be physically marked and the associated radioactive material removed.

A minimum of 18 systematic solid samples will be collected for each survey unit of ES (up to 1,000 m^2) placed on the screening pad for scoping survey and FSS. Any contamination found in ES will be characterized and remediated as directed by TtEC, the HPS Navy basewide radiological contractor. Removal action support surveys will be performed until post-removal sample results are less than the release criteria. Scoping survey sample data may be used as the FSS if all sample results are less than the release criteria.

Scoping survey and FSS samples will be systematically collected based on a random start point and sample spacing using Equation 4-2 from the D-1 Radiological Work Plan (Shaw, 2010a), as shown in Section 5.2, using the most current version of VSP software. Additional samples will

be collected at locations where the investigation level is exceeded. The samples will be analyzed at the HPS Navy radiological laboratory by gamma spectroscopy. ES determined to be below the release criteria may be used as backfill, with RASO concurrence, pending additional chemical analysis, if required.

7.11.4 Outfall Removal or Replacement

No removal or replacement of storm water or other outfalls is anticipated during the implementation of this work.

7.12 Trench Surveys

Following excavation, scoping surveys of each trench unit will be completed. If the scoping survey sample results are less than release criteria then the scoping survey data will be used as an FSS, and backfilling will be acceptable with the concurrence of the RASO.

Scoping and FSSs will include 100 percent gamma scan surveys of the exposed trench sidewalls and floor for each survey unit. Systematic sample locations using a random start will be determined, using the most current version of VSP software. Samples collected from each trench survey unit will be analyzed per the SAP (Appendix A). Additional gamma surveys and sampling will be performed if the investigation levels are exceeded.

Any area from a trench that indicates radioactive materials present above the release criteria will be characterized and remediated. Remedial action support surveys will be considered completed when post remediation sample results do not indicate activity above the release criteria. A FSS will be performed on each trench unit after the remedial action support survey concludes the trench unit is at or below the release criteria.

Trench units will be considered acceptable for backfill when no contamination is found above the release criteria during a single phase of systematic sampling, either from a scoping survey or an FSS.

7.13 Backfill Placement and Compaction

The excavation trenches will be backfilled when the results of the surveys and sampling confirm that contamination above the release criteria has been removed and concurrence from RASO is obtained. Two sources of backfill material may be available for use.

One backfill source may be soil that is radiologically released, i.e., suitable ES produced during SD and SS excavation. Such ES excavated from IRP sites will be segregated, sampled, and chemically analyzed. If the chemical analysis results meet the screening criteria listed in the SAP (Appendix A), the soil may be used to backfill where the criteria meet the intended reuse. Soil that meets the industrial reuse criteria will only be used in industrial and open space reuse areas.

Soil that meets residential criteria may be used as backfill at any location. To the extent practicable, ES meeting the appropriate backfill criterion will be placed in trenches as close to the original excavation trenches as possible.

An alternative backfill source is imported soil material. Import soil shall be sampled and analyzed per the SAP (Appendix A) and will be approved by the RASO prior to use. Backfill and compaction requirements will be performed in accordance with the specification provided in the D-1 Design Plan (Shaw, 2010b). Backfill shall be placed to the piping and grades as specified in the design plan to assure surface drainage. A final topographic survey will not be performed. When possible, trenches will be backfilled to approximately their original grade prior to excavation. Areas where a new drainage swale will be installed will be backfilled to the level indicated in the associated design drawings.

7.14 Site Restoration

In most areas of Parcel D-1, post-backfill site restoration will be limited to installing surface drainage swales to direct overland storm water runoff to outfalls along the San Francisco Bay shoreline, consistent with recent or planned grading along the boundary with Parcel G. Installing replacement subsurface SD piping will be limited to those areas where they are required to properly direct storm water flows to San Francisco Bay and comply with storm water discharge requirements. The locations of subsurface replacement piping will be identified in the D-1 Design Plan (Shaw, 2010b). No SS piping will be replaced.

Any damage to the surface or subsurface elements of the in-place fire protection system resulting from this removal action will be repaired.

The surface drainage swales may coincide with roadway locations. The D-1 Design Plan (Shaw, 2010b)will provide the locations and details that will allow for the safe combined use of vehicles and storm water. Swale design will include the intended vehicular traffic. Disturbed roadways will be repaired, using compacted granular materials, unless traffic or storm water conveyance requirements require other materials.

7.15 Decontamination and Free-Release Surveying Procedures

7.15.1 Equipment and Material

Free-release surveys consisting of a 100 percent scan of accessible areas for alpha/beta contamination will be conducted on equipment and tools subsequent to demobilization and decommissioning. Swipes will be taken to ensure that no removable contamination is present. Free-release criteria will meet the limits established in Table 8 for equipment and material. Should the levels exceed those listed in Table 8, the equipment will not be permitted to leave the

site, and appropriate decontamination will be performed. If equipment survey results are below the free-release criteria listed in Table 8, the equipment will be released to the owner.

Equipment or material that cannot be easily or cost-effectively decontaminated will be evaluated for possible limited use in radioactive material use areas, or disposed of as radioactive waste. Applicable Shaw SOP(s), governing decontamination of equipment and tools shall be followed when equipment and material decontamination is necessary.

Surveys will be documented and given a unique survey number.

7.15.2 Personnel

If during the course of routine personnel surveys, contamination is detected and the need is identified for personnel decontamination, it shall be performed per the RPP and Shaw SOP T-RA-005. Shaw will also notify RASO of any personnel contamination incident.

7.16 Waste Classification Storage and Disposal

All waste materials as a result of this activity shall be controlled and managed in accordance with the WMP, which is described in Section 8.0 of this D-1 Sewer Work Plan.

7.17 Demobilization

Upon completion and acceptance of the work, construction materials, equipment, and debris will be removed from the area. All temporary access and traffic control measures shall be removed. As required, construction equipment will be decontaminated, inspected, and accepted by Shaw's PRSO, SSHO, and Construction Manager.

7.18 Traffic Control Plan

Impacts to traffic outside of HPS are expected to be minimal due to this project. Daily traffic load associated with construction personnel entering and leaving the site may be offset by reductions in tenant traffic or activity by other HPS Navy contractors. The remaining impacts will be limited to waste, import soil, other material, and equipment transportation. To the extent possible, waste, material and equipment transportation will be restricted to non-peak traffic hours to minimize the impact to the surrounding community. Mobilization and demobilization of construction equipment are one-time events, and therefore will not adversely impact traffic flow outside HPS.

In contrast, traffic flow within Parcel D-1 or adjacent areas of HPS will be periodically but significantly altered during this project, as some streets will be wholly or partially closed to excavate SD and SS piping. Appropriate traffic control measures on site will be selected in the field based on actual field conditions at the active work areas. Specific traffic safety and control measures that will be implemented are summarized in the following subsections. These safety

and control measures shall conform to the applicable specifications of the *Manual of Traffic Controls for Construction and Maintenance Work Zones* (California Department of Transportation, 1996).

The project team will coordinate construction activities that may generate traffic impacts with the CSO and the ROICC to avoid conflicts with other activities being performed concurrently at HPS.

7.18.1 Traffic Control and Safety Measures

The Traffic Control Plan is shown in Appendix F of the D-1 Execution Plan (Shaw, 2010c).

To expedite the passage of facility traffic through or around the work areas and within HPS, Shaw will install and maintain necessary signs, temporary railings, barricades, and other facilities for the safety, convenience, and direction of both Shaw and non-Shaw traffic. Shaw will furnish competent flaggers whose sole duties will be to direct the movement of facility traffic through or around the work areas and to give adequate warning to contractors, tenants, and others of any dangerous conditions to be encountered.

Water and dust abatement measures will be applied to the Parcel D-1 roads that will be used by construction vehicles for alleviation or prevention of dust nuisance.

Materials or equipment will not be stored where they may interfere with the free and safe passage of persons or vehicles. At the end of each day's work and at other times when construction operations are suspended for any reason, Shaw will remove equipment and other obstructions from that portion of the roadway for use by facility and tenant traffic. In addition, Shaw will adhere to all facility speed limit requirements.

7.18.2 Traffic Controls

Traffic controls will be used to provide for the efficient performance of the work in a safe working environment while minimizing the impact on normal traffic flow. Traffic controls will be required during construction activities to provide for equipment operations and truck loading for on-site and off-site transportation. Traffic controls may include, but are not limited to, the following:

- Loading and transport of waste and debris will be scheduled to minimize disruptions to facility traffic
- Transportation demand management strategies such as car/van pool for construction workers will be encouraged

- Transport trucks removing waste and debris from site areas will be scheduled to avoid queuing along major streets. Close coordination between Shaw and the truck dispatcher will be maintained at all times during loading and unloading activities
- A sufficient area to park passenger vehicles on site in the support areas and haul trucks in the exclusion zones will be provided
- Cones, flags, signs, and other traffic control measures, as needed, to facilitate loading and unloading will be used
- To facilitate safe traffic patterns, as necessary, trench plates may be used over open excavations

During non-construction periods, non-applicable signs will be covered with black plastic or temporarily removed.

Other project-specific measures will be used to minimize the impacts of the proposed construction activities. These measures include the following:

- Proper design geometrics will be applied to access driveways and all internal streets to accommodate trucks and fire apparatuses
- Clean access points for trucks will be maintained at the project entrance to allow for efficient movement of construction traffic and expedite the entry and exit of construction vehicles
- An adequate turning radius will be provided in all areas, including loading areas near the stockpiles
- Sufficient area will be provided for parking vehicles on site during construction, including space for haul trucks
- Close coordination will be maintained between the Navy and other facility contractors to ensure safety and to minimize impacts to other activities within HPS

8.0 Waste Management Plan

The purpose of the WMP is to present the waste management practices and procedures to be followed for the types and quantities of waste expected to be generated during the field activities associated with the removal activities during the basewide SD and SS systems radiological characterization and remediation. The WMP identifies waste management activities conducted during the storage and the preparation and/or disposal of waste (including waste characterization, packaging, storage, and management while in storage). The transportation and disposition of waste material at appropriate disposal and recycling facilities are also included.

The WMP provides information on how wastes, including potentially hazardous wastes, LLRW, and/or low-level mixed waste (LLMW) associated with project activities will be managed and disposed. A secondary goal of this section is to ensure that waste minimization practices are followed, to the extent practicable, to reduce the volume of waste that will be generated, stored, and removed from the site for disposal.

8.1 Project Waste Descriptions

Site work will consist of excavation of buried SD and SS piping and associated soil. Waste generated during this removal action will either be radiological or non-radiological in nature.

LLRW and/or LLMW wastes anticipated to be produced may include, but may not be limited to:

- Soil/sediment
- Debris (including but not limited to piping)
- Wastewater
- PPE

Non-radiological wastes anticipated to be generated may include, but may not be limited to:

- Debris (including piping and concrete/asphalt)
- Wastewater
- PPE
- Packaging materials

The following disposal options will be applied to the wastes previously described:

- LLRW and LLMW will be properly stored on site pending packaging and disposal by Environmental Management Solutions, Inc. (EMS), the HPS Navy basewide radiological waste disposal contractor, to a permitted disposal facility.

- Soil, debris, and wastewater intended for off-site disposal and classified as a Toxic Substances Control Act (TSCA) hazardous, RCRA hazardous, or non-RCRA (California) hazardous waste will be transferred to ITSI, the HPS Navy basewide disposal contractor within Parcel D-1 for transport to a CERCLA off-site, rule-approved hazardous waste facility for treatment and/or disposal.
- Debris intended for off-site disposal and classified as non-hazardous waste will be transported to a CERCLA off-site, rule-approved waste facility by ITSI, the HPS Navy basewide non-radiological waste disposal contractor.
- Cleared vegetative wastes without elevated levels of radioactivity will be disposed of at an off-site green waste recycling and disposal facility.
- Wastewater will be characterized and profiled for appropriate off-site treatment and/or disposal by an HPS Navy basewide waste disposal contractor.

Use of any disposal facility for LLRW and LLMW is subject to approval by the DoD LLRW Executive Agency (Army) and selection of and transport to such facilities will be performed by EMS, the HPS Navy radiological waste disposal contractor.

8.2 Waste Management for Hazardous/Non-Hazardous Wastes

In accordance with the ARARs, the substantive requirements of the state and federal hazardous waste generation, characterization, storage, treatment, and management regulations of Title 22 CCR, Sections 66261, 66262, and 66264, and 40 CFR, Parts 261, 262, and 264, are applicable to the management of hazardous wastes generated during the investigation activities and associated project activities.

8.2.1 Waste Classification

According to RCRA requirements of Title 22 CCR, Section 66261.10, waste characteristics can be measured by an available standardized test method or be reasonably classified by generators of waste based on their knowledge of the waste, provided that the waste has already been reliably tested or if documentation exists of chemicals used.

A waste determined not to be a RCRA-hazardous waste may still be considered a State of California-regulated non-RCRA hazardous waste. Wastes determined to be hazardous wastes under California regulations and not under federal regulations are referred to as non-RCRA hazardous wastes. The state's RCRA program for determining hazardous waste is broader in scope than the federal RCRA standard. Title 22 CCR, Section 66261.24(a)(2), lists the Total Threshold Limit Concentration (TTLCs) and the Soluble Threshold Limit Concentrations (STLCs) for non-RCRA hazardous waste. A waste is considered hazardous if its total concentrations exceed the TTLCs or if the extract concentrations from the Waste Extraction Test (WET) exceed the STLCs. A WET is required when the total concentrations exceed the STLC by

a factor of 10, but are less than the TTLCs. California also has additional hazardous waste classification criteria (including 96-hour fish bioassays) that may need to be considered on a case-by-case basis.

The waste classification requirements also apply to water generated from daily decontamination activities, dewatering of excavation material, collected storm water, and waste oils and fluids (if any) generated from the on-site project equipment. Wastewater resulting from excavation storm water runoff, dewatering, and decontamination water will be collected and contained in tanks or other appropriate containers. When the container is approximately half-full or at least every 45 days, whichever occurs first, it will be sampled to determine proper disposition of the wastewater. PPE will be characterized based on generator knowledge and will be disposed at an off-site landfill. Waste oils and fluids (if generated) will be sampled for off-site disposal.

8.2.2 Waste Accumulation and Storage

Regulations per 40 CFR, Part 262, and 22 CCR, Section 66262, are applicable to the generation, storage, management, and accumulation of RCRA and non-RCRA hazardous wastes, respectively. Specific requirements apply to the accumulation time for hazardous wastes on site and to the accumulation and labeling of hazardous wastes. This project may result in the temporary accumulation of hazardous wastes. These wastes will be managed, accumulated, and inspected in accordance with the regulations.

8.2.3 Soil

Hazardous and non-hazardous soil may be generated during excavation of SD and SS piping. Soil excavated from within IR sites will be stockpiled as described in Section 7.0 of this D-1 Sewer Work Plan and sampled and analyzed for final disposition or potential reuse, if the soil meets import fill requirement. Soil excavated from areas outside of IR sites will be stockpiled pending return to the excavation as fill material, minus any soil considered LLRW or soils with visible staining or odor. The operation and maintenance of the stockpiles will conform to the requirements of RCRA staging pile regulations of Section 264.554 of 40 CFR and with Division 20, Chapter 6.5, Section 25123.3 of the California Health and Safety Code.

8.2.4 Debris

Debris, including terra cotta, concrete, VCP, and other piping, will be scanned for radiological evaluation and potential release for disposal as non-hazardous debris. All associated material will be removed from the piping prior to stockpiling. If staining is observed or contamination is suspected debris may be characterized to meet the disposal facility requirements. Other debris that may be generated may include asphalt or concrete, which may be reused on site or disposed off site.

8.2.5 Wastewater and Waste Fluids

Facilities that store hazardous wastes in tanks or containers for over 90 days are expected to follow applicable requirements contained in 22 CCR, Section 66264, and 40 CFR, Part 264.

Any wastewater generated (for example, decontamination water generated from equipment and personnel decontamination and water generated from dewatering excavated material) will be collected in containers such as Baker tanks, Rain for Rent® tanks, or 55-gallon drums and labeled. Tanks will be temporarily staged within a pre-designated and secondarily contained (unless tanks are double-walled) on-site waste accumulation area pending characterization and appropriate disposal. Tank trucks or drums will be used to transfer water from the point of generation to the tank storage area. Wastewater generated from hazardous and non-hazardous waste and/or decontamination activities will be segregated from wastewater generated from radioactive decontamination.

When possible, waste fluids generated from heavy equipment maintenance activities will be collected and removed from the site for recycling. If waste fluids are required to be stored on site, they will be labeled accordingly, contained within DOT-approved containers, and situated within a pre-designated and properly designed hazardous waste container storage area. Containers of hazardous wastes containing free liquids have stringent secondary containment requirements, including the following:

- The base of the container will be free of cracks or gaps and sufficiently impervious to contain leaks, spills, and accumulated precipitation until the collected material is detected and removed.
- The base of the container will be sloped or the containment system will be otherwise designed and operated to drain and remove liquids resulting from leaks, spills, or precipitation. Alternatively, the containers may be elevated on pallets to prevent contact with accumulated liquids.
- The containment system will have sufficient capacity to contain 10 percent of the total volume of containers or the volume of the largest container, whichever is greater, plus the maximum rainfall from a 25-year, 24-hour storm event.
- Spilled or leaked waste and accumulated precipitation will be removed from the sump or collection area in a timely manner to prevent overflow of the collection system.

8.2.6 Container Labeling

Indelible ink will be used to label containers of potentially hazardous waste with a detailed description, including accumulation start date; and the words "Analysis Pending – Potentially Hazardous." A container log will be used to track contents, accumulation start data, sample identification number, sample date, and disposal date. If containers are determined to contain non-hazardous waste, they will be labeled accordingly. If containers are determined to contain

hazardous waste, they will immediately be labeled with a completed "Hazardous Waste" label that will include:

- EPA identification number of the generator
- Name and address of the generator
- EPA waste code
- DOT shipping name (prior to off-site shipment)
- Description of contents
- Date of generation

An inventory of waste containers will be maintained. In addition, weekly inspections of container storage areas will be conducted and logged while wastes remain in these areas to ensure the integrity of the containers and secondary containment, to check for leaks or spills, and to ensure that labels and markings are in good condition.

8.2.7 Waste Accumulation Areas

Shaw and its subcontractors will implement the following hazardous waste storage area requirements for waste stored on site, if appropriate:

- A sign stating, "Danger Hazardous Waste Area-Unauthorized Personnel Keep Out" (written in English and Spanish), will be posted at each waste accumulation area and stockpile in sufficient numbers to be seen from any approach. The signs will be legible from a distance of at least 25 feet.
- Aisle space will be maintained to allow for the unobstructed movement of personnel, fire-protection equipment, spill-control equipment, and decontamination equipment to any area of facility operation in an emergency, unless aisle space is not needed for any of these purposes.
- The following emergency equipment will be located or available to personnel during active waste management activities at each accumulation area:
  - A device, such as a telephone or a hand-held two-way radio, capable of summoning emergency assistance
  - Portable fire extinguishers, fire control equipment, spill control equipment, and decontamination equipment
  - Water at adequate volume and pressure to supply water hose streams, or foam-producing equipment, automatic sprinklers, or water spray systems
  - A spill-response kit for minor spills to include a shovel, adsorbent pads and/or "kitty litter," and a collection container

Bulk quantities of fuel, oil, or other hazardous material will not be stored on site. These materials will be managed by an off-site contractor who will, on an as-needed basis, perform equipment fueling and maintenance activities.

8.2.8 Waste Disposal

Hazardous wastes may be transported off-site for appropriate recycling or disposal. Used PPE will generally be managed and disposed of as non-hazardous waste, unless work is required in areas of significant contamination. Other waste streams requiring off-site disposal will be sampled and analyzed, as necessary, to ensure that the waste is properly characterized and profiled and meets the waste-acceptance criteria and packaging requirements for the proposed treatment, storage, and disposal facility (TSDF) prior to transport.

Hazardous waste will be disposed of only at a hazardous waste disposal facility prequalified by a Navy HPS contractor and permitted for the disposal of the particular type of hazardous waste generated. Wastes disposed of off-site will be sent to RCRA Subtitle C or RCRA Subtitle D facilities that meet the requirements of 40 CFR, Part 300.440 (CERCLA off-site policy).

8.2.9 Waste Transportation

Hazardous wastes sent off site for disposal or recycling will be done so in accordance with the DOT Hazardous Material Transportation regulations of 49 CFR, Parts 171–177, and 40 CFR, Part 262, Subpart B, and 22 CCR, Section 66262, which involves packaging, placarding, labeling, and manifesting requirements. Additionally, hazardous wastes will be sent off site for disposal or recycling with appropriate land disposal restriction (LDR) certification notices per 40 CFR, Part 268, and 22 CCR, Section 66268. Personnel having the required DOT training will perform all DOT functions. In addition, all transporter and disposal contractors will be subject to the subcontractor qualification process. Under no circumstances will Shaw personnel sign hazardous waste manifests.

If material is hazardous, it will be shipped under the appropriate hazard class. All hazardous waste will be transported under DOT hazardous material regulations. Each shipment of a suspected hazardous material will be properly classed using the Hazardous Material Table in 49 CFR, Part 172.101. DOT-trained personnel will make all determinations.

8.2.10 Waste Minimization

To minimize the volume of all waste streams generated during the project, the following general guidelines will be followed:

- Wastes that are potentially radiological (i.e., generated during the SD and SS removal) will not be mixed with any other wastes.
- Waste material will not be contaminated unnecessarily.

- Work will be planned ahead.
- Material may be stored in large containers, but the smallest reasonable container will be used to transport the material to the location where it is needed.
- Cleaning and extra sampling supplies will be maintained outside any potentially contaminated area to keep them clean and to minimize additional waste generation.
- Mixing of detergents or decontamination solutions will be performed outside potentially contaminated areas.
- Drop cloths or other absorbent material will be used to contain small spills or leaks.
- Contaminated material will not be placed with clean material.
- Wooden pallets inside the exclusion zone will be covered with plastic.
- Material and equipment will be decontaminated and reused when practicable.
- Volume reduction techniques will be used when practicable.
- Waste containers will be verified to ensure that they are solidly packed to minimize the number of containers.
- Only waste containers adequately sized to contain the volume of waste generated will be used.
- Less hazardous substances will be used whenever possible (only the volume of standard solutions needed for testing will be brought; minimal amounts of decontamination water and solvent rinses will be used).

8.2.11 Inspections

While all waste accumulation areas will be informally inspected on a daily basis, formal inspections of all container accumulation and stockpile areas will be conducted and recorded at least weekly in accordance with 40 CFR, Part 264, Subpart I, and 22 CCR, Section 66264. The PM or designee will conduct inspections. Inspections will be recorded in a dedicated field logbook, and a weekly inspection checklist will be completed. The container storage area(s) will be inspected to ensure the following:

- The containers will be checked for good condition. If a container is not in good condition or appears to be leaking, the waste will be transferred to another container.
- All containers used will be checked to be sure that they are made of material that will not react with, and are otherwise compatible with, the hazardous waste to be stored.
- The containers will be checked to ensure that they remain closed at all times, except when adding or removing waste.

- The container label will be checked to ensure that it is filled out properly and to check the waste accumulation date.

Containers used for storage of collected runoff and decontamination water will be inspected on a daily basis and the inspections will be logged. The inspections will ensure that tanks have adequate secondary containment, are properly labeled, that they are in good condition (no apparent structural defects or deterioration), and have no visible leaks.

8.2.12 Documentation

Documentation requirements apply to all waste managed during project activities. Field records will be kept of all waste-generation activities. All pages of the field data record log will be signed and dated by the supervising field leader who is entering the data. In addition, the following information will be recorded in the log:

- Description of waste-generating activities
- Location of waste generation (including depth, if applicable)
- Type and volume of waste
- Date and time of generation
- Description of any waste sampling
- Name of person recording information
- Name of field manager at time of generation

8.2.13 Hazardous Waste Manifests and LDR Certification

Off-site transportation and disposal of hazardous wastes will be handled by ITSI, the HPS Navy non-radiological waste disposal contractor. All hazardous waste transported from the site will be accompanied by a hazardous waste manifest. Navy personnel will be responsible for reviewing and signing all waste documentation, including waste profiles, manifests, and LDR notifications (manifest packages). Prior to signing the manifest, the designated Navy official will ensure that pre-transport requirements of packaging, labeling, marking, and placarding are met according to 40 CFR, Parts 262.30–262.33, and 49 CFR, Parts 100–178.

8.3 Waste Management for Radioactive Wastes

The following subsections address specific control and management practices for LLRW and LLMW Disposal of all LLRW and LLMW will be handled through the Navy's LLRW Disposal Program. EMS is the Navy HPS basewide radiological disposal contractor.

8.3.1 Waste Classification

Radioactive wastes will be classified as specified in 49 CFR and/or disposal facility requirements. These wastes will be categorized as either LLRW or LLMW. Waste characteristics, including the radionuclides present and their associated specific activity, will be

measured by an available standardized test method such as gamma spectroscopy, strontium analysis, and/or alpha spectroscopy. Additionally, for LLMW, chemical waste characteristics can be measured by a standardized test method or be reasonably classified by generators of waste based on their knowledge of the waste, provided that the waste has already been reliably tested for acceptance at the waste disposal facility. The state is broader in scope in its RCRA program in determining hazardous waste. Relevant information pertaining to this requirement can be found in Section 8.2.1 of this D-1 Sewer Work Plan.

8.3.2 Waste Accumulation and Storage

As for hazardous waste, specific requirements apply to the accumulation time for LLMW on site and to the accumulation and labeling of LLMW. This project may result in the temporary accumulation of LLMW in containers. These wastes will be managed, accumulated, and inspected in accordance with the regulations. Accumulation time requirements do not apply to LLRW.

All LLRW and LLMW will be packaged by EMS, the HPS Navy basewide radiological contractor, per the direction of a waste broker certified by the DoD Executive Agency for LLRW (Army Joint Munitions Command) in accordance with federal directives and disposal facility requirements. Typical containers that may be used for these wastes include 55-gallon drums, B-25 boxes, and covered roll-off containers. Containers will be properly lined, and absorbent will be used if it is considered necessary. All containers will be surveyed and/or swiped when received. Each container will be properly inventoried and labeled. Inventories will include material description and isotopic identification, and hazardous components if appropriate. The contents of each container will be recorded in the field logbook, and each container will be assigned a unique identification number.

Containers will be stored in a designated and posted radioactive material storage area, as described in Section 8.3.6 of this D-1 Sewer Work Plan.

8.3.3 Soil, Debris, and Materials

Soil, debris, and materials classified as LLRW or LLMW may be generated during excavation. When classified as LLRW or LLMW, these wastes may be placed in 55-gallon drums, B-25 boxes, and/or roll-off containers. These containers will be managed as described in Section 8.3.2 of this D-1 Sewer Plan.

8.3.4 Wastewater and Waste Fluids

Wastewater from the radioactive material decontamination area will be maintained separately from hazardous decontamination and dewatering wastewater. If the wastewater chemical characteristics are unknown, wastewater will be managed as LLRW wastewater until characterized. Known or suspected LLMW wastewater will be segregated during accumulation

and storage. When decontaminating and dewatering radioactively contaminated material, every effort should be made to minimize the generation of mixed waste.

8.3.5 Labeling and Posting of Containers Containing Radioactive Waste

Each waste container containing LLRW or LLMW will be labeled. The activity contained in each waste container will be reported in pCi/g and maximum contact radiation levels will be measured in milliRoentgen per hour (mR/hr). Following the surveying and labeling, the waste container will be placed in a designated and posted radioactive material storage area. The waste container will be labeled with a "Caution – Radioactive Material" sign. The sign will also note the maximum surface radiation level (measured in mR/hr). An inventory of contents with radionuclide and specific activity (if available) will be posted on the outside of the container or a notice will be posted stating where this information is found. LLMW will also be marked in accordance with the requirements in Section 8.2.6 of this D-1 Sewer Work Plan. The waste inventories will be managed under the appropriate NRC license, including the mixed waste inventory due to the radioactive constituents.

8.3.6 Waste Accumulation Areas

Shaw and Shaw subcontractors working on this project will implement, at a minimum, the following requirements for radioactive waste stored on site within a designated radioactive waste storage area:

- The display of industry standard placard and barrier materials with wording that includes the following, "Caution, Radioactive Materials Area-Unauthorized Personnel Keep Out" (written in English and Spanish), at each radioactive waste storage area sufficient to be seen from any approach. The signs will be legible and clearly conspicuous for outdoor and indoor locations.
- Aisle space will be maintained to allow for the unobstructed movement of personnel, fire-protection equipment, spill-control equipment, and decontamination equipment to any area of facility operation in an emergency, unless aisle space is not needed for any of these purposes.
- The areas will be secured to prevent unauthorized access to the material.
- The following emergency equipment will be located or available to personnel during radioactive waste management activities at each accumulation area:
  - A device, such as a telephone or a hand-held two-way radio, capable of summoning emergency assistance
  - Portable fire extinguishers, fire-control equipment, spill-control equipment, and decontamination equipment

Filled containers generated during performance of this D-1 Sewer Work Plan will be stored at HPS at the site where they were generated or within a RASO-approved storage location under control of an NRC-licensed Navy HPS contractor that is a signatory to the MOU, until the contained material can be disposed.

8.3.7 Waste Disposal

EMS, the HPS Navy basewide radiological disposal contractor, will package, ship, manifest, transport, and dispose of LLRW and LLMW. The certified waste broker will coordinate closely with RASO. LLRW and LLMW inventories will be managed under the appropriate NRC license due to the radioactive constituents.

EMS will be responsible for preparing the hazardous waste manifests for the LLMW and the radioactive waste manifests for the LLRW. LLRW manifests will be signed by EMS or the Navy as appropriate. LLMW manifests are signed by the CSO. EMS will also be responsible for coordinating the shipment of LLMW and LLRW and coordinating with the waste-disposal facilities.

8.3.8 Waste Transportation

Wastes sent off site for disposal will be done so in accordance with the DOT Radioactive Material Transportation regulations of 49 CFR, by a certified waste broker contracted by the DoD LLRW. Personnel having the required DOT training will perform assistance as needed.

EMS will be responsible for surveying and taking radiation measurements on the outside of the container prior to shipment. EMS will work with the PRSO to ensure that empty containers being returned to vendors meet the release limits for equipment and materials identified in Table 8.

8.3.9 Waste Minimization

To minimize the volume of radioactive waste generated during the project, the following general guidelines will be followed:

- Waste material will not be contaminated unnecessarily.
- Work will be planned ahead.
- Cleaning and extra sampling supplies will be maintained outside any potentially contaminated area to keep them clean and to minimize additional waste generation.
- Mixing of detergents or decontamination solutions will be performed outside potentially contaminated areas.
- When decontaminating radioactively contaminated material, every effort should be made to minimize the generation of mixed waste.

- Contaminated material will not be placed with clean material.
- Wooden pallets inside the exclusion zone will be covered with plastic.
- Material and equipment will be decontaminated and reused when practicable.
- Volume reduction techniques will be used when practicable.

8.3.10 Inspections

While all waste accumulation areas will be informally inspected on a daily basis, formal inspections of all container accumulation areas will be conducted and recorded at least weekly in accordance with the appropriate NRC license requirements. The PRSO or designee will conduct inspections that will be recorded in a dedicated field logbook, and a weekly inspection checklist will be completed. The container storage area(s) will be inspected to ensure the following:

- The containers will be checked for good condition. If a container is not in good condition the certified waste broker will be informed.
- The containers will be checked to ensure that they remain closed and secured at all times, except when adding or removing waste.
- The container label will be checked to ensure that it is visible and filled out properly.

8.3.11 Documentation

Documentation requirements apply to all waste managed during project activities. Field records will be kept of all waste-generation activities. All pages of the field data record log will be signed and dated by the person entering the data. In addition, the following information will be recorded in the log:

- Description of waste-generating activities
- Location of waste generation (including depth, if applicable)
- Type and volume of waste
- Date and time of generation
- Description of any waste sampling
- Name of person recording information
- Name of PRSO at time of generation

8.3.12 Radioactive Waste Manifests

All radioactive waste transported from HPS will be accompanied by a radioactive waste manifest and/or hazardous waste manifest as appropriate. The LLRW/LLMW manifests are the responsibility of EMS, the HPS Navy basewide radiological disposal contractor. LLRW manifests are signed by EMS or the CSO.

The CSO and RASO will each receive one copy of the manifest; the remaining copies will be given to the transporter. The manifest will be returned to the Navy's signatory official for the base's recordkeeping requirements.

8.4 Updating the Waste Management Plan

The WMP will be updated as changes in site activities or conditions or changes in applicable regulations occur. Revisions to the WMP will be reviewed and approved by the Navy. All changes to the WMP associated with radioactive or mixed waste will require approval from RASO.

9.0 Environmental Protection Plan

This EPP presents information regarding the environmental management program for the basewide SD and SS systems radiological characterization and remediation. The purpose of this EPP is to detail the means of compliance with the applicable or relevant and appropriate environmental regulatory requirements for the remediation effort. This EPP will help ensure that activities associated with the environmental management program are conducted in a systematic and well-documented manner. The EPP includes environmental compliance procedures and regulatory, procedural, and training requirements associated with conducting the field activities. The Shaw PM's responsibility is to verify that all project personnel are aware of the compliance requirements of this plan.

9.1 Existing Natural Resources

Project activities will be conducted within Parcel D-1, which is largely a vegetation-free constructed area lacking wetlands. With no natural shorelines along Parcel D-1, its entire interface with San Francisco Bay is via constructed vertical walls that constitute ship berths. The majority or all of the SD and SS piping removal and related work will occur in developed areas though sometimes in proximity to constructed seawalls and the San Francisco Bay.

Discrete wetlands less than 5 acres in size exist in some areas of HPS but none have been identified in Parcel D-1. The wetlands have low-vegetative diversity classifications, potentially toxic inputs, and are small and discontinuous in nature (Levine-Fricke-Recon, Inc., and PRC Environmental Management, Inc. [LFR-PRC], 1997; Tetra Tech EM, Inc. [TtEMI], 2003). These wetland/habitat features provide low-quality habitat and little opportunity for wildlife breeding.

The climate in the San Francisco Bay Area is temperate and influenced by the regional topography and proximity to the Pacific Ocean. Fairly constant and predictable, the climate has a bimodal seasonal pattern with respect to temperature and rainfall. Summers are usually warm and dry, with the exception of morning and evening fog due to a marine inversion layer. Winters are wet and cool with most annual precipitation occurring between October and March.

9.2 Description of Habitat and Sensitive Species

San Francisco Bay coastal open water, tidal channels, and wetlands are adjacent to the project area and within its associated 1,000-foot zone of influence (ZOI). While numerous species of plants, wildlife, and other biota have been observed near or within HPS no federally listed or candidate species are known to permanently reside or regularly breed within the project impact area or ZOI (LFR-PRC, 1997; TtEMI, 2002; California Department of Fish and Game [CDFG], 2003).

The majority or all of the projected work activities will be conducted in developed areas that provide little potential habitat for either plants or animals. There are no known sensitive species.

The upland habitat is composed of ruderal upland species and relatively flat topography. Surface elevations are generally 5 to 10 feet above mean sea level.

In general, vegetation is sparse or absent within Parcel D-1. Elsewhere in HPS wetland/habitat features typically provide low-quality habitat and little opportunity for wildlife breeding. The dominant vegetation in such wetland areas is common pickleweed (*Salicornia virginica*) and salt grass (*Distichillis spicata*), while the uplands have a predominance of fennel (*Foeniculum vulgare*), black mustard (*Brassica nigra*), barley (*Hordeum murinum*), cultivated oat (*Avena sativa*), plantain (*Plantago* sp.), and perennial rye grass (*Lolium perene*). Habitats within the project area (Parcel D-1) are composed of disturbed upland species.

The California Natural Diversity Database maintained by the CDFG has no published records of special-status species within the proposed project's direct impact area and ZOI. These findings are consistent with previous site-specific surveys, which have investigated HPS for the presence of special-status plants and wildlife species (LFR-PRC, 1997; TtEMI., 2002; CDFG, 2003; Tetra Tech FW, Inc., 2004). Table 10 lists the threatened and endangered species at or near HPS.

9.3 Run-On and Runoff Control Provisions

The SWPPP is included in the D-1 Execution Plan (Shaw, 2010c). The SWPPP addresses run-on and runoff control measures and other BMPs that will be implemented during field activities to prevent the migration of potentially contaminated soil and sediment.

9.4 Regulatory Requirements

Based on the analysis in the Final AM (Navy, 2006), the Navy recommended a removal action for potentially radioactive material associated with base SD and SS piping that includes excavation and off-site disposal. This alternative was recommended because it best meets the NCP criteria of overall protectiveness of human health; compliance with ARARs; long-term effectiveness; reduction of mobility, toxicity, or volume through treatment; short-term effectiveness; implementability; cost; and state and community acceptance. Implementation requires that soils above the cleanup levels for the ROCs be excavated, stockpiled, and transported off site to an appropriately permitted TSDF. Additionally, soils within IR site areas will be stockpiled and sampled separately for chemical contamination. Prior to the start of work, DTSC and RWQCB will be notified of the intent to begin cleanup. A complete discussion of ARARs and evaluation of potential ARARs is presented in the AM (Navy, 2006).

9.4.1 Specific Environmental/Regulatory Requirements

Environmental/regulatory requirements applicable to the basewide SD and SS systems radiological characterization and remediation are described as follows.

9.4.1.1 Hazardous Waste Management

Excavated soils and waste material classified as potentially TSCA or hazardous waste will be temporarily staged on a 20-mil HDPE or polyvinyl chloride liner pending off-site disposal. Wastes staged on site will be protected from run-on and runoff and will be covered to prevent wind dispersion. HPS will use its EPA generator identification number on the manifests that accompany each hazardous waste shipment.

9.4.1.2 Air Emissions

The substantive requirements of the BAAQMD rules relating to visible emissions, fugitive dust, and particulate matter emissions must be complied with; however, no permits are required. A grading permit is also not required, as the federal government is exempt under county ordinance, provided grading is supervised and inspected by a registered professional engineer.

Shaw will implement this D-1 Sewer Work Plan in accordance with the *Final Base-wide Dust Control Plan, Hunters Point Shipyard, San Francisco, California* (TtEC, 2009).

9.4.1.3 Storm Water Pollution Prevention Plan

The SWPPP is found in the D-1 Execution Plan (Shaw, 2010c), which addresses installation and maintenance of appropriate BMPs for controlling storm water. The SWPPP has been prepared in accordance with SWRCB requirements; however, a general NPDES storm water construction permit will not be required. Because the field activities are regulated under CERCLA, only the substantive requirements of the NPDES permit apply.

9.4.1.4 Base Approvals

Shaw will coordinate with the ROICC, CSO, RASO, and the RPM to obtain necessary approvals for work tasks. Required approvals may include underground utility clearance, implementing or altering RCAs or traffic controls, handling of ESs or other wastes, and other activities.

9.4.2 Excavation Activities

Excavation activities will be performed in accordance with pertinent regulatory requirements. The applicable regulations, along with the methods to assure compliance with these regulations, are described as follows.

9.4.2.1 Excavation Management Plan

Unstable earth conditions are not expected during the removal activities. Soil will be excavated in approximate 100-foot trench sections in order for these sections to be shored or stabilized and

covered until released. Daily inspections of excavations will be performed by a competent person to assess the stability of the slopes, trenches, and nearby area. Any excavation deeper than 5 feet will require that notification be given to Cal-DOSH, per Shaw's current, annual excavation permit. Excavation permits will be posted. OSHA and Cal-DOSH excavation regulations and permits will be followed at all times. Excavation activities will be conducted in accordance with the requirements within CCR Title 8, Sections 1539–1541, and Title 29 CFR, Parts 1910 and 1926.

9.4.2.2 Fugitive Dust

Shaw will implement the Base-wide Dust Control Plan (TtEC, 2009) throughout the work. Fugitive dust emissions may occur during soil excavation and waste-handling activities. All construction activities will comply with the substantive requirements of BAAQMD Rule 40 and Regulations 6-305 and 8 pertaining to fugitive dust emissions and maintaining, covering, and stockpiling excavated soil. Dust will be controlled during excavation with water application. Ambient air monitoring for dust, including potential airborne radioactivity, will be performed upwind and downwind of the project area per the APP/SSHP/RPP and D-1 Radiological Work Plan (Shaw, 2010a). The monitoring results will be used to determine if additional measures are required to control adverse impacts from airborne contaminants. Measures may include increased PPE levels for project personnel, reduction or stopping of excavation activities, and/or dust abatement using water application or by covering stockpiles with plastic sheets.

9.4.2.3 Floodplains and Wetlands

The excavation activities are not located within a 100-year floodplain defined by the U.S. Geologic Survey. No Parcel D-1 areas have wetlands and such areas are not expected to be impacted by site activities. Therefore, requirements pertaining to floodplain and wetlands protection are not applicable because those features are being avoided.

9.4.2.4 Endangered Species and Migratory Birds

No federally listed species are known to permanently reside on or in the vicinity of HPS (Levine-Fricke-Recon, Inc. and PRC, 1997); however, San Francisco Bay is a seasonal home for birds migrating along the Pacific Flyway, and numerous species of migratory birds have been observed at HPS. Disturbance of habitats will be restricted to only those areas necessary for site mobilization and setup and locations where work is being performed. To comply with the substantive provisions of the action-specific ARARs identified for HPS activities, the Navy will implement avoidance and minimization measures.

9.4.2.5 Worker Health and Safety

Field activities will be governed by Shaw's APP/SSHP/RPP (Shaw, 2010d), RWPs, and Shaw's NRC License.

All activities will be performed in accordance with Navy, OSHA, and Cal-DOSH requirements for worker safety. The APP/SSHP/RPP provides requirements and guidelines that will be used in the field to protect the health and safety of workers. An SSHO will provide full-time oversight of activities to ensure compliance with OSHA regulations and the APP/SSHP/RPP. In parallel, qualified RCTs will provide continuous oversight of work area operations to ensure compliance with the occupational and environmental standards and practices defined in Shaw's radioactive materials license and subject to enforcement by the NRC.

9.5 Release Prevention, Response, and Reporting

9.5.1 Spill Prevention

The primary activities that may result in a spill include vehicle fueling and management of decontamination waste. Spill prevention practices for these activities are as follows:

- **Fueling** – All vehicles will be fueled and serviced prior to moving onto the site. Any on-site fueling of equipment will be conducted within a designated and controlled area. No bulk quantities of fuel will be stored on site.
- **Wastewater** – Wastewater will be stored in double-walled temporary tanks or 55-gallon drums within a secondary containment area. Therefore, any spills from the containers or tanks will be contained and will not be released into the surrounding areas.

9.5.2 Spill Response

In the event of a release of hazardous material into the environment, per the APP/SSHP/RPP, Shaw will contain or control the release or evacuate the area if the spill is significant or represents an immediate health threat. Spills, leaks, and fires at HPS must be reported to the RPM, ROICC, and CSO. In addition, all spills involving radioactive material must be reported to the PRSO and RASO. Absorbent pads, shovels, and 55-gallon drums will be kept on site to address the possibility of spills.

9.5.3 Spill/Release Reporting

The steps below outline the chain of communications that will be followed if a significant spill of any hazardous substance occurs. A significant spill is defined as any spill over the reportable quantity as determinable by federal and/or state regulations, as well as any spill below the reportable quantity that is not properly contained and releases into the environment.

1. Site personnel involved in the spill will immediately contact the Shaw Construction Manager and SSHO. At least one of the following two individuals will be on site during all remedial activities:

Construction Manager	Jim Click (303) 345-8998
SSHO	Mark Egan (925) 321-6169

The Shaw SSHO or Construction Manager will contact the RPM, ROICC, CSO, and RASO individuals identified below:

RPM	James Whitcomb (619) 532-0936
ROICC	Shirley Ng (510) 755-5878
CSO	Mike Mentink (415) 743-4729
RASO	Laurie Lowman (757) 887-7650 or Matthew Slack (757) 887-4212

2. If a release of a waste or hazardous substance, regardless of quantity, could threaten human health or the environment outside the facility, the PM will verify that the National Response Center (800-424-8802) and the local Emergency Response Coordinator (Fire Department) have been notified by the Navy. Releases will be reported, and written follow-up emergency notices will be submitted under the Superfund Amendments and Reauthorization Act, Title II requirements.

In concert with these actions, the Shaw PM or designee will make additional notifications within Shaw in accordance with the APP/SSHP/RPP and applicable Shaw SOPs and other policies.

In the event of a spill of radioactive material, Shaw will make appropriate notifications in accordance with its NRC license requirements. Notifications will also include the Navy RPM, RASO, potentially-affected Shaw subcontractors, and other appropriate parties.

9.6 Project and Personnel Requirements

Shaw personnel training requirements and inspection programs are described as follows. Protocols for inspections by regulatory agencies and third parties are also addressed.

9.6.1 Personnel Training/Certification Requirements

Project personnel training/certification requirements are as follows:

- OSHA 40-hour Hazardous Waste Operations and Emergency Response and annual 8-hour refresher training

- Radiation worker training
- D-1 Radiological Work Plan and Task-specific Plan training for the specific site or task
- Activity Hazard Analysis training for the specific task
- APP/SSHP/RPP training, as required
- Site personnel performing DOT functions, such as selecting, packaging, marking, labeling, preparing shipping papers for, and loading non-radiological wastes, must be trained in accordance with the requirements of DOT Course HM-126F
- Project personnel performing non-radiological waste management activities must be certified under Shaw's waste management training in accordance with Title 40 CFR, Parts 262.11 through 265.16
- Personnel handling/storing radioactive material will be trained in accordance with Shaw's NRC license requirements
- Only waste disposal contractors certified by DoD Executive Agency (Army Joint Munitions Command, Rock Island) will ship LLRW and LLMW. EMS is the Navy HPS basewide radiological waste disposal contractor

All Shaw project personnel (including Shaw subcontractors) will be trained according to Shaw's compliance policies and procedures and Radiological Protection Program, or equivalent. Shaw's personnel records will be verified along with the subcontractors' training records prior to beginning project activities.

Project-specific training/certification records will be kept on site until project completion. At project completion, the records will be filed within the project files.

9.6.2 Inspection and Audit Procedures

Site inspections and audits may occur during the removal activities to ensure compliance with applicable state and federal regulations, Shaw's NRC license and the APP/SSHP/RPP.

9.6.2.1 Internal Inspections by Shaw

Shaw inspections will be conducted regularly to document compliance with environmental health and safety regulations and Shaw's procedures. The inspection requirements are documented within this D-1 Sewer Work Plan, Shaw's procedures, and in the APP/SSHP/RPP.

9.6.2.2 Inspections by Regulatory Agencies

Regulatory inspections will be handled by Shaw in accordance with its compliance procedure for environmental inspections by regulatory agencies. These procedures require that, in addition to contacting the RPM and CSO, project personnel, or the PM must notify appropriate personnel.

NRC license inspections will be met by the Shaw License RSO or designee. Shaw will promptly notify RASO upon receiving notice of any intent to inspect, or of any actual inspection.

9.6.2.3 Designated Representative for Inspections by Regulatory Agencies

Shaw is the designated on-site representative for inspections of its work by regulatory agencies. Any non-regulatory third party requesting access to inspect the site must be referred to the Navy for access. Shaw personnel and its subcontractors must not grant site access or answer questions for unauthorized personnel. Shaw will notify the RPM and CSO of any attempts to gain site access by third parties.

Members of the media asking questions or attempting to access the project area will be referred to the RPM.

9.7 Documentation and Records Retention

Documentation of regulatory compliance issues and records retention will be conducted in accordance with the Shaw compliance procedures for documentation and records retention and *Installation Restoration Manual 2001* (Navy, 2001). Project documents will be retained for the contract-specified minimum or 10 years. In addition, compliance records will be maintained in accordance with the compliance procedure for documentation and records retention.

9.8 Updating the EPP

This EPP will be updated as needed to reflect changing site conditions.

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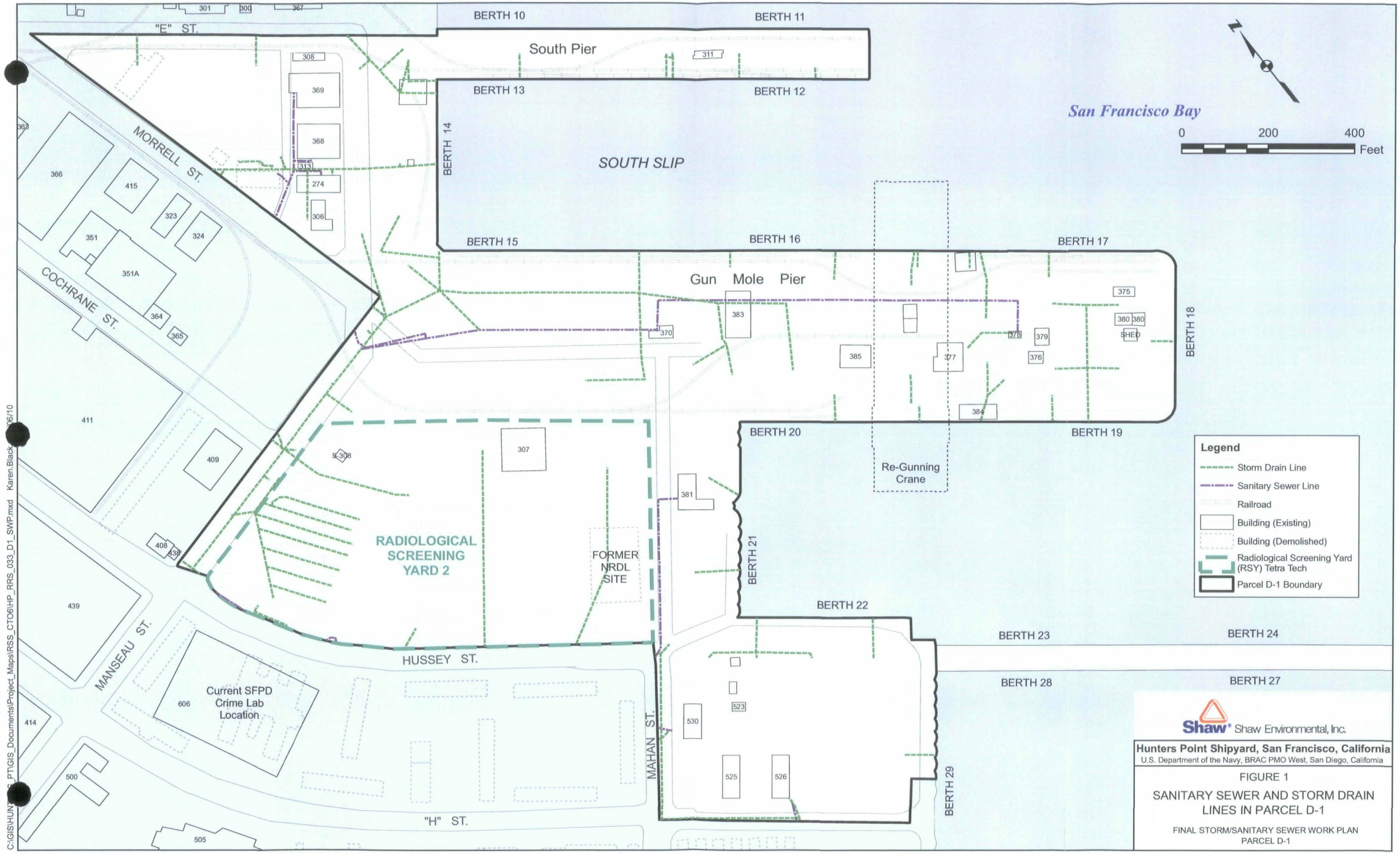
Figures


"E" ST.
MORRELL ST.
COCHRANE ST.
MANSEAU ST.
HUSSEY ST.
"H" ST.
MAHAN ST.
BERTH 10
BERTH 11
South Pier
BERTH 13
BERTH 12
BERTH 14
SOUTH SLIP
BERTH 15
BERTH 16
BERTH 17
Gun Mole Pier
BERTH 18
BERTH 19
BERTH 20
Re-Gunning Crane
BERTH 21
BERTH 22
BERTH 23
BERTH 24
BERTH 28
BERTH 27
BERTH 29
San Francisco Bay
0 200 400 Feet
RADIOLOGICAL SCREENING YARD 2
FORMER NRDL SITE
Current SFPD Crime Lab Location
SHED
Legend
Storm Drain Line
Sanitary Sewer Line
Railroad
Building (Existing)
Building (Demolished)
Radiological Screening Yard (RSY) Tetra Tech
Parcel D-1 Boundary
Shaw Environmental, Inc.
Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California
FIGURE 1
SANITARY SEWER AND STORM DRAIN LINES IN PARCEL D-1
FINAL STORM/SANITARY SEWER WORK PLAN
PARCEL D-1
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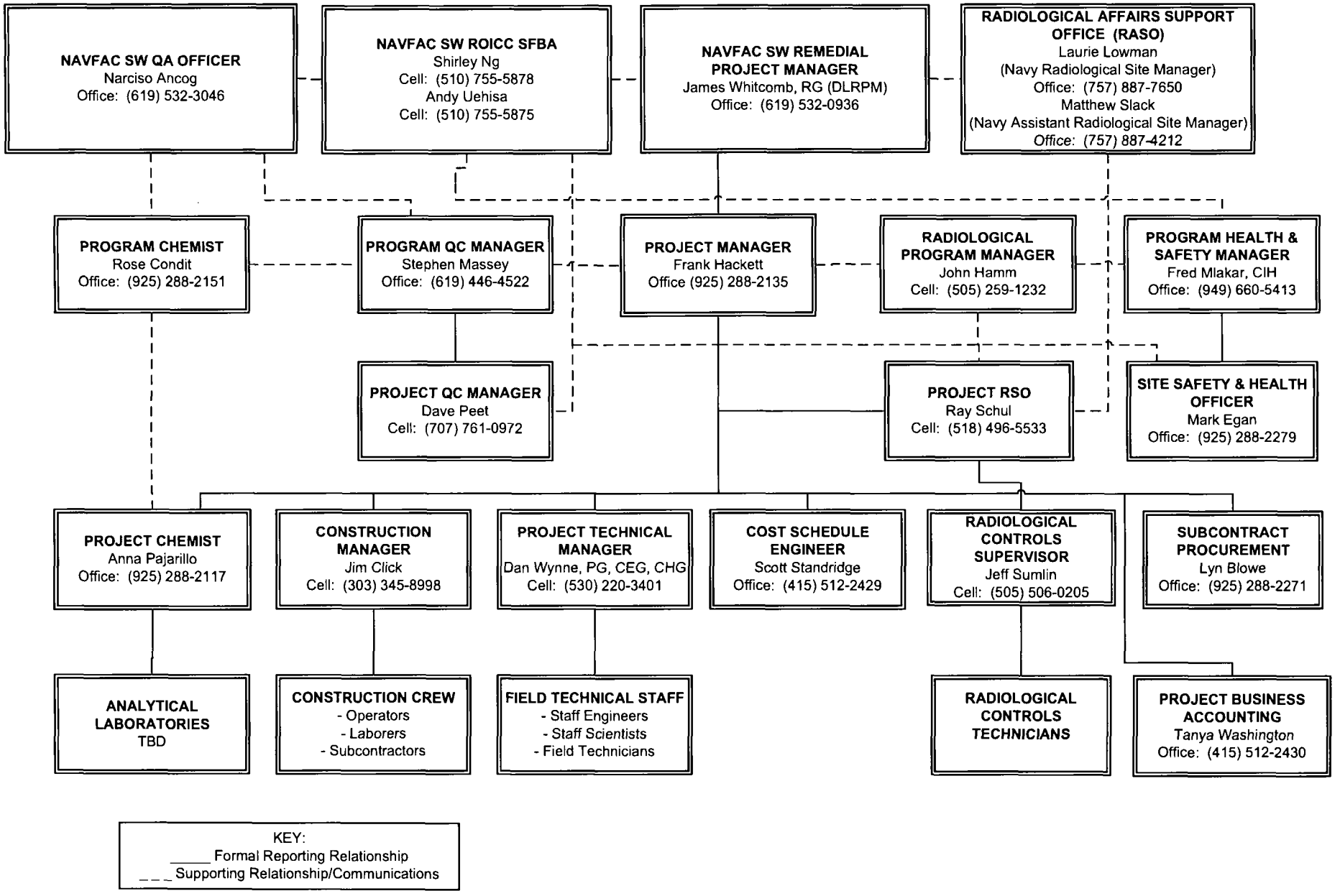
Hunters Point Shipyard (CTO #0006)
Project Organization

Figure 2



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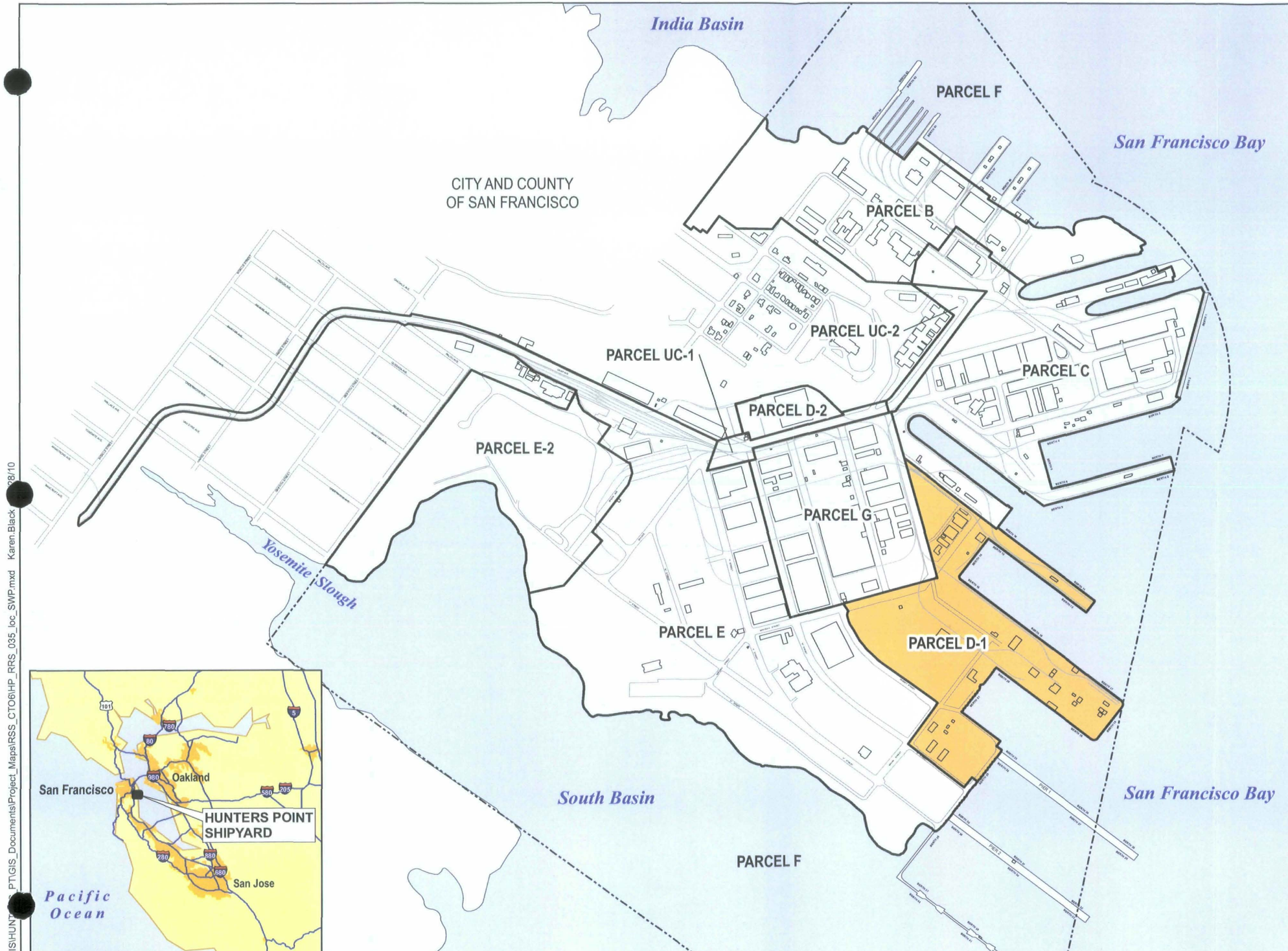
7/7/2010



Legend

- Parcel D-1
- Parcel Boundary
- Parcel F Boundary
- Buildings

N

0 800 1,600 Feet

Shaw® Shaw Environmental, Inc.

Hunters Point Shipyard, San Francisco, California

U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 3

HUNTERS POINT SHIPYARD AND PARCEL D-1 LOCATION MAP

STORM DRAIN AND SANITARY SEWER REMOVAL WORK PLAN, PARCEL D-1

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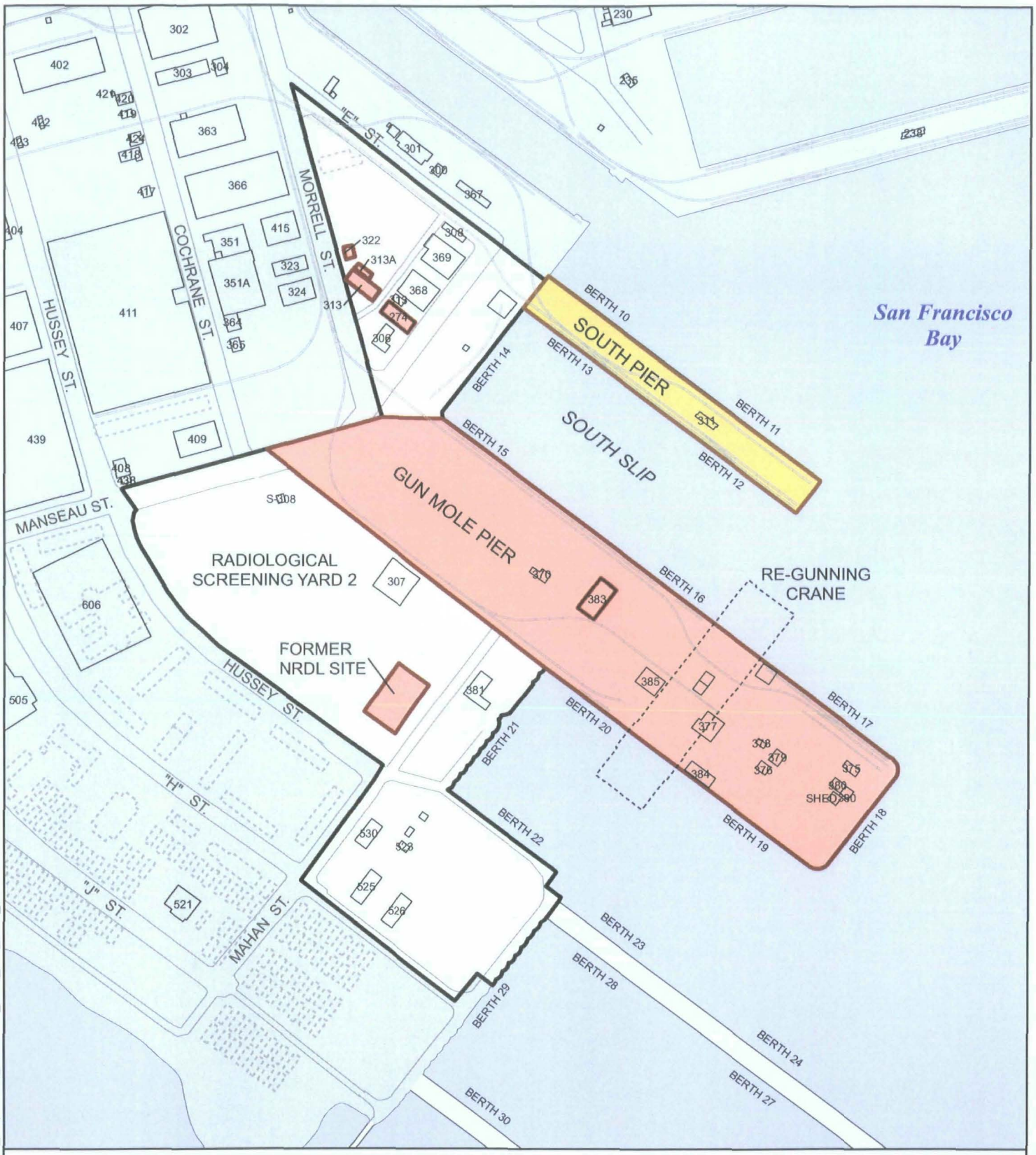

Radiologically Impacted Building or Site per HRA

Radiologically Impacted Building or Site per Navy Contract (CTO 0006)

Parcel D-1 Boundary (includes Gun Mole and South Piers)

Railroad

Building (Existing)

Building (Demolished)

0 400 800 Feet

Note: Parcel D-1 berths are raiologically impacted.

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U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 4

RADIOLOGICALLY IMPACTED AREAS PARCEL D-1

FINAL STORM/SANITARY SEWER WORK PLAN PARCEL D-1

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Tables

Table 1
Radionuclides of Concern for Parcel D-1 Sewer Removal

Domain	ROCs						
	^{137}Cs	^{226}Ra	^{90}Sr	^{239}Pu	^{232}Th	^{152}Eu	^{3}H
Storm Drain and Sanitary Sewer Systems – throughout the entire parcel	•	•	•	These ROCs are not for Parcel D-1 sewers outside of radiologically-impacted areas			
Sewers within Building 274 Radiologically-Impacted Area	•	•	•	•	•		
Sewers within Building Site 313 Radiologically-Impacted Area	•	•	•	•	•		
Sewers within Building Site 313A Radiologically-Impacted Area	•	•	•	•	•		
Sewers within Building 322 Radiologically-Impacted Area	•	•	•	•	•		
Sewers within Building 383 Radiologically-Impacted Area	•	•	•				•
Sewers within NRDL Site Radiologically-Impacted Area	•	•	•	•			
Sewers within Gun Mole Pier Radiologically-Impacted Area	•	•	•	•		•	
Sewers within South Pier Radiologically-Impacted Area	•	•	•	•			

Radiologically-Impacted Areas defined in accordance with Final Historical Radiological Assessment (NAVSEA, 2004) and shown on Figure 4 of this work plan.

Table 2
Release Criteria

Radionuclide	Applicability within Parcel D-1		Soil[a] (pCi/g)		Water (pCi/L)[c]
	All Sewers	Sewers within One or More Specific Radiological Sites[b]	Residential	Outdoor Worker	
Cesium-137	Yes	(all sewers)	0.113	0.113	119
Radium-226	Yes	(all sewers)	1.0[d]	1.0[d]	5[e]
Strontium-90	Yes	(all sewers)	0.331	10.8	8
Europium-152	No	Gun Mole Pier	0.13[f]	0.13[f]	60
Plutonium-239	No	Gun Mole Pier, South Pier, Buildings 313, 313A and 322 Sites, and NRDL Site	2.59	14.0	15
Thorium-232	No	Gun Mole Pier, South Pier, Buildings 313, 313A and 322 Sites, and NRDL Site	1.69	2.7	15
Tritium	No	Building 383 Area	2.28	4.23	20,000

NOTES:

[a] The on-site and off-site laboratory will ensure that the MDA meets the listed release criteria by increasing sample size or counting time as necessary. The MDA is defined as the lowest net response level, in counts, that can be seen with a fixed level of certainty, customarily 95 percent. The MDA is calculated per sample by considering background counts, amount of sample used, and counting time.

[b] Radiological Sites within Parcel D-1 are: Building 274; Building 383 Site; Buildings 313, 313A and 322 Sites; Former NRDL Site; Gun Mole Pier; and South Pier.

[c] Release criteria for water have been derived from Radionuclides Notice of Data Availability Technical Document (EPA, 2000) by comparing the limits from two criteria and using the most conservative limit.

[d] Limit is 1 pCi/g above background per agreement with EPA.

[e] Limit is for total radium concentration

[f] Based on EPA-decay corrected PRGs for commercial reuse and a previous action memorandum (TtEMI, 2000, 2001)

EPA denotes U.S. Environmental Protection Agency.

MDA denotes minimum detectable activity.

pCi/g denotes picocurie per gram.

pCi/L denotes picocurie per liter.

Table 3
Summary of Potential Chemical-Specific ARARs

Type/Name of Potential ARAR	Citation	Description and Comments	Potentially Applicable or Relevant and Appropriate
RCRA	42 USC 6901 et seq. 40 CFR 240-271	RCRA establishes standards for the generation, management, and disposal of solid and hazardous waste. RCRA is relevant and appropriate in that solid wastes generated from remedial actions at the site may result in the generation and disposal of solid or hazardous waste subject to RCRA requirements.	Relevant and Appropriate
Standards Applicable to Generators of Hazardous Waste	22 CCR 66262.10 et seq.	These standards are applicable to all generators of hazardous waste in the state of California and are implemented by the Division of Toxic Substances Control. Generators are required to obtain an EPA identification number and to adequately characterize wastes to determine if they are hazardous.	Applicable

ARAR denotes applicable or relevant and appropriate requirement.
CCR denotes California Code of Regulations.
CFR denotes Code of Federal Regulations.
EPA denotes U.S. Environmental Protection Agency.
RCRA denotes Resource Conservation and Recovery Act.
USC denotes United States Code.

Table 4
Summary of Potential Location-Specific ARARs

Type/Name of Potential ARAR	Citation	Description and Comments	Potentially Applicable or Relevant and Appropriate
CWA	33 USC 1344 et seq., Section 404	The CWA regulates the discharge of non-toxic and toxic pollutants by specific and non-specific sources. Section 404 specifically regulates dredging and discharging of fill material to waterways. Permits are required as part of the Section 404 requirements; however, because the project is being completed under CERCLA authority, a permit is not necessary. The substantive aspects of the permit will be followed.	Relevant and Appropriate
Executive Order No. 11990, Protection of Wetlands	Executive Order No. 11990	This presidential order mandates that agencies shall take action to minimize the destruction, loss, or degradation of wetlands. Site activities will not occur in designated wetlands. Wetlands located outside of the remediation area will remain unaffected by site activities.	Relevant and Appropriate
Porter-Cologne Water Quality Control Act, as administered by the SWRCB and the Regional Water Quality Control Board, San Francisco Bay Region	California Water Code, Division 7, Section 13000	This act defines legislative intent to attain the highest water quality reasonable considering the demands on the resource. It applies to all groundwater and soil remediation projects where groundwater protection is an issue. This is applicable to the extent that groundwater will not be degraded as a result of the actions taken to remove radioactive sources from the site.	Applicable
San Francisco Bay Water Quality Control Plan (Basin Plan; 1995)	Basin Plan	This plan defines beneficial uses for groundwater, wetlands, and surface waters (including San Francisco Bay) throughout the Basin.	Applicable
Endangered Species Act	16 USC 1531-1543	The Endangered Species Act protects listed species and their habitat in the area of the proposed remedial action. To the extent such species are present at the site, this requirement is potentially applicable.	Relevant and Appropriate
Coastal Zone Management Act	16 USC 1451 - 1464	This act requires federal agencies conducting or supporting activities directly affecting the coastal zone to ensure that such activities are consistent with the state program. "Coastal Zone" is defined as the "coastal waters...and the adjacent shore lands (including the waters therein and hereunder) strongly influenced by each other and in proximity to the shorelines of several coastal states, and includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches...The zone extends inland from the shorelines only to the extent necessary to control shore lands, the uses of which have a direct and significant impact on the coastal water."	Relevant and Appropriate

Table 4 (continued)
Summary of Potential Location-Specific ARARs

ARAR denotes applicable or relevant and appropriate requirement.

CERCLA denotes Comprehensive Environmental Response, Compensation, and Liability Act.

CWA denotes Clean Water Act.

SWRCB denotes State Water Resources Control Board.

USC denotes United States Code.

– California Water Board.

Table 5
Summary of Potential Action-Specific ARARs

Type/Name of Potential ARAR	Citation	Description and Comments	Potentially Applicable or Relevant and Appropriate
BAAQMD Regulations under the CAA	BAAQMD Regulations 6-301, 6-302, and 6-305	Regulation 6 – Particulate Matter and Visible Emissions discusses standards and limitations for emissions of PM_{10}. Emissions are not permitted to leave the boundary of the site. Due to the nature of operations, it is anticipated that emissions could potentially occur; therefore, mitigation measures will be implemented. These will include frequent watering of dirt roads and misting of areas where emissions might be expected to occur. Additionally, a Dust Control Plan will be implemented.	Applicable
California Air Resources Board Asbestos Airborne Toxic Control Measures for Construction, Grading, Quarrying, and Surface Mining Operations	BAAQMD Regulation 11, Rule 15	This regulation defines specific requirements and site controls that need to be met where grading may occur. An Asbestos Dust Mitigation Plan will be prepared to document the measures that will be taken to prevent airborne exposure to asbestos fibers resulting from the disturbance of serpentine-containing soils.	Applicable
RCRA AOC Policy	55 Federal Register 8758-8760	The preamble to the NCP discusses the AOC policy. EPA interprets RCRA to allow certain discrete areas of contamination to be considered RCRA units. Because of this, consolidation of hazardous waste within the AOC does not create a new point of hazardous waste generation for purposes of RCRA. All wastes will be managed within the AOC to allow for reconsolidation following radioactive source screening.	Applicable
RCRA Land Disposal Restrictions	22 CCR 66268.7 et seq.	This regulation describes standards applicable to the disposal of hazardous waste on land. It is applicable because RCRA-hazardous wastes may be disposed of off site, requiring LDRs. Notifications will be prepared for all RCRA-regulated wastes. Soils, which are screened for radioactive materials and returned to the excavations, will not trigger the LDR requirements, as they will be managed under the AOC policy.	Applicable
Staging Piles	40 CFR 264.554	Staging piles may be used on site for temporary accumulation of non-flowable hazardous wastes. Wastes will not be treated while in the pile and may be stored for up to 2 years. This regulation will allow for temporary waste storage that will not trigger LDR requirements.	Applicable
DTSC Hazardous Waste Transportation	22 CCR 262.20-23 22 CCR 262.30-33	These regulations provide specifics for manifest usage during hazardous waste transportation. Additionally, they mandate compliance with DOT regulations for packaging, labeling, marking, and placarding.	Applicable
NPDES Permit as	Order 99-08	The State of California implements the CWA by requiring	Applicable

Table 5 (continued)
Summary of Potential Action-Specific ARARs

Type/Name of Potential ARAR	Citation	Description and Comments	Potentially Applicable or Relevant and Appropriate
managed by the SWRCB		permits for discharges to navigable waters. It is expected that a NPDES General Permit for Construction Activities will be required. A Stormwater NPDES General Permit requires the implementation of Best Management Practices, implementation of an SWPPP, implementation of a stormwater monitoring program, and the elimination of non-stormwater discharges.	
DOT Hazardous Material Regulations	49 CFR 171 and 172	These regulations specify requirements for packaging, labeling, marking, manifesting, placarding, and safe transport of hazardous materials (including hazardous waste). All requirements will be adhered to and DOT-trained personnel will perform DOT functions.	Applicable
Storage and Control of Licensed Material	10 CFR 20.1801	This regulation requires the securing of radioactive materials to prevent unauthorized access by unauthorized persons. Radioactive wastes will be secured to prevent unauthorized access prior to transport off site.	Applicable

AOC denotes Area of Contamination.
ARAR denotes applicable or relevant and appropriate requirement.
BAAQMD denotes Bay Area Air Quality Management District.
CAA denotes Clean Air Act.
CCR denotes California Code of Regulations.
CFR denotes Code of Federal Regulations.
CWA denotes Clean Water Act.
DOT denotes Department of Transportation.
DTSC denotes Department of Toxic Substances Control.
EPA denotes U.S. Environmental Protection Agency.
LDR denotes land disposal restriction.
NCP denotes National Oil and Hazardous Substances Pollution Contingency Plan.
NPDES denotes National Pollutant Discharge Elimination System.
PM_{10} denotes particulate matter less than 10 microns in diameter.
RCRA denotes Resource Conservation and Recovery Act.
SWPPP denotes Stormwater Pollution Prevention Plan.
SWRCB denotes State Water Resources Control Board.

Table 6
Instrumentation for Radiological Surveys

Measurement/ Technique	Primary Use	Type of Instrumentation: Detector Type and Ludlum Model Number(s)	Type of Instrumentation: Meter Description and Ludlum Model Number(s) or equivalent	Typical Background	Typical Total Efficiency (%)	Detection Sensitivity	Typical Minimum Detectable Concentration
Surface alpha/beta scans	Equipment, materials, and debris	Large-area gas - proportional 43-68 (126 cm^2)	Data logger 2360	150-250 cpm β^- 0-2 cpm α	~6 β^- total efficiency ~6 α total efficiency	900 dpm/100 cm^2 β^- 100 dpm/100 cm^2 α	553 dpm/ 100 cm^2 β^- 53 dpm/ 100 cm^2 α
Direct measurement static alpha/beta		Scintillation, Ludlum Model 43-93 (100 cm^2)		100-200 cpm β^- 0-5 cpm α			
Surface gamma scans	Equipment, materials, debris and trenches	NaI 2-inch x 2-inch scintillation Ludlum Model 44-10	Data logger 2221	5,000 cpm γ	N/A	1,500 cpm γ 1.6 pCi/g ^{137}Cs 1.34 pCi/g ^{226}Ra	353 cpm γ
Direct measurement static gamma	Trenches and excavated soil						
Surface beta/gamma scans	Equipment, materials, debris, and personnel	Geiger-Mueller Ludlum Model 44-9	Ratemeter 3	50 to 100 cpm β^- γ	~10 β^- γ total efficiency	~ 1,000 dpm per probe area β^- γ	358 dpm/100 cm^2 β^- γ
Direct measurement static beta/gamma	Equipment, materials, debris, and personnel						
Exposure rates	All inclusive	MicroR Meter with integral 1-inch x 1-inch NaI scintillation	Ratemeter 19	7-8 µR/hr	N/A	2 µR/hr	N/A

α denotes alpha
β^- denotes beta
γ denotes gamma.
N/A denotes not applicable.
µR/hr denotes microroentgen per hour.
cm^2 denotes square centimeters.
^{137}Cs denotes cesium-137.
dpm denotes disintegrations per minute.
cpm denotes counts per minute.
NaI denotes sodium iodide.
pCi/g denotes picocurie per gram.
^{226}Ra denotes radium-226.

Table 7
On-Site Laboratory Instrumentation

Laboratory Instruments				
Measurement/ Technique	**Type of Instrumentation***	**Typical Background**	**Typical Efficiency (%)**	**Detection Sensitivity**
Gamma spectroscopy	High-purity Germanium Detector	N/A	N/A	0.05 pCi/g (for ^{137}Cs) 0.5 pCi/g (for ^{226}Ra)
Gross alpha and beta/gamma on swipes (swipes)	Protean IPC9025 low-background gas-flow proportional counter	1-5 cpm β^- 0-0.5 cpm α	~62 β ~27 α	4-10 dpm/100 cm^2 β^- 2-5 dpm/100 cm^2 α
^{90}Sr Analysis	Protean low-background gas-flow proportional counter	N/A	~30% ^{90}y ~30% ^{90}Sr	0.070 pCi/g
Alpha Spectroscopy	Octec 8 chamber analyzer		~30% α	0.020 pCi/g

** or equivalent*

Types of radiation: α - alpha, β - beta

cm^2 denotes square centimeters.

cpm denotes count per minute.

^{137}Cs denotes cesium-137.

dpm denotes disintegration per minute.

N/A denotes not applicable.

pCi/g denotes picocurie per gram.

^{226}Ra denotes radium-226.

RRO denotes radiological remedial objective.

^{90}Sr denotes strontium-90.

^{90}y denotes yttrium-90.

Table 8
Equipment and Materials Release Criteria

Contaminant	Removable[a] (dpm/100 cm^2)	Total[a] (dpm/100 cm^2)
^{226}Ra	20 α	100 α
^{137}Cs	1000 β^-, γ	5,000 β^-, γ
^{90}Sr	200 β^-	1000 β^-
^{152}Eu	1000 β^-, γ	5000 β^-, γ
^{239}Pu	20 α	100 α
^{232}Th	20 α	100 α
^{3}H	5000 β^-	NA

[a] These limits are for the release of equipment and materials and are based on Regulatory Guide 1.86 (Atomic Energy Commission, 1974).

Types of radiation: α denotes alpha, γ denotes gamma, β^- denotes beta

cm^2 denotes square centimeters.

dpm denotes disintegration per minute.

Table 9
Derived Airborne Concentrations

Radionuclide	Worker	
	DAC (μCi/mL)	10% DAC (μCi/mL)
^{226}Ra	3.0×10^{-10}	3.0×10^{-11}
^{137}Cs	2.0×10^{-9}	2.0×10^{-10}
^{90}Sr	6.0×10^{-8}	6.0×10^{-9}
^{152}Eu	1.0×10^{-8}	1.0×10^{-9}
^{239}Pu	3.0×10^{-12}	3.0×10^{-13}
^{232}Th	5.0×10^{-13}	5.0×10^{-14}
^{3}H	2.0×10^{-5}	2.0×10^{-6}

The above guideline values were determined using the NRC's 10 CFR, Part 20, Appendix B.

μCi/mL denotes microcuries per milliliter (activity).
CFR denotes Code of Federal Regulations.
DAC denotes derived airborne concentration.
NRC denotes Nuclear Regulatory Commission.

Table 10
Threatened and Endangered Species at or Near HPS

Scientific Name	Common Name	HPS Observations	Designation Codes
Ocnorhynchus tshawytscha	Chinook salmon	Observed	SSC, SE, FT
Gavia immer	Common loon	Observed	SSC
Pelecanus erythrorhychos	American white pelican	May be present	SSC
Pelecanus occidentalis californicus	California brown pelican	Observed	SE, FE
Phalacrocorax auritus	Double crested cormorant	Observed	SSC
Bucephala islandica	Barrow's goldeneye	Observed	SSC
Charadrius alexandrinus	Snowy plover	May be present	SSC
Numenius madagascariensis	Long-billed curlew	Observed	SSC
Larus californicus	California gull	Observed	SSC
Sterna caspia	Caspian tern	May be present	SSC
Sterna elegans	Elegant tern	May be present	SSC
Circus cyaneus	Northern harrier	May be present	SSC
Pandion haliaetus	Osprey	Observed	SSC
Falco peregrinus	Peregrine falcon	Observed	SE, FE
Asio flammeus	Short-eared owl	May be present	SSC
Athene cunicularia	Burrowing owl	Observed	SSC
Eremophila alpestris	Horned lark	May be present	SSC
Lanius ludovicianus	Loggerhead shrike	Observed	SSC
Geothlypis trichas	Common yellowthroat	May be present	SSC
Melospiza melodia	Song sparrow	May be present	SSC

Source: Base-Wide Radiological Work Plan, Hunters Point Shipyard, San Francisco, California, Revision 1, October 5, 2007. Tetra Tech EC, Inc.

FE denotes listed as endangered by the federal government.
FT denotes listed as threatened by the federal government.
HPS denotes Hunters Point Shipyard.
SE denotes listed as endangered by the State of California.
SSC denotes California Department of Fish and Game Species of Special Concern.

Appendix A
Sampling and Analysis Plan

SAP Worksheet #1 – Title and Approval Page

Final
Sampling and Analysis Plan
(Field Sampling Plan and Quality Assurance Project Plan)
July 9, 2010

Parcel D-1 Storm Drain and Sanitary Sewer Removal
Hunters Point Shipyard, San Francisco, California
Document Control Number: SHAW-8822-0006-0148

Prepared for:
U.S. Department of the Navy
Base Realignment and Closure
Program Management Office West
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Naval Facilities Engineering Command, Southwest
EMAC Contract Number N62473-08-D-8822
Contract Task Order 0006

Review Signatures: Rose Condit Date: July 9, 2010
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Infrastructure, Inc.
Program Chemist

Approval Signatures: Nars Ancog Date: 7/14/2010
Nars Ancog
U.S. Navy Quality Assurance Officer

EXECUTIVE SUMMARY

This Sampling and Analysis Plan (SAP) has been prepared by Shaw Environmental & Infrastructure, Inc. (herein referred to as Shaw) to support the storm drain (SD) and sanitary sewer (SS) systems removal within Parcel D-1 at Hunters Point Shipyard. The removal is being performed to support the radiological remediation unrestricted release of Parcel D-1 of Hunters Point Shipyard (HPS), in San Francisco, California. A location map for HPS identifying the boundaries of Parcel D-1 is shown Figure 1.

The *Final Historical Radiological Assessment* (Naval Sea Systems Command [NAVSEA], 2004) and Shaw's contract with the U.S. Department of the Navy (Navy) (Contract N62473-08-D-8822, Contract Task Order 0006) identified eight areas/features in Parcel D-1 as radiologically-impacted areas, including the SD and SS systems (Figure_2). This SAP addresses the radiological survey and removal of the SD and SS systems within Parcel D-1. The other areas or features in Parcel D-1 that are radiologically impacted are addressed in the SAP appended to the *Parcel D-1 Radiological Work Plan, Hunters Point Shipyard* (Shaw, 2010a).

The radionuclides of concern (ROCs) identified for the Parcel D-1 SD and SS systems are cesium-137 (^{137}Cs), radium-226 (^{226}Ra), and Strontium-90 (^{90}Sr) (NAVSEA, 2004).

This SAP will be used as a reference document by all field and laboratory personnel engaged in the sampling and analysis activities for this removal project. Included in this SAP are data quality objectives, field sampling procedures, quality assurance (QA)/quality control requirements, and data gathering methods that will be used for this SD and SS systems removal project. The QA elements of this SAP were prepared in accordance with the *Uniform Federal Policy for Quality Assurance Project Plans* (UFP-QAPP) (U.S. Environmental Protection Agency [EPA], 2005) to ensure that all data collected are precise, accurate, representative, complete, and comparable to meet their intended use.

Prior radiological investigations have confirmed the presence of ^{226}Ra and ^{137}Cs within the HPS SD and SS systems. The presence of other radionuclides, such as ^{90}Sr, will be assessed during the screening process activities.

This SAP will govern the removal of SD and SS piping from within other identified areas or features of Parcel D-1, including several piers and building sites. For those radiologically-impacted areas or features of Parcel D-1 that are identified (NAVSEA, 2004) to have ROCs in addition to ^{137}Cs, ^{226}Ra, and ^{90}Sr. The additional ROCs for the other radiologically-impacted areas or features are listed in Table 1 of the *Project Work Plan Parcel D-1 Storm Drain and Sanitary Sewer Removal* (Shaw, 2010b) and will be evaluated during the SD and SS systems removal within those areas or features.

Table 1 provides the release criteria for these and other radionuclides of concern at HPS that have been established by the Navy in agreement with the EPA, Region IX.

Table 1
Release Criteria

Radionuclide of Concern	Surfaces (dpm/100 cm²)		Soil [a] (pCi/g)		
	Equipment Waste [b]	Structures [c]	Outdoor Worker [d]	Residential [d]	Water [e] (pCi/L)
Cesium-137	5,000	5,000	0.113	0.113	119
Europium-152	5,000	5,000	0.13 [f]	0.13 [f]	60
Plutonium-239	100	100	14.0	2.59	15
Radium-226	100	100	1.0 [f]	1.0 [f]	5 [g]
Strontium-90	1,000	1,000	10.8	0.331	8
Thorium-232	1,000	36.5	2.7	1.69	15
Tritium	5,000	5,000	4.23	2.28	20,000

Notes:
BOLDED ROCs are identified for the entire SD and SS systems within Parcel D-1. UNBOLDED ROCs are indicated only for the SD and SS systems within other identified radiologically-impacted areas or features of Parcel D-1 (NAVSEA, 2004).

[a] *EPA Preliminary Remediation Goals for two future-use scenarios.*

[b] *These limits are based on U.S. Atomic Energy Commission (AEC) Regulatory Guide 1.86 (AEC, 1974). Limits for removable surface activity are 20 percent of these values.*

[c] *These limits are based on 25 mrem/yr, using RESRAD-Build Version 3.3 or Regulatory Guide 1.86 (AEC, 1974), whichever is lower.*

[d] *The on-site and off-site laboratory will ensure that the minimum detectable activity (MDA) meets the listed release criteria by increasing sample size or counting time as necessary. The MDA is defined as the lowest net response level, in counts, that can be seen with a fixed level of certainty, customarily 95 percent. The MDA is calculated per sample by considering background counts, amount of sample used, and counting time.*

[e] *Release criteria for water have been derived from Radionuclides Notice of Data Availability Technical Support Document, (EPA, 2000) by comparing the limits from two criteria and using the most conservative limit.*

[f] *Limit is 1 picocuries per gram (pCi/g) above background per agreement with EPA.*

[g] *Limit is for total radium concentration.*

dpm denotes disintegrations per minute.
cm² denotes square centimeters.
pCi/g denotes picocuries per gram.
pCi/L denotes picocuries per liter.

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Acronyms

^{3}H	tritium
^{90}Sr	strontium-90
^{137}Cs	cesium-137
^{152}Eu	europium-152
^{226}Ra	radium-226
^{232}Th	thorium-232
^{239}Pu	plutonium-239
α	alpha
β	beta
γ	gamma
AEC	U.S. Atomic Energy Commission
BFB	bromofluorobenzene
bgs	below ground surface
CARB	California Air Resources Board
CCC	calibration check compounds
CCSF	City and County of San Francisco
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF	calibration factor
cm^2	square centimeter
COD	chemical oxygen demand
CoC	chain of custody
CSO	Caretaker Site Office
cy	cubic yard
D-1 Design Plan	*Design Plan for the Parcel D-1 Sanitary Sewer and Storm Drain Removal*
D-1 Execution Plan	*Draft Final Execution Plan for the Parcel D-1 Radiological Remediation and Support*
D-1 Radiological Work Plan	*Draft Final Parcel D-1Radiological Work Plan*
D-1 Sewer Work Plan	*Draft Final Project Work Plan Parcel D-1 Storm Drain and Sanitary Sewer Removal*
DoD	U.S. Department of Defense
DOT	U.S. Department of Transportation
dpm	disintegrations per minute
DQI	Data Quality Indicator
DQA	Data Quality Assessment
DTSC	California Department of Toxic Substances Control
ECD	electron capture detector
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
EMS	Environmental Management Systems, Inc.
FID	flame ionization detector
FSS	final status survey

Acronyms (Continued)

ft/yr	feet per year
GC	gas chromatograph
H&S	health and safety
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDPE	high density polyethylene
HPS	Hunters Point Shipyard
HSO	Health and Safety Officer
ICAL	initial multipoint calibration
ICP	inductively coupled plasma
ICS	interference check solution
ICV	initial calibration verification
IDL	instrument detection limit
IR	Installation Restoration
L	liter
LCD	laboratory control duplicate
LCS	laboratory control sample
LLRW	low-level radioactive waste
m^2	square meter
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDA	minimum detectable activity
MDL	method detection limit
mg/kg	milligram per kilogram
mL	milliliter
MS	mass spectrometer (generally in association with GC)
MS	matrix spike (generally in association with MSD)
MSD	matrix spike duplicate
NaI	sodium iodine
NAVFAC SW	Naval Facilities Engineering Command Southwest
NAVSEA	Naval Seas System Command
Navy	U.S. Department of the Navy
NOA	Naturally Occurring Asbestos
NPL	National Priorities List
NRDL	National Radiological Defense Laboratory
NWT	New World Technology
OCP	organic chlorine pesticide
OSHA	Occupational Safety and Health Administration
PAH	polycyclic (or polynuclear) aromatic hydrocarbon
PCB	polychlorinated biphenyl
pCi/g	picocuries per gram
pCi/L	picocuries per liter
PM	Project Manager
POC	point of contact
PPE	personal protective equipment
PQL	project quantitation limits

Acronyms (Continued)

PQO	project quality objectives
PRSO	Project Radiation Safety Officer
QA	quality assurance
QAMS	Quality Assurance Management Staff
QAO	Quality Assurance Officer
QC	quality control
QL	quantitation limit
QSM	Quality System Manual
RASO	Radiological Affairs Support Office
RER	relative error ratio
RF	response factor
RL	reporting limit.
ROC	radionuclides of concern
ROICC	Resident Officer In Charge of Construction
RPD	relative percent difference
RPM	Remedial Project Manager
RSD	relative standard deviation
RSL	regional screening level
RSO	Radiation Safety Officer
RSY	Radiological Screening Yard
SAP	Sampling and Analysis Plan
SD	storm drain
SF Bay	San Francisco Bay
SOP	Standard Operating Procedure
SPCC	system performance check compound
SS	sanitary sewer
SSHO	Site Safety and Health Officer
STD	standard
SU	survey unit
SVOC	semi-volatile organic compounds
T&D	transportation and disposal
TA	Test America, Inc.
TBD	to be determined
TPH	total petroleum hydrocarbon
TRPH	total recoverable petroleum hydrocarbon
TSA	Technical Systems Audit
TSS	Total suspended solids
TtEC	TetraTech EC, Inc.
UFP-QAPP	Uniform Federal Policy - Quality Assurance Project Plan
VOA	volatile organic analysis
VOC	volatile organic compound
VSP	visual sampling plan
Water Board	San Francisco Bay Regional Water Quality Control Board
WS	Worksheet

SAP Worksheet #2 – SAP Identifying Information

Site Name/Number:	**Hunters Point Shipyard (HPS)**
Parcel:	**Parcel D-1**
Contractor Name:	**Shaw Environmental & Infrastructure, Inc. (Shaw)**
Contract Number:	**N62473-08-D-8822,**
Contract Title:	**EMAC**
Work Assignment Number (optional):	**Contract Task Order 0006**

1. This Sampling and Analysis Plan (SAP) was prepared in accordance with the requirements of the U.S. Environmental Protection Agency (EPA) *Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP)* (EPA, 2005) and *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, Quality Assurance Management Staff (QAMS)* (EPA, 2001). With additional guidance from:
    - Quality Systems Manual for Environmental Laboratories Version 4.1 (U.S. Department of Defense [DoD], 2009)
    - Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4 (EPA, 2006a)
    - *Environmental Work Instruction 3EN2.1 – Chemical Data Validation* (Naval Facilities Engineering Command Southwest [NAVFAC SW], 2001)
    - Environmental Work Instruction 2 – Review, Approval, Revision, and Amendment of SAPs (NAVFAC SW, 2006)
2. Identify regulatory program: Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
3. This is a project-specific SAP
4. List dates of scoping sessions that were held:

Kickoff meeting July 15, 2009

5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation.

Title	Date
Final SAP, Base-Wide Storm Drain and Sanitary Sewer Removal Hunters Point Shipyard, San Francisco, CA,	*Tetra Tech, EC. Inc(TtEC) October 9, 2009*

SAP Worksheet #2 – SAP Identifying Information (continued)

6. List organizational partners (stakeholders) and connection with lead organization: Example for project-specific SAPs:

Lead Regulatory Oversight by the EPA, Region 9
Department of Toxic Substance Control (DTSC)
San Francisco Regional Water Quality Control Board (Water Board), Radiological Affairs Support Office (RASO)

7. Lead organization: NAVFAC SW

8. If any required SAP elements or 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:

Worksheet #13 (Secondary Data Sources) is not applicable for this project as secondary data evaluation is not required.

SAP Worksheet #2 – SAP Identifying Information (continued)

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
A. Project Management		
Documentation		
1	Title and Approval Page	
2	Table of Contents; SAP Identifying Information	
3	Distribution List	
4	Project Personnel Sign-Off Sheet	
Project Organization		
5	Project Organizational Chart	
6	Communication Pathways	
7	Personnel Responsibilities and Qualifications Table	
8	Special Personnel Training Requirements Table	
Project Planning/ Problem Definition		
9	Project Planning Session Documentation (including Data Needs Tables); Project Scoping Session Participants Sheet	
10	Problem Definition, Site History, and Background. Site Maps	
11	Site-Specific Project Quality Objectives	
12	Measurement Performance Criteria Table	
13	Sources of Secondary Data and Information Secondary Data Criteria and Limitations Table	No secondary data used for this project
14	Summary of Project Tasks	
15	Reference Limits and Evaluation Table	
16	Project Schedule/Timeline Table	
B. Measurement Data Acquisition		
Sampling Tasks		
17	Sampling Design and Rationale	
18	Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table; Sample Location Map(s)	
19	Analytical Methods/SOP Requirements Table	
20	Field Quality Control (QC) Sample Summary Table	
21	Project Sampling SOP References Table Sampling SOPs	
22	Field Equipment Calibration, Maintenance, Testing, Inspection Table	

SAP Worksheet #2 – SAP Identifying Information (continued)

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
Analytical Tasks		
23	Analytical SOPs; Analytical SOP References Table	
24	Analytical Instrument Calibration Table	
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	
Sample Collection		
26	Sample Handling System, Documentation Collection, Tracking, Archiving and Disposal ;Sample Handling Flow Diagram	
27	Sample Custody Requirements, Procedures/SOPs Sample Container Identification; Example Chain-of-Custody Form	
Quality Control Samples		
28	QC Samples Table Screening/Confirmatory Analysis Decision Tree	
Data Management Tasks		
29	Project Documents and Records Table	
30	Analytical Services Table; Analytical and Data Management SOPs	
C. Assessment Oversight		
31	Planned Project Assessments Table; Audit Checklists	
32	Assessment Findings and Corrective Action Responses Table	
33	Quality Assurance (QA) Management Reports Table	
D. Data Review		
34	Verification (Step I) Process Table	
35	Validation (Steps IIa and IIb) Process Table	
36	Validation (Steps IIa and IIb) Summary Table	
37	Usability Assessment	

SAP Worksheet #3 – Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
James Whitcomb	Remedial Project Manager (RPM)	NAVFAC SW	(619) 532-0936	james.h.whitcomb@navy.mil Base Realignment and Closure Program Management Office West, 1455 Frazee Road, Suite 900 San Diego, CA 92108-0970
Laurie Lowman	Radiological Site Manager	RASO	(757) 887-7650 (757) 887-4692	laurie.lowman@navy.mil Building 1971, NWS Yorktown, VA 23691-0260
Matthew Slack	Assistant Radiological Site Manager	RASO	(757) 887-4692 (757) 887-4212	matthew.slack@navy.mil Building 1971, NWS Yorktown, VA 23691-0260
Nars Ancog	Quality Assurance Officer (QAO)	NAVFAC SW	(619) 532-3046	narciso.ancog@navy.mil Building 127, 1220 Pacific Highway San Diego, CA 92132-5190
Shirley Ng	Resident Officer in Charge of Construction (ROICC)	NAVFAC SW	(510) 755-5878	Shirley.ng@navy.mil San Francisco Bay Area 2450 Saratoga Ave., Bldg. 110, Suite 200 Alameda, CA 94501
Ryan Miya	RPM	DTSC	(510) 540-3776	RMiya@dtsc.ca.gov 700 Heinz Ave., Bldg. F, Suite 200 Berkeley, CA 94710-2721
Mark Ripperda	EPA Project Manager	EPA, Region 9	(415) 972-3028	ripperda.mark@epa.gov 75 Hawthorne Street, SFD-8-B San Francisco, CA 94105-3901
Ross Steenson	Representative	Water Board	(510) 622-2492	rsteenson@waterboards.ca.gov 1515 Clay Street, Suite 1400 Oakland, CA 94612
Rose Condit	Program Chemist	Shaw	(925) 288-2151	Rose.Condit@shawgrp.com 4005 Port Chicago Highway Concord, CA 94520

SAP Worksheet #3 – Distribution List (continued)

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
Frank Hackett	Project Manager (PM)	Shaw	(925) 288-2135	Frank.Hackett@shawgrp.com 4005 Port Chicago Highway Concord, CA 94520
Dave Peet	Project Quality Control Manager (Maintains Field Copy of SAP)	Shaw	(707) 761-0972	david.peet@shawgrp.com 4005 Port Chicago Highway Concord, CA 94520
Anna Pajarillo	Project Chemist (Maintains Field Copy of SAP)	Shaw	(925) 288-2117	anna.pajarillo@shawgrp.com 4005 Port Chicago Highway Concord, CA 94520
Ray Schul	Project Radiation Safety Officer (PRSO)	Shaw	(518) 496-5533	raymond.schul@shawgrp.com 4005 Port Chicago Highway Concord, CA 94520

SAP Worksheet #4 – Project Personnel Sign-Off Sheet

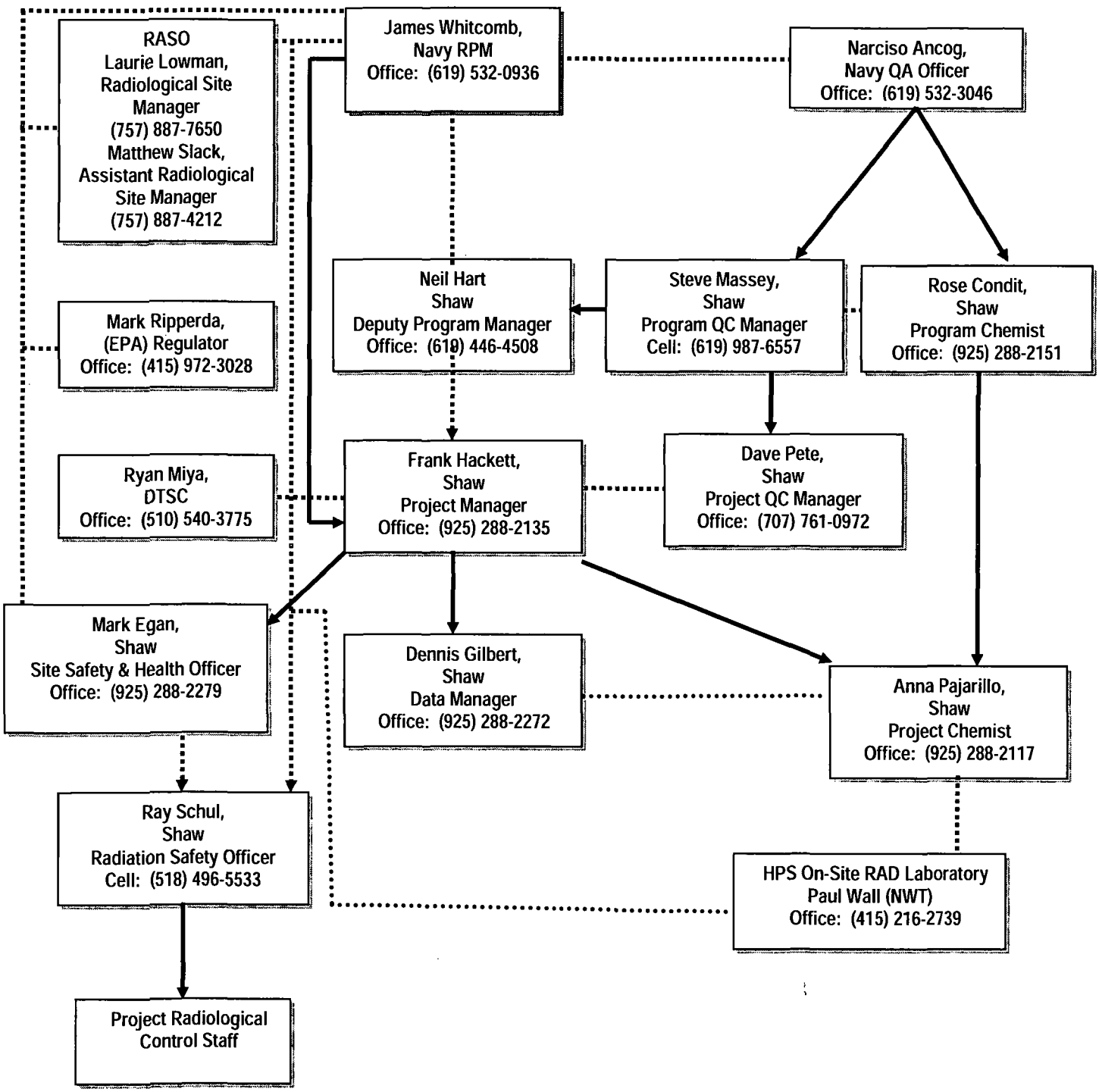
The Project Personnel Sign-Off Sheet will be used to document all key project personnel performing site work have read the applicable sections of the SAP and will perform the sampling and analysis tasks as described.

Name	Organization/Title/Role	Signature/Email Receipt	Date SAP Read
Anna Pajarillo	Shaw, Project Chemist		
Dave Pete	Shaw, Project QC Manager		
Frank Hackett	Shaw, PM		
John Hamm	Shaw, Radiological Program Manager		
Ray Schul	Shaw, PRSO		
Paul Wall	New World Technologies, Inc. (NWT) / Laboratory Manager		
Mike Dahlquist	Curtis & Tompkins Laboratory		
Linda Rauto	Laboratory Data Consultants		

TBD- Analytical laboratory and data validation company are to be determined for this project. Both subcontractors will be identified in the Final SAP.

SAP Worksheet #5 – Project Organization Chart

All lines of responsibility (solid lines) and lines of communication (dotted lines) are provided.



SAP Worksheet #6 – Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Telephone Number and/or email	Procedure
Point of Contact (POC) with U.S. Department of the Navy (Navy) RPM	Shaw PM	Frank Hackett	(925) 288-2135	All materials and information about the project will be forwarded to RPM by PM.
SAP approval	NAVFAC SW QAO	Narciso Ancog	(619) 532-3046	NAVFAC SW QAO will review and approve the SAP prior to regulatory review and field implementation. Field sampling will not begin without approved SAP.
SAP review and radiological concurrence	RASO	Laurie Lowman	(757) 887-4692 (757) 887-7650	RASO will review and concur on the SAP as related to the radiological aspects of the site.
Submittal of samples to the on-site laboratory	Shaw Sampling Personnel	Paul Wall (HPS on-site radiological laboratory)	(415) 216-2739	Shaw sampler will transfer samples to the on-site laboratory at the end of each day.
Review of radiological data and concurrence on radiological actions	RASO	Matthew Slack	(757) 887-4692	RASO will review all appropriate radiological data provided by the PRSO or designee and will concur on actions proposed by the PRSO.
SAP Changes in the Field	Shaw Project Chemist or Program Chemist	Anna Pajarillo Rose Condit	(925) 288-2117 (925) 288-2151	The Project Chemist is responsible for documenting field changes related to sampling and for informing or seeking approval from the Program Chemist or Navy QAO. The Project Chemist is also responsible for generating SAP amendments as necessary for approval by the Navy QAO. The Project Chemist oversees the documentation, notification and corrective actions associated with data collection issues. Due to the potential impact field changes and SAP amendments may have on the project, the Project Chemist is to be notified of such issues within 24 hours.

SAP Worksheet #6 – Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Telephone Number and/or e-mail	Procedure
Construction or Sampling Quality Issues	Shaw Project QC Manager, Program Chemist or Program QC Manager	Dave Peet Rose Condit Steve Massey	(707) 761-0972 (925) 288-2151 (619) 987-6557	In general, the Project Chemist is the POC for sampling and chemistry issues and the Project QC Manager is the POC for other quality issues. If quality issues are not resolved at the project level (in consultation with the PM, Construction Manager, technical lead, etc.), then the issue will be elevated to the Program QC Manager or the Program Chemist. The Program QC Manager or Program Chemist will seek additional guidance or approval from the Navy QAO, if necessary. Upon resolution, the Project QC manager or Project Chemist oversees the documentation, notification and corrective actions associated with the QA issue in writing.
Stop Work Issues (Quality)	Navy Quality Assurance Officer	Nars Ancog	(619) 532-3046	The Navy QAO is authorized to suspend project execution if QA requirements are not adequately followed. The Navy QAO will notify the Navy RPM and Shaw Program QC Manager if QC issues requiring Stop Work are identified. The Shaw Program QC Manager or Program Chemist, in consultation with the PM and Navy RPM, will work with the Navy QAO to resolve QA issues and resume work. Upon resolution, the Project QC Manager oversees the documentation, notification, and corrective actions associated with site issues in writing within 5 business days.
Health and Safety (H&S) Issues	Shaw Site Safety and Health Officer (SSHO)	Mark Egan	(925) 288-2279	The SHSO is the POC for H&S issues. If H&S issues are not resolved at the project level (in consultation with the PM, Construction Manager, Technical Lead, etc.), then the issue will be elevated to the Program Health and Safety Officer (HSO). The Program HSO or designee will seek additional guidance or approval from the Navy HSO, if necessary. Upon resolution, the SSHO oversees the documentation, notification, and corrective actions associated with the issue in writing. Due to the potential seriousness of H&S issues, the SSHO is to be notified of H&S issues immediately.
Sample Collection Issues	Shaw Project Chemist or Program Chemist	Anna Pajarillo Rose Condit	(925) 288-2117 (925) 288-2151	The Project Chemist is the POC for sampling and chemistry issues. If sampling issues are not resolved at the project level (in consultation with the PM, Construction Manager, Technical Lead, Geologist, etc.), then the issue will be elevated to the Program Chemist or Program QC Manager. The Program Chemist or Program QC Manager will seek additional guidance or approval from the Navy QAO, if necessary.

SAP Worksheet #6 – Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Telephone Number and/or e-mail	Procedure
Sample Collection Issues (continued)	Shaw Project Chemist or Program Chemist	Anna Pajarillo Rose Condit	(925) 288-2117 (925) 288-2151	Upon resolution, the Project Chemist oversees the documentation, notification, and corrective actions associated with the QA issue in writing. Due to the potential impact sampling issues may have on the project the Project Chemist is to be notified of sampling issues within 24 hours.
Stop Work Issues (H&S)	Health and Safety Officer (HSO) Shaw Employees	Mark Egan	(925) 288-2279	All employees have the right and duty to stop work when conditions are unsafe, or when established safety procedures are being disregarded. Whenever an employee determines that workplace conditions present an immediate uncontrolled risk of injury or illness, immediate resolution with the appropriate supervisor shall be sought. Should the supervisor be unable or unwilling to correct the unsafe conditions, the employee is authorized and required to issue a STOP Work Order in accordance with Shaw Procedures No. HS040, "Stop Work Authority" (2006). The specific activity or operation in question shall be discontinued until the issue is resolved.
Laboratory Reporting or Data Quality Issues	Shaw Project Chemist Data Manager	Anna Pajarillo Dennis Gilbert	(925) 288-2117 (925) 288-2272	The Project Chemist is the POC for laboratory issues. The project data manager is the POC for electronic data deliverables. If laboratory issues are not resolved with the project chemist or data manager, then laboratory the issue will be elevated to the Program Chemist. Upon resolution, the Project Chemist oversees the documentation, notification, and corrective actions associated with the laboratory issue in writing.
Field Activity Issues	Shaw Construction Manager or PM	James Click Frank Hackett	(303) 245-8998 (925) 288-2135	The Construction Manager is the POC for all project site activities such as scheduling, staffing, subcontractors, field work, etc. The Construction Manager, in consultation with the PM and Navy RPM, if necessary, will resolve all project site issues. Upon resolution, the Construction Manager oversees the documentation, notification, and corrective actions associated with site issues in writing.

SAP Worksheet #7 – Personnel Responsibilities and Qualifications Table

Name	Title/Role	Organizational Affiliation	Responsibility
James Whitcomb	RPM	Navy	Manages governmental oversight of the project. Manages project funding and scope. Coordinates project documents review. Primary contact and liaison with regulatory agencies. Responsible for technical oversight of the project.
Nars Ancog	QAO	Navy	Provides governmental oversight of the Shaw QA Program. Provides quality-related directives through Contracting Officer's Technical Representative. Provides technical and administrative oversight of Shaw surveillance audit activities. Reviews and approves the SAP prior to regulatory review or field implementation. Acts as point-of-contact on all matters concerning QA and the client's Laboratory QA Program. Authorized to suspend project execution if QA requirements are not adequately followed.
Laurie Lowman	Radiological Site Manager	RASO	Reviewing radiological laboratory data on a routine basis. Reviewing and approving on-site laboratory SOPs for each type of analysis performed. Performing on-site reviews of all radiological site operations including the on-site laboratory. Reviewing and approving all radiological work plans and final reports. Performing quality reviews on chains of custody (CoCs) to ensure samples are handled in accordance with the Work Plan and SAP. Providing review and concurrence on data for proposed radiological actions. Ensuring that all necessary sample results are provided and are consistent with proposed radiological actions. Comparing radiological data with the requirements of the Work Plan, Design Plans, Task-specific Plans, and SAP to ensure that all proper conditions have been met to implement the action requested. Ensuring that the radiological data reported are consistent with the intent for which the data were provided. Comparing the sample number matrix with the intent of the data package to ensure that the sample number is consistent with the intent of the data package. Reviewing sample acquisition information to ensure that the duration the sample was analyzed for meets the minimum required time necessary to meet the minimum detectable activity (MDA). Comparing each of the radionuclide's specific activity with the release criteria to ensure that the decision made is consistent with the specific activity reported. Comparing the MDA with the release criteria to ensure that it is sufficiently below the release levels. Evaluating the qualifiers provided in the sample results to ensure that the information provided is consistent with the results provided. Reviewing uncertainty counting and the 2 sigma total uncertainty data along with the laboratory qualifiers to determine if the data are of sufficient quality.

SAP Worksheet #7 – Personnel Responsibilities and Qualifications Table (continued)

Name	Title/Role	Organizational Affiliation	Responsibility
Frank Hackett	PM	Shaw	Manages oversight of the project for Shaw. Point of contact for communication with the Navy RPM and Navy Contracting Officer. Ensures that all requirements of project contract are attained in a manner consistent with project plans. Oversees planning, execution, and conclusion of all project activities. Manages project budgets and schedules.
Ray Schul	PRSO	Shaw	Oversees overall radiological operations and documentation for the project. Acts at the technical lead for radiological data collection and analysis. Monitors the performance of on-site radiological laboratory. Ensures that 10% of the samples are forwarded to the off-site QA laboratory for analysis. Receives and reviews QA laboratory sample data to ensure data qualify objectives are met.
Rose Condit	Program Chemist	Shaw	Reviews and approves the SAP. Guides the selection of subcontract analytical laboratories. Conducts field and laboratory audits. Serves as a POC for the Navy QAO. Develops corrective action as required. Serves as a technical advisor to the project.
Dan Wynne	Project Technical Manager	Shaw	Develops Work Plans to address project scope of work. Prepares Work Plan variances, if necessary. Manages technical project elements. Reports to PM.
Anna Pajarillo	Project Chemist	Shaw	Develops the project chemical data quality objectives (PQOs) and prepares the SAP. Selects qualified subcontract laboratories. Implements chemical data QC procedures and audits field performance. Reviews laboratory data prior to use. Performs validation of laboratory data. Reviews data validation report. Prepares the appropriate sections of the report summarizing the project sampling activities.

SAP Worksheet #7 – Personnel Responsibilities and Qualifications Table (continued)

Name	Title/Role	Organizational Affiliation	Responsibility
Dave Pete	Project QC Manager	Shaw	Develops the project QC objectives and prepares the Quality Control Plan. Administers the Quality Control Plan. Manages QC documentation and QC deliverables. Lists definable features of work. Conducts inspections (preparatory, initial, follow-up, completions).
Mark Egan	SSHO	Shaw	Develops and administers the Site Health and Safety Plan. Manages personnel and environmental monitoring. Coordinates preparation of Job Safety Analyses. Selects appropriate personal protective equipment and facilitates daily safety meetings. Reviews essential health and safety requirements with on-site personnel.
Field Technician	Field Technician (sampling)	Shaw	Performs all sampling in accordance with approved SAP. Ensures that field QC samples are collected as specified in the SAP. Completes field documentation and implements field corrective actions as required. Must have Occupational Safety and Health Administration (OSHA) 40-hour Certification and 8-hour OSHA Refresher Certification.

SAP Worksheet #8 – Special Personnel Training Requirements Table

Routine Training Requirements: All field personnel will be required to have completed the OSHA 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) Standard Protection training, continued 8-hour HAZWOPER and submit to annual medical surveillance, as required by OSHA. The Shaw SSHO will be responsible for ensuring that training and/or certification is met and that qualified personnel are performing the work.

Project Function	Specialized Training - Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records and Certificates
All On-Site Project Personnel	Radiation Worker Training (see Radiation Protection Plan)	Shaw PRSO	Prior to the start of site work	All On-Site Project Personnel	Shaw SSHO	Shaw Project Files

SAP Worksheet #9 – Project Scoping Session Participants Sheet

Project Name: Parcel D-1 Radiological Remediation and Support	**Site Name:** Parcel D-1
Projected Date(s) of Sampling:	
Project Manager: Frank Hackett	**Site Location:** Hunters Point Shipyard, San Francisco, CA
Date of Session: July 15, 2009	
Scoping Session Purpose: Kickoff meeting for Parcel D-1 Radiological Remediation Support	

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
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Wayne Akiyama	Hydrogeologist	Shaw	925-288-2003	Wayne.Akiyama@shawgrp.com	Technical Lead
Comments/Decisions:	Meeting minutes in Navy project files and Shaw project files				
Action Items/ Decisions	See meeting minutes				

SAP Worksheet #10 – Problem Definition

The planning team consists of the representatives of the Navy and Shaw with primary oversight by EPA with input from DTSC and the Water Board. The Navy is the lead federal agency for the direction of the site activities and the prime decision-maker.

Due to previous activities, HPS Parcel D-1 contains radiologically-impacted areas. The radionuclides of concern (ROCs) for the Parcel D-1 storm drain (SD) and sanitary sewer (SS) systems are strontium-90 (^{90}Sr), cesium-137 (^{137}Cs), and radium-226 (^{226}Ra). The following additional ROCs are found within select portions of SD and SS piping found within areas or features of Parcel D-1 that are indicated radiologically-impacted (NAVSEA, 2004): europium-152 (^{152}Eu), thorium-232 (^{232}Th), plutonium-239 (^{239}Pu), and tritium (^{3}H). Shaw will perform media sampling and dynamic scans of SD and SS trench floors and walls upon removing SD and SS piping and associated soil, and swipe sampling and scans of removed SD and SS piping. This work will be performed to support the management of SD and SS piping as waste and the unrestricted release of trench survey units (SUs). The final objective of this project is to achieve unrestricted free release of all radiologically-impacted areas in Parcel D-1. Piping includes pipe and all components (manholes, drop inlets, clean-outs, lift stations, etc.).

10.1 CONCEPTUAL SITE MODEL

10.1.1 Hunters Point Shipyard Background

HPS is located in the City and County of San Francisco (CCSF), California. HPS occupies a promontory, extending eastward into San Francisco (SF) Bay from the CCSF (Figure 1). The lands adjoining HPS are a part of the CCSF and designated by the CCSF Planning Department as South Bayshore, although the area is more frequently referred to as "Bayview Hunters Point." It is a low-density demographic area with about 10 persons per acre (U.S. Census, 2000). Approximately 50 percent of the residents in Bayview Hunters Point own their own homes. Predominant land uses in Bayview Hunters Point are industrial and residential, with over half devoted to industrial use.

HPS operated as a Navy shipyard from approximately 1940 to 1974 and as a private shipyard under lease from the Navy between 1976 and 1986. The Navy resumed active management in 1985. Past shipyard operations left hazardous materials onsite and HPS was placed on the National Priorities List (NPL) pursuant to CERCLA. In 1991, HPS was designated for closure pursuant to the Defense Base Closure and Realignment Act of 1990. Additional details on HPS history are provided in the Final Revised Feasibility Study for Parcel D (SulTech, 2007) and the *Draft Record of Decision for Parcels D-1 and UC-1* (Navy, 2009).

HPS consists of 420 acres of upland areas and 446 acres, underlying the water of SF Bay. The 420 upland acres were initially divided into Parcels A, B, C, D, and E to focus on future use and

environmental investigation and cleanup activities. Parcel D has recently been subdivided into Parcels D-1, D-2, G, and UC-1.

10.1.2 Parcel D-1

Parcel D-1 is located on the southeastern portion of the former Parcel D (Figure 1). According to the CCSF's redevelopment plan, Parcel D-1 is to be zoned for the industrial and maritime industrial uses. Most land at Parcel D-1 was formerly part of the industrial support area and used for shipping, ship repair, and office and commercial activities. Portions of Parcel D-1 were also used by the Naval Radiological Defense Laboratory (NRDL). The Gun Mole Pier and the South Pier were formerly used for decontamination of naval vessels, following nuclear weapons testing and for other maritime uses. Table 10-1 identifies the project specific areas in Parcel D-1 and their associated isotopes of concern.

Table 10-1
Project Specific Areas and Associated Isotopes of Concern

Area or Feature of Parcel D-1	Contamination Potential					Contaminated Media							Potential Migration Pathways							Actions	Isotopes of Concern
	Known-restricted Access	Known-continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soils	Surface Water	Groundwater	Air	Structures	Drainage System		
All SD Piping	✓					L	M	L	L	N	M	H	L	L	L	L	N	L	M	Removal and Remediation; Final Status Survey (FSS) on Trenches	^{137}Cs, ^{226}Ra, and ^{90}Sr
All SS Piping	✓					N	M	N	N	N	L	H	N	L	N	N	N	L	M	Removal and Remediation; FSS on Trenches	^{137}Cs, ^{226}Ra, and ^{90}Sr
SD and SS within Building 274 footprint				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Removal and Remediation; FSS on Trenches	^{137}Cs, ^{226}Ra, and ^{90}Sr
SD and SS within Building 313 Site			✓			L	L	N	N	N	N	N	L	L	N	N	N	N	N	Removal and Remediation; FSS on Trenches	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr, and ^{232}Th
SD and SS within Building 313A Site			✓			M	L	N	N	N	N	M	L	L	N	N	N	N	L	Removal and Remediation; FSS on Trenches	^{137}Cs, ^{239}Pu ^{226}Ra, ^{90}Sr, and ^{232}Th
SD and SS within National Radiological Defense Laboratory (NRDL) Site on Mahan Street			✓			M	M	N	N	N	N	N	L	L	N	N	N	N	N	Removal and Remediation; FSS on Trenches	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr

Table 10-1
Project Specific Areas and Associated Isotopes of Concern

Area or Feature of Parcel D-1	Contamination Potential					Contaminated Media							Potential Migration Pathways							Actions	Isotopes of Concern
	Known-restricted Access	Known-continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soils	Surface Water	Groundwater	Air	Structures	Drainage System		
SD and SS within Building. 383 Area				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Removal and Remediation; FSS on Trenches	^{3}H, ^{226}Ra, and ^{90}Sr
SD and SS within Building 322 Site			✓			L	N	N	N	N	N	N	L	N	N	N	N	N	N	Removal and Remediation; FSS on Trenches	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr, and ^{232}Th
SD and SS within Gun Mole Pier			✓			L	L	N	N	N	L	N	L	L	N	N	N	L	N	Removal and Remediation; FSS on Trenches	^{137}Cs, ^{152}Eu, ^{239}Pu, ^{226}Ra, and ^{90}Sr
SD and SS within South Pier			✓			L	L	N	N	N	L	N	L	L	N	N	N	L	N	Removal and Remediation; FSS on Trenches	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr

Legend:
H denotes Evidence of radiological contamination has been identified
L denotes Potential for radiological contamination is remote.
M denotes Potential for radiological contamination has not been fully assessed.
N denotes Evidence of radiological contamination has not been found, or known contamination has been removed, and surveys indicate that release criteria are met.

Source: Table 8-2, Final Historic Radiological Assessment (NAVSEA, 2004).

10.2 SOIL AND GROUNDWATER CONDITIONS OF PARCEL D-1

10.2.1 Origin of Parcel D-1

The lands of Parcel D-1 were largely created circa 1942 during the rapid expansion of HPS early in World War II. Prior to that time nearly all of what is now Parcel D-1 is indicated to have lain offshore. The pre-HPS shoreline apparently intersected only the extreme northern portion of Parcel D-1; the shoreline nearly paralleled the future alignment of E Street.

Surficially, all of Parcel D-1 is fill or constructed surface. The non-pier areas of Parcel D-1 are surfaced in concrete, asphalt, and gravel-sand fills. The pier surfaces are surfaced primarily in asphalt, with some concrete areas, and some building foundations.

10.2.2 Earthen Materials of Parcel D-1

For the purpose of this project all of Parcel D-1 may be considered semi-engineered earthen fill of various types. The fill is heterogeneous and was largely derived from nearby sources during the construction of HPS. The fill varies in size from sand to cobble. The majority of fill is believed to have been quarried from nearby onshore bedrock sources. The fill probably also includes various debris and some sediments dredged from nearby locations. Smaller areas of younger fill are present as SD and SS and other underground utility cover, as well as backfill placed into excavations made for environmental remediation.

The fill contains some clasts of the rock serpentinite, derived from nearby highlands during construction of HPS. Serpentinite sometimes contains mineral types in sufficient abundances to constitute Naturally Occurring Asbestos (NOA). Modern regulations, concerning asbestos and NOA did not exist when HPS was constructed and the extent, size and abundance of serpentinite clasts within the Parcel D-1 fill are not known.

The depth to base of fill within Parcel D-1 apparently varies from approximately 12 feet to at least 45 feet. Several logs of borings made near Mahan Street and Hussey Street show that sands encountered as shallow as 3 feet were part of the Undifferentiated Upper Sand deposits characterized as occurring more deeply elsewhere at HPS; it is unclear if those sands were correctly identified or are in fact are also fill.

10.2.3 Groundwater within Parcel D-1

It is expected that much of the SD and SS systems removal described in this project will intersect the water table.

10.2.3.1 Parcel-Wide Information

Shallowest groundwater in Parcel D-1 is unconfined and classified as the A-aquifer within HPS studies (SulTech, 2007). The depth to groundwater at Parcel D-1 reportedly ranges from six to

eight feet below ground surface (bgs). Within Parcel D-1 the A-aquifer exists primarily within fill materials and is reported to be 10 to 40 feet thick, hence no excavations proposed in the *Draft Final Execution Plan for the Parcel D-1 Radiological Remediation and Support* (D-1 Execution Plan; Shaw, 2010c) would fully penetrate the aquifer.

A small dissolved-phase chlorinated ethenes plume is reported to have originated within Parcel G and flowed into Parcel D-1 at the intersection of Cochrane Street and Manseau Street. The status of remediation of the plume is not known. Monitoring data from 2007 that is available to Shaw indicate that contaminant concentrations in the plume are near or less than agency-promulgated thresholds for beneficial uses. Based on this information, Shaw does not expect SD and SS systems removal in this area to be hindered by the plume residue.

Close to SF Bay the groundwater elevation fluctuates in a muted response to tidal fluctuations. The inland extents of tidally-induced fluctuations in groundwater elevation are:

- approximately 400 feet in the vicinity of former Buildings 313 and 368
- approximately 250 feet beneath most of the parcel

The direction of groundwater flow within Parcel D-1 is largely immaterial to the implementation. The hydraulic conductivity of the A-aquifer within the original Parcel D reportedly ranged from 0.025 to 580 feet per day based on data from slug and pumping tests. The wide range of reported hydraulic conductivities indicates that the aquifer consisted of very heterogeneous materials.

Estimated groundwater velocities (average linear velocity at which groundwater moves through the pore spaces in the aquifer) were calculated, using an average hydraulic gradient of 0.001, and an assumed typical A-aquifer effective porosity of 0.25. Average linear velocities across the original Parcel D ranged from approximately 1.5 feet per year (ft/yr) to 31 ft/yr.

10.2.3 2 Groundwater within the Pier Fills

Visual evaluation of exposed fill beneath the surface of the Gun Mole Pier indicates it is primarily a gravel-sand mixture. It is subjectively interpreted to have a high hydraulic conductivity and that groundwater would tend to flow relatively rapidly through the pier foundation material in response to tidal fluctuations in the adjoining bay waters. Based on this, it may be assumed that the groundwater within Gun Mole Pier foundation materials is in good communication and general chemical equilibrium with adjoining waters of SF Bay.

Shaw has no information about the fill material or hydraulic conductivity of the South Pier and conservatively assumes it is similar to that inferred for the Gun Mole Pier.

10.2.4 HPS Historical Use

HPS operated as a ship repair and maintenance facility beginning in the 1930s. It was extensively built and used during World War II. After World War II, HPS activities shifted toward submarine maintenance and repair. HPS was also the site of the NRDL from the 1940s through the 1960s. The Navy discontinued shipyard activities at HPS in 1974. From 1976 to 1986, the HPS was leased to Triple-A Machine Shop, a private ship repair company. In 1986, Triple-A Machine Shop ceased operations, and the Navy resumed occupancy of HPS. In 1989, HPS was placed on the NPL as a Superfund Amendments and Reauthorization Act site pursuant to CERCLA. In 1991, HPS was selected for closure pursuant to the terms of the Defense Base Closure and Realignment Act of 1990 (Public Law 101-508; U.S. 101st Congress 1990). Closure of HPS includes conducting environmental remediation activities and eventual transfer of the HPS property to the CCSF for future non-defense uses.

This SAP will focus on the SS and SD systems within Parcel D-1.

10.2.5 Sanitary Sewer and Storm Drain System

The HPS SD and SS systems were a combined system when built in the 1940s. The system used the same conveyance piping with approximately 40 separate outfalls into SF Bay. The combined system was in use and in expansion until 1958, when the first of a series of system separation projects began. The Building 819 pump station was built and used to pump SS from HPS to CCSF treatment works. Dedicated SS piping was installed within the combined system. Twenty-eight outfalls were converted for exclusive use as SD outlets, while the remaining twelve continued to serve as combined SD and SS outfalls.

A second SD and SS systems separation project occurred in 1973, when some SD outfalls in the South Basin Area (just offshore from the Parcel E shoreline) were removed. The last separation project was conducted in 1976, when more dedicated SS piping was installed. Complete segregation of the SD and SS piping was never achieved. Radiological contamination could have impacted both the SS and SD systems, and therefore all components of the SS and SD systems in Parcel D-1 are considered impacted as documented in the *Final Historical Radiological Assessment* (HRA; NAVSEA, 2004).

The majority of the SD piping at Parcel D-1 is reinforced concrete, vitrified clay or corrugated metal. The piping diameters are as great as 42 inches (SD) and 15 inches (SS). Piping is laid as deep as approximately five feet (SS) and 10.5 feet (SD) bgs.

2001 Radiological Survey at Gun Mole Pier

A radiological survey of a portion of the Gun Mole Pier near Berth 15 was performed by Tetra Tech Environmental Management, Inc. in 2001. Surface measurements of gamma and beta

radiation were obtained to determine whether elevated radioactivity remained. The locations of the sampling points were determined based on the former locations of the concrete test pad and NRDL barge on the pier. A portable detection instrument equipped with a sodium iodide (NaI) scintillation probe was used to measure the gamma levels around the pier. The measurements were made both in a systematic grid pattern and specific locations over drains, surface cracks, and other unusual features. Beta levels were also measured at selected locations using a Geiger-Mueller detector. This investigation indicated that only background radioactivity existed in the areas surveyed.

10.2.6 Final Historical Radiological Assessment

The HRA (NAVSEA, 2004) was conducted to evaluate all previous uses of radioactive materials at HPS and to assess their potential impact. The HRA identified 84 HPS sites as radiologically-impacted, indicating that each site was potentially radiologically contaminated based on historic information. This SAP governs the removal of SD and SS piping from within Parcel D-1, including radiologically-impacted areas.

SAP Worksheet #11 – Project Quality Objectives/Systematic Planning Process Statements

Step 1	Define the Problem that Necessitates the Study

Due to previous activities, Hunters Point Parcel D-1 contains radiologically-impacted areas. The ROCs for Parcel D-1 are ^{90}Sr, ^{137}Cs, ^{152}Eu, ^{226}Ra, ^{232}Th, ^{239}Pu, and ^{3}H. Shaw will implement basic radiation survey protocols in radiologically-impacted areas of Parcel D-1 to achieve to unrestricted release.

Step 2	Identify the Goal of the Study

The goal of the sampling activities are:

- Verify that release criteria for ROCs have been met
- Verify that import fill (if needed to backfill SD and SS trenches) is suitable for use

The Study Questions are:

- Are all soils/materials, remaining in place below remedial action objectives for ROCs?
- Is selected import soil suitable for use as backfill material?

Step 3	Identify Information Inputs

Radiological screening data collected during radiological surveys and on-site laboratory analysis to confirm screening survey results.
Background concentrations of ^{226}Ra, ^{137}Cs, and ^{90}Sr will be determined for this project.

Radiological surveys required to support the unrestricted release of a areas are to include:

1) 100 percent gamma scan surveys units with 2-inch by 2-inch NaI detectors (or equivalent). Results within 3 sigma of background levels are considered acceptable
2) Systematic and biased sampling of the Class 1 SUs
3) Laboratory data review and statistical analysis of collected data
4) Systematic and biased static alpha, beta (buildings and structures), and gamma static readings

If off-site import fill is necessary to backfill trenches, then backfill material will be sampled and analyzed for:

- Volatile organic compounds (VOCs) (EPA 8260B)
- Semi volatile organic compounds (SVOCs) (EPA 8270C)
- Total petroleum hydrocarbons (TPH) (purgeable and extractable) (EPA 8015B)
- CA Title 22 Metals (EPA 6010C/7471A)
- Pesticides (EPA 8081B)
- Polychlorinated biphenyls (PCBs) (EPA 8082)
- Asbestos (California Air Resources Board [CARB] 435)
- ROCs (HPS on-site laboratory)

Import material will be approved before use, according to Hunters Point Backfill Review and Acceptance Procedure SOP HPO-Tt-027 (2006) (DCN: FWSD-RAC-06-0764).

SAP Worksheet #11 – Project Quality Objectives/Systematic Planning Process Statements (Continued)

Step 4	Define the Boundaries of the Study
The radiologically-impacted areas to be remediated under this SAP include approximately 19,500 feet of SD and SS piping and associated impacted soil. Characterization survey in the trench and approximately 43,500 cubic yards of excavated materials.	
Step 5	**Develop the Analytic Approach**
• If gamma radiation is reported at background plus 3 sigma for soil during gamma scans, then removal of the area and additional surveys and sampling will continue as necessary to support the release criteria until otherwise directed by the Navy RPM and RASO. Otherwise, no further action will be required. • If ^{226}Ra is reported 1.0 pCi/g above the background concentration for post-excavation samples, then excavation of the area and additional surveys and sampling will continue as necessary to support the release criteria until otherwise directed by the Navy RPM and RASO. Otherwise, no further action will be required. • If ^{137}Cs is reported at 0.113 pCi/g or above for post-excavation samples, then excavation of the area and additional surveys and sampling will continue as necessary to support the release criteria until otherwise directed by the Navy RPM and RASO. Otherwise, no further action will be required. • If ^{90}Sr is reported at 0.331 pCi/g or above for post-excavation samples, then excavation of the area and additional surveys and sampling will be conducted as necessary to support the release criteria until otherwise directed by Navy RPM and RASO. Otherwise, no further action will be required. • If any other radioisotope is detected above a location-specific release criteria stated in WS 15a or 15b, then the Project Radiation Safety Officer (PRSO) will notify the Radiological Site Manager (RSM) and excavation of the area and additional surveys and sampling will continue as necessary to support the release criteria until otherwise directed by the Navy RPM and RASO. • If chemical and radiological analytical results from a potential import soil source are below the criteria (shown in WS# 15a and 15n-15s) and the source has been approved by the Navy according to HPS SOP HPO-Tt-0270, then this source will be considered suitable for backfill. • If chemical and radiological analytical results from a potential import soil source do not meet the criteria (shown in WS# 15a and15n-15s) and the source has not been approved by the Navy according to HPS SOP HPO-Tt-0270, then this source will not be considered suitable for backfill.	
Step 6	**Specify Performance or Acceptance Criteria**
To limit uncertainty in obtained environmental data, criteria for the precision, accuracy, representativeness, completeness, and comparability parameters and reporting limits for the chemicals of concern have been developed. Measurement errors will be controlled by using appropriate sampling and analytical methods and following established SOPs. The Multi-Agency Radiation Site Survey and Investigation Manual (MARSSIM, DoD, et al, 2000) guidelines will be used and a 95 percent confidence level for detecting radioactivity above the release levels will be assumed with Type I and II errors limited to 5 percent. When double sampling is used the Type I error rate will be set to a maximum of 2.5 percent or as specified in the Radiological Work Plan.	
Step 7	**Plan the Design for Obtaining Data**
The survey design specified for use in the *Project Work Plan Parcel D-1 Storm Drain and Sanitary Sewer Removal* (Shaw, 2010b) was developed to perform radiological FSSs based on MARSSIM guidelines. Specific details, regarding types of radiation measurements, instrument detection capabilities, quantities and locations of data to be collected and investigation levels are discussed in the *Project Work Plan Parcel D-1 Storm Drain and Sanitary Sewer Removal* (Shaw, 2010b).	

SAP Worksheet #12 – Measurement Performance Criteria Table – Field QC Samples

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field Duplicates	Radiochemical Analysis	As directed by PRSO	Precision	≤30%	S
Radiological QA split samples (handled by TtEC and on-site laboratory)	ROCs	10% of the samples submitted to the on-site radiological laboratory. Minimum one per survey unit or minimum one per isotope per survey unit1	Precision	30% difference	S&A

Note:

1. *On-site laboratory duplicates for gamma spectroscopy will consist of reanalyzing the original sample in the original container on the same gamma spectroscopy system.*

SAP Worksheet #13 – 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
No Secondary Data for this Project				

SAP Worksheet #14 – Summary of Project Tasks

14.1 SCOPE OF WORK

The work activities that may be performed by Shaw in radiologically-impacted areas include:

- Preparatory activities
- Geophysical surveying for utilities
- Topographic surveying
- Mobilization
- Radiological surveys
- Trenching, excavating, removing, and stockpiling SD and SS piping
- Backfilling
- Removing and stockpiling asphalt, concrete, railroad tracks, railroad ties, etc.
- Asbestos and lead-based paint abatement and demolition of non-radiologically-impacted buildings on Gun Mole Pier
- Free-release surveys and decontamination of equipment
- Final Status Surveys of SS and SD trenches, and excavated soil

Radiologically-impacted areas in Parcel D-1 include the SS and SD systems as well as building sites and piers. This SAP governs the removal and radiological survey (including collection of media samples) of all SD and SS piping with Parcel D-1.

14.2 SAMPLE COLLECTION METHODS AND PROCEDURES

The following sections describe the sampling methods and procedures that will be used for this project, depending on the media being sampled. Soil samples may be collected from SD and SS trenches or from off-site borrow sources.

14.2.1 Soil Sampling

Samples will be collected from the excavator bucket, using the following general sampling procedure:

1. Obtain a new (unused) disposable sampling scoop (or other non-disposable decontaminated sampling equipment).
2. Put on a new (unused) pair of sampling gloves and other appropriate personal protective equipment (PPE).
3. Excavations will not be entered for sampling. Direct the excavator operator to obtain a sample from the desired location. Allow excess water, if present, to drain from the soil before sample collection.
4. Collect the sample for radiological analysis into the appropriate sample containers using a disposable sampling scoop.
5. Label, package, and prepare the samples for shipment to the on-site laboratory.

14.2.2 Shallow Soil Sampling with Hand Auger

Shallow soil samples may be collected, using hand augers or direct push drilling techniques. Samples collected, using hand augers and drive tubes will be collected into clean brass or stainless steel sleeves using the following general sampling procedure:

1. Obtain a new or decontaminated hand auger and drive-tube sampling kit.
2. Don appropriate PPE as specified in the project Work Plan.
3. Clear the area to be sample of surface debris and vegetation using equipment that will not be used for sample collection.
4. Advance hand auger to the targeted sampling depth.
5. Insert a clean brass or stainless steel sleeve into the drive assembly of the hand auger. Advance the hand auger into the soil a minimum of six inches, and then remove it from the boring.
6. Retrieve the sleeve and check to see that soil recovery is adequate. If there is sufficient recovery, mark or note the leading end of the sleeve.
7. Place Teflon tape over the trailing end of the sleeve and seal the end with a plastic cap.
8. If VOC analysis is required (i.e. borrow source) collect samples for VOCs with EnCore® (or equivalent) from the leading end of the sleeve.
9. Place Teflon tape over the leading end of the sleeve and seal the end with a plastic cap.
10. Label, package, and prepare the samples for shipment to the laboratory. Place the samples in cold storage after collection.

14.2.3 EnCore® Soil Sampling for VOCs

Sampling for VOCs will only be performed for import fill sampling if necessary, using the following procedure:

1. Obtain EnCore® device and T-Handle (or equivalent).
2. Put on a new, clean, and chemical-resistant pair of disposable gloves prior to taking the sample; the Sample Technician will test the plunger for free movement by pushing the plunger rod down until it rests against the tabs.
3. The locking lever on the EnCore® T-Handle must be depressed as the cartridge is inserted. Line up the slots on the cartridge with the locking pins in the T-Handle. Insert the cartridge, plunger end first, into T-Handle with the locking tabs aligned and twist the cartridge clockwise, locking the cartridge in place.
4. Apply EnCore® to freshly exposed surface soil or from one end of a sleeve core as soon as it is brought to the surface. Holding the device with the T-Handle up and the cartridge down, insert the sampling device into the soil. The coring body must be full; check to make sure the plunger end is seen in the viewing hole. Withdraw the sampling device from the soil and wipe of excess dirt from the cartridge body.
5. Cap the cartridge core while it is still on the T-Handle. Push or twist the cap onto the core until the groves are seated over the ridge of the coring body.

6. Remove the capped sampler by pushing down the locking lever on T-Handle and twisting and pulling the sampler from T-Handle. The plunger is locked by rotating plunger rod until the wings rest against the tabs. Attach the label and seal the cartridge in the EnCore® sampler bag.
7. The EnCore® sampler holding time is 48 hours. Soil samples are to be shipped to the laboratory for preservation or freezing within the 48 hour holding time. After preservation, the soil sample can be held up to 14 days for analysis.
8. Store the Encore® sampler bag in a cooler with ice until it can be delivered to the laboratory.

14.3 WASTE CHARACTERIZATION SAMPLING

All waste generated (radiological, mixed and non-radiological) will be characterized for proper disposal. Wastes generated include soil, sediment, removed SD and SS piping, building debris, and wastewater. All excavated soil will be transported to the Radiological Screening Yard (RSY) and will be sampled and managed there by the Navy contracted RSY operator, TtEC. Off-base transportation and disposal of all wastes (radiological, mixed and non-radiological) will be performed by other Navy contractors, EMS, Inc. and ITSI, not under the direction of Shaw.

Shaw will sample, manage, and dispose of small volume of waste water that may be generated from site activities.

14.3.1 Wastewater

Wastewater samples will be collected from approved storage areas, using the following procedure:

1. Obtain an unused disposable bailer for each sample event.
2. Put on a new, clean, and chemical-resistant pair of disposable gloves.
3. Tie the bailer to a nylon cord or string.
4. Lower the bailer into the containment area. Allow sufficient time for the bailer to fill with water.
5. Retrieve the bailer and fill appropriate bottle(s) for analyses being requested.
6. If the storage container is equipped with sampling taps, samples may be collected at these locations.
7. Cap the bottle(s) and wipe any moisture from the outside of the bottle(s).
8. Label, package, and prepare the samples for shipment to the laboratory. Transfer the samples to cold storage after collection.

14.3.2 Swipe Sampling

Swipe samples will be collected, following Shaw SOP T-RA-012 (appended to the D-1 Execution Plan (Shaw, 2010c). Swipe samples will be documented on the chain of custody (CoC and a radiological survey record.

14.3.3 Debris Sampling

Non-radiological debris will be handled, sampled (if necessary) and disposed of off-site by the Navy's non radiological waste subcontractor, ITSI. Additional sampling of building debris by Shaw is not anticipated. However, if deemed necessary to collect samples of building material or debris for chemical analysis, the following sampling procedure will be implemented. Solid material may need to be broken into smaller pieces.

1. Break up the material into pieces that will fit into a 250 milliliter (mL) wide mouth jar or plastic resealable bag.
2. Label, package, and prepare the samples for shipment to the laboratory. Place the samples in cold storage after collection

14.3.4 Piping Sediment Sampling

SD and SS piping sediment sampling is conducted to assess residual radioactivity that may be present in sediments deposited inside the SD and SS systems, using the following procedure.

1. There is no specific method identified to collect these samples, because the type of material found inside the SD and SS piping can vary. Samples may be collected using a plumber's snake, swabs, scraper, trowel, etc.
2. Collect sample into the appropriate sample containers.
3. Label, package, and prepare the samples for shipment to the laboratory. Place the samples in cold storage after collection.

14.4 EQUIPMENT DECONTAMINATION

Decontamination of non-disposable sampling equipment that comes in contact with samples (such as sleeve rings and the split-spoon sampling device) will be performed to prevent the introduction of extraneous material into samples and to prevent cross-contamination between samples. All sampling equipment will be decontaminated by steam cleaning or by washing with a non phosphate detergent such as Liquinox™ or equivalent. Decontamination water will be collected in 55-gallon U.S. Department of Transportation (DOT)-approved drums or a poly-tank.

The following procedures will be used for decontamination of non disposable sampling equipment:

1. If mud or soil is adhering to the sampling equipment, first rinse with potable water. This step will decrease the gross contamination and reduce the frequency at which the non-phosphate detergent and water solution need to be changed.
2. Wash with the non-phosphate detergent and water solution. This step will remove remaining contamination from the equipment. Dilute the non-phosphate detergent as directed by the manufacturer.
3. Rinse with potable water. Change the water frequently.
4. Rinse with deionized water. This step will rinse any detergent solution and potable water residues. Rinsing will be done by applying the deionized water from a clean squeeze bottle (or equivalent) while holding equipment over a bucket.

Following decontamination, sampling equipment will be screened using a hand-held alpha/beta survey meter or the counting of a wipe sample on a bench top alpha/beta sample counter. If radioactive contamination, exceeding the release limits for equipment and materials shown below is detected, the equipment and local area will be secured, and the PRSO will be notified.

Radionuclide	Removable (dpm/100cm^2)	Total (dpm/100cm^2)
Radium-226	20 – alpha (α)	100 – α
Strontium-90	200 – beta (β^-)	1,000 – β^-
Cesium-137	1,000 – beta & gamma (γ)	5,000 – β^-, γ
Europium-152	1,000 β^-, x-ray	5,000 – β^-, x-ray
Plutonium-239	20 – α	100– α
Thorium-232	200 – α	1,000– α
Tritium	5,000– β^-	Not Applicable

14.5 SAMPLE NUMBERING

Samples will be uniquely numbered using a system that identifies the following:

Trench Survey Unit: **WW-PXT-YYY-UUU**

WW – CTO or TO number
P – Abbreviation for Parcel
X – Parcel designation (e.g., A for Parcel A, B for Parcel B, etc.)
T – Indicates a trench sample
YYY – Three-character trench survey unit number
UUU – Three-character consecutive sample number starting from 001 (number of samples collected from each survey unit)

Pipe Sediment: **WW-PXPI-QQQQ-UU**

WW – CTO or TO number
P – Abbreviation for Parcel
X – Parcel designation (e.g. A for Parcel A, B for Parcel B, etc.)
PI – Abbreviation to indicate a pipe sediment sample
QQQQ – Four-character consecutive sample number that begins with 001 for this project and continues consecutive throughout the project with no repeated numbers
UU – Two-character consecutive sample number starting from 01 (number of sediment samples collected from each pipe)

Pipe/Manhole Swipes: **WW-PXS-YYAABBCC-SS-UU**

WW – CTO or TO number
P – Abbreviation for Parcel
X – Parcel designation (e.g. A for Parcel A, B for Parcel B, etc.)
S – Indicates a swipe sample
YY – Two-character component identifier (PI – Pipe, MH: - Manhole)
AA – Two –character work area number (e.g. 06 for Area 6, 10 for Area 10, etc.)

BB – Two-character identifier for IR site or "00" for non-IR site
CC – Two-character trench identification number (e.g. 4A, 8C, 1G, etc.)
SS – Two character trench pipe component number
UU – Two-character consecutive sample number starting from 01 for this project (number of swipes performed for each pipe)

Ancillary Samples: **WWABDDDD-QQQ**

WW – CTO or TO number
A – Abbreviation for ancillary
B – Abbreviation for building
DDDD – Building number
QQQ – Sample number

RSY Survey Pads: **WW-PX-AQQQQ-UU**

WW – CTO or TO number
P – Abbreviation for Parcel
X – Parcel designation (e.g. A for Parcel A, B for Parcel B, etc.)
A – Indicates that the sample is from a survey pad
QQQQ – Four-character consecutive pile number that begins with 0001 for this project and continues consecutively throughout the project with no repeated numbers
UU – Two-character consecutive sample number starting from 01 (number of sediment samples collected from each pipe)

Manhole Sediment: **WW-PXMHYYY-QQQ-UU**

WW – CTO or TO number
P – Abbreviation for Parcel
X – Parcel designation (e.g. A for Parcel A, B for Parcel B, etc.)
MH – Indicates a manhole sediment sample
YYY – Three-character manhole identification number
QQQ – Three-character consecutive sample number that begins with 001 for this project and continues consecutively throughout the project with no repeated numbers
UU – Two-character consecutive sample number starting from 01 (number of samples collected for each manhole)

Extraneous Pipe Sediment and Swipes: **WW-PXS/P-EPYYY-UU**

WW – CTO or TO number
P – Abbreviation for Parcel
X – Parcel designation (e.g. A for Parcel A, B for Parcel B, etc.)
S/P – Use "S: to indicate a swipe sample and use "P" to indicate a sediment sample
EP – Indicates an extraneous pipe sample
YYY – Three-character unique extraneous pipe identifier
UU – Two-character consecutive sample number starting from 01 for this project (number of swipes performed or sediment samples collected from each pipe)

Import Soil: BS-XXXBS – Indicates borrow source
XXX – Three-character consecutive number starting from 001

Wastewater: **WW-XXX**

WW – Indicates wastewater
XXX – Three-character consecutive number starting at 001

14.6 ANALYTICAL REQUIREMENTS

The following chemical analytical methods may be used for import fill characterization for this project:

Test Methods for Evaluating Solid Waste, Physical Chemical Methods, SW-846, Update III and IV (EPA, 1996):

- Organochlorine Pesticides by EPA Method 8081
- PCBs by EPA Method 8082
- TPH as gasoline range organics (C_6 – C_{10}) by EPA Method 5035/8015B (purgeable)
- TPH as diesel range organics (C_{10} – C_{24}) and motor oil range organics (C_{24} – C_{36}) by EPA Method 8015B (extractable)
- Metals by EPA Methods 6010/6020
- Mercury by EPA Method 7471
- SVOCs by EPA Method 8270
- Polycyclic aromatic hydrocarbon (PAHs) by EPA Method 8270-SIM
- VOCs by EPA Method 5035/8260B

Environmental Measurements Laboratory Procedures Manual, HASL-300 (Department of Energy, 1997).

- Gamma spectroscopy analysis by C1402-98 Standard Guide of High-Resolution Gamma-Ray Spectrometry or by on-site laboratory standard operating procedures.

All analytical methods will be performed, according to the applicable EPA and DoD Quality System Manual (QSM) QC requirements as applicable described in Worksheets (WSs) #24 and #28.

14.7 DATA MANAGEMENT

This section describes the data management procedures for data review, verification, reporting, and validation for chemical analyses (off-site laboratory for import fill).

14.7.1 Data Reduction, Verification, and Reporting

All analytical data generated by the laboratory projects will be reviewed prior to reporting to assure the validity of reported data. This internal laboratory data review process will consist of

data reduction, three levels of documented review, and reporting. Review processes will be documented using appropriate checklist forms, or logbooks, that will be signed and dated by the reviewer.

14.7.2 Data Reduction

Data reduction involves the mathematical or statistical calculations used by the laboratory to convert raw data to the reported data. The laboratory will perform reduction of analytical data as specified in each of the appropriate analytical methods and laboratory SOPs. For each method, all raw data results will be recorded using method-specific forms or a standardized output from each of the various instruments.

All data calculations will be verified and initialed by personnel both generating and approving them. All raw and electronic data, notebook references, supporting documentation, and correspondence will be assembled, packaged, and stored for a minimum of 10 years for future use. All reports will be held client confidential. If the laboratory is unable to store project-related data for 10 years, then it is the responsibility of the laboratory to contact Shaw to make alternative arrangements.

14.7.3 Laboratory Data Verification and Review

The laboratory analyst who generates the analytical data will have the primary responsibility for the correctness and completeness of data. Each step of this verification and review process will involve the evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. This application of technical knowledge and experience to the evaluation of data is essential in ensuring that data of known quality are generated consistently. All data generated and reduced will follow well-documented in-house protocols.

Level 1. Technical (Peer) Data Review

Analysts will review the quality of their work based on an established set of guidelines, including the QC criteria established in each method, in this SAP, and as stated within the laboratory QA Manual. This review will, at a minimum, ensure that the following conditions have been met:

- Sample preparation information is correct and complete.
- Analysis information is correct and complete.
- Appropriate SOPs have been followed.
- Calculations are verified.
- There are no data transposition errors.
- Analytical results are correct and complete.
- QC samples are within established control limits.
- Blanks and laboratory control samples (LCSs) are within appropriate QC limits.

- Special sample preparation and analytical requirements have been met.

Documentation is complete, for example, any anomalies and holding times have been documented and forms have been completed.

Level 2. Technical Data Review

A supervisor or data review specialist whose function is to provide an independent review of data packages will perform this review. This review will also be conducted, according to an established set of guidelines and will be structured to verify the following finding of Level 1 data review:

- All appropriate laboratory SOPs have been followed.
- Calibration data are scientifically sound, appropriate to the method, and completely documented.
- QC samples are within established guidelines.
- Qualitative identification of contaminants is correct.
- Manual integrations are justified and properly documented.
- Quantitative results and calculations are correct.
- Data are qualified correctly.
- Documentation is complete, for example, any anomalies and holding times have been documented and appropriate forms have been completed.
- Data are ready for incorporation into the final report.
- The data package is complete and complies with contract requirements.

The Level 2 review will be structured so that all calibration data and QC sample results are reviewed and all of the analytical results from at least 10% of the samples are checked back to the sample preparation and analytical bench sheets. If no problems are found with the data package, the review will be considered complete.

If any problems are found with the data package, an additional 10% of the sample results will be checked back to the sample preparatory and analytical bench sheets. This cycle will then be repeated either until no errors are found in the checked data set or until all data has been checked. All errors and corrections noted will be documented.

Level 3. Administrative Quality Assurance Data Review

The Laboratory QA Manager will review 10% of all data packages. This review should be similar to the review as provided in Level 2, except that it will provide a total overview of the data package to ensure its consistency and compliance with project requirements. All errors noted will be corrected and documented.

14.8 On-Site Radiological Laboratory Data Management

Shaw will submit samples for radiological analysis to the Navy HPS radiological laboratory, operated by TtEC throughout the duration of the project.

The HPS radiological laboratory must have written SOPs defining the instrumentation, calibration, method detection, and QC requirements. The SOPs must be available to the analysts performing the work. The SOPs must meet or exceed the requirements of the analytical methods cited in this SAP. The laboratory must maintain logs of all activities that have an impact on the quality of the laboratory results. The laboratory must maintain the instruments in working condition required by the methods specified for the analyses. Sufficient redundancy in equipment must be available in the laboratory to handle downtime situations.

14.8.1 HPS On-Site Laboratory Reporting

The HPS radiological laboratory will provide a summary data report for each sample submitted. The report will provide the following sample information:

- Activity concentration results for ROCs
- Time of count activity
- Uncertainty specifics
- Flagged parameters based on gamma spectroscopy readouts

Ten percent of the samples submitted to the Navy HPS radiological laboratory will be submitted to Test America, Inc. (TA), Earth City, Missouri laboratory for quality assurance by the HPS radiological laboratory operator. Shaw does not manage these QA split samples to TA, the HPS radiological laboratory operator will handle all subcontracting for radiological QA analysis and will submit a copy of the TA report to Shaw with the on-site laboratory data. The TA report will include the following information.

- Cover page (with laboratory name, address, phone number, contact person, and sample delivery group number, as well as project name and project number)
- Table of contents
- Case narrative
- Sample receipt information including CoC records, cooler temperature and sample condition
- Sample cross-reference table
- Analytical results for each sample including qualifier, total uncertainty, reporting limit, method detection limit, count time, preparation and analysis date
- Method blank report
- Laboratory control sample report
- Duplicate sample evaluation report

Data from the on-site and off-site gamma spectroscopy analysis will be compared for samples that have count times and MDAs that are within 30 percent of one another. Results from these

samples will be considered acceptable if the difference between the results is within 20 percent. If the difference between the results is greater than 30 percent, then the data from both laboratories will be reviewed to evaluate the difference. A minimum of 10 percent of the samples will also be sent to the off-site laboratory for ^{90}Sr analysis.

If ^{137}Cs is detected in soil samples above the release criteria, then the samples will also be analyzed for ^{90}Sr and alpha spectroscopy for isotopic plutonium and isotopic uranium at the off-site laboratory.

14.8.2 On-Site Laboratory Quality Control Checks

The following subsections describe in detail the laboratory QC samples required for the on-site laboratory. Use of laboratory control standards will be documented, if necessary, in the applicable SOP that governs the procedure in use. All certifications from the laboratory control standard use at the on-site laboratory will be submitted to the PRSO for the project file.

14.8.3 Laboratory Duplicates

Laboratory sample duplicates are prepared and analyzed with each batch of systematic samples for most inorganic analyses. Laboratory duplicate samples will be analyzed independently as appropriate. For this project, a laboratory duplicate will be prepared and analyzed by gamma spectroscopy for the on-site laboratory for each survey unit's systematic samples. A laboratory duplicate will be prepared and analyzed for the on-site laboratory for each batch of alpha spectroscopy and strontium samples. A batch is defined as 20 samples or less. If the sample analysis identifies no activity greater than the MDA to be present, the total activity of the sample will be used for comparison.

14.8.4 Calibration

All instruments and equipment must be calibrated in accordance with the manufacturer's requirements and/or laboratory SOPs. Each instrument must be calibrated with the standard appropriate to the type of instrument and the calibration range established for the method.

Initial multipoint calibrations (ICALs) are performed when the method is first used and again whenever the continuing calibrations fail to meet their respective acceptance criteria. In addition, if the instrument undergoes significant maintenance, the ICAL must be repeated. Calibration of all equipment will be performed in accordance with the on-site laboratory's SOPs. Continuing calibrations verify that the instrument performance has remained within the limits set at the time of the ICAL. The frequency of continuing calibrations is specified in referenced methods.

14.8.5 Instrument Blanks

Instrument backgrounds are run to ensure that contaminants from previous runs are out of the system and do not contaminate succeeding runs. Instrument backgrounds are performed before

sample analyses are performed and after samples containing high concentrations of potentially interfering materials are found, in accordance with a NWT SOP.

14.9 Data Recording and Transfer

This section details the requirements for data reporting and data package formats that will be provided by the laboratory.

14.9.1 Electronic Deliverables

The electronic data deliverable (EDD) will be in Shaw database format (ShawView or equivalent). The analytical laboratory will follow the requirements stated in the laboratory interface document for the analytical laboratory EDD.

Field information (e.g., date and time collected, sample identification, etc.) will be entered directly into the main database from the CoC form (Attachment 1) or uploaded from electronic files generated in the field.

14.9.2 Laboratory Data Reports

All relevant raw data and documentation, including (but not limited to) logbooks, data sheets, electronic files, and final reports, will be maintained by the laboratory for at least 10 years. The laboratory will notify Shaw 30 days before disposal of any relevant laboratory records. The laboratory data packages for import fill soil samples will contain the following information:

Deliverable Requirement	Level IV	Level III	Level II
Case Narrative	X	X	
Corrective Action Report(s)	X	X	
Cross-reference of field sample numbers, laboratory identification numbers, and analytical QC batches	X	X	X
CoC form, cooler receipt form	X	X	X
Sample log-in sheet	X		
Data summary for each blank and sample	X	X	X
Initial and continuing calibration blank – Metals	X	X	
Method blank summary	X		
Surrogate recovery report (including concentration spiked, percent recovered, and percent recovery acceptance limits) gas chromatograph (GC)/mass spectrometer (MS) – *GC and GC/MS*	X	X	X
Internal standard areas and retention time reports (including acceptance limits and out-of-control flags) – *GC and GC/MS*	X	X	
LCS/laboratory control duplicate(LCD) report (including concentration spiked, percent recovered, percent recovery acceptance limits, relative percent difference (RPD), and RPD acceptance limits	X	X	X
Matrix spike (MS)/matrix spike duplicate (MSD) report (including concentration spiked, percent recovered, percent recovery acceptance limits, RPD, and RPD acceptance limits)	X	X	X
Post-digestion spike recovery – *Metals*	X	X	
Duplicate sample report – Inorganic and vapor analyses	X	X	
Instrument performance check (tuning) report –*GC/MS*	X	X	

Deliverable Requirement	Level IV	Level III	Level II
Initial calibration data (including acceptance limits)	X	X (summary only)	
Continuing calibration data (including acceptance limits)	X	X (summary only)	
Reconstructed ion chromatogram for each sample and rerun, blank, spike, duplicate, and standard –*GC/MS*	X		
Instrument quantitation report–*GC and GC/MS*	X		
Chromatogram for each sample and rerun, blank, spike, duplicate, and standard –*GC*	X	If requested	
Raw and background subtracted mass spectra for each; target analyte found–*GC/MS*	X		
Inductively coupled plasma (ICP) interference check sample report – *Metals*	X	X	
Standard addition results – *Metals*	X	X	
ICP serial dilution results – *Metals*	X	X	
Data and instrument print outs – *Metals*	X		
ICP inter-element correction factors – *Metals*	X	X	
Sample preparation bench sheets	X	X	
Standard preparation logs	X		
Analysis run logs	X	X	
Percent moisture	X	X	
pH	X		

The following data deliverables are required for this project:

- Import borrow soil used for backfill - 90% EPA Level III and 10% EPA Level IV

14.10 DATA VALIDATION

All import fill material analysis (if needed) will be validated by an independent third party validation company at EPA Level III. Laboratory data for waste samples will not be validated but will be reviewed by a Shaw Project Chemist.

Data review / validation will be in accordance with the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 2004), USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (EPA, 2008), Quality Systems Manual (DoD, 2009), laboratory SOPs and the QC criteria specified in this SAP. Data will be validated and flagged with the following data qualifiers:

J qualifier denotes the analyte was positively identified, but the associated numerical value is estimated.

U qualifier denotes the analyte was analyzed for, but not detected. The associated numerical value is at or below the reporting limit.

R qualifier denotes the data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

UJ qualifier denotes the analyte was analyzed for, but not detected. There is uncertainty associated with the reporting limit or MDA.

14.10.1 Level III and Level IV Data Validation

If import fill is needed for the project and samples are collected. Data validation requirements will follow the guidelines established in Navy EWI #1. The following section briefly describes what is reviewed for each validation level.

For a Level III data validation effort, the data values for routine and QC samples are generally assumed to be correctly reported by the laboratory. Data quality is assessed by comparing the parameters listed below to the appropriate criteria (or limits) as specified in the project SAP, DoD QSM or by EPA method-specific requirements. If calculations for quantitation are verified, it is done on a limited basis and may require raw data in addition to the standard data forms normally present in a data package.

Level III data review may include the following quality control (QC) elements (depending on the analysis being reviewed):

- Sample Receipt and Preservation
- Sample Holding Times
- Laboratory Method Blanks
- Surrogate Recoveries
- Laboratory Control Sample/Laboratory Control Sample Duplicate Recoveries (LCS/LCSD)
- Matrix Spike/Matrix Spike Duplicate Recoveries (MS/MSD)
- Relative Percent Differences (RPD)
- Breakdown check standards (OCP analysis)
- Initial Calibrations
- Continuing Calibration Verification
- Second Column Confirmation
- Retention Time Evaluation (GC Methods)
- Interference Check Standards (Metals)
- Serial Dilutions and Post Digestion Spikes (Metals)
- Field Blanks
- Field Duplicate

Level IV validation includes all of the above and the following QC elements:

- Internal standard recoveries
- Instrument tuning and system performance (GC/MS)
- Analyte identification (e.g., spectra and chromatograms)

- Analyte quantitation (calculation check)

SAP Worksheet #15a – Reference Limits and Evaluation Table – Soil
Analytical Group: Gamma Spectroscopy (on-site laboratory operated by TtEC)

Analyte	CAS Number	Project Action Limit Soil (pCi/g)	Project Action Limit Reference	Project QL Goal (pCi/g)	Laboratory-Specific (pCi/g)	
					MDAs	MDLs
Actinium-228	14331-83-0	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Americium-241	86954-36-1	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Bismuth-212	14913-49-6	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Bismuth-214	14733-03-0	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Cesium-137	10045-97-3	0.113	Release Criteria [b]	0.07	0.07	Not Applicable[1]
Cobalt-60	10198-40-0	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Europium-152	14683-23-9	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Europium-154	15585-10-1	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Lead-210	14255-04-0	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Lead-212	15092-94-1	None Established	Not applicable	(1)	(1)	Not Applicable[1]
Lead-214	15067-28-4	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Potassium-40	13966-00-2	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Protactinium-234M	378783-76-7	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Radium-226	13982-63-3	1.0 above background	Release Criteria [c]	1.4	1.4	Not Applicable[1]
Thallium-208	14913-50-9	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Thorium-232	7440-29-1	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Thorium-234	15065-10-8	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Uranium-235	15117-96-1	None Established	Not Applicable	(1)	(1)	Not Applicable[1]

Notes:

(1) Project quantitation limits (QLs) and minimum detectable activities (MDAs) are determined on a sample specific basis and will vary. MDLs are not applicable to radiochemical analyses.

[a] Limits are based on AEC Regulatory Guide 1.86. Limits for removable surface activity are 20 percent of these values.

[b] Limits are adopted from the Final Base-wide Radiological Removal Action Memorandum – Revision 2006 for residential (Navy, 2006).

[c] Limit is 1 picocurie per gram (pCi/g) above background per agreement with EPA.

MDL denotes method detection limit

SAP Worksheet #15b – Reference Limits and Evaluation Table – Soil
Analytical Group: Alpha Spectroscopy (on-site laboratory operated by TtEC)

Analyte	CAS Number	Project Action Limit Soil (pCi/g)	Project Action Limit Reference	Project QL Goal (pCi/g)	Laboratory-Specific (pCi/g)	
					MDAs	MDLs
Plutonium-239	97918-67-7	2.59	Note [b]	1.29	1.29	Not Applicable[1]
Thorium-232	15117-56-3	1.69	Note [b]	1.0	0.78	Not Applicable[1]
Radium-226	13982-63-3	1.0 above background	Release Criteria [c]	0.5	0.5	Not Applicable[1]
Americium-241	86954-36-1	1.36	Note [b]	0.68	0.68	Not Applicable[1]

Notes:

(1) The minimum detectable activities (MDAs) are determined on a sample specific basis and will vary. MDLs are not applicable to radiochemical analyses.

[a] Limits are based on AEC Regulatory Guide 1.86. Limits for removable surface activity are 20 percent of these values.

[b] Limits are adopted from the Final Base-wide Radiological Removal Action Memorandum – Revision 2006 for residential.

[c] Limit is 1 picocurie per gram (pCi/g) above background per agreement with EPA.

MDL denotes method detection limit.

SAP Worksheet #15c – Reference Limits and Evaluation Table – Swipe
Analytical Group: Gross Alpha/Gross Beta (on-site laboratory operated by TtEC)

Analyte	CAS Number	Project Action Limit (pCi/swipe)	Project Action Limit Reference	Project QL Goal (pCi/swipe)	Laboratory-Specific (pCi/swipe)	
					MDAs	MDLs
Gross Alpha	12587-46-1	None Established	Not Applicable	(1)	(1)	Not Applicable [1]
Gross Beta	12587-47-2	None Established	Not Applicable	(1)	(1)	Not Applicable [1]

Notes:
(1) Project quantitation limits (QLs) and minimum detectable activities (MDAs) are determined on a sample specific basis and will vary.
MDLs are not applicable to radiochemical analyses.
MDL denotes method detection limit.
pCi denotes picocurie.

SAP Worksheet #15d – Reference Limits and Evaluation Table – Soil Analytical Group: Gamma Spectroscopy (off-site subcontract radiological laboratory managed by TtEC)

Analyte	CAS Number	Project Action Limit Soil (pCi/g)	Project Action Limit Reference	Project QL Goal (pCi/g)	Laboratory-Specific (pCi/g)	
					MDAs	MDLs
Actinium-228	14331-83-0	None Established	Not Applicable	(1)	(1)	Not Applicable [1]
Americium-241	86954-36-1	None Established	Not Applicable	(1)	(1)	Not Applicable [1]
Bismuth-212	14913-49-6	None Established	Not Applicable	(1)	(1)	Not Applicable [1]
Bismuth-214	14733-03-0	None Established	Not Applicable	(1)	(1)	Not Applicable [1]
Cesium-137	10045-97-3	0.113	Release Criteria [b]	0.07	0.07	Not Applicable [1]
Cobalt-60	10198-40-0	None Established	Not Applicable	(1)	(1)	Not Applicable [1]
Europium-152	14683-23-9	None Established	Not Applicable	(1)	(1)	Not Applicable [1]
Europium-154	15585-10-1	None Established	Not Applicable	(1)	(1)	Not Applicable [1]
Lead-210	14255-04-0	None Established	Not Applicable	(1)	(1)	Not Applicable [1]
Lead-212	15092-94-1	None Established	Not Applicable	(1)	(1)	Not Applicable [1]
Lead-214	15067-28-4	None Established	Not Applicable	(1)	(1)	Not Applicable [1]
Potassium-40	13966-00-2	None Established	Not Applicable	(1)	(1)	Not Applicable [1]
Protactinium-234M	378783-76-7	None Established	Not Applicable	(1)	(1)	Not Applicable [1]
Radium-226	13982-63-3	1.0 above background	Release Criteria [c]	1.4	1.4	Not Applicable [1]
Thallium-208	14913-50-9	None Established	Not Applicable	(1)	(1)	Not Applicable [1]
Thorium-232	7440-29-1	None Established	Not Applicable	(1)	(1)	Not Applicable [1]
Thorium-234	15065-10-8	None Established	Not Applicable	(1)	(1)	Not Applicable [1]
Uranium-235	15117-96-1	None Established	Not Applicable	(1)	(1)	Not Applicable [1]

Notes:

(1) Project quantitation limits (QLs and minimum detectable activities MDAs are determined on a sample specific basis and will vary. MDLs are not applicable to radiochemistry analyses.

[a] Limits are based on AEC Regulatory Guide 1.86. Limits for removable surface activity are 20 percent of these values.

[b] Limits are adopted from the Final Base-wide Radiological Removal Action Memorandum – Revision 2006 for residential.

[c] Limit is 1 picocurie per gram (pCi/g) above background per agreement with EPA.

MDL denotes method detection limit.

SAP Worksheet #15e – Reference Limits and Evaluation Table – Soil
Analytical Group: Strontium-90 (off-site subcontract radiological laboratory managed by TtEC)

Analyte	CAS Number	Project Action Limit Soil (pCi/g)	Project Action Limit Reference	Project QL Goal (pCi/g)	Laboratory-Specific (pCi/g)	
					QLs	MDAs
Total Strontium	7440-24-6	0.331	Release Criteria	0.17	0.17	Not Applicable[1]
Strontium-90	10098-97-2	0.331	Release Criteria	0.17	0.17	Not Applicable[1]

Notes:

1. Minimum detectable activities (MDAs) are determined on a sample specific basis and will vary.

MDA denotes minimum detectable activities.

pCi/g denotes picocuries per gram.

QL denotes project quantitation limits.

SAP Worksheet #15f – Reference Limits and Evaluation Table – Soil
Analytical Group: Alpha Spectroscopy (off-site subcontract radiological laboratory managed by TtEC)

Analyte	CAS Number	Project Action Limits Soil (pCi/g)	Project Action Limit Reference	Project QL Goal (pCi/g)	Laboratory-Specific (pCi/g)	
					MDAs	MDLs
Uranium-233/234	13968-55-3/ 13966-29-5	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Uranium-235-236	15117-96-1/ 13982-70-2	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Uranium-238	7440-61-1	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Thorium-228	14274-82-9	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Thorium-232	14269-63-7	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Plutonium-238	13981-16-3	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Plutonium-239/240	10-12-8	None Established	Not Applicable	(1)	(1)	Not Applicable[1]

Notes:

(1) Project quantitation limits (QLs and minimum detectable activities (MDAs are determined on a sample specific basis and will vary. MDLs are not applicable to radiochemistry analyses.

MDA denotes minimum detectable activities.

MDL denotes method detection limit.

pCi/g denotes picocuries per gram.

QL denotes project quantitation limits.

SAP Worksheet #15g – Reference Limits and Evaluation Table – Soil
Analytical Group: Tritium (off-site subcontract radiological laboratory managed by TtEC)

Analyte	CAS Number	Project Action Limit Soil (pCi/g)	Project Action Limit Reference	Project QL Goal (pCi/g)	Laboratory-Specific (pCi/g)	
					MDAs	MDLs
Tritium	10028-17-8	None Established	Not Applicable	2.28	2.28	Not Applicable[1]

Notes:

1. Minimum detectable activities (MDAs) are determined on a sample specific basis and will vary. MDLs are not applicable to radiochemistry analyses.

MDA denotes minimum detectable activities.

MDL denotes method detection limit.

pCi/g denotes picocuries per gram.

QL denotes project quantitation limits.

SAP Worksheet #15h – Reference Limits and Evaluation Table – Swipe
Analytical Group: Gross Alpha/Gross Beta (Field Instruments)

Analyte	CAS Number	Project Action Limit (dpm/100cm^2)	Project Action Limit Reference	Project MDC Goal	Laboratory-Specific (dpm/100cm^2) MDC
Gross Alpha	12587-46-1	20	Removal Action - Action Memorandum per 2006 Table 1	10% of Action Limit [1]	<90% of Action Limit
Gross Beta	12587-47-2	200	Removal Action – Action Memorandum per 2006 Table 1	10% of Action Limit [1]	<90% of Action Limit

Notes:

1. The field instrument MDC goal is 10% of the Project Action Limit; the acceptable MDC is < 90% of the Project Action Limit

cm^2 denotes square centimeters

dpm denotes disintegrations per minute

MDC denotes minimum detectable concentration

QL denotes project quantitation limits.

SAP Worksheet #15i – Reference Limits and Evaluation Table - Water Samples Analytical Group: Gamma Spectroscopy (off-site subcontract radiological laboratory managed by TtEC)

Analyte	CAS Number	Project Action Limits (pCi/L)	Project Action Limit Reference	Project QL Goal (pCi/L)	Laboratory-Specific (pCi/L)	
					MDAs	MDLs
Actinium-228	14331-83-0	None Established	Not applicable	(1)	(1)	Not applicable[1]
Americium-241	86954-36-1	None Established	Not applicable	(1)	(1)	Not applicable[1]
Bismuth-212	14913-49-6	None Established	Not applicable	(1)	(1)	Not applicable[1]
Bismuth-214	14733-03-0	None Established	Not applicable	(1)	(1)	Not applicable[1]
Cesium-137	10045-97-3	119	SF Public Utilities Dept Wastewater discharge limit	60	60	Not applicable[1]
Cobalt-60	10198-40-0	None Established	Not applicable	(1)	(1)	Not applicable[1]
Europium-152	14683-23-9	None Established	Not applicable	(1)	(1)	Not applicable[1]
Europium-154	15585-10-1	None Established	Not applicable	(1)	(1)	Not applicable[1]
Lead-210	14255-04-0	None Established	Not applicable	(1)	(1)	Not applicable[1]
Lead-212	15092-94-1	None Established	Not applicable	(1)	(1)	Not applicable[1]
Lead-214	15067-28-4	None Established	Not applicable	(1)	(1)	Not applicable[1]
Potassium-40	13966-00-2	None Established	Not applicable	(1)	(1)	Not applicable[1]
Protactinium-234M	378783-76-7	None Established	Not applicable	(1)	(1)	Not applicable[1]
Thallium-208	14913-50-9	None Established	Not applicable	(1)	(1)	Not applicable[1]
Thorium-232	7440-29-1	None Established	Not applicable	(1)	(1)	Not applicable[1]
Thorium-234	15065-10-8	None Established	Not applicable	(1)	(1)	Not applicable[1]
Uranium-235	15117-96-1	None Established	Not applicable	(1)	(1)	Not applicable[1]

Notes:

(1) Project quantitation limits (QLs) and minimum detectable activities (MDAs are determined on a sample specific basis and will vary. MDLs are not applicable to radiochemistry analyses.

MDA denotes minimum detectable activities.

MDL denotes method detection limit.

pCi/L denotes picocuries per liter.

QL denotes project quantitation limits.

SAP Worksheet #15j – Reference Limits and Evaluation Table - Water Samples Analytical Group: Radium-226 (off-site subcontract radiological laboratory managed by TtEC)

Analyte	CAS Number	Project Action Limits (pCi/L)	Project Action Limit Reference	Project QL Goal (pCi/L)	Laboratory-Specific (pCi/L)	
					MDAs	MDLs
Radium-226	13982-63-3	5.0	SF Public Utilities Dept Wastewater discharge limit	2.5	2.5	Not Applicable[1]

Notes:

1. MDAs are determined on a sample specific basis and will vary. MDLs are not applicable to radiochemistry analyses.

MDA denotes minimum detectable activities.

MDL denotes method detection limit.

pCi/L denotes picocuries per liter.

QL denotes project quantitation limits.

SAP Worksheet #15k – Reference Limits and Evaluation Table - Water Samples Analytical Group: Strontium-90 (off-site subcontract radiological laboratory managed by TtEC)

Analyte	CAS Number	Project Action Limits (pCi/L)	Project Action Limit Reference	Project QL Goal (pCi/L)	Laboratory-Specific (pCi/L)	
					MDAs	MDLs
Total Strontium	7440-24-6	8	SF Public Utilities Department Wastewater discharge limit	4	4	Not Applicable[1]
Strontium-90	10098-97-2	8	SF Public Utilities Department Wastewater discharge limit	4	4	Not Applicable[1]

Notes:

1. MDAs are determined on a sample specific basis and will vary. MDLs are not applicable to radiochemistry analyses.

MDA denotes minimum detectable activities.

MDL denotes method detection limit.

pCi/L denotes picocuries per liter.

QL denotes project quantitation limits.

SAP Worksheet #15l – Reference Limits and Evaluation Table – Water Samples Analytical Group: Alpha Spectroscopy (off-site subcontract radiological laboratory managed by TtEC)

Analyte	CAS Number	Project Action Limits (pCi/L)	Project Action Limit Reference	Project QL Goal (pCi/L)	Laboratory-Specific (pCi/L)	
					MDAs	MDLs
Uranium-233/234	13968-55-3/ 13966-29-5	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Uranium-235-236	15117-96-1/ 13982-78-2	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Uranium-238	7440-61-1	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Thorium-228	14274-82-9	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Thorium-232	14269-63-7	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Plutonium-238	13981-16-3	None Established	Not Applicable	(1)	(1)	Not Applicable[1]
Plutonium-239/240	10-12-8	None Established	Not Applicable	(1)	(1)	Not Applicable[1]

Notes:
(1) Project quantitation limits (QLs and minimum detectable activities (MDAs are determined on a sample specific basis and will vary. MDLs are not applicable to radiochemistry analyses.
MDL denotes method detection limit.
pCi/L denotes picocuries per liter.

SAP Worksheet #15m – Reference Limits and Evaluation Table – Water Samples Analytical Group: Tritium (off-site subcontract radiological laboratory managed by TtEC)

Analyte	CAS Number	Project Action Limit (pCi/L)	Project Action Limit Reference	Project QL Goal (pCi/L)	Laboratory-Specific (pCi/L)	
					MDAs	MDLs
Tritium	10028-17-8	20,000	Removal Action – Action Memorandum	2.28	2.28	Not Applicable[1]

Notes:
1 Minimum detectable activities (MDAs) are determined on a sample specific basis and will vary. MDLs are not applicable to radiochemistry analyses.
MDL denotes method detection limit.
pCi/L denotes picocuries per liter.

SAP Worksheet #15n – Reference Limits and Evaluation Table- Pesticides and PCBs (Soil Matrix)

Analyte	CAS Number	Remedial Action Objectives (mg/kg)	Project Action Limit Reference	Project QL Goal (mg/kg)	Laboratory-Specific (mg/kg)	
					QLs	MDLs
Aroclor-1016	12674-11-2	3.9	EPA RSLs (for backfill only)[a]	1.0	0.012	0.003
Aroclor-1221	11104-28-2	0.17	EPA RSLs (for backfill only)	0.05	0.024	0.008
Aroclor-1232	11141-16-5	0.17	EPA RSLs (for backfill only)	0.05	0.012	0.0037
Aroclor-1242	53469-21-9	0.22	EPA RSLs (for backfill only)	0.05	0.012	0.0028
Aroclor-1248	12672-29-6	0.22	EPA RSLs (for backfill only)	0.05	0.012	0.0021
Aroclor-1254	11097-69-1	0.22	EPA RSLs (for backfill only)	0.05	0.012	0.003
Aroclor-1260	11096-82-5	0.22	EPA RSLs (for backfill only)	0.05	0.012	0.0011
Chlordane (alpha)	57-74-9	1.6	EPA RSLs (for backfill only)	0.05	0.0017	0.00032
Chlordane (gamma)	57-74-9	1.6	EPA RSLs (for backfill only)	0.05	0.0017	0.00037
DDD	72-54-8	2.0	EPA RSLs (for backfill only)	0.05	0.0033	0.00087
DDE	72-55-9	1.4	EPA RSLs (for backfill only)	0.05	0.0033	0.00089
DDT	50-29-3	1.7	EPA RSLs (for backfill only)	0.01	0.0033	0.0001
alpha-BHC	319-84-6	0.072	EPA RSLs (for backfill only)	0.025	0.0017	0.00042
beta-BHC	319-85-7	0.27	EPA RSLs (for backfill only)	0.05	0.0017	0.00047
gamma-BHC (Lindane)	58-89-9	0.52	EPA RSLs (for backfill only)	0.05	0.0017	0.00031
Heptachlor	76-44-8	0.11	EPA RSLs (for backfill only)	0.05	0.0017	0.00037
Aldrin	309-00-2	0.029	EPA RSLs (for backfill only)	0.005	0.0017	0.00036
Heptachlor Epoxide	1024-57-3	0.053	EPA RSLs (for backfill only)	0.025	0.0017	0.00038
Endosulfan I	115-29-7	370	EPA RSLs (for backfill only)	1.0	0.0017	0.00030
Dieldrin	60-57-1	0.03	EPA RSLs (for backfill only)	0.01	0.0033	0.00068
Endrin	72-20-8	18	EPA RSLs (for backfill only)	1.0	0.0033	0.00081
Methoxychlor	72-43-5	310	EPA RSLs (for backfill only)	0.5	.017	0.0055
Toxaphene	8001-35-2	0.44	EPA RSLs (for backfill only)	0.010	0.060	0.020

Notes:
[a] *Imported backfill soil sample data will be compared to the Region 9 Regional Screening Levels (April 2009, Residential).*
mg/kg denotes milligrams per kilogram.
QL denotes quantitation limit.
MDL denotes method detection limit.
RSL denotes regional screening level

SAP Worksheet #15o– Reference Limits and Evaluation Table – Metals (Soil Matrix)

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference	Project QL Goal (mg/kg)	Laboratory-Specific (mg/kg)	
					QLs	MDL
Antimony	7440-36-0	31	EPA RSLs (for backfill only)[a]	5.0	0.5	0.16
Arsenic	7440-38-2	11.1	HPS Ambient concentration	5.0	0.25	0.083
Barium	7440-39-3	15000	EPA RSLs (for backfill only)	100	0.25	0.054
Beryllium	7440-41-7	160	EPA RSLs (for backfill only)	5.0	0.1	0.019
Cadmium	7440-43-9	70	EPA RSLs (for backfill only)	5.0	0.25	0.026
Chromium	7440-47-3	280	EPA RSLs (for backfill only)	5.0	0.25	0.063
Cobalt	7440-48-4	23	EPA RSLs (for backfill only)	5.0	0.25	0.030
Copper	7440-50-8	270	EPA RSLs (for backfill only)	5.0	0.25	0.086
Lead	7439-92-1	400	EPA RSLs (for backfill only)	10	0.25	0.073
Mercury	7439-97-6	0.71	EPA RSLs (for backfill only)	0.2	0.02	0.0063
Molybdenum	7439-98-7	390	EPA RSLs (for backfill only)	5.0	0.25	0.056
Nickel	7440-02-0	112	EPA RSLs (for backfill only)	5.0	0.25	0.068
Selenium	7782-49-2	390	EPA RSLs (for backfill only)	5.0	0.5	0.16
Silver	7440-22-4	390	EPA RSLs (for backfill only)	5.0	0.25	0.075
Thallium	7440-28-0	5.1	EPA RSLs (for backfill only)	2.0	0.5	0.16
Vanadium	7440-62-2	390	EPA RSLs (for backfill only)	5.0	0.25	0.057
Zinc	7440-66-6	23,000	EPA RSLs (for backfill only)	10	1	0.073

Notes:

[a] *Imported backfill soil sample data will be compared to the Region 9 Regional Screening Levels (April 2009, Residential). At the discretion of the Navy RPM, import material that exceeds screening levels may be brought onsite for use as backfill if the concentrations do not exceed the Hunters Point Ambient Levels or background values.*

MDL denotes method detection limit.

mg/kg denotes milligrams per kilogram.

QL denotes quantitation limit.

RSL denotes regional screening level

SAP Worksheet #15p – Reference Limits and Evaluation Table- Volatile Organic Compounds (Soil Matrix)

Analyte	CAS Number	Project Action Limit (mg/kg) [1]	Project Action Limit Reference[1]	Project QL Goal (mg/kg)	Laboratory-Specific (mg/kg)	
					QLs	MDLs
Acetone	67-64-1	61,000	EPA RSLs (for backfill only)[a]	0.1	0.020	0.0032
Benzene	74-43-2	1.1	EPA RSLs (for backfill only)	0.1	0.005	0.00097
Bromodichloromethane	75-27-4	0.28	EPA RSLs (for backfill only)	0.1	0.010	0.0011
Bromoform	75-25-2	612	EPA RSLs (for backfill only)	0.1	0.005	0.00073
Bromomethane	74-83-9	7.9	EPA RSLs (for backfill only)	0.1	0.010	0.0012
2-Butanone	78-93-3	28000	EPA RSLs (for backfill only)	0.1	0.010	0.0016
Carbon Disulfide	75-15-0	670	EPA RSLs (for backfill only)	0.1	0.005	0.0015
Carbon Tetrachloride	56-23-5	0.25	EPA RSLs (for backfill only)	0.1	0.005	0.00097
Chlorobenzene	108-90-7	310	EPA RSLs (for backfill only)	0.1	0.005	0.00063
Dibromochloromethane	124-48-1	0.70	EPA RSLs (for backfill only)	0.1	0.005	0.00051
Chloroethane	75-00-3	None	Not Applicable[b]	0.1	0.010	0.0014
Chloroform	67-66-3	0.30	EPA RSLs (for backfill only)	0.1	0.005	0.0011
Chloromethane	74-87-3	120	EPA RSLs (for backfill only)	0.1	0.010	0.0013
cis-1,3-Dichloropropene	542-75-6	1.7	EPA RSLs (for backfill only)	0.1	0.005	0.00083
Trans-1,3-Dichloropropene	10061-2-6	1.7	EPA RSLs (for backfill only)	0.1	0.005	0.00077
1,2-Dichlorobenzene	95-50-1	2000	EPA RSLs (for backfill only)	0.1	0.005	0.0016
1,3-Dichlorobenzene	541-73-1	None	Not Applicable[b]	0.1	0.005	0.0012
1,4-Dichlorobenzene	106-46-7	1.1	EPA RSLs (for backfill only)	0.1	0.005	0.0014
1,1-Dichloroethane	75-34-3	3.4	EPA RSLs (for backfill only)	0.1	0.005	0.0015
1,2-Dichloroethane	107-06-2	0.45	EPA RSLs (for backfill only)	0.1	0.005	0.00093
1,1-Dichloroethene	75-35-4	250	EPA RSLs (for backfill only)	0.1	0.005	0.0013
cis-1,2-Dichloroethene	156-59-2	780	EPA RSLs (for backfill only)	0.1	0.005	0.00099
trans-1,2-Dichloroethene	156-60-5	110	EPA RSLs (for backfill only)	0.1	0.005	0.0015
1,2-Dichloropropane	78-87-5	0.93	EPA RSLs (for backfill only)	0.1	0.005	0.0016
Ethyl benzene	100-41-4	5.7	EPA RSLs (for backfill only)	0.1	0.005	0.0012
2-Hexanone	591-78-6	None	Not Applicable[b]	0.1	0.010	0.0013
Methylene Chloride	75-09-2	11	EPA RSLs (for backfill only)	0.1	0.020	0.0031
Methyl isobutyl ketone (MIBK)	108-10-1	5300	EPA RSLs (for backfill only)	0.1	0.010	0.0013
Methyl tertiary butyl ether	1634-04-4	39	EPA RSLs (for backfill only)	0.1	0.005	0.0015

SAP Worksheet #15p – Reference Limits and Evaluation Table- Volatile Organic Compounds (Soil Matrix) (continued)

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference	Project QL Goal (mg/kg)	Laboratory-Specific (mg/kg)	
					QLs	MDLs
Naphthalene	91-20-3	3.9	EPA RSLs (for backfill only)	0.1	0.005	0.0011
Styrene	100-42-5	6500	EPA RSLs (for backfill only)	0.1	0.005	0.0011
1,1,2,2-Tetrachloroethane	79-34-5	0.59	EPA RSLs (for backfill only)	0.1	0.005	0.00096
Tetrachloroethene	127-18-4	0.57	EPA RSLs (for backfill only)	0.1	0.005	0.00080
Toluene	108-88-3	5000	EPA RSLs (for backfill only)	0.1	0.005	0.0013
1,1,1-Trichloroethane	71-55-6	9000	EPA RSLs (for backfill only)	0.1	0.005	0.0013
1,1,2-Trichloroethane	79-00-5	1.1	EPA RSLs (for backfill only)	0.1	0.005	0.00093
Trichloroethene	79-01-6	2.8	EPA RSLs (for backfill only)	0.1	0.005	0.0011
Vinyl acetate	108-05-4	990	EPA RSLs (for backfill only)	0.1	0.050	0.0024
Vinyl Chloride	75-01-4	0.06	EPA RSLs (for backfill only)	0.025	0.010	0.0015
Xylene (Total)	1330-20-7 95-47-6	600	EPA RSLs (for backfill only)	0.1	0.005	0.0014

Notes:
[a] *Imported backfill soil sample data will be compared to the Region 9 Regional Screening Levels (April 2009, Residential).*
[b] *No EPA RSL available for this compound*
MDL denotes method detection limit.
mg/kg denotes milligrams per kilogram.
QL denotes quantitation limit.
RSL denotes regional screening level

SAP Worksheet #15q – Reference Limits and Evaluation Table- Total Petroleum Hydrocarbons (Soil Matrix)

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference	Project QL Goal (mg/kg)	Laboratory-Specific (mg/kg)	
					QLs	MDLs
TPH as gasoline range organics (C6-C10)	86290-81-5	3500	HPS TPH Action Level	500	1	0.072
TPH as diesel range organics (C10-C24)	68334-30-5			500	1	0.28
TPH as motor oil range organics (C24 –C36)	none			500	5	0.97

Notes:
HPS denote Hunters Point Shipyard
MDL denotes method detection limit.
mg/kg denotes milligrams per kilogram.
QL denotes quantitation limit.

SAP Worksheet #15r -- Reference Limits and Evaluation Table- Semivolatile Organic Compounds (Soil Matrix)

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference	Project QL Goal (mg/kg)	Laboratory-Specific (mg/kg)	
					QLs	MDLs
Bis(2-Chloroethoxy) methane	111-91-1	180	EPA RSLs (for backfill only)[b]	0.33	0.33	0.017
Bis(2-Chloroethyl) Ether	111-44-4	0.19[a]	EPA RSLs (for backfill only)[b]	0.33	0.33	0.089
Bis(2-Chloroisopropyl) ether	39638-32-9	None	Not Applicable[c]	0.33	0.33	0.095
Bis(2-Ethylhexyl) Phthalate	117-81-7	35	EPA RSLs (for backfill only)[b]	0.33	0.33	0.015
Butyl Benzyl Phthalate	85-68-7	260	EPA RSLs (for backfill only)[b]	0.33	0.33	0.015
4-Chloroaniline	106-47-8	2.4	EPA RSLs (for backfill only)[b]	0.33	0.33	0.075
2-Chloronaphthalene	91-58-7	6300	EPA RSLs (for backfill only)[b]	0.33	0.33	0.019
2-Chlorophenol	95-57-8	390	EPA RSLs (for backfill only)[b]	0.33	0.33	0.088
4-Chlorophenyl phenyl ether	7005-72-3	None	Not Applicable[c]	0.33	0.33	0.015
Di-n-Octyl Phthalate (DOP)	117-84-0	2400	EPA RSLs (for backfill only)[b]	0.33	0.33	0.015
Dibenzofuran	132-64-9	None	Not Applicable[c]	0.33	0.33	0.018
1,2-Dichlorobenzene	95-50-1	2000	EPA RSLs (for backfill only)[b]	0.33	0.33	0.091
1,3-Dichlorobenzene	541-73-1	None	EPA RSLs (for backfill only)[b]	0.33	0.33	0.089
1,4-Dichlorobenzene	106-46-7	2.6	EPA RSLs (for backfill only)[b]	0.33	0.33	0.088
3,3'-Dichlorobenzidine	91-94-1	1.1[a]	EPA RSLs (for backfill only)[b]	1.7	0.67	0.110
2,4-Dichlorophenol	120-83-2	180	EPA RSLs (for backfill only)[b]	0.33	0.33	0.076
Diethyl Phthalate (DEP)	84-66-2	49000	EPA RSLs (for backfill only)[b]	0.33	0.33	0.018
Di-N-butyl Phthalate	84-74-2	6100	EPA RSLs (for backfill only)[b]	0.33	0.33	0.016
Dimethyl Phthalate (DMP)	131-11-3	None	Not Applicable[c]	0.33	0.33	0.070
2,4-Dimethylphenol	105-67-9	1200	EPA RSLs (for backfill only)[b]	1.7	0.33	0.069
2,4-Dinitrophenol	51-28-5	120	EPA RSLs (for backfill only)[b]	1.7	0.67	0.330
2,4-Dinitrotoluene	121-14-2	1.6	EPA RSLs (for backfill only)[b]	0.33	0.33	0.072
2,6-Dinitrotoluene	606-20-2	61	EPA RSLs (for backfill only)[b]	0.33	0.33	0.074
4,6-Dinitro-2-methylphenol	534-52-1	6.1	EPA RSLs (for backfill only)[b]	1.7	0.67	0.160
4-Bromophenyl phenyl eher	101-55-3	None	Not Applicable[c]	1.7	0.33	0.015
4-Chloro-3-methylphenol	59-50-7	None	Not Applicable[c]	1.7	0.33	0.070
Hexachlorobenzene	118-74-1	0.3[a]	EPA RSLs (for backfill only)[b]	0.33	0.33	0.083
Hexachlorobutadiene	87-68-3	6.2	EPA RSLs (for backfill only)[b]	0.33	0.33	0.090
Hexachlorocyclopentadiene	77-47-4	370	EPA RSLs (for backfill only)[b]	0.33	0.67	0.100

SAP Worksheet #15r – Reference Limits and Evaluation Table- Semivolatile Organic Compounds (Soil Matrix) (continued)

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference	Project QL Goal (mg/kg)	Laboratory-Specific (mg/kg)	
					QLs	MDLs
Hexachloroethane	67-72-1	35	EPA RSLs (for backfill only)[b]	0.33	0.33	0.088
3/4-Methylphenol (m/pCresol)	108-39-4/ 106-44-5	310	EPA RSLs (for backfill only)[b]	0.33	0.33	0.078
2-Methylphenol (o-Cresol)	95-48-7	3100	EPA RSLs (for backfill only)[b]	0.33	0.33	0.084
2-Nitroaniline	88-74-4	180	EPA RSLs (for backfill only)[b]	1.7	0.67	0.067
3-Nitroaniline	99-09-2	None	Not Applicable[c]	1.7	0.67	0.120
2-Nitrophenol	88-75-5	None	Not Applicable[c]	1.7	0.67	0.090
4-Nitrophenol	100-02-7	None	Not Applicable[c]	1.7	0.67	0.085
4-Nitroaniline	100-01-6	24	EPA RSLs (for backfill only)[b]	1.7	0.67	0.099
Nitrobenzene	98-95-3	4.4	EPA RSLs (for backfill only)[b]	0.33	0.33	0.079
N-Nitroso-Di-n-Propylamine	621-64-7	0.069[a]	EPA RSLs (for backfill only)[b]	0.33	0.33	0.088
N-Nitrosodiphenylamine	86-30-6	99	EPA RSLs (for backfill only)[b]	0.33	0.33	0.076
Acenaphthene	83-32-9	3400	EPA RSLs (for backfill only)[b]	0.33	0.067	0.015
Acenaphthylene	208-96-8	None	Not Applicable[c]	0.33	0.067	0.019
Anthracene	120-12-7	17000	EPA RSLs (for backfill only)[b]	0.33	0.067	0.014
Benz(a)anthracene	56-55-3	0.15	EPA RSLs (for backfill only)[b]	0.33	0.067	0.014
Benzo(a)pyrene	50-32-8	0.015[a]	EPA RSLs (for backfill only)[b]	0.33	0.067	0.015
Benzo(b)fluoranthene	205-99-2	0.15	EPA RSLs (for backfill only)[b]	0.33	0.067	0.015
Benzo(k)fluoranthene	207-08-9	1.5	EPA RSLs (for backfill only)[b]	0.33	0.067	0.018
Benzo[g,h,i]perylene	191-24-2	None	Not Applicable[c]	0.33	0.067	0.016
Chrysene	218-01-9	15	EPA RSLs (for backfill only)[b]	0.33	0.067	0.015
Dibenz(a,h)anthracene	53-70-3	0.015	EPA RSLs (for backfill only)[b]	0.33	0.067	0.016
Fluoranthene	206-44-0	2300	EPA RSLs (for backfill only)[b]	0.33	0.067	0.015
Fluorene	86-73-7	2300	EPA RSLs (for backfill only)[b]	0.33	0.067	0.017
Indeno(1,2,3-cd)pyrene	193-39-5	0.15	EPA RSLs (for backfill only)[b]	0.33	0.067	0.015
Naphthalene	91-20-3	3.9	EPA RSLs (for backfill only)[b]	0.33	0.067	0.018
Phenanthrene	85-01-8	None	Not Applicable[c]	0.33	0.067	0.014
Pyrene	129-00-0	1700	EPA RSLs (for backfill only)[b]	0.33	0.067	0.015
Pentachlorophenol (PCP)	87-86-5	3.0	EPA RSLs (for backfill only)[b]	1.7	0.67	0.130
Phenol	108-95-2	18000	EPA RSLs (for backfill only)[b]	0.33	0.33	0.083

SAP Worksheet #15r – Reference Limits and Evaluation Table- Semivolatile Organic Compounds (Soil Matrix) (continued)

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference	Project QL Goal (mg/kg)	Laboratory-Specific (mg/kg)	
					QLs	MDLs
1,2,4-Trichlorobenzene	120-82-1	87	EPA RSLs (for backfill only)[b]	3	0.33	0.087
2,4,5-Trichlorophenol	95-95-4	6100	EPA RSLs (for backfill only)[b]	1.7	0.33	0.069
2,4,6-Trichlorophenol	88-06-2	44	EPA RSLs (for backfill only)[b]	1.7	0.33	0.073

Notes:
[a] PQL is above the project comparison limit, these analytes are not expected to be present in backfill material and special analytical methods are not warranted. The laboratory will report all analytes to the MDL with "J" qualifier to identify trace concentrations if present.
[b] Imported backfill soil sample data will be compared to the Region 9 Regional Screening Levels (April 2009, Residential).
[c] No EPA RSL available for this compound
MDL denotes method detection limit.
mg/kg denotes milligrams per kilogram.
QL denotes quantitation limit.
RSL denotes regional screening level

SAP Worksheet #15s – Reference Limits and Evaluation Table- Asbestos (Soil Matrix)

Analyte	CAS Number	Project Action Limit (%)	Project Action Limit Reference	Project QL Goal (%)	Laboratory-Specific (%)	
					QLs	MDLs
Asbestos	-------	< 0.25	Action Level for Import Fill California Air Resources Board	0.25	0.25	0.10

Notes:
% denotes percent.
MDL denotes method detection limit.
QL denotes quantitation limit.

SAP Worksheet #16 – Project Schedule/Timeline Table

Activities	Organization	Dates		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Field Activities	Shaw	Field Work: Summer 2010	Field Work: Spring 2011	Final Report	2011
Off-Site Laboratory Analysis	Curtis and Tompkins	Import Fill samples: 21 business days after delivery to the lab	Hardcopy lab data due 5 days after preliminary	Data Report	14 days
Data Review/validation	LDC	After hardcopy data received from laboratory	15 - 21 Days after receipt of hardcopy data	Validation Report	Final Report Due Date 2011
NIRIS Upload (backfill soil sample data if collected)	Shaw	After hardcopy data received from 3rd party validation	30 Days after validation completed and reviewed by Shaw	NIRIS Upload	Due 30 days after validation completed

SAP Worksheet #17 – Sampling Design and Rationale

17.1 BACKGROUND (REFERENCE SAMPLING)

Prior to the start of SD and SS excavation activities an average background level will be determined by performing a minimum of 18 measurements at systematic or random locations within a designated background area selected by the PRSO and with the concurrence of RASO. These background samples will be collected in the background area at systematic locations and analyzed by the on-site laboratory by gamma spectroscopy to establish an average background value for ^{226}Ra and ^{137}Cs, which will be used in conjunction with the release criteria listed in WS # 15.

The background values for ^{226}Ra and ^{137}Cs will be determined at the on-site laboratory by counting for a period typically necessary to meet the applicable maximum MDA. If the result of the average background determination indicate ^{226}Ra activity less than half the release criterion (without regard to MDA) with few or no negative results, then the background will be considered acceptable.

Background values will be calculated using the reported activity, regardless if the value is below MDA or less than zero.

Measurement uncertainty values will be considered acceptable if, in the opinion of the laboratory manager, a longer duration count would not improve the counting statistics markedly, and:

1. The two-sigma total uncertainty is less than 10 picocuries per gram (pCi/g) for ^{226}Ra for activity indicated below the MDA.
2. The two-sigma uncertainty for ^{137}Cs is less than 10 pCi/g for activity indicated below the MDA.

Data collected in reference areas will be statistically evaluated using a graphical format, such as a frequency distribution chart, and approved for use by the RASO. The purpose of the evaluation is to ensure that the data collected in the reference area are consistent with a normal distribution and that the variability of the background is not too high.

Ten percent of these samples will also be analyzed for ^{90}Sr and alpha spectroscopy, as necessary, by the on-site laboratory. Ten percent of the reference area samples shall be sent to an offsite laboratory for QA purposes and counted in the cumulative number of samples processed by the onsite laboratory. This requirement shall apply specifically to the background (reference) area and FSS samples, in addition to the cumulative total described above.

17.2 PIPING REMOVAL SAMPLING

The general approach to removing the SD and SS piping will be to remove the overlying pavement, excavate the soils down to the piping, remove the piping, and remove soils within one

foot to the sides and below the piping. Radiological screening and sampling will be performed ex-situ on excavated soil, piping, and debris.

Removed surface pavement material within radiologically-impacted areas will be radiologically evaluated for release and re-use or for classification as low-level radioactive waste (LLRW).

The soil overlying the SD and SS piping will be excavated and transported to a designated RSY for subsequent survey and sampling activities performed by TtEC, the Navy contracted RSY operator. The depth of the excavation will extend to a minimum of one foot laterally and below the piping. Excavated soil removed from non-Installation Restoration (IR)site areas will be managed so that, once free released, it can be returned to the general area from which it was excavated.

To the extent practicable, SD and SS piping will be removed and staged separately. If the piping cannot be extracted separately (as may be the case for terracotta pipe) and it is broken into pieces, those pieces, less than 6 inches in any direction, will be managed as excavated soil.

Where practicable, piping segments shall be removed intact and will be placed in designated laydown areas within the radiologically controlled area from which it was removed to allow for radiological characterization and sampling as required. Excavated piping segments will be considered potentially radiologically contaminated until survey and sampling data prove otherwise, and they shall be controlled as potentially radioactively contaminated material and handled accordingly. Every effort will be taken to contain silts and debris that may be inside the piping. If sediment is present within removed piping, a minimum of one sample will be collected for every 10 linear feet for radiological analysis. These sediment samples will be collected from the interior surfaces of extracted piping and analyzed by gamma spectroscopy by the on-site laboratory. Open SD and SS piping left in place during the removal process will be plugged to prevent water from entering or exiting piping and to prevent the release of any contaminations that may be present in the piping. In no case will sediment from removal or installation work be allowed to enter the SF Bay.

Excavated piping and debris will be screened for alpha and beta/gamma emitters. Swipe samples will be collected from the interior and exterior surfaces to identify the presence of removable surface contamination for the purposes of health and safety monitoring and equipment and debris release. Swipe samples will be analyzed for gross alpha/gross beta by Shaw, using a dual channel sample counter. A minimum of one exterior and interior swipe sample will be collected for each 10 linear feet of excavated piping. Additional swipe samples may be collected based on the result of the field surveys, and are typically collected in the event that a specific criteria or release limit has been exceeded and additional information is necessary to determine the impact in order to properly release the debris.

In instances where surveys cannot be performed, such as broken piping, the piping will be managed as excavated soil. Radiologically contaminated material identified during surveys will be stored at the originating site pending disposal. Additional samples will be analyzed for ^{90}Sr and alpha spectroscopy at an off-site laboratory if ^{137}Cs activity above the release criteria is identified during on-site laboratory gamma spectroscopy analysis.

A grab soil sample will be collected from the bottom of the excavated trench section where there is evidence of a breach in the SD and SS piping. A breach will be defined as: (1) gap/crack/break in the piping segments; (2) abrupt end to a pipe (open ended); (3) missing section of pipe; and (4) other visible signs of piping failure/leakage. The sample will be analyzed for the radioactivity and chemicals of concern from upgradient sources.

If it is required to remove piping from a radiologically-impacted site, an initial surface radiological survey will be performed to identify surface and near-surface (less than 30 centimeters [12 inches] bgs) radioactive material for subsequent removal and proper on-site storage pending disposal through the Navy's LLRW Disposal Contractor, EMS, Inc., prior to excavation.

Excavated debris and piping not radiologically contaminated will be stockpiled in a temporary laydown area. Subsequently, these wastes will be transported by another Navy contractor, ITSI, off site for disposal at a CERCLA Off-site, Rule-approved landfill. Trucks transporting these non-radiological wastes will pass through the on-site portal monitor operated by TtEC prior to exiting HPS.

Excavated soil, piping, and debris will be placed on stockpile/laydown pads for storage, sampling, and/or radiological screening. Water collected from the screening pads will be characterized for chemical and radiological constituents.

Throughout the excavation process, soil and piping shall be visually inspected for chemical staining or odors. Material from an IR site that emits odors or is stained shall be segregated for further characterization sampling and analysis by another Navy contractor in accordance with the disposal facility's requirements. If the material is identified outside the bounds of an IR site, then the Navy will be notified to determine any further action.

All soil and sediment samples will be analyzed by gamma spectroscopy by the on-site radiological lab. A minimum of 10 percent of the samples analyzed for gamma spectroscopy also will be analyzed for ^{90}Sr by the on-site laboratory. Additional samples will be analyzed for ^{90}Sr, isotopic plutonium, and isotopic uranium, if the off-site laboratory results indicate concentrations of ^{137}Cs concentrations in soil are at or above its release criteria. When on-site laboratory results indicate concentrations of ^{90}Sr at the release criteria or greater, additional analysis for isotopic

plutonium and isotopic uranium will be performed. Isotopic plutonium, isotopic uranium, and ^{90}Sr will be performed by the off-site laboratory. A minimum of 10 percent of all radiological analyses performed by the onsite laboratory shall be submitted to an offsite laboratory for QA purposes.

Trench segment piping confirmed as having radioactive contamination present above the release criteria may require further trench sampling if there is evidence of leakage out of the piping, as directed by the Shaw PRSO.

17.3 EXCAVATED SOIL SAMPLING

Excavated soil will be segregated as radiologically-impacted or will be transported to a screening pad for subsequent dewatering (if necessary) and radiological survey activities (performed by TtEC). Excavated soil in the radiological screening yard will be handled by TtEC, USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (EPA, 2008),according to the *Base-Wide Storm Drain and Sanitary Sewer Removal Project Work Plan* (TtEC, 2009) as discussed below.

Excavated soil placed on the screening pads will be spread out in lifts not to exceed 6 inches in height and up to 1,000 square meters (m^2) in surface area. As necessary, the material will be allowed to dewater prior to performing radiological surveys. The radiological surface survey will consist of a high-density survey process with the use of sodium iodide (NaI) detectors. The high-density survey process will result in a 100 percent scan survey, as detailed in Section 4.0 of the *Base-Wide Storm Drain and Sanitary Sewer Removal Project Work Plan* (TtEC, 2008). Radioactive material identified during screening activities will be collected, segregated, and stored in appropriate containers for subsequent packaging and disposal under the direction of the Navy LLRW Disposal Program as directed by the TtEC Radiation Safety Officer (RSO). (TtEC, 2009)

Collected field data will be logged and survey points plotted on survey unit grid maps to document survey results. These data will be used to directly tie the locations of any elevated radiation measurements to the corresponding grid coordinates, which will be established during the development of the systematic sampling plan. Data analysis will be performed as the data are received, and questionable areas will be flagged in the field for resurvey/verification. Locations where surface radiation levels appear to be greater than 3 sigma of the mean background level will be noted on a subcontractor-provided grid map. Areas confirmed as having radiation levels greater than the established 3 sigma of the mean background area level will be evaluated further for the presence of radioactive material and may include additional biased sampling points. If radioactive material is confirmed, the area will be physically marked and the associated radioactive material removed. (TtEC, 2009)

A minimum of 18 systematic solid samples will be collected for each survey unit of excavated soil (up to 1,000 m^2) and placed on the screening pad for a Scoping Survey and FSS. Any contamination found in excavated soil will be characterized and remediated as directed by the TtEC RSO. Remedial action support surveys will be performed until post-remediation sample results are less than the release criteria. Scoping survey sample data may be used as the FSS if all sample results are less than the release criteria. (TtEC, 2009)

Scoping survey and FSS samples will be systematically collected based on a random start point and sample spacing utilizing Equation 4-2 from the *Base-wide Storm Drain and Sanitary Sewer Removal Project Work Plan* (TtEC, 2007) or using the most current version of Visual Sample Plan (VSP) software with a triangular grid pattern. Additional samples will be collected at locations where the investigation level is exceeded, or as directed by the TtEC RSO. The samples will be analyzed at the on-site radiological laboratory by gamma spectroscopy. Excavated soil determined to have residual radioactive contamination below the release criteria after a single phase of systematic sampling may be used as backfill, pending additional chemical analytical results. Radiologically contaminated material identified during surveys or sample analysis will be placed in storage containers pending disposal (TtEC, 2009).

The Navy has applied a conservative remediation decision criteria (any one sample result exceeding the action level or release criteria will require remediation), and this conservative approach effectively overrides the large uncertainty in single sample results. Measurement uncertainty values will be considered acceptable if, in the opinion of the laboratory manager, a longer duration count would not improve the counting statistics markedly, and:

1. The two-sigma total uncertainty for ^{226}Ra is less than 10 pCi/g for activity indicated below the MDA.

2. The two-sigma uncertainty for ^{137}Cs is less than 10 pCi/g for activity indicated below the MDA.

Since any indicated activity above the release criteria will be remediated prior to an FSS, using these limits for uncertainty measurement effectively overrides a larger uncertainty in a single sample result (TtEC, 2009).

A minimum of 10 percent of the FSS samples analyzed by the on-site radiological laboratory will be randomly selected and sent to an off-site laboratory for QA purposes. The TtEC RSO or designee may select additional samples for off-site analysis for QA purposes, if appropriate. Data from the on-site and off-site gamma spectroscopy analysis will be compared, and the acceptance criteria of RPD for each on-site/off-site laboratory pair are established at 30 percent in instances where the same method was used for analysis, and when both activities are reported above the

quantification or reporting limit (with no qualifiers or flags). If any appropriate RPD is not within the established acceptance criteria, then the Navy, including RASO, will be notified and corrective actions will be identified and implemented. RASO is the Navy technical lead for determining radiological sample analysis and will provide guidance for corrective actions. At the direction of the Navy, corrective actions may include, but not be limited to, reanalysis of the sample by the appropriate laboratory, additional field sampling, counting for an additional time period, or analysis by alternative vendors (TtEC, 2009).

17.4 TRENCH SAMPLING

Following completion of excavation activities, scoping surveys of the trenches will be completed. If the scoping survey sample results are less than the release criteria, then the scoping survey data will be used as an FSS, and backfilling will be acceptable with the concurrence of the RASO. Scoping and FSSs for the excavated sections will include scans and systematic sampling.

Scan surveys will consist of surface (trench sidewalls and floor) scans with a sodium-iodide gamma detector as described in the *Draft Final Radiological Work Plan for Hunters Point Shipyard Parcel D-1, San Francisco, California* (D-1 Radiological Work Plan; Shaw, 2010a). Collected field data will be logged and survey points plotted on survey unit grid maps to document survey results. These data will be used to directly tie the locations of any elevated radiation measurements to the corresponding grid coordinates, which will be established during the development of the systematic sampling plan. Data analysis will be performed as the data are received, and questionable areas will be flagged in the field for resurvey/verification. Locations where surface radiation levels appear to be greater than 3 sigma of the mean background level will be noted on a grid map. Areas confirmed as having radiation levels greater than the established 3 sigma of the mean background area level will be evaluated further for the presence of radioactive material and may include additional biased sampling points. If radioactive material is confirmed, the area will be physically marked and the associated radioactive material removed.

A minimum of 18 samples will be collected after establishing a grid consisting of cells not to exceed 1,000 m^2 over the excavated trench surfaces (sidewalls and bottom). Systematic sample collection locations will be generated using the most current version of VSP. If results from systematic samples exceed release criteria, affected locations will be remediated as discussed in the following paragraph.

Any area from a trench that indicates radioactive materials present above the release criteria will be remediated. After remedial action, post-remediation samples will be collected. Remedial action support surveys will be considered completed when post-remediation sample results do

not indicate activity above the release criteria. An FSS will be performed on each SU after the remedial action support survey has concluded.

SUs will be considered acceptable for backfill or limited storm drain replacement when no contamination is found above the release criteria during a single phase of systematic sampling, either from a scoping survey or FSS.

The Navy has applied a conservative remediation decision criteria (any one sample result exceeding the action level or release criteria will require remediation) and it effectively overrides the large uncertainty in single sample results. Measurement uncertainty values will be considered acceptable if, in the opinion of the laboratory manager, a longer duration count would not improve the counting statistics markedly, and:

1. The two-sigma total uncertainty is less than 10 pCi/g for ^{226}Ra for activity indicated below the MDA.
2. The two-sigma uncertainty for ^{137}Cs is less than 10 pCi/g for activity indicated below the MDA.

Since any indicated activity above the release criteria will remediated prior to a FSS, using these limits for uncertainty measurement effectively overrides a larger uncertainty in a single sample results.

The post-excavation trench soil samples will be analyzed by the on-site laboratory by gamma spectroscopy with 10 percent of the FSS samples analyzed for ^{90}Sr. If on-site laboratory results indicate concentrations of ^{137}Cs in soil are at or above its release criteria, the sample will be analyzed for ^{90}Sr and alpha spectroscopy analysis (for isotopic plutonium and uranium). If off-site laboratory results indicate ^{90}Sr concentrations equal to or greater than the release criteria, additional analysis for isotopic plutonium and uranium will be performed.

Ten percent or more of the FSS soil samples analyzed by the onsite laboratory will be randomly selected and sent to an off-site laboratory for gamma spectroscopy analysis for QA purposes. Data from the on-site and off-site laboratories will be compared, and the acceptance criteria of RPD for each laboratory pair are established at 30% in instances where the same method was used for analysis, and when both activities are reported above the quantification or reporting limits (no flags or qualifiers). If any appropriate RPD is not within acceptance criteria, then the RASO and the Navy will be notified and correction actions will be implemented.

17.5 IMPORT FILL SAMPLING

Excavated soil cleared of radioactivity will be used to backfill SD and SS trenches. This material will be cleared by the base wide radiological contractor, TtEC. Upon receiving authorization from Base Realignment and Closure, Project Management Office, and RASO, the trenches shall

be backfilled and compaction shall be performed in preparation for site restoration. General backfill and site restoration approach shall follow the *Design Plan for the Parcel D-1 Sanitary Sewer and Storm Drain Removal* (D-1 Design Plan; Shaw, 2010d).

Materials that were excavated and processed through the RSY shall be tracked and returned to the approximate location they were initially excavated from.

If needed, off-site import soil may be used to backfill the excavations. Import fill will be sampled according to the DTSC Information Advisory on Clean Import Fill Material (DTSC 2001) prior to use on site. Import material used as backfill material at HPS will be evaluated with the HPS Backfill Review and Acceptance Procedure, HPO-Tt-0270 (2006) (DCN: FWSD-RAC-06-0764). The first 5,000 cubic yards (cy) of proposed source area will be sampled in place (if possible), and analyzed prior to removal from the borrow area. In general, the fill source area should be located in non-industrial areas, and not from sites undergoing an environmental cleanup. Non-industrial sites include those that were previously undeveloped, or used solely for residential or agricultural purposes. Agricultural property requires additional sampling for pesticides prior to acceptance. The source area sampling procedure will depend on the location and state of the borrow soil (i.e., undeveloped land or stockpiles).

Twelve grab samples will be collected from the first 5,000 cy of borrow material. Samples will be collected from random depths. Samples will be collected using either disposable sampling scoops, shovels, hand augers or slide hammer depending on the condition of the borrow source. The project chemist and sampling technician will select the best tool for the conditions. If the first 5,000 cy of borrow material is acceptable for use, then one additional sample will be collected for every addition 1,000 cy of borrow soil used. The additional samples can either be collected in-place at the source or from incoming trucks. The additional samples will be analyzed for the same parameters as the first 5,000 cy.

Import fill soil samples will be analyzed for the following parameters:

- VOCs – EPA 5035/8260B
- SVOCs – EPA 8270
- PAHs – EPA 8270-SIM
- Organochlorine Pesticides – EPA 8081
- PCBs – EPA 8082
- TPH purgeable (as gasoline) – EPA 5035/8015B
- TPH extractable (as diesel) – EPA 8015B
- CCR Title 22 metals (17) –6020/7471/7471
- Gamma Spec (for ^{226}Ra and ^{137}Cs) – (HPS on-site laboratory)
- Asbestos – CARB 435

17.6 WASTE CHARACTERIZATION SAMPLING

Radiological soil and sediment waste will be managed by the radiological waste contractor, Environmental Management Systems, Inc. (EMS, Inc.), under the direction of the Navy Low Level Radiological Waste Program. Sampling, off-site transportation and disposal of non-radiologically-impacted soil and debris waste will be managed by a separate contractor, ITSI, under the Base-Wide Chemical Waste Transpiration and Disposal contract.

Small amounts of decontamination waste water may be generated by Shaw during site activities. Waste water from decontamination activities will be collected and stored in approved storage containers. One water sample per container may be collected as required by the disposal facility and analyzed for:

- VOCs (EPA Method 8260B)
- SVOCs (EPA 8270C)
- Organochlorine Pesticides (EPA 8081B)
- PCBs (EPA 8082)
- Herbicides (EPA 8151A)
- Title 22 Metals (EPA Method 6010B/7470A)
- TPH-purgeables and extractables, (EPA Method 8015B)
- Total recoverable petroleum hydrocarbon (TRPH) (EPA 1664)
- Total oil and grease (SM 5520B)
- pH (EPA 9045)
- Total suspended solids (TSS) (SM 2540D)
- Ignitability (EPA 1010)
- Total cyanide (SM 4500-CN)
- Phenols (EPA 420.1)
- Chemical oxygen demand (COD) (SM 5220C)
- Dissolved sulfide (SM 4500S^2)
- Radionuclides (ROCs) (EPA 901/905) (DOE A-01-R)

SAP Worksheet #18 – Sampling Locations and Methods/SOP Requirements Table

Sampling Location	Sample ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference
Trench Survey Unit (biased, systematic, and remedial action)	06-PDIT-YYY-001 Through 06—PDIT-YYY-XXX	Soil	Various	Alpha, beta and gamma-emitting isotopes	TBD[a]	WS # 14
Pipe Sediment	06-PD1PI-0001-01 Through 06-PD1PI-QQQQ-UU	Sediment	NA	Alpha, beta and gamma-emitting isotopes	TBD[a]	WS#14
Pipe/Manhole Swipes	06-PD1S-PIAABBCC-SS-01 Through 06-PD1S-PIAABBCC-SS-UU	Swipe	NA	Gross Alpha/Gross Beta	TBD[a]	WS#14
Ancillary Samples	06A-BDDDD-001 Through 06A-BDDDD-UUU	Soil or Debris	Various	Alpha, beta, and gamma-emitting isotopes	TBD[a]	WS#14
RSY Survey Pads	06-PD1-AQQQQ-01 Through 06-BD1-AQQQQ-UU	Soil	0-6"	Alpha, beta, and gamma-emitting isotopes	TBD[a]	WS#14
Manhole Sediment	06-PD1MHYYY-001-01 Through 06-PD1MHYYY-QQQ-UU	Sediment	NA	Alpha, beta, and gamma-emitting isotopes	TBD[a]	WS#14
Extraneous Pipe Sediment and Swipes	06-PDIP-EPYYY-01 Through 06-PDIP-EPYYY-UU	Sediment	NA	Alpha, beta, and gamma-emitting isotopes	TBD[a]	WS#14
Extraneous Pipe Swipes	06-PDIS-EPYYY-01 Through 06-PDIS-EPYYY-UU	Swipe	NA	Gross Alpha/Gross Beta	TBD[a]	WS#14
Import Soil Source	BS-001 Through BS-XXX (sequentially as needed to obtain correct frequency)	Soil	Various	TPH, VOCs, SVOCs, Pesticides. PCBs, Metals, Asbestos, Gamma-emitting isotopes (on-site lab)	12 estimated for first 5,000 cy (No duplicates)	WS #14
Wastewater	WW-tank#-date	Water	NA	VOCs, SVOCs, pesticides, PCBs, herbicides, Title 22 metals, TPH, total oil & grease, TRPH, pH, TSS, ignitability, total cyanide, phenols, COD, dissolved sulfide and radionuclides	1 per container (No duplicates)	WS#14

SAP Worksheet #18 – Sampling Locations and Methods/SOP Requirements Table (continued)

Notes:

[a] TBD – the number of samples cannot be pre-determined but will be based on piping size and depth. The number of radiological samples for on-site analysis will also be determined by the Radiation Safety Officer. Each sample will be numbered sequentially and global position survey coordinates will be recorded.

Cy denotes cubic yard.

SAP Worksheet #19 – Analytical SOP Requirements Table

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Sample Mass or Volume	Container (number, Size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/analysis)
Soil	PCBs	Preparation: 3550B/3540C Analysis: EPA 8082A SOP# PCB 3.2	30 grams	4- or 8-ounce glass jar with Teflon®-lined lid or stainless steel liner	Cool at 4±2°C	14 days to extraction 40 days after extraction
Soil	TPH as diesel and motor oil, silica gel cleanup	Preparation: EPA 3550B/3540C Analysis: EPA 8015B SOP# TEH 5.1	50 grams	4- or 8-ounce glass jar with Teflon®-lined lid or stainless steel liner	Cool at 4±2°C	14 days for extraction and 40 days for analysis
Soil	TPH as gasoline	Preparation: EPA 5035A Analysis: EPA 8015B SOP# TVH 7.1	5 grams	3 EnCore® devices or equivalent	Cool at 4±2°C	48 hours for unpreserved (can be frozen upon receipt for 7 days) 14 days for preserved or frozen
Soil	Organochlorine Pesticides	Preparation: 3550B/3540C Analysis: EPA 8081B SOP# OCP_3.3	30 grams	4- or 8-ounce glass jar with Teflon®-lined lid or stainless steel liner	Cool at 4±2°C	14 days to extraction 40 days after extraction
Soil	SVOCs/PAH	Preparation: 3550B/3540C Analysis: EPA 8270D SOP# 8270_SIM 8.1	30 grams	4- or 8-ounce amber glass jar with Teflon®-lined lid or stainless steel liner	Cool at 4±2°C	14 days to extraction 40 days after extraction
Soil	Metals	Preparation: 3050B Analysis: EPA 6010B/6020A SOP# ICP 4.4	2 grams	4 or 8 ounce glass jar with Teflon®-lined lid or stainless steel liner	Cool at 4±2°C	180 days
Soil	Mercury	Preparation & Analysis: EPA 7471B SOP# Hg_soil 5.2	2 grams	4- or 8-ounce glass jar with Teflon®-lined lid or stainless steel liner	Cool at 4±2°C	28 days

SAP Worksheet #19 – Analytical SOP Requirements Table (continued)

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Sample Mass or Volume	Container (number, Size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/analysis)
Soil	VOCs	Preparation: 5035 Analysis: EPA 8260C SOP# MSVOA 2.4	30 grams	3 - EnCores®	Cool at 4±2°C	48 hours to preservation 14 days after preservation
Soil	Asbestos	CARB Method 435 SOP# Forensic Lab	2 grams	4-ounce glass jar with Teflon®-lined lid or plastic baggie	None	Not Applicable
Soil/ Sediment	Gamma Spectroscopy (on-site laboratory)	C1402-98 Standard Guide for High Resolution Gamma-ray Spectrometry and/or on-site laboratory SOP	350 grams	250-ml or 500-mL plastic container	None	Not Applicable
Soil/ Sediment	Strontium-90 (on-site laboratory)	EPA 905 MOD or DOE SR-03-RC MOD NWT Laboratory SOP	5 grams	250-ml or 500-mL plastic container	None	Not Applicable
Soil/ Sediment	Alpha Spectroscopy (on-site laboratory)	Actinide Alpha Radioactivity in Soil Using Ortec Alpha Spectroscopy Detection System NWT Laboratory SOP	250 grams	250-ml or 500-mL plastic container	None	Not Applicable
Swipe	Alpha/beta-emitting radionuclides	Gross Alpha/Gross Beta by ZnS (Ag) detecting Shaw SOP T-RA-006 and SOP T-RA-012	Swipe	Envelope with paper swipe	None	Not Applicable

SAP Worksheet #19 – Analytical SOP Requirements Table (continued)

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Sample Mass or Volume	Container (number, Size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/analysis)
Soil	Gamma Isotopes	EPA 901.1 MOD SOP RCHL-A-05, Rev1	250 grams	250mL plastic container	None	180 days
Soil	Strontium-90	EPA 905 MOD or DOE SR-03-RC MOD SOP ST-RD-0403 R8	5 grams	250mL plastic container	None	180 days
Soil	Isotopic Uranium, Plutonium, Thorium	DOE A-01-R MOD SOP ST-RD-0210 R6	5 grams	250mL plastic container	None	180 days
Soil	Tritium	EPA 906.0 MOD SOP ST-RD-0302 R11	100 grams	250mL plastic container	None	180 days
Swipe	Alpha/beta-emitting radionuclides	EPA 9310 or equivalent SOP ST-RD-0403 R8	Swipe	Envelope with paper swipe	None	N/A
Wastewater	PCBs	Preparation: EPA 3520C/3510C Analysis: EPA 8082A SOP# PCB_409	1 L	Two (2) x 1-L amber bottles	Cool at 4±2ºC	7 days for extraction and 40 days after extraction
Wastewater	VOCs	Preparation: EPA5030BAnalysis: EPA 8260C SOP# VOC_525	40 mL	Three(3) x 40-mL vials, Teflon™-lined septum	HCl to pH< 2, Cool at 4±2°C	14 days
Wastewater	SVOCs	Preparation: EPA 3520C/3510C Analysis: EPA 8270D SOP# SVOC_506	1 L	Two (2) x 1-L amber bottles	Cool at 4±2ºC	7 days for extraction and 40 days after extraction

SAP Worksheet #19 – Analytical SOP Requirements Table (continued)

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Sample Mass or Volume	Container (number, Size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/analysis)
Wastewater	Metals	Preparation: 3010a Analysis: EPA 6010B/6020A SOP# ICP_834	50 mL	One(1) x minimum 500-mL HDPE bottle	HNO_3 to pH< 2	180 days
Wastewater	Mercury	EPA 7470A SOP# Hg_CV 812	50 mL	One(1) x minimum 500-mL HDPE bottle	HNO_3 to pH< 2	28 days
Wastewater	Total Petroleum Hydrocarbons (TPH) as diesel / Motor Oil	Preparation: EPA 3520C/3510C Analysis: EPA 8015B SOP# TEPH_406	1 L	Two (2) x 1-L amber bottles	Cool at 4±2°C	7 days for extraction and 40 days for analysis
Wastewater	TPH-gasoline	Preparation: EPA5030B Analysis: EPA 8015B SOP# TVPH_425	40 mL	Three (3) x 40-mL vials, Teflon™-lined septum	HCl to pH< 2, Cool at 4±2°C	14 days
Wastewater	Organochlorine Pesticides	Preparation: EPA 3520C/3510C Analysis: EPA 8081A SOP# OCP_402	1 L	Two (2) x 1-L amber bottles	Cool at 4±2°C	7 days for extraction and 40 days after extraction
Wastewater	Herbicides	EPA 3510C/8151A SOP# CH	1 L	Two (2) x 1-L amber bottles	Cool at 4±2°C	7 days for extraction and 40 days after extraction
Wastewater	Gamma Spec (Cesium-137 and Radium – 226)	C1402-98 Standard Guide for High-Resolution Gamma-ray Spectrometry SOP# On-Site Laboratory	250 mL	1 – 250 ml or 500 ml plastic bottle	None	Not Applicable

SAP Worksheet #19 – Analytical SOP Requirements Table (continued)

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Sample Mass or Volume	Container (number, Size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/analysis)
Wastewater	Strontium-90	Preparation & Analysis: EPA Method 905.0 or equivalent SOP# ST-RD-0403 R8	1 L	Two x 1-L HDPE	HNO_3 to pH < 2	6 months
Wastewater	Radium-226	Preparation & Analysis: EPA 903.0 MOD SOP ST-RD-0102 R6	1 L	One (1) x 1-L poly/glass	HNO_3 to pH < 2	180 days
Wastewater	Gamma Isotopes	Preparation & Analysis: EPA 901.1 MOD SOP ST-RD-0102 R6	1 L	One (1) x 1-L poly/glass	HNO_3 to pH < 2	180 days
Wastewater	Isotopic Uranium, Plutonium, Thorium	Preparation & Analysis: DOE A-01-R MOD	1 L	One (1) x 1-L poly/glass	HNO_3 to pH < 2	180 days
Wastewater	Tritium	Preparation & Analysis: EPA 906.0 MOD	120 mL	One (1) x 250mL Amber Glass	None	180 days
Wastewater	Oil and Grease	Preparation & Analysis SM 1664: SOP# Wet Chemistry Section 1.1	1 L	Two x 1-L Amber	H_2SO_4 to pH < 2 Cool at 4±2°C	28 days
Wastewater	TRPH	Preparation & Analysis EPA 1664 SOP# Wet Chemistry Section 1.1	1 L	Two x 1-L Amber	H_2SO_4 to pH < 2 Cool at 4±2°C	28 days
Wastewater	Dissolved sulfide	Preparation & Analysis : SM 4500S[2] SOP# Wet Chemistry Section 1.1	100 ml	One x 500 ml HDPE	NaOH and ZnAc to pH>10 Cool at 4±2°C	7 days

SAP Worksheet #19 – Analytical SOP Requirements Table (continued)

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Sample Mass or Volume	Container (number, Size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/analysis)
Wastewater	Chemical oxygen demand (COD)	Preparation & Analysis: SM 5220C SOP# Wet Chemistry Section 4.9	100 ml	One x 250 ml HDPE	H_2SO_4 to pH < 2 Cool at 4±2°C	28 days
Wastewater	Total cyanide	Preparation & Analysis: SM 4500-CN SOP# DV-WC-0018	100 ml	One x 500 ml HDPE	NaOH to pH>10 Cool at 4±2°C	14 days
Wastewater	Total suspended solids (TSS)	Preparation & Analysis: SM 2540D SOP# Wet Chemistry Section 4.3	100 ml	One x 500 ml HDPE	Cool at 4±2°C	7 days
Wastewater	Phenols	Preparation & Analysis: EPA 420.1 SOP# Wet Chemistry Section 1.6	1 L	Two x 1-L Amber	H_2SO_4 to pH < 2 Cool at 4±2°C	28 days
Wastewater	pH & Ignitability	Preparation & Analysis EPA 9045 / EPA 1010 SOP# 1126/ 629	500 ml	One x 500 ml HDPE	Cool at 4±2°C	Analyze as soon as possible

Notes:
°C denotes degrees centigrade
HDPE denotes high density polyethylene
HNO_3 denotes nitric acid
HCl denotes hydrochloric acid
H_2SO_4 denotes nitric acid
L denotes liter
mL denotes milliliter
NaOH denotes sodium hydroxide
TRPH denotes total recoverable petroleum hydrocarbons
ZnAc denotes zinc acetate

SAP Worksheet #20 – Field Quality Control Sample Summary Table

Matrix	Analytical Group	# of Primary Sampling Locations	# of Field Duplicates	# of MS/MSDs	# of Field Blanks	# of Equipment Rinse Blanks	# of Trip Blanks	Total # of Samples to Laboratory
Soil/Sediment/ Swipes (piping)	Gamma Spectroscopy Alpha-Spectroscopy Strontium-90 (All on-site laboratory)	Unknown at this time	NA	None	None	None	None	TBD[a]
Soil/Sediment/ Swipes (trenches)	Gamma Spectroscopy Alpha-Spectroscopy Strontium-90 (All on-site laboratory)	Unknown at this time	As directed by PRSO	None	None	None	None	TBD
Import Fill	PCBs / TPH /OCP OCPs / Metals SVOC VOCs Asbestos Radiological	12 (estimated as needed)	None	1	None	None (if disposable sampling equipment used)	None	12 (estimated as needed)
Wastewater	PCBs / TPH OCPs / Metals SVOC/ VOCs Cyanide Oil & Grease TRPH Radiological	As necessary per permit	None	None	None	None (if disposable sampling equipment used)	None	As needed

[a] *TBD – the number of samples cannot be pre-determined but will be based on survey unit (SU) size. The number of radiological samples for on-site analysis will also be determined by the Radiation Safety Officer. Each sample will be numbered sequentially and global position survey coordinates will be recorded.*

SAP Worksheet #21 – Project Sampling SOP References Table

Reference Number	Title	Date, Revision and / or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SAP WS# 14	Excavation Sampling	NA	Shaw	Disposable Scoop	N	
SAP WS# 14	Hand Auger Sampling	NA	Shaw	Hand Auger / Drive Tube	N	
SAP WS# 14	EnCore® Sampler	NA	Shaw	Encore®	N	
SAP WS# 14	Waste Water Sampling	NA	Shaw	Disposable bailer	N	

Notes:
NA denotes not applicable, procedure described in SAP Worksheet #14.

SAP Worksheet #22 – Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Verification Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	Standard Operating Procedure (SOP) Reference
No Field instruments for chemical screening will be used for this project						
Radiological Controls Portable Instrument Procedures are described in detail in the Radiation Protection Plan and in Shaw SOP T-RA-006					PRSO	Shaw T-RA-006

SAP Worksheet #23 – Analytical SOP References Table

Lab SOP Number[a]	Title, Revision Date, and / or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
TEH_5.1	TEH_rv14 – 10/14/09	Definitive	Soil/Water – TPH extractable	GC-FID	C&T Lab	N
TVH_7.1	TVH_BTXE_rv15 – 10/14/09	Definitive	Soil/Water – TPH extractable	GC-FID	C&T Lab	N
PCB_3.2	PCB_rv7 – 10/15/07	Definitive	Soil/Water – PCBs	GC-ECD	C&T Lab	N
2.4	MSVOA_rv9 – 3/8/10	Definitive	Soil/Water – VOCs	GC/MS	C&T Lab	N
8.1	BNA_rv 10 – 10/12/10	Definitive	Soil/Water – SVOCs	GC/MS	C&T Lab	N
3.3	Pesticides_rv11 – 2/15/08	Definitive	Soil/Water – OCP	GC (ECD)	C&T Lab	N
4.4 / 4.6	ICP_rv11 – Oct 2009 ICPMS_rv 7 -5/5/10	Definitive	Soil/Water – Metals	ICP or ICP/MS	C&T Lab	N
5.1 / 5.2	Hg_soil_rv13 – 7471A 9/10/09	Definitive	Soil/Water – Mercury	Cold Vapor	C&T Lab	N
1.1	Wet Chemistry Section 1.1	Definitive	Water – Total oil & grease	Gravimetric	C&T Lab	N
1.1	Wet Chemistry Section 1.1	Definitive	Water – TRPH	Gravimetric	C&T Lab	N
1.6	Wet Chemistry Section 1.6	Definitive	Water – TSS	Gravimetric	C&T Lab	N
4.3	Wet Chemistry Section 4.3	Definitive	Water – total cyanide	Distillation & Colorimeter or titration	C&T Lab	N
4.9	Wet Chemistry Section 4.9	Definitive	Water – Dissolved sulfide	Colorimeter or titration	C&T Lab	N

SAP Worksheet #23 – Analytical SOP References Table (Continued)

Lab SOP Number[a]	Title, Revision Date, and / or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
4.2	Wet Chemistry Section 4.2	Definitive	Water – COD	Titration	C&T Lab	N
RCHL-A-05, Rev 2	Determination of Gamma Radioactivity in Various Matrices Using Ortec HpGe Gamma Spectroscopy Detection Systems and Gamma Vision-32 Software Rev.1, 3/17/10	Definitive	Soil-Gamma Emitting Radionuclides	EG&G Ortec Beryllium Window HPGe Gamma Spectroscopy System	NWT	N
ST-RD-0403 R10	Low Background Gas Flow Proportional Counting System Analysis Rev. 10, 4/26/10	Definitive	Soil/Water- Strontium-90	Gas Flow Proportional Counter	Test America-St. Louis	N
ST-RD-0102 R6	Gamma Vision Analysis Rev.6, 07/31/09	Definitive	Soil- Gamma Isotopes Water- Radium-226	Gamma Spectrometer	Test America-St. Louis	N

Notes:
[a] Copies of laboratory SOPs are provided in electronic format in Attachment 3
ECD denotes electron capture detector.
FID denotes flame ionization detector.
GC denotes gas chromatograph.
ICP denotes inductively coupled plasma.
MS denotes mass spectrometer.
OCP denotes organic chlorine pesticide

SAP Worksheet #24a – Analytical Instrument Calibration Table (Gas Chromatography)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
GC/FID or ECD	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit.	Initial calibration prior to sample analysis	Target analyte CF or RFRSD less than or equal to 20%[a] Mean CF or RF RSD less than or equal to 20%[a]	Repeat analysis of concentrations not meeting acceptance criteria If necessary, perform instrument maintenance (such as clean/change injection port, clip column, clean detector, etc); then repeat initial calibration.	Lab Manager / Analyst	5.1/7.1/3.2
GC/FID or ECD	Second-source calibration verification.	Once per five-point initial calibration	Less than 20% difference for target analytes.	If necessary, perform instrument maintenance then repeat initial calibration.	Lab Manager / Analyst	
GC/FID or ECD	Daily calibration verification.	Before sample analysis and every 10 samples or every 12 hours, as specified by the method	Less than 20% difference for all target analytes.	If necessary, perform instrument maintenance; then repeat initial or daily calibration; reanalyze samples with non-compliant bracketing CCVs	Lab Manager / Analyst	

Notes:
[a] If RSD for any analyte is > 20%, regression fit may be used for the calibration curve for that analyte. Acceptance criterion for first-order regression is r^2 0.99.
CF denotes calibration factor.
CCV denotes continuing calibration verification.
ECD denotes electron capture detector.
FID denotes flame ionization detector.
GC denotes gas chromatography.
RF denotes response factor.
RSD denotes relative standard deviation.

SAP Worksheet #24b – Analytical Instrument Calibration Table (ICP or ICPMS)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
ICP	ICAL per manufacturer's instructions, with a minimum of one high standard and a calibration blank.	Initial calibration prior to sample analysis	Accepted if the ICV passes within ± 10% of true value.	Perform injector or pump maintenance if necessary, then repeat initial calibration.	Lab Manager / Analyst	4.4 / 4.6
	Low concentrations standard at or near the reporting limit.	Daily after ICAL	Within ± 20% of true value.	Perform injector or pump maintenance if necessary, remake low level standard; then repeat initial calibration.	Lab Manager / Analyst	
	Second-source calibration verification, prepared at the calibration midpoint.	Once per initial calibration	Within ± 10% of true value.	Perform injector or pump maintenance if necessary, then repeat initial calibration.	Lab Manager / Analyst	
	CCV, same source as initial calibration.	Following initial calibration, after every 10 samples and the end of the sequence	Within ± 10% of true value	Perform injector or pump maintenance if necessary, then repeat initial calibration. Reanalyze samples with non-compliant bracketing CCVs	Lab Manager / Analyst	

Notes:
CCV denotes continuing calibration verification.
EPA denotes U.S. Environmental Protection Agency
ICAL denotes initial calibration
ICP denotes inductively coupled plasma.
ICV denotes initial calibration verification.

SAP Worksheet #24c – Analytical Instrument Calibration Table (GC-MS VOA)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
GC/MS VOA (8260B)	Check of mass spectral ion intensities (tuning procedure) using BFB (8260B)	Prior to initial calibration and calibration verification	Must meet the EPA method requirements before samples are analyzed m/z Required Intensity (relative abundance) mass 50 -15 to 40% of m/z 95 mass 75- 30 to 60% of m/z 95 mass 95- Base peak, 100% relative abund. mass 96 -5 to 9% of m/z 95 mass 173Less than 2% of m/z 174 mass 174Greater than 50% of m/z 95 mass 175-5 to 9% of m/z 174 mass 176Greater than 95% but less than 101% of m/z 174 mass 177-5 to 9% of m/z 176	If necessary, perform preventative maintenance such as clean/change injection port, clip column, clean detector, etc. and retune instrument and verify the tune acceptability	Lab Manager / Analyst	2.4
	Five-point initial calibration (ICAL) for target analytes, lowest standard at or near the reporting limit	Initial calibration prior to sample analysis	8260B: The minimum average SPCC RF is 0.1 for chloromethane, 1,1-dichloroethane, and bromoform and 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane. RSD<15% [a]	If necessary, perform preventative maintenance. and retune instrument and verify the tune acceptability, then repeat initial calibration	Lab Manager / Analyst	
	Second-source calibration verification	Once per five-point initial calibration	Less than 20% difference for all target analytes and CCCs	First – reanalyze second source standard. If necessary, perform preventative maintenance. Then repeat ICAL	Lab Manager / Analyst	

SAP Worksheet #24c – Analytical Instrument Calibration Table (GC-MS VOA) (continued)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
GC/MS VOA (8260B) (Continued)	Daily calibration verification	Before sample analysis and every 12 hours of analysis time	Less than 20% difference for all target analytes and CCCs, SPCCs – RFs per ICAL requirements	If necessary, perform preventative maintenance such as clean/change injection port, clip column, clean detector, etc. Then repeat initial calibration Reanalyze samples with non-compliant bracketing CCVs	Lab Manager / Analyst	TBD [a]
	Internal standards	During acquisition of calibration standard	Areas within -50% to +100% of last calibration verification (12 hours) for each	Inspect MS and GC for malfunctions; determine if IS failure was due to sample matrix or instrument malfunction. If necessary re-extract and reanalyze samples with non-compliant Internal standards	Lab Manager / Analyst	

Notes:
[a] If relative standard deviation (RSD) for any analyte is >15%, regression fit may be used for the calibration curve for that analyte. Acceptance criterion for first-order regression is $r^2 \geq 0.99$.
BFB denotes bromofluorobenzene.
CCC denotes calibration check compounds.
CCV denotes continuing calibration verification.
GC denotes gas chromatography.
ICAL denotes initial multipoint calibration.
MS denotes mass spectrometer.
m/z denotes mass/charge ratio.
RF denotes response factor.
SPCC denotes system performance check compound.
VOA denotes volatile organic analysis.

SAP Worksheet #24d -- Analytical Instrument Calibration Table (Cold Vapor)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
Cold Vapor	ICAL, with a minimum of three standards and one calibration blank; lowest standard at or near the reporting limit	Initial calibration prior to sample analysis	Correlation coefficient > 0.995; accepted if the CV passes	Reanalyze concentrations not meeting acceptance criteria If necessary perform maintenance, then repeat initial calibration	Lab Manager / Analyst	5.1 / 5.2
	Second-source ICV, prepared at the calibration midpoint	Once per initial calibration	Less than 10% difference from initial calibration for all target analytes	Repeat ICV with fresh standard if deemed necessary Recalibrate if ICV continues to fail	Lab Manager / Analyst	
	CCV, same source as initial calibration	After every 10 samples and at the end of the sequence	Less than 20% difference from initial calibration for all target analytes	Perform maintenance, and then repeat daily calibration verification. If still out, recalibrate	Lab Manager / Analyst	
	Calibration blank	After initial calibration, before CCV calibration, after every 10 samples, and at the end of the sequence	No target analytes ≥ PQL	Re-prepare and reanalyze the blank, then recalibrate the instrument.	Lab Manager / Analyst	

Notes:
CCV denotes continuing calibration verification.
ICAL denotes initial multipoint calibration.
ICV denotes initial calibration verification.
PQL denotes project quantitation limits.

SAP Worksheet #24e – Analytical Instrument Calibration Table (GC-MS SVOC)

Instrument	Calibration Procedure	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
GC/MS SVOC	Check of mass spectral ion intensities (tuning procedure) using and DFTPP (8270C)	Prior to initial calibration and calibration verification	Must meet the tuning criteria requirements before samples are analyzed Mass - Ion Abundance Criteria 51 - 10-80% of Base Peak 68 - < 2% of mass 69 70 - < 2% of mass 69 127 - 10-80% of Base Peak 197 - < 2% of mass 198 198 - Base peak, or > 50% of Mass 442 199 - 5-9% of mass 198 275 - 10-60% of Base Peak 365 - > 1% of mass 198 441 - present but < 24% of mass 442 442 - Base Peak, or > 50% of mass 198 443 - 15-24% of mass 442	Re-tune instrument and verify the tune acceptability.	Lab Manager / Analyst	8.1
	Minimum five-point initial calibration for target analytes; lowest standard at or near the reporting limit	Initial calibration prior to sample analysis	The minimum average SPCC RF is 0.050 Target analyte CF or RF RSD less than or equal to 20%[b] RSD average is less than or equal to 15% for target analytes RSD for CCC, less than or equal to 30%	Repeat analysis of concentration not meeting acceptance criteria. If still out of acceptance criteria perform maintenance (if necessary), obtain fresh calibration standards, then repeat initial calibration.	Lab Manager / Analyst	
	Second-source calibration verification	Once per five-point initial calibration	Less than 20% difference for most target analytes, 25% for difficult compounds	Repeat analysis Perform maintenance if necessary, then repeat initial calibration.	Lab Manager / Analyst	

SAP Worksheet #24e – Analytical Instrument Calibration Table (GC-MS SVOC) (continued)

Instrument	Calibration Procedure	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
GC/MS SVOC (Continued)	Daily calibration verification (CCV)	Before sample analysis and every 12 hours, as specified by the method	RSD for CCCs, less than or equal to 30% and Less than 20% difference for all other target analytes, OR RSD average is less than or equal to 15% for target analytes	Repeat CCV analysis Evaluate the system and perform maintenance if necessary, if still out then recalibrate. Reanalyze affected samples.	Lab Manager / Analyst	8.1
	Internal Standards	During data acquisition of calibration standard	Areas within -50% to +100% of last calibration verification (12 hours) for each	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Lab Manager / Analyst	
	Check of mass spectral ion intensities (tuning procedure) using and DFTPP (8270C)	Prior to initial calibration and calibration verification	Must meet the method's requirements before samples are analyzed	Re-tune instrument and verify the tune acceptability.	Lab Manager / Analyst	
	Check of mass spectral ion intensities (tuning procedure) using and DFTPP (8270C)	Prior to initial calibration and calibration verification	Must meet the method's requirements before samples are analyzed	Re-tune instrument and verify the tune acceptability.	Lab Manager / Analyst	

SAP Worksheet #24e – Analytical Instrument Calibration Table (GC-MS SVOC) (continued)

Instrument	Calibration Procedure	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
GC/MS SVOC (Continued)	Minimum five-point initial calibration for target analytes; lowest standard at or near the reporting limit in accordance with Department of Defense Quality System Manual requirements.	Initial calibration prior to sample analysis	The minimum average SPCC RF is 0.050 Target analyte CF or RF RSD less than or equal to 20%[b] RSD average is less than or equal to 15% for target analytes [a] RSD for CCC, less than or equal to 30%	Repeat analysis of concentration not meeting acceptance criteria. If still out of acceptance criteria perform maintenance (if necessary), obtain fresh calibration standards, then repeat initial calibration.	Lab Manager / Analyst	8.1
	Second-source calibration verification	Once per five-point initial calibration	Less than 20% difference for most target analytes, 25% for difficult compounds	Repeat analysis Perform maintenance if necessary, then repeat initial calibration.	Lab Manager / Analyst	
	Daily calibration verification (CCV)	Before sample analysis and every 12 hours, as specified by the method	RSD for CCCs, less than or equal to 30% and Less than 20% difference for all other target analytes, OR RSD average is less than or equal to 15% for target analytes	Repeat CCV analysis Evaluate the system and perform maintenance if necessary, if still out then recalibrate. Reanalyze affected samples	Lab Manager / Analyst	
	Internal Standards	During data acquisition of calibration standard,	Areas within -50% to +100% of last calibration verification (12 hours) for each	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Lab Manager / Analyst	

Notes:
[a] If relative standard deviation (RSD) for any analyte is > 15%, regression fit may be used for the calibration curve for that analyte.
Acceptance criterion for first-order regression is $r^2 \geq 0.99$.
CCC denotes calibration check compounds. *GC denotes gas chromatography.* *DFTPP denotes deacfluorotriphenylphosphine*
CCV denotes continuing calibration verification. *MS denotes mass spectrometer.* *SPCC denotes system performance check compound.*
CF denotes calibration factor. *RF denotes response factor.* *SVOC denotes semi-volatile organic compound*

SAP Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC	Injection port Maintenance	Preventative maintenance	Change septum, clean injection port, clip column	Daily	CCV passes criteria	Reinspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	Analyst/ Department Manager	C&T 5.1
GC	Trap	CCV response dropping, sample foamed over	Change trap	When responses start to drop or after foam over samples	CCV passes criteria	Rebake trap, replace trap, reanalyze CCV, recalibrate	Analyst/ Department Manager	C&T 5.1
GC-MS	Injection port Maintenance	Preventative maintenance	Change septum, clean injection port, clip column	Daily	Tune and CCV pass criteria	Reinspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	Analyst/ Department Manager	C&T 8.1
GC-MS	Trap	CCV response dropping, sample foamed over	Change trap	When responses start to drop or after foam over samples	Tune and CCV passes criteria.	Rebake trap, replace trap, reanalyze CCV, recalibrate	Analyst/ Department Manager	C&T 8.1
GC-MS	Detector maintenance	Column change, unable to tune instrument	Clean detector, change pump oil	When responses drop and tunes start to fail	Tune passes, air and water are not present in the scan	Disassemble detector and check parts, check heating element, reanalyze tune	Analyst/ Department Manager	C&T 8.1
ICP	Injector Maintenance	Preventative maintenance	Change injector and torch	Daily to every other day	Intensity of 1 ppm Manganese STD within criteria	Replace, investigate injector, reanalyze	Analyst/ Department Manager	C&T 4.4
ICP	Pump Maintenance	Preventative maintenance	Replace pump windings	Daily	Monitor ISTD counts for variation	Replace windings, recalibrate and reanalyze	Analyst/ Department Manager	C&T 4.4

SAP Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table (continued)

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
EG&G Ortec Beryllium Window Gamma Spectroscopy System	Clean cave; fill LNO2/physical check/physical activity	Not applicable	Not applicable	Weekly	Acceptable background	Recalibrate Instrument maintenance Consult lab manager	NWT Laboratory Manager	RCHL-A-05, Rev 1
	QA check/ Background check/Check Deviation	Not applicable	Not applicable	Prior to use and at minimum daily	Within 3 sigma of measured population	Recalibrate Instrument maintenance Consult lab manager	NWT Laboratory Manager	RCHL-A-05, Rev 1
	QA check/ Source check/ Check deviation	Not applicable	Not applicable	Prior to use and at minimum daily	Within 3 sigma of measured population	Recalibrate Instrument maintenance Consult lab manager	NWT Laboratory Manager	RCHL-A-05, Rev 1
	QC check/ sample duplicates	Not applicable	Not applicable	Once per batch or every 20 samples	RPD = 30	Recalibrate Instrument maintenance Consult lab manager	NWT Laboratory Manager	RCHL-A-05, Rev 1
Gas Flow Proportional Counter	1. Clean Instrument 2. Inspect windows 3. QA check	1. Physical check 2. Physical check 3. Background and source count	1. Physical check 2. Physical check 3. Check deviation	1. Daily 2. High counts and/or background 3.Daily	1. Non applicable 2. No physical defects 3. Within 3 sigma of 20 day population	Recalibrate Instrument maintenance Consult with Technical Director	Test America-St. Louis Group Leader/Analyst	ST-RD-0403 R8

SAP Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table (continued)

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Gamma Spectrometer	1. Clean cave; fill dewar with N2 2. QA check	1. Physical check 2. Background and source check	1. Physical check 2. Check deviation	1. Weekly 2. Daily	1. Acceptable background 2. Within 2 sigma of measured population	Recalibrate Instrument maintenance Consult with Technical Director	Test America-St. Louis Group Leader/Analyst	ST-RD-0102 R6

SAP Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table (continued)

Notes:
SOP denotes standard operating procedure.
CCV denotes continuing calibration verification.
GC denotes gas chromatography.
ICP denotes inductively coupled plasma.
ISTD denotes internal standards.
MS denotes mass spectrometer.
STD denotes standard.

SAP Worksheet #26 – Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Shaw E & I, Field Technician or Project Chemist
Sample Packaging (Personnel/Organization): Shaw E & I, Field Technician or Project Chemist
Coordination of Shipment (Personnel/Organization): Shaw E & I, Field Technician or Project Chemist
Type of Shipment/Carrier: Lab Courier, UPS or FedEx
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): NWT Laboratory Sample Receiving
Sample Custody and Storage (Personnel/Organization): NWT Laboratory Sample Receiving
Sample Preparation (Personnel/Organization): NWT Laboratory analyst
Sample Determinative Analysis (Personnel/Organization): NWT Laboratory Analyst
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): For the samples shipped to laboratory for off-site analysis, the samples will be shipped the same day as collection if possible, if not possible to ship the same day; storage on site in refrigerator or ice-packed cooler in locked building.
Lab Sample Storage (No. of days from sample collection): Minimum 6 months
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 30 days
Biological Sample Storage (No. of days from sample collection): Not Applicable to this project
SAMPLE DISPOSAL
Personnel/Organization: Subcontract Laboratory
Number of Days from Analysis: 60 days

SAP Worksheet #27 – Sample Custody Requirements Table

27.1 SAMPLE CUSTODY AND DOCUMENTATION

Sampling information will be recorded on a CoC form (Attachment 1) and in a permanently bound field logbook, Sample Collection Logbook (Attachment 2). All entries will be legible and recorded in indelible ink.

27.2 SAMPLE LABELING

Sample labels will be filled out with indelible ink and affixed to each sample container. Non-waterproof sample labels will be covered with clear tape. Sample containers will be placed in resealable plastic bags to protect the sample from moisture during transportation to the laboratory. Each sample container will be labeled with the following, at minimum:

- Sample identification number
- Sample collection date (month/day/year)
- Time of collection (24-hour clock)
- Sampler's initials
- Analyses to be performed
- Preservation (if any)
- Location (site name)

27.3 CHAIN OF CUSTODY

In addition to providing a custody exchange record for the samples, the CoC form serves as a formal request for sample analyses. The CoC will be completed, signed, and distributed as follows:

- One copy retained by the sample coordinator (this may be an electronic copy)
- Original sent to the analytical laboratory with the sample shipment

After the laboratory receives the samples, the Sample Custodian will inventory each shipment before signing for it, and note on the original *CoC form any discrepancy in the number of samples,* temperature of the cooler or broken samples. The Project Chemist will be notified immediately of any problems identified with shipped samples. The Project Chemist will in turn notify the Project QC Manager, and together they will determine the appropriate course of action. The Project Chemist will also notify the PM if the project budget and schedule may be impacted.

The laboratory will initiate an internal CoC that will track the sample within the various areas of the laboratory. The relinquishing signature of the Sample Custodian and the custody acceptance signature of the laboratory personnel transfer custody of the sample. This procedure is followed

each time a sample changes hands. The laboratory will archive the samples and maintain their custody as required by the contract or until further notification from the Project Chemist, at which time the samples will either be returned to the project for disposal, or disposed by the laboratory.

27.4 SAMPLE PACKING AND SHIPMENT

After sample collection, sample labels will be affixed to each sample container. Each sample will be placed in a resealable plastic bag to keep the sample container and the label dry. All glass sample containers will be protected with bubble wrap (or other cushioning material) to prevent breakage. A temperature blank will be placed in every cooler with samples.

Samples to be shipped by commercial carrier will be packed in a sample cooler lined with a plastic bag. Ice will be added to the cooler in sufficient quantity to keep the samples cooled to 4±2 degrees °C for the duration of the shipment to the laboratory. Sample cooler drain spouts will be taped from the inside and outside of the cooler to prevent any leakage. Saturday deliveries will be coordinated with the laboratory.

If samples are picked up by a laboratory courier service, the CoC form will be completed and signed by the laboratory courier. The cooler will then be released to the courier for transportation to the laboratory.

If a commercial carrier is used, the CoC form will include the airbill number in the "Transfers Accepted By" column, and will be sealed in a resealable bag. The CoC form will then be taped to the inside of the sample cooler lid. The cooler will be taped shut with strapping tape, and two custody seals will be taped across the cooler lid. Clear tape will be applied to the custody seals to prevent accidental breakage during shipping. The samples will then be shipped to the analytical laboratory. A copy of the courier airbill will be retained for documentation.

The shipping of samples to the analytical laboratory by land delivery services will be performed according to the DOT regulations. The International Air Transportation Association regulations will be adhered to when shipping samples by air courier services. Transportation methods will be selected to assure that the samples arrive at the laboratory in time to permit testing according to established holding times and project schedules. No samples will be accepted by the receiving laboratory without a properly prepared CoC record and properly labeled and sealed shipping container(s).

27.5 FIELD LOGBOOKS

The Sample Collection Logbook with consecutively numbered pages will be assigned to this project. All entries will be recorded in indelible ink. Corrections will be made following the procedure described below in Section 27.6, "Document Corrections." At the end of each

workday, the responsible sampler will sign the logbook pages, and any unused portions of a logbook page will be crossed out, signed, and dated.

At a minimum, the logbook will contain the following information:

- Project name and location (on the front page of the log book)
- Date and time of collection for each sample (in the upper right corner of each page)
- Sample number
- Sample location (i.e., soil boring or sampling point)
- Sample type (i.e., soil and water)
- Composite or grab
- Composite type (the number of grab samples)
- Depth of sample
- Weather information (e.g., rain, sunny, approximate temperature, etc.)
- Containers used and requested analyses

In the graph paper portion of the field logbook, the sampler will fill in the following information:

- A map with sample locations (drawn or paste copy). Each sample location must be clearly identified on the map. Several sample locations may be presented on one map; however, the page with the map must be referred on each of the individual sample pages
- Field analyses performed, including results, instrument checks, problems, and calibration records for field instruments
- Descriptions of deviations from this SAP
- Problems encountered and corrective action taken
- Identification of field QC samples
- Verbal or written instructions from the Navy and Shaw Project QC Manager

The sampler will cross out the unused portion and sign each page.

27.6 DOCUMENT CORRECTIONS

Changes or corrections on any project documentation will be made by crossing out the item with a single line, initialing by the person performing the correction, and dating the correction. The original item, although erroneous, will remain legible beneath the cross out. The new information will be written above the crossed-out item. Corrections will be written clearly and legibly with indelible ink.

SAP Worksheet #28a – Laboratory QC Samples Table (EPA 8015B)

Matrix: Soil

Total Petroleum Hydrocarbons by Gas Chromatography

EPA Method 8015M / Lab SOP 5.1 / 7.1

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Internal standards (optional)	Every sample, spiked sample, standard, and method blank	Areas within -50% to +100% of last calibration verification	Determine if problem is matrix related; if not related to matrix interference, then re-extract and reanalyze affected samples.	Lab Manager / Analyst	Quantitation	Areas within -50% to +100% of last calibration verification
Method blank	One per analytical batch (TPH-g) and one per preparation batch (TPH-d)	No target analytes ≥ PQL	Determine the source of contamination, reanalyze blank, then re-extract and reanalyze method blank and all samples processed with the contaminated blank	Lab Manager / Analyst	Representativeness	No target analytes ≥ PQL
MS/MSD	One MS/MSD pair per analytical/preparation batch	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)	Determine if matrix related. if not related to matrix interference, evaluate LCS results; if not matrix related re-extract and reanalyze MS/MSD and all associated batch samples	Lab Manager / Analyst	Precisions and Accuracy	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)
LCS or LCS/LCD pair if there is not enough sample for MS/MSD	One LCS or LCS/LCD pair per analytical/preparation batch	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)	Re inject LSC, or reanalyze the LCS or re-extract and reanalyze the LCS and all associated batch samples	Lab Manager / Analyst	Precisions and Accuracy	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)

SAP Worksheet #28a – Laboratory QC Samples Table (EPA 8015B) (continued)

Matrix: Soil
Total Petroleum Hydrocarbons by Gas Chromatography
EPA Method 8015M / Lab SOP 5.1 / 7.1

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogate standards	Every sample, spiked sample, standard, and method blank	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)	Determine if problem is matrix related, if not then re-extract and reanalyze all affected samples	Lab Manager / Analyst	Accuracy	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)
MDL study	Once per 12-month period	Detection limits established will be below the reporting limits (RLs)	Repeat the MDL study	Lab Manager / Analyst	Representativeness	Detection limits will be below the RLs

Notes:
LCD denotes laboratory control duplicate.
LCS denotes laboratory control sample.
MDL denotes method detection limit.
MS denotes matrix spike.
MSD denotes matrix spike duplicate.
PQL denotes project quantitation limit.
QC denotes quality control.
RL denotes reporting limit.

SAP Worksheet #28b – Laboratory QC Samples Table (EPA 6010B)

Matrix: Soil						
ICP Metals						
EPA Method 6010B/ Lab SOP 4.4						
QC Check	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Calibration blank	After initial calibration, before CCV calibration, after every 10 samples, and at the end of the sequence	No target analytes ≥ RL in accordance with DoD QSM requirements	Re-prepare and reanalyze the blank, then recalibrate the instrument	Lab Manager / Analyst	Representativeness	No target analytes ≥ RL in accordance with DoD QSM requirements
IDL study	Once per 12-month period	IDLs will be below the quantitation Limits (QLs)	Perform maintenance if necessary, then repeat the IDL study	Lab Manager / Analyst	Sensitivity	IDLs will be below the PQLs
MDL study (water only)	Once per 12-month period	MDLs will be below the PQLs	Repeat the MDL study	Lab Manager / Analyst	Sensitivity	MDLs will be below the PQLs
Method blank	One per digestion batch	No target analytes ≥ PQL	Identify the source of blank contamination, then re-prepare and reanalyze the method blank and all samples processed with the contaminated blank	Lab Manager / Analyst	Representativeness	No target analytes ≥ PQL
ICS	At the beginning of an analytical run	Within ±20% of expected value	Terminate analysis, perform maintenance to correct the problem if necessary, recalibrate if necessary then reanalyze ICS and all affected samples	Lab Manager / Analyst	Accuracy	Within ±20% of expected value

SAP Worksheet #28b – Laboratory QC Samples Table (EPA 6010B) (continued)

Matrix: Soil						
ICP Metals						
EPA Method 6010B/ Lab SOP 4.4						
QC Check	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
MS/MSD for all analytes	One MS/MSD pair per preparation batch	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)	Evaluate LCS recovery; Identify problem; if not related to matrix interference then re-prepare and reanalyze the MS/MSD pair and all samples in the associated batch	Lab Manager / Analyst	Precision and Accuracy	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)
LCS or LCS/LCD pair if there is not enough sample for MS/MSD	One LCS or LCS/LCD pair per each preparation batch	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)	Terminate analysis, identify and correct the problem, then re-prepare and reanalyze all affected samples and Quality Control checks in accordance with DoD QSM requirements	Lab Manager / Analyst	Precision and Accuracy	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)
Dilution test	Each new sample matrix	1:5 dilution must agree within ±10% of the original determination	Evaluate for matrix interference Perform post-digestion spike	Lab Manager / Analyst	Accuracy	10% Difference
Post digestion spike addition	When matrix spike or dilution test fails	Recovery within 75% to 125% of expected results	Narrate matrix interference	Lab Manager / Analyst	Accuracy	Recovery within 75% to 125% of expected results

Notes:
CCV denotes continuing calibration verification
DoD denotes Department of Defense
ICS denotes interference check solution
IDL denotes instrument detection limit
LCD denotes laboratory control duplicate.
LCS denotes laboratory control sample.
MDL denotes method detection limit.
MS denotes matrix spike.
MSD denotes matrix spike duplicate.
PQL denotes project quantitation limit.
QC denotes quality control
QL denotes quantitation limit
QSM denotes Quality System Manual
RL denotes reporting limit.

SAP Worksheet #28c – Laboratory QC Samples Table (EPA 8260B)

Matrix: Soil

VOCs

EPA Method 8260B/ Lab SOP 2.4

QC Check	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Check of mass spectral ion intensities (tuning procedure) using BFB (8260B)	Prior to initial calibration and calibration verification	Must meet the method requirements before samples are analyzed See WS#24	Retune instrument and verify the tune acceptability in accordance with DoD QSM requirements	Lab Manager / Analyst	Representativeness	Meets all EPA Method requirements See WS #24
Internal standards	During acquisition of calibration standard, samples, and QC check samples	Areas within -50% to +100% of last calibration verification (12 hours)	Inspect MS and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Lab Manager / Analyst	Representativeness	Meets all EPA Method requirements
Method blank	One per analytical batch	No target analytes ≥ ½ QL. For common laboratory contaminants, no analytes detected > QL	Determine the source of blank contamination, If necessary, re-extract and reanalyze method blank and all samples processed with the contaminated blank	Lab Manager / Analyst	Representativeness; Bias Contamination	No target analytes ≥ QL
MS/MSD for all analytes	One MS/MSD per analytical/preparation batch	DoD QSM specified control limits or laboratory statistically derived control limits (see Attachment 4)	Determine if problem is matrix related; if not related to matrix interference, re-extract and reanalyze MS/MSD and all associated batch samples	Lab Manager / Analyst	Precision and Accuracy	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)
LCS or LCS/LCD pair if there is not enough sample for MS/MSD	One LCS or LCS/LCD per analytical/preparation batch	DoD QSM Limits or laboratory statistically derived control limits (see Attachment 4)	Re-analyze the LCS (LCS/ LCD) and all associated batch	Lab Manager / Analyst	Precision and Accuracy	DoD QSM Limits or laboratory statistically derived control limits (see Attachment 4)

SAP Worksheet #28c – Laboratory QC Samples Table (EPA 8260B) (continued)

Matrix: Soil

VOCs

EPA Method 8260B/ Lab 2.4

QC Check	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogate standards	Every sample, spiked sample, standard, and method blank	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)	Determine if problem is matrix related; if not related to matrix interference, reanalyze the extract or re-extract and reanalyze all affected samples	Lab Manager / Analyst	Accuracy	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)
(MDL study	Once per 12-month period	Detection limits established will be below the RLs established in accordance with DoD QSM requirements	Perform instrument maintenance; then repeat the MDL study	Lab Manager / Analyst	Sensitivity	Meets project RL requirements

Notes:
BFB denotes bromofluorobenzene.
DoD denotes Department of Defense.
DQI denotes quantitative and qualitative measures of principal quality attributes, including precision, accuracy, representativeness, comparability, completeness, and sensitivity.
GC denotes gas chromatograph.
LCD denotes laboratory control duplicate.
LCS denotes laboratory control sample.
MDL denotes method detection limit.
MS denotes mass spectrometer.
MS denotes matrix spike.
MSD denotes matrix spike duplicate.
QC denotes quality control.
QSM denotes Quality System Manual.
RL denotes reporting limit.

SAP Worksheet #28d –Laboratory QC Samples Table (EPA 8270C)

Matrix: Soil						
SVOCs						
EPA Method 8270D/ Lab SOP 8.1						
QC Check	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Check of mass spectral ion intensities (tuning procedure) using DFTPP	Prior to initial calibration and calibration verification	Must meet the method requirements before samples are analyzed See WS#24	Retune instrument and verify the tune acceptability prior to any sample analyses	Lab Manager / Analyst	Representativeness	Meets all EPA Method requirements See WS#24
Internal standards	During acquisition of calibration standard, samples, and QC check samples	Areas within -50% to +100% of last calibration verification (12 hours) for each	Inspect MS and GC for malfunctions; evaluate for matrix interference, mandatory reanalysis of samples analyzed while system was malfunctioning	Lab Manager / Analyst	Representativeness	Areas within -50% to +100% of last calibration verification (12 hours) for each
Method blank	One per analytical batch	No target analytes ≥ ½ RL. For common laboratory contaminants, no analytes detected > RL	Identify the source of blank contamination, then re-extract and reanalyze method blank and all samples processed with the contaminated blank	Lab Manager / Analyst	Representativeness	No target analytes ≥ RL
MS/MSD for all analytes	One MS/MSD per analytical/preparation batch	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)	Determine if problem is matrix related; if not related to matrix interference, re-extract and reanalyze MS/MSD and all associated batch samples	Lab Manager / Analyst	Precision and Accuracy	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)

SAP Worksheet #28d – Laboratory QC Samples Table (EPA 8270C) (continued)

Matrix: Soil						
SVOCs						
EPA Method 8270D/ Lab SOP 8.1						
QC Check	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
LCS or LCS/LCD pair if there is not enough sample for MS/MSD	One LCS or LCS/LCD per analytical/preparation batch	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)	Re inject the LCS/LCSD; if still fails then re-extract and reanalyze the LCS (LCS/ LCD) and all associated batch samples in accordance with DoD QSM requirements	Lab Manager / Analyst	Precision and Accuracy	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)
Surrogate standards	Every sample, spiked sample, standard, and method blank	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)	Determine if problem is related to sample matrix, if not, then re-extract and reanalyze all affected samples	Lab Manager / Analyst	Accuracy	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)
Method detection limit (MDL) study	Once per 12-month period	Detection limits established will be below the RLs	Perform maintenance if necessary; then repeat the MDL study	Lab Manager / Analyst	Sensitivity	Meets project RL requirements

Notes:
DFTPP denotes deacfluorotriphenylphosphine
DoD denotes Department of Defense.
GC denotes gas chromatograph
LCD denotes laboratory control duplicate
LCS denotes laboratory control sample.
MDL denotes method detection limit
MS denotes mass spectrometer
MS denotes matrix spike
MSD denotes matrix spike duplicate
QC denotes quality control
QSM denotes Quality System Manual
RL denotes reporting limit

SAP Worksheet #28e – Laboratory QC Samples Table (EPA 8081A / 8082)

Matrix: Soil

OC Pesticides and PCBs

EPA Method 8081A / 8082 Lab SOP 3.2 / 3.3

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	One per preparation batch	No target analytes ≥ QL	Identify the source of blank contamination, if necessary, re-extract and reanalyze method blank and all samples processed with the contaminated	Lab Manager / Analyst	Representativeness	No target analytes ≥ QL
DDT/Endrin Breakdown Check	Daily prior to analysis of samples and every 12 hours	Breakdown ≤ 15%	Perform maintenance, recalibrate if necessary, reanalyze sample extracts	Lab Manager / Analyst	Quantitation	Breakdown ≤ 15%
(MS/MSD for all analytes	One MS/MSD pair per analytical/preparation batch	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)	Identify if the problem is matrix related; if not related to matrix interference, re-extract and reanalyze MS/MSD and all associated batch samples	Lab Manager / Analyst	Precisions and Accuracy	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)
LCS or LCS/LCD pair if there is not enough sample for MS/MSD	One LCS or LCS/LCD pair per analytical/preparation batch	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)	re-inject the LCS/LCSD, if still out of control, then re-extract and reanalyze the LCS and all associated batch samples	Lab Manager / Analyst	Precisions and Accuracy	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)
Surrogate standards	Every sample, spiked sample, standard, and method blank	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)	Evaluate possible matrix interference, re-analyze sample extract. re-extract and reanalyze all affected samples	Lab Manager / Analyst	Accuracy	DoD control limits if available; otherwise Laboratory statistically derived control limits (see Attachment 4)

SAP Worksheet #28e – Laboratory QC Samples Table (EPA 8081A / 8082) (continued)

Matrix: Soil						
OC Pesticides and PCBs						
EPA Method 8081A / 8082 Lab SOP 3.2 / 3.3						
QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
MDL study	Once per 12-month period	Detection limits established will be below the RLs	Perform maintenance if necessary, Repeat the MDL study	Lab Manager / Analyst	Representativeness	Detection limits will be below the RLs
Retention Time study	Establish initially, verify during daily calibrations	Within ±3 standard deviations of each analyte retention time from the initial study	Perform instrument maintenance if necessary; adjust windows, then re-evaluate analyte identification	Lab Manager / Analyst	Accuracy	Within ±3 standard deviations of each analyte retention time from the initial study
Second Column Confirmation	100 % of all detected organochlorine pesticide pesticides above MDL	Analyte concentration % difference between columns ≤ 40%	Evaluate possible matrix interference on either column, reanalyze, narrate	Lab Manager / Analyst	Accuracy	Analyte concentration % difference between columns ≤ 40%

Notes:
DoD denotes Department of Defense.
LCD denotes laboratory control duplicate.
LCS denotes laboratory control sample.
MDL denotes method detection limit.
MS denotes matrix spike.
MSD denotes matrix spike duplicate.
QC denotes quality control.
QL denotes quantitation limit.

SAP Worksheet #28f – Laboratory QC Samples Table (Gamma Isotopes – On-site Laboratory Operated by TtEC)

Matrix: Waste water and Soil

Gamma Isotopes

Gamma/RCHL-A-05, Rev 1 (on-site laboratory)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	Daily	Absolute value less than analyte RL	Identify the source of blank contamination, if necessary, reprocess method blank and all samples d with the contamination	NWT Lab Manager	Accuracy	Absolute value less than analyte RL
LCS	1 per preparatory batch and or every 20 samples	Gamma source check +/- 10% of known activity	re-prep and reanalyze the LCS and all associated batch samples	NWT Lab Manager	Accuracy	Gamma source check +/- 10 of known activity
Sample Duplicate	1 per preparatory batch and or every 20 samples	RPD less than or equal to 40%	Re-prepare and reanalyze the sample and duplicate for failed analytes. If RPD/RER still out of range report as matrix interference. If reanalysis is in range, re-extract samples in batch.	NWT Lab Manager	Precision	RPD less than or equal to 40%

Notes:
LCS denotes laboratory control sample.
NWT denotes New World Technologies, Inc.
QC denotes quality control.
RER denotes relative error ratio.
RL denotes reporting limit.
RPD denotes relative percent difference.

SAP Worksheet #28g – Laboratory QC Samples Table (Alpha Isotopes - On-site Laboratory Operated by TtEC))

Matrix: Soil
Alpha Isotopes
Actinides/RCHL-A-08, Rev 3 (on-site laboratory)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	Daily	Absolute value less than analyte RL	Identify the source of blank contamination, if necessary, re-prep and reanalyze method blank and all samples processed with contamination	NWT Lab Manager	Accuracy	Absolute value less than analyte RL
LCS	1 per preparatory batch and or every 20 samples	Gamma source check +/- 10% of known activity	re-prep and reanalyze the LCS and all associated batch samples	NWT Lab Manager	Accuracy	Gamma source check +/- 10 of known activity
Tracer	Per sample	Th-229, U-232, Am-242, Pu-239, Ra-226, and Ra-224: 30-110%	Evaluate the data to determine the source of difference and to determine if matrix effect or analytical error.	NWT lab Manager	Accuracy	Th-229, U-232, Am-242, Pu-239, Ra-226, and Ra-224: 30-110%
Sample Duplicate	1 per preparatory batch and or every 20 samples	RPD less than or equal to 40%	Re-prepare and reanalyze the sample and duplicate for failed analytes. If RPD/RER still out of range report as matrix interference. If reanalysis is in range, re-extract samples in batch.	NWT Lab Manager	Precision	RPD less than or equal to 40%

Notes:
LCS denotes laboratory control sample.
NWT denotes New World Technologies, Inc.
QC denotes quality control.
RER denotes relative error ratio.
RL denotes reporting limit.
RPD denotes relative percent difference.

SAP Worksheet #28h – Laboratory QC Samples Table (Gamma Isotopes - Subcontract Radiological Laboratory managed by TtEC)

Matrix: Soil
Gamma Isotopes
EPA 901.1 MOD/SOP ST-RD-102 R6

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per preparatory batch	Analytes < RL	Identify the source of blank contamination, if necessary, re-prepare and reanalyze method blank and all samples with the contamination	Subcontract Radiological Lab managed by TtEC	Accuracy	Analyte < RL
LCS	1 per preparatory batch	Within in-house limits (Limits are for tuna can LCS peometry until 250mL Ra-226 geometry is active – Limits for Ra-226 listed are advisory until enough data points are generated to be statistically meaningful	Re-prepare and reanalyze the LCS and all associated batch samples	Subcontract Radiological Lab managed by TtEC	Accuracy	Tuna Can: Cs-137: 94-118% Co-60: 90-110% Am-241: 90-110% 250mL Poly: Ra-226: 70-130%
Sample Duplicate	1 per preparatory batch	RPD less than or equal to 40% and/or RER less than or equal to 1	Re-prepare and reanalyze the sample and duplicate for failed analytes. If RPD/RER still out of range report as matrix interference. If reanalysis is in range, re-extract samples in batch.	Subcontract Radiological Lab managed by TtEC	Accuracy	RPD less than or equal to 40% pr RER less than or equal to 1

Notes:
Laboratory information from Final SAP Basewide Storm Drain and Sanitary Sewer Removal (TtECI, 2009).
LCS denotes laboratory control sample. *QC denotes quality control.* *RER denotes relative error ratio.*
mL denotes milliliter. *RL denotes reporting limit.* *RPD denotes relative percent difference.*

SAP Worksheet #28i – Laboratory QC Samples Table (Strontium-90 - Subcontract Radiological Laboratory managed by TtEC)

Matrix: Wastewater
Strontium-90
EPA 905 MOD or DOE SR-03-RC MOD/SOP ST-RD-0403 R8

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per preparatory batch	Analytes < RL	Identify the source of blank contamination, if necessary, re-prepare and reanalyze method blank and all samples processed with the contaminated blank	Subcontract Radiological Lab managed by TtEC	Accuracy	Analyte < RL
LCS and/or LCSD	1 per preparatory batch	Within in-house limits	re-prepare and reanalyze the LCS and all associated batch samples	Subcontract Radiological Lab managed by TtEC	Accuracy	EPA 905 MOD: 75-135% (water) 69-137% (soil) DOE SR-03-RC MOD: 70-130% RPD < 40% and/or RER < 1
MS/MSD	As requested	Within in-house limits	The data will be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error	Subcontract Radiological Lab managed by TtEC	Accuracy	EPA 905 MOD: 33-150% (water) 69-137% (soil) DOE SR-03-RC MOD: 33-150% (water) 70-130% (soil) RPD < 40% and/or RER < 1

SAP Worksheet #28i – Laboratory QC Samples Table (Strontium-90 - Subcontract Radiological Laboratory managed by TtEC) (continued)

Matrix: Wastewater
Strontium-90
EPA 905 MOD or DOE SR-03-RC MOD/SOP ST-RD-0403 R8

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Carriers	Per sample, blank, LCS, MS, MSD	Sr and Yt carriers ≥40% and ≤ 110%	Truncate carriers/tracers above 100% recovery to eliminate low biased results. Re-prepare and reanalayze sample if carrier is low (high biased results) if there is activity in the sample above the RL. No reanalyzsis if matrix interference is nonconformance during sample preparation.	Subcontract Radiological Lab managed by TtEC	Accuracy	Sr and Yt carriers ≥40% and ≤ 110%
Sample Duplicate	1 per preparatory batch	RPD less than or equal to 40% and/or RER less than or equal to 1	Inspect mass spectrometer and gas chromatograph for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	Subcontract Radiological Lab managed by TtEC	Accuracy	RPD less than or equal to 40% pr RER less than or equal to 1

Notes:
Laboratory information from Final SAP Basewide Storm Drain and Sanitary Sewer Removal (TtECI, 2009).
LCD denotes laboratory control duplicate.
LCS denotes laboratory control sample.
MS denotes matrix spike.
MSD denotes matrix spike duplicate.
QC denotes quality control.
RER denotes relative error ratio.
RL denotes reporting limit.
RPD denotes relative percent difference.

SAP Worksheet #28j -- Laboratory QC Samples Table (Isotopic Uranium - Subcontract Radiological Laboratory managed by TtEC)

Matrix: Wastewater						
Isotopic Uranium						
DOE A-01-R MOD/SOP ST-RD-0210 R6						
QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per preparatory batch	Analytes < RL	Identify the source of blank contamination, if necessary, re-extract and reanalyze method blank and all samples processed with the contaminated	Subcontract Radiological Lab managed by TtEC	Accuracy	Analyte < RL
LCS/LCD	1 per preparatory batch	Within in-house limits	re-prepare and reanalyze the LCS and all associated batch samples	Subcontract Radiological Lab managed by TtEC	Accuracy	U-234: 87-127% (w) 70-122% (soil) U-238: 87-128% (w) 70-130% (soil) RPD ≤ 40% and/or RER ≤ 1
MS/MSD	As requested	Within in-house limits	The data will be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error	Subcontract Radiological Lab managed by TtEC	Accuracy	U-234: 65-146%(water) 70-130%(soil) U-238: 68-143% (water) 70-130%(soil) RPD ≤ 40% and/or RER ≤ 1

SAP Worksheet #28j – Laboratory QC Samples Table (Isotopic Uranium - Subcontract Radiological Laboratory managed by TtEC) (Continued)

Matrix: Wastewater
Isotopic Uranium
DOE A-01-R MOD/SOP ST-RD-0210 R6

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Tracer	Per sample, blank, LCS, MS/MSD	Within in-house limits	Truncate carriers/tracers above 100% recovery to eliminate low biased results. Re-prepare and reanalayze sample if carrier is low (high biased results) if there is activity in the sample above the RL. No reanalyzsis if matrix interference is nonconformance during sample preparation.	Subcontract Radiological Lab managed by TtEC	Accuracy	U-232: 30-110%
Sample Duplicate	1 per preparatory batch	RPD less than or equal to 40% and/or RER less than or equal to 1	Re-prepare and reanalyze the sample and duplicate for failed analytes. If RPD/RER still out of range report as matrix interference. If reanalysis is in range, re-extract samples in batch.	Subcontract Radiological Lab managed by TtEC	Accuracy	RPD less than or equal to 40% pr RER less than or equal to 1

Notes:
Laboratory information from Final SAP Basewide Storm Drain and Sanitary Sewer Removal (TtECI, 2009).
LCD denotes laboratory control duplicate.
LCS denotes laboratory control sample.
MS denotes matrix spike.
MSD denotes matrix spike duplicate.
QC denotes quality control.
RER denotes relative error ratio.
RL denotes reporting limit.
RPD denotes relative percent difference.

SAP Worksheet #28k – Laboratory QC Samples Table (Isotopic Thorium - Subcontract Radiological Laboratory managed by TtEC)

Matrix: Soil
Isotopic Thorium
EPA 901.1 MOD/SOP ST-RD-102 R6

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per preparatory batch	Analytes < RL	Identify the source of blank contamination, if necessary, re-extract and reanalyze method blank and all samples processed with the contaminated	Subcontract Radiological Lab managed by TtEC	Accuracy	Analyte < RL
LCS/LCD	1 per preparatory batch	Within in-house limits	Re-prepare and reanalyze the LCS and all associated batch samples	Subcontract Radiological Lab managed by TtEC	Accuracy	Th-230: 83-120% RPD ≤ 40% and/or RER ≤ 1
MS/MSD	As requested	Within in-house limits	The data will be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error	Subcontract Radiological Lab managed by TtEC	Accuracy	Th-230: 70-130% RPD ≤ 40% and/or RER ≤ 1
Tracer	Per sample, blank, LCS, MS/MSD	Within in-house limits	Truncate carriers/tracers above 100% recovery to eliminate low biased results. Re-prepare and reanalayze sample if carrier is low (high biased results) if there is activity in the sample above the RL. No reanalyzsis if matrix interference is nonconformance during sample preparation.	Subcontract Radiological Lab managed by TtEC	Accuracy	Th-229: 30-110%

SAP Worksheet #28k – Laboratory QC Samples Table (Isotopic Thorium - Subcontract Radiological Laboratory managed by TtEC) (continued)

Matrix: Soil						
Isotopic Thorium						
EPA 901.1 MOD/SOP ST-RD-102 R6						
QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Sample Duplicate	1 per preparatory batch	RPD less than or equal to 40% and/or RER less than or equal to 1	Re-prepare and reanalyze the sample and duplicate for failed analytes. If RPD/RER still out of range report as matrix interference. If reanalysis is in range, re-extract samples in batch.	Subcontract Radiological Lab managed by TtEC	Accuracy	RPD less than or equal to 40% pr RER less than or equal to 1

Notes:
Laboratory information from Final SAP Basewide Storm Drain and Sanitary Sewer Removal (TtECI, 2009).
LCD denotes laboratory control duplicate.
LCS denotes laboratory control sample.
MS denotes matrix spike.
MSD denotes matrix spike duplicate.
QC denotes quality control.
RER denotes relative error ratio.
RL denotes reporting limit.
RPD denotes relative percent difference.

SAP Worksheet #28I – Laboratory QC Samples Table (Isotopic Plutonium - Subcontract Radiological Laboratory managed by TtEC)

Matrix: Wastewater and Soil
Isotopic Plutonium
DOE A-01-R MOD/SOP ST-RD-0210 R6

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per preparatory batch	Analytes < RL	Identify the source of blank contamination, if necessary, re-extract and reanalyze method blank and all samples processed with the contaminated	Subcontract Radiological Lab managed by TtEC	Accuracy	Analyte < RL
LCS/LCD	1 per preparatory batch	Within in-house limits	Identify problem, then re-extract and reanalyze the LCS and all associated batch samples	Subcontract Radiological Lab managed by TtEC	Accuracy	Pu-238: 80-110% (w) 64-118% (soil) Pu-239/240: 84-115% (w) 75-118% (soil) RPD ≤ 40% and/or RER ≤ 1
MS/MSD	As requested	Within in-house limits	The data will be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error	Subcontract Radiological Lab managed by TtEC	Accuracy	Pu-238: 70-130% (water) 70-130% (soil) Pu-239/240: 70-130% (water) 70-130% (soil) RPD ≤ 40% and/or RER ≤ 1

SAP Worksheet #28I – Laboratory QC Samples Table (Isotopic Plutonium - Subcontract Radiological Laboratory managed by TtEC) (continued)

Matrix: Soil						
Isotopic Plutonium						
DOE A-01-R MOD/SOP ST-RD-0210 R6						
QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Tracer	Per sample, blank, LCS, MS/MSD	Within in-house limits	Truncate carriers/tracers above 100% recovery to eliminate low biased results. Re-prepare and reanalayze sample if carrier is low (high biased results) if there is activity in the sample above the RL. No reanalyzsis if matrix interference is nonconformance during sample preparation.	Subcontract Radiological Lab managed by TtEC	Accuracy	Pu-242: 30-110%
Sample Duplicate	1 per preparatory batch	RPD less than or equal to 40% and/or RER less than or equal to 1	Re-prepare and reanalyze the sample and duplicate for failed analytes. If RPD/RER still out of range report as matrix interference. If reanalysis is in range, re-extract samples in batch.	Subcontract Radiological Lab managed by TtEC	Accuracy	RPD less than or equal to 40% pr RER less than or equal to 1

Notes:
Laboratory information from Final SAP Basewide Storm Drain and Sanitary Sewer Removal (TtECI, 2009).
LCD denotes laboratory control duplicate.
LCS denotes laboratory control sample.
MS denotes matrix spike.
MSD denotes matrix spike duplicate.
QC denotes quality control.
RER denotes relative error ratio.
RL denotes reporting limit.
RPD denotes relative percent difference.

SAP Worksheet #28m – Laboratory QC Samples Table (Tritium - Subcontract Radiological Laboratory managed by TtEC)

Matrix: Wastewater

Tritium

EPA 906.0 MOD/SOP ST-RD-0302 R11

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per preparatory batch	Analytes < RL	Identify the source of blank contamination, if necessary, re-extract and reanalyze method blank and all samples processed with the contaminated	Subcontract Radiological Lab managed by TtEC	Accuracy	Analyte < RL
LCS/LCD	1 per preparatory batch	Within in-house limits	Reextract and reanalyze the LCS and all associated batch samples	Subcontract Radiological Lab managed by TtEC	Accuracy	67-111% (water) 75-140% (soil) RPD ≤ 40% and/or RER ≤ 1
MS/MSD	As requested	Within in-house limits	The data will be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error	Subcontract Radiological Lab managed by TtEC	Accuracy/Precision	27-150% (water) 62-129% (soil) RPD ≤ 40% and/or RER ≤ 1
Sample Duplicate	1 per preparatory batch	RPD less than or equal to 40% and/or RER less than or equal to 1	Re-prepare and reanalyze the sample and duplicate for failed analytes. If RPD/RER still out of range report as matrix interference. If reanalysis is in range, re-extract samples in batch.	Subcontract Radiological Lab managed by TtEC	Accuracy	RPD less than or equal to 40% pr RER less than or equal to 1

Notes:
Laboratory information from Final SAP Basewide Storm Drain and Sanitary Sewer Removal (TtECI, 2009).
LCD denotes laboratory control duplicate.
LCS denotes laboratory control sample.
MS denotes matrix spike.
MSD denotes matrix spike duplicate.
QC denotes quality control.
RER denotes relative error ratio.
RL denotes reporting limit.
RPD denotes relative percent difference.

SAP Worksheet #28n – Laboratory QC Samples Table (Gamma and Radium-226 - Subcontract Radiological Laboratory managed by TtEC)

Matrix: Wastewater
Gamma and Radium-226
EPA901.1 MOD and 903.0 MOD/SOPST-RD-0102 R6 and SOP ST-RD-0403 R8

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per preparatory batch	Analytes < RL	Identify the source of blank contamination, if necessary, re-prepare and reanalyze method blank and all samples processed with the contaminated	Subcontract Radiological Lab managed by TtEC	Accuracy	Analyte < RL
LCS/LCD	1 per preparatory batch	Within in-house limits	Re-prepare and reanalyze the LCS and all associated batch samples	Subcontract Radiological Lab managed by TtEC	Accuracy	72-130% RPD ≤ 40% and/or RER ≤ 1
MS/MSD	As requested	Within in-house limits	The data will be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error	Subcontract Radiological Lab managed by TtEC	Accuracy/Precision	50-130% RPD ≤ 40% and/or RER ≤ 1
Carriers	Per sample, blank, LCS, MS, MSD	Ba and Yt carriers ≥40% and ≤ 110%	Truncate carriers/tracers above 100% recovery to eliminate low biased results. Re-prepare and reanalayze sample if carrier is low (high biased results) if there is activity in the sample above the RL. No reanalyzsis if matrix interference is nonconformance during sample preparation.	Subcontract Radiological Lab managed by TtEC	Accuracy	Ba and Yt carriers ≥40% and ≤ 110%

SAP Worksheet #28n – Laboratory QC Samples Table (Gamma and Radium-226 - Subcontract Radiological Laboratory managed by TtEC) (continued)

Matrix: Wastewater and Soil						
Gamma and Radium-226						
EPA901.1 MOD and 903.0 MOD/SOPST-RD-0102 R6 and SOP ST-RD-0403 R8						
QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Sample Duplicate	1 per preparatory batch	RPD less than or equal to 40% and/or RER less than or equal to 1	Re-prepare and reanalyze the sample and duplicate for failed analytes. If RPD/RER still out of range report as matrix interference. If reanalysis is in range, re-extract samples in batch.	Subcontract Radiological Lab managed by TtEC	Accuracy	RPD less than or equal to 40% pr RER less than or equal to 1

Notes:
Laboratory information from Final SAP Basewide Storm Drain and Sanitary Sewer Removal (TtECI, 2009).
LCD denotes laboratory control duplicate.
LCS denotes laboratory control sample.
MS denotes matrix spike.
MSD denotes matrix spike duplicate.
QC denotes quality control.
RER denotes relative error ratio.
RL denotes reporting limit.
RPD denotes relative percent difference.

SAP Worksheet #28o – Laboratory QC Samples Table (Isotopic Thorium - Subcontract Radiological Laboratory managed by TtEC)

Matrix: Wastewater
Isotopic Thorium
DOE A-01-R MOD/SOP ST-RD-0210 R6

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per preparatory batch	Analytes < RL	Identify the source of blank contamination, if necessary, re-prepare and reanalyze method blank and all samples processed with the contaminated	Subcontract Radiological Lab managed by TtEC	Accuracy	Analyte < RL
LCS/LCD	1 per preparatory batch	Within in-house limits	Re-prepare and reanalyze the LCS and all associated batch samples	Subcontract Radiological Lab managed by TtEC	Accuracy	Th-230: 92-138% RPD ≤ 40% and/or RER ≤ 1
MS/MSD	As requested	Within in-house limits	The data will be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error	Subcontract Radiological Lab managed by TtEC	Accuracy/Precision	Th-230: 82-139% RPD ≤ 40% and/or RER ≤ 1
Tracer	Per sample, blank, LCS, MS/MSD	Within in-house limits	Truncate carriers/tracers above 100% recovery to eliminate low biased results. Re-prepare and reanalayze sample if carrier is low (high biased results) if there is activity in the sample above the RL. No reanalyzsis if matrix interference is nonconformance during sample preparation.	Subcontract Radiological Lab managed by TtEC	Accuracy	Th-230: 30-110%

SAP Worksheet #28o – Laboratory QC Samples Table (Isotopic Thorium - Subcontract Radiological Laboratory managed by TtEC) (continued)

Matrix: Wastewater						
Isotopic Thorium						
DOE A-01-R MOD/SOP ST-RD-0210 R6						
QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Sample Duplicate	1 per preparatory batch	RPD less than or equal to 40% and/or RER less than or equal to 1	Re-prepare and reanalyze the sample and duplicate for failed analytes. If RPD/RER still out of range report as matrix interference. If reanalysis is in range, re-extract samples in batch.	Subcontract Radiological Lab managed by TtEC	Accuracy	RPD less than or equal to 40% pr RER less than or equal to 1

Notes:
Laboratory information from Final SAP Basewide Storm Drain and Sanitary Sewer Removal (TtECI, 2009).
LCD denotes laboratory control duplicate.
LCS denotes laboratory control sample.
MS denotes matrix spike.
MSD denotes matrix spike duplicate.
QC denotes quality control.
RER denotes relative error ratio.
RL denotes reporting limit.
RPD denotes relative percent difference.

SAP Worksheet #29 – Project Documents and Records Table

Document	Where Maintained
Final Work Plan and SAP	Shaw Project file NAVFAC Administrative Record for CERCLA Sites
Field notes/logbook	Shaw Project file NAVFAC Administrative Record for CERCLA Sites
Chain of custody forms	Shaw Project file NAVFAC Administrative Record for CERCLA Sites
Laboratory raw data package	Shaw Project file NAVFAC Administrative Record for CERCLA Sites
Audit/assessment checklists/reports	Shaw Project file and laboratory NAVFAC Administrative Record for CERCLA Sites
Corrective action forms/reports	Shaw Project file and laboratory
Laboratory equipment calibration logs	Laboratory (Radiological Analyses- HPS on-site laboratory and Test America, St. Luis)
Sample preparation logs	Laboratory (Radiological Analyses- HPS on-site laboratory and Test America, St. Luis)
Run logs	Laboratory (Radiological Analyses- HPS on-site laboratory and Test America, St. Luis)
Sample disposal records	Laboratory (Radiological Analyses- HPS on-site laboratory and Test America, St. Luis)
Data Validation Reports and Validated data	Shaw Project file NAVFAC Administrative Record for CERCLA Sites

SAP Worksheet #30 – Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Numbers	Analytical Method	Data Package Turnaround Time	Laboratory/Organization (Name, Address, Contact, & Telephone #)	Backup Laboratory (Name, Address, Contact, & Telephone#)
Soil / Sediment	Gamma Spec Alpha Spec Gross Alpha/Beta Strontium-90 Tritium	All Radiation Survey Confirmation Samples	Gamma Spec Alpha Spec Gross Alpha/Beta-	7 Days	New World Environmental, Contact: Paul Wall 200 Fisher Avenue San Francisco, CA 94124 (415) 216-2729	Test America Laboratories, Inc St. Louis [1,2] Contact: Ivan Vania 13715 Rider Trail North Earth City, MO 63045
Soil	OCPs/ PCBs TPH Metals SVOC VOCs ROCs Asbestos	Import Fill	8081B/8082 8015B 6010/7471 8270D 8260B On-site Lab CARB 435	21 Days	Curtis & Tompkins[2] 2323 5th Street Berkeley, CA 94520 Mike Dahlquist (510) 486-0900	ASL Laboratory Group[2] 225 Commerce Dr. Ft. Collins, CO, 80524 (970) 490-1511
Waste Water	OCPs / PCBs TPH Metals SVOC VOCs TRPH / O&G pH TSS Ignitability Cyanide Phenols COD Dissolved sulfide ROCs	Waste Water	8081B / 8082 8015B 6010/7471 8270D 8260B 1664 9045 SM 2540D 1010 4500-CN 420.1 5220C 4500S[2] 901/905 DOE A-01-R	21 Days	Curtis & Tompkins [2] 2323 5th Street Berkeley, CA 94520 Mike Dahlquist (510) 486-0900	ASL Laboratory Group[2] 225 Commerce Dr. Ft. Collins, CO, 80524 (970) 490-1511

Test America St. Louis, will perform radiological analysis on 10% QA split samples from the NWT on-site laboratory

Subcontract laboratories will be DoD ELAP certified or have current valid NFESC approval. In addition, the laboratory will be State of California NELAP approved. The laboratory will maintain these certifications throughout the project

SAP Worksheet #31 – Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Actions	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions
Laboratory Technical Systems Audit (TSA)	If deemed necessary prior to start of sampling activities	E	Shaw	Project or Program Chemist	Laboratory Quality Assurance Officer(QAO)	Laboratory QAO	Laboratory QAO and Shaw Project Chemist
Initial Inspection / Preparatory Meeting	Prior to the start of sampling activities	I	Shaw	Project or Program Chemist	Project Chemist or Sample Technician	Project Chemist or Sample Technician	Program Chemist or QC Manager
Field audits	As needed as the project progresses	I	Shaw and/or Navy QAO	Project or Program Chemist	Project or Program Chemist	Project or Program Chemist	Project or Program Chemist
Field documentation review	At least once at the beginning of sampling activities and then as needed as the project progresses	I	Shaw	Program Chemist or Project QC Manager	Technical Manager; Field Sampling Technician or Project Chemist	Technical Manager; Field Sampling Technician or Project Chemist	Program Chemist or Project QC Manager

SAP Worksheet #32 – Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Field Sampling Technical System Audit	Written Audit Report	Shaw PM or Technical Manager	48 hours after audit	Email or letter	Shaw Field Technician, Project or Program Chemist	24 hours after notification
Off-Site Laboratory Audit (if performed for project)	Written Audit Report	Laboratory QA Manager, Laboratory PM	5 days after audit	Corrective Action Plan	Shaw Field Technician, Project or Program Chemist	10 business days after receiving report
Laboratory Data Review Findings	Memo	Laboratory QA Manager, Laboratory PM	48 hours after audit	Email or letter	Shaw Field Technician, Project or Program Chemist	3 days after notification

SAP Worksheet #33 – QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Field Sampling Technical System Audit (TSA)Report	At least once at the beginning of sampling activities and then as needed as the project progresses	Within 24 hours of Field Sampling Audit	Shaw Project QC Manager or Shaw Project Chemist	Shaw PM
Off-Site Laboratory TSA Report (if performed)	Prior to sample receipt at laboratory	Within 48 hours of on-site audit	Shaw Project or Program Chemist	Laboratory QA Manager, Laboratory PM
Data Review Report	After all waste sample data reviewed by Project Chemist	As received from laboratory	Shaw Project or Program Chemist	Shaw PM
Data Validation Report	After all data packages are received from laboratory	Within 2 weeks of data package receipt	Independent 3rd party data validation company	Shaw Project or Program Chemist
Removal Action Completion Report	After completion of all field work	Project document delivery schedule is provided in the Work Plan	Shaw Project Technical Manager	Navy RPM, RASO and regulatory agencies (see distribution list)

SAP Worksheet #34 – Verification (Step I) Process Table

Verification Input	Description	Internal (I)/ External (E)	Responsible for Verification (Name, Organization)
Chain of custody forms	Chain of custody forms will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the chain of custody should be initialed by the reviewer, a copy of the chain of custody retained in the project file, and the original and remaining copies taped inside the cooler for shipment.	I	Field Sampling Team Leader or Project Chemist (Shaw)
Field notes/logbook	Field notes will be reviewed internally and placed in the project file upon project completion.	I	Project Chemist (Shaw)
Audit reports	Upon report completion, a copy of all audit reports will be placed in the project file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the project file. At the beginning of each week, and at the completion of the site work, project file audit reports will be reviewed internally to ensure that all appropriate corrective actions have been taken and that corrective action reports are attached. If corrective actions have not been taken, the PM will be notified to ensure action is taken.	I	Project Technical Manager or PM (Shaw)
Laboratory data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal. All received data packages will be verified by the Shaw Chemist and a third party reviewer according to the data validation procedures specified in this Sampling and Analysis Plan.	I / E	Laboratory, Shaw Chemist and 3rd party reviewer (Laboratory Data Consultants)
Electronic data deliverables	All EDDs will be verified internally by the subcontract laboratory for completeness and technical accuracy prior to submittal to Shaw. All received EDDs will be verified by Shaw and/or the validation company against the hardcopy laboratory reports	I / E	Laboratory, Shaw Chemist and 3rd party reviewer (Laboratory Data Consultants)

SAP Worksheet #35 – Validation (Steps IIa and IIb) Process Table

Step IIa / IIb	Validation Input	Description	Responsible for Validation
IIa	Sampling Methods and Procedures	Ensure that the required sampling methods were used to collect project samples, any field changes or deviations are noted in the field logbook. Review field sample collection logbooks for compliance with the Approved SAP.	Shaw Project QC Manager or Project Chemist
IIa	Holding times	Ensure the samples were analyzed within the EPA holding times. If holding times were not met, verify that deviations were documented and proper notifications were made.	Analyst – Laboratory PM
IIa	Analytes	Ensure that the required list of analytes was reported per project requirements.	Analyst – Laboratory PM, Shaw Project Chemist
IIa	Hardcopy data packages	Review data package for compliance with EPA Method Requirements, per EPA National Functional Guidelines; Approved SAP, Navy EWI #1 and DoD QSM requirements.	3rd Party Data Validation Company-Laboratory Data Consultants
IIa	Documentation of all EPA Method QC sample Results; 100% Level III data review	Determine if all EPA Method required QC samples were analyzed and met required control limits per SAP and DoD QSM requirements when applicable.	3rd Party Data Validation Company-Laboratory Data Consultants
IIb	Documentation of all SAP QC sample Results	Determine if all SAP required QC samples were collected and met required control limits per SAP and DoD QSM requirements when applicable.	Shaw Project Chemist and 3rd Party Data Validation Company-Laboratory Data Consultants

SAP Worksheet #35 – Validation (Steps IIa and IIb) Process Table (continued)

Step IIa / IIb	Validation Input	Description	Responsible for Validation
IIb	Sampling Plan	Determine whether the SAP was executed as specified (number, location, type of field samples collected).	Shaw Project QC Manager or Project Chemist
IIb	Sampling Procedures	Evaluate whether sampling procedures were followed with respect to techniques, decontamination, sample volume and preservation.	Shaw Project QC Manager or Project Chemist
IIb	Field duplicate precision	Compare results for field duplicates with criteria established in the SAP.	Shaw Project Chemist and 3rd Party Data Validation Company-Laboratory Data Consultants
IIb	Project Reporting Limits (QL) met	Review all laboratory data to ensure that project-specific quantitation limits specified in the SAP are met.	Shaw Project Chemist and 3rd Party Data Validation Company-Laboratory Data Consultants
IIb	Method performance criteria	Evaluate laboratory QC data against project-specific criteria.	3rd Party Data Validation Company-Laboratory Data Consultants

Notes:
IIa denotes compliance with methods, procedures, and contracts.
IIb denotes comparison with measurement performance criteria in the SAP.

SAP Worksheet #36 – Analytical Data Validation (Steps IIa and IIb) Summary Table

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa	Soil	PCBs TPH Metals PAHs OCPs SVOC VOCs	In accordance with laboratory SOP, NAVFAC EWI#1, and EPA Level III and IV guidance	Laboratory Data Consultants and Curtis and Tompkins PM
IIb	Soil	PCBs TPH Metals PAHs OCPs SVOC VOCs	In accordance with Validation Company SOP NAVFAC SWEWI#1, and EPA National Functional Guidelines	Laboratory Data Consultants

Notes:
IIa denotes compliance with methods, procedures, and contracts.
IIb denotes comparison with measurement performance criteria in the SAP.

SAP Worksheet #37 – Usability Assessment

37.1 DATA QUALITY ASSESSMENT REPORT

Based on data validation/review, the Project Chemist will determine if the project quality objectives (PQOs) have been met, and will calculate data completeness. To reconcile the collected data with project PQOs and to establish and document data usability, the data will be reviewed *against data quality indicators (Section 37.2).*

The Project Chemist will prepare a Data Quality Assessment (DQA) Report. The DQA Report will cover the following topics:

- Implementation of sampling design and analysis according to the approved SAP (or sample completeness and representativeness)
- Proper frequency of field QC samples and the adequacy of field decontamination procedures
- Accuracy and precision of the data collected
- Data comparability, if appropriate
- Data usability for project decisions

The DQA Report will be included in the Final Project Report.

37.2 DATA QUALITY INDICATORS

This section defines the data quality indicators and their use for assessment of data quality.

37.2.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. The following equation illustrates the method for calculating relative percent difference (RPD) to assess a method's precision:

$$\text{Precision as RPD} = \frac{|\text{Result-Duplicate Result}|}{\text{Result + Duplicate Result/2}} \times 100\%$$

The laboratory uses matrix spike (MS)/matrix spike duplicate (MSD) pairs to assess the precision of analytical procedures, with one MS/MSD pair analyzed for every batch of up to 20 samples. According to the Navy requirements, analytical laboratories perform MS/MSD on the Navy project samples. This allows determining whether matrix interferences may be present.

The laboratory uses LCS/LCD pairs when matrix spikes are not practical due to the nature of sample or analytical method used, and they are prepared and analyzed with each batch of samples instead of MS/MSD. LCS/LCD may also be prepared in place of MS/MSD in the case

that a sufficient sample volume was not obtained in the field to perform the MS/MSD analysis. For inorganic analyses, analytical precision is usually calculated based on the sample and sample duplicate results.

Analytical laboratory will have statistically based acceptability limits for RPDs established for each method of analysis and sample matrix. The laboratory will review the QC samples to ensure that internal QC data lies within the limits of acceptability. Any suspect trends will be investigated and corrective actions taken.

Soil field duplicates assess the heterogeneity of contaminant distribution and not precision, soil field duplicates will not be collected for this project.

37.2.2 Accuracy

Accuracy measures the bias of an analytical system by comparing the difference of a measurement with a reference value. The percent recovery of an analyte, which has been added to the environmental samples at a known concentration before extraction and analysis, provides a quantitation tool for analytical accuracy. The spiking solutions used for accuracy determinations are not used for instrument calibrations. The following equation illustrates how accuracy is evaluated:

$$\text{Accuracy as percent recovery} = \frac{\text{Spiked Sample Result} - \text{Sample Result}}{\text{Spiked Sample True Value}} \times 100\%$$

Percent recoveries for MS, MSD, and LCS that are analyzed for every batch of up to 20 samples serve as a measure of analytical accuracy. Surrogate standards are added to all samples, blanks, MSs, MSDs, and LCSs analyzed for organic contaminants to evaluate the method's accuracy and to help determine matrix interferences.

As a general rule, the recovery of most compounds spiked into samples is expected to fall within a range of 70 to 130%. This range represents the EPA advisory acceptability limits for MS, MSD, and LCS recoveries for all organic analysis methods. The surrogate standard advisory acceptability limits are also 70 to 130% for all organic analyses. Laboratories may use the advisory limits until the in-house, statistically-based control limits are developed for each method of organic analysis and sample matrix.

Control limits are defined as the mean recovery, plus-or-minus three standard deviations, of the 20 data points, with the warning limits set as the mean plus-or-minus two standard deviations. The laboratory will review the QC samples and surrogate standard recoveries for each analysis to

ensure that internal QC data lie within the limits of acceptability. The laboratory will investigate any suspect trends and take appropriate corrective actions.

37.2.3 Representativeness

Unlike precision and accuracy, which can be expressed in quantitative terms, representativeness is a qualitative parameter. Representativeness is the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. It is a qualitative parameter that depends on proper design of the sampling program.

Field personnel will be responsible for ensuring that samples are representative of field conditions by collecting and handling samples according to the approved site-specific Sampling and Analysis Plan, this Chemical Data Quality Management Plan, and field SOPs. Errors in sample collection, packaging, preservation, or CoC procedures may result in samples being judged non-representative and may form a basis for rejecting the data.

Data generated by the laboratory must be representative of the laboratory database of accuracy and precision measurements for analytes in different matrices. Laboratory procedures for sample preparation will ensure that aliquots used for analysis are representative of the whole sample. Aliquots to be analyzed for volatile parameters will be removed before the laboratory composites/homogenizes the samples, to avoid losing volatile compounds during mixing.

37.2.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another, whether it was generated by a single laboratory or during inter-laboratory studies. The use of standardized field and analytical procedures ensures comparability of analytical data.

Sample collection and handling procedures will adhere to EPA-approved protocols. Laboratory procedures will follow standard analytical protocols, use standard units, standardized report formats, follow the calculations as referenced in approved analytical methods, and use a standard statistical approach for QC measurements.

37.2.5 Completeness

Completeness is a measure of whether all the data necessary to meet the project have been collected. For the data to be considered complete, they must meet all acceptance criteria including accuracy and precision and other criteria specified for an analytical method. The data will be reviewed and/or validated to keep invalid data from being processed through data collection. Completeness is evaluated using the following equation:

$$Completeness = \frac{Acceptable\ Results}{Total\ Results} \times 100\%$$

The goal for completeness for all QC parameters, except holding times, will be 90%. The goal for holding times will be 100%. If these goals are not achieved, the sources of non-conformances will be evaluated to determine whether re-sampling and re-analysis is necessary.

37.3 PROJECT-REQUIRED REPORTING LIMITS

Following Navy requirements, the laboratory will determine the MDLs for each method, instrument, analyte and matrix by using the procedure described in Title 40 Code of Federal Regulations Part 136B and the DoD QSM (DoD, 2009). The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero.

A MDL study involves preparation/digestion and analysis of seven replicates of a given matrix spiked with target analytes at concentrations two to five times greater than the estimated MDL. At a minimum, the laboratory will conduct annual MDL studies or quarterly MDL verifications (according to DoD QSM requirements). The laboratory will select reporting limits (RL) for all analytes at concentration levels that exceed the calculated MDL by a factor of two to ten.

SAP Worksheet #38 – References

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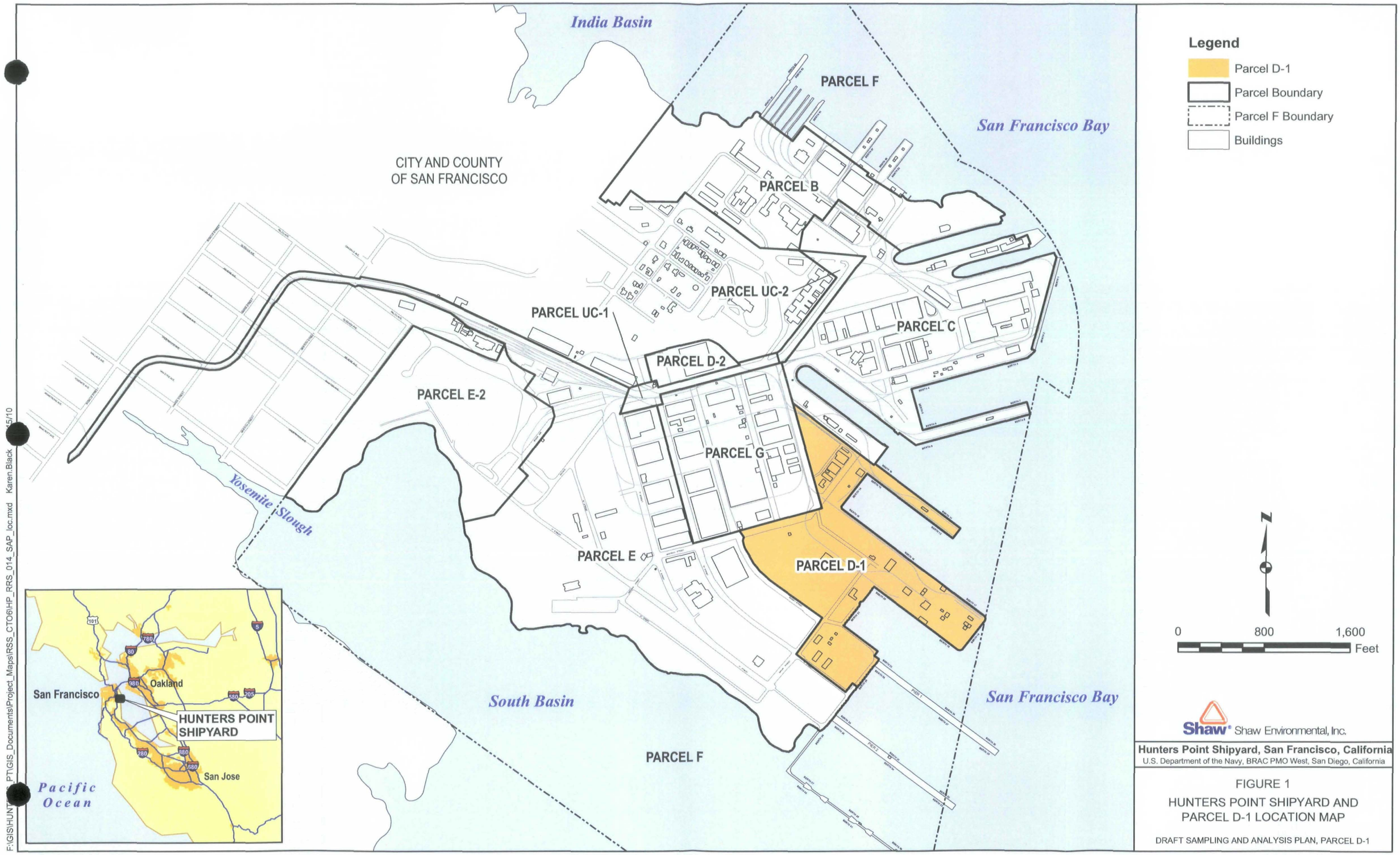
FIGURES

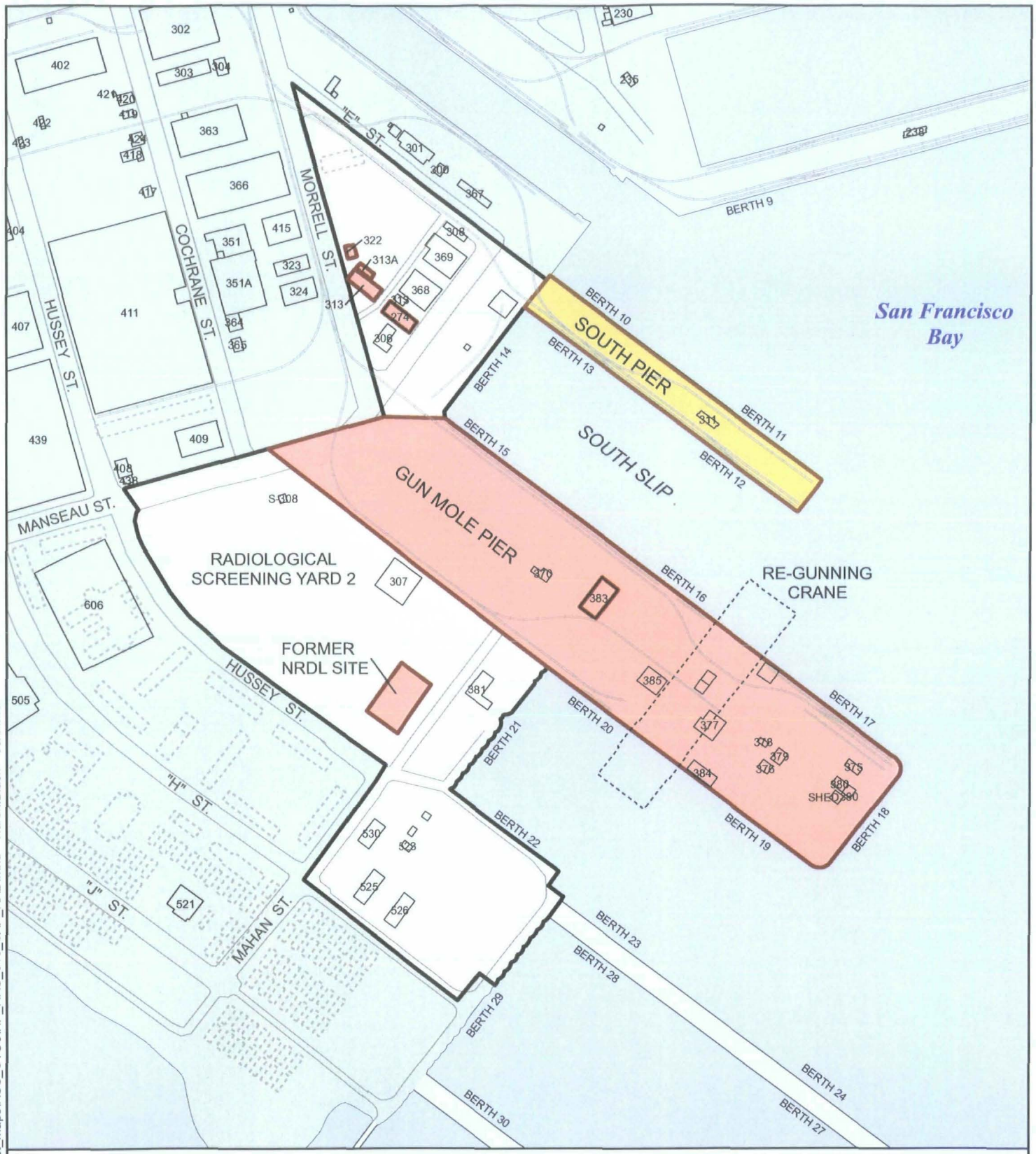


Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 1
HUNTERS POINT SHIPYARD AND
PARCEL D-1 LOCATION MAP

DRAFT SAMPLING AND ANALYSIS PLAN, PARCEL D-1

F:\GIS\HUNTERS_PT\GIS_Documents\Project_Maps\RSS_CTO6\HP_RRS_014_SAP_loc.mxd Karen.Black 5/10



Radiologically Impacted Building or Site per HRA

Radiologically Impacted Building or Site per Navy Contract (CTO 6)

Parcel D-1 Boundary (includes Gun Mole and South Piers)

Railroad

Building (Existing)

Building (Demolished)

0 400 800 Feet

Note: Parcel D-1 berths are radiologically impacted.

Shaw® Shaw Environmental, Inc.

Hunters Point Shipyard, San Francisco, California

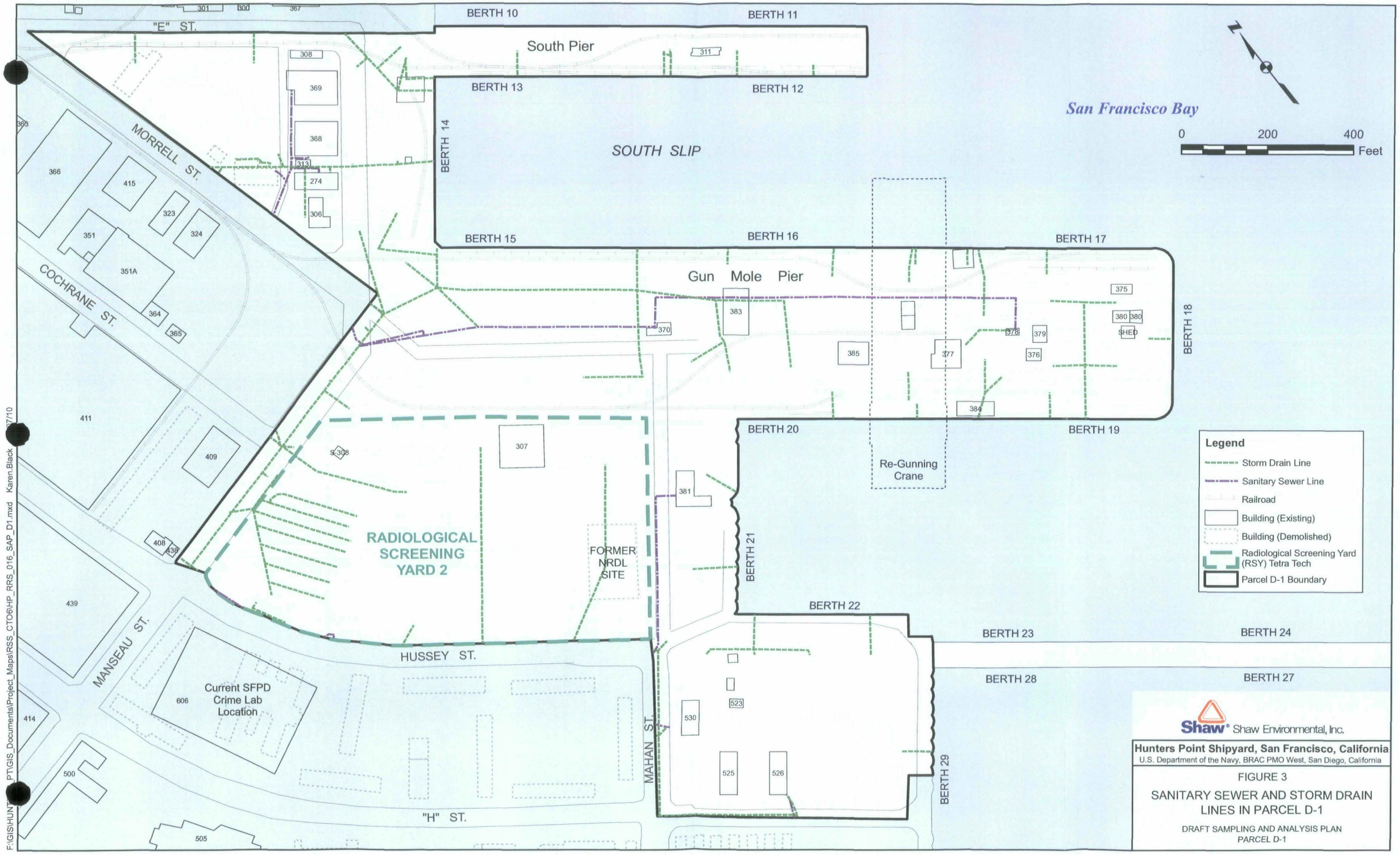
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2

RADIOLOGICALLY IMPACTED AREAS PARCEL D-1

DRAFT SAMPLING AND ANALYSIS PLAN, PARCEL D-1

F:\GIS\HUNTERS_PT\GIS_Documents\Project_Maps\RSS_CTO6\HP_RRS_015_SAP_RAD.mxd Karen.Black 05/04/10


BERTH 10
BERTH 11
South Pier
BERTH 13
BERTH 12
BERTH 14
SOUTH SLIP
San Francisco Bay
0
200
400
Feet
"E" ST.
MORRELL ST.
COCHRANE ST.
BERTH 15
BERTH 16
BERTH 17
Gun Mole Pier
BERTH 18
BERTH 20
BERTH 19
Re-Gunning Crane
RADIOLOGICAL SCREENING YARD 2
FORMER NRDL SITE
BERTH 21
BERTH 22
BERTH 23
BERTH 24
BERTH 28
BERTH 27
HUSSEY ST.
MANSEAU ST.
Current SFPD Crime Lab Location
MAHAN ST.
BERTH 29
"H" ST.
Legend
Storm Drain Line
Sanitary Sewer Line
Railroad
Building (Existing)
Building (Demolished)
Radiological Screening Yard (RSY) Tetra Tech
Parcel D-1 Boundary
Shaw Environmental, Inc.
Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California
FIGURE 3
SANITARY SEWER AND STORM DRAIN LINES IN PARCEL D-1
DRAFT SAMPLING AND ANALYSIS PLAN
PARCEL D-1
F:\GIS\HUNTERS_PT\GIS_Documents\Project_Maps\RSS_CTO6\HP_RRS_016_SAP_D1.mxd Karen.Black 7/10

ATTACHMENTS

Attachment 1
Chain of Custody Form

CHAIN OF CUSTODY

Shaw

Shaw Environmental and Infrastructure Inc.

4006 Port Chicago Hwy
Concord, CA 94520

Ref. Document # 136250 - 001

Page 1 of 1

Project Number: 136250
Project Name / Location: Hunters Point
Purchase Order #:

Project Manager: Frank Hackett
(Name & phone #)

Shipment Date:
Waybill Number:
Lab Destination:
Lab Contact Name / ph. #:

Send Report To: Anna Pajarillo
Phone/Fax Number: 925-288-2117
Address: 4006 Port Chicago Hwy
City: Concord, CA 94520

anna.Pajarillo@Shawgrp.com

Sampler's Name(s):

Analyses Requested

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (soil) / Container (soil) / Beginning depth (ft)	Ending depth (ft)									Cooler Temperature
Temperature Blank																	X

Special Instructions:

Turnaround Time: Standard 10 Day ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By:	Date: Time:	Received By:	Date: Time:
Relinquished By:	Date: Time:	Received By:	Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO =Soil
GW = Ground Water SED-Sediment
WW = Waste Water
SW = Swipe

Attachment 2
Sample Collection Log Book

Shaw® Shaw Environmental, Inc.

DATE			2010
TIME	:		
PAGE	OF		
PROJECT NO.	136250		

SAMPLE COLLECTION LOG

PROJECT NAME Parcel D-1 Radiological Remediation and Support

SAMPLE NO. _____

SAMPLE LOCATION _____

SAMPLE TYPE ☐ Soil ☐ Swipe ☐ Air ☐ Other (give description)

COMPOSITE ☐ YES ☐ NO

COMPOSITE TYPE _____

DEPTH OF SAMPLE _____

WEATHER _____

MAP ON PAGE ☐

ANALYSES		CONTAINER AND AMOUNT COLLECTED
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐

COMMENTS:

PREPARED BY: _____

Attachment 3
Laboratory SOP – (electronic format only – CD)

UNSCANNABLE MEDIA

To use the unscannable media document # 2237822
contact the Region IX Superfund Records Center

Attachment 4
Laboratory Control Limits

EPA 200.7, EPA 6010B, EPA 6010C QC Limits

C&T In-House Limits
effective: May 24, 2010

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
Water	Aluminum	78 - 120	20	65 - 120	26
	Antimony	78 - 120	20	70 - 120	21
	Arsenic	80 - 120	20	74 - 126	26
	Barium	80 - 120	20	75 - 120	24
	Beryllium	80 - 120	20	80 - 120	20
	Cadmium	80 - 120	20	77 - 120	20
	Calcium	80 - 120	20	53 - 133	27
	Chromium	80 - 120	20	75 - 120	20
	Cobalt	80 - 120	20	73 - 120	20
	Copper	79 - 120	20	70 - 120	21
	Iron	80 - 120	20	66 - 121	27
	Lead	79 - 120	20	66 - 120	25
	Magnesium	79 - 120	20	63 - 124	20
	Manganese	80 - 120	20	65 - 124	28
	Molybdenum	80 - 120	20	79 - 120	20
	Nickel	80 - 120	20	71 - 120	20
	Potassium	72 - 120	20	64 - 126	26
	Selenium	80 - 120	20	71 - 123	25
	Silver	79 - 120	21	68 - 120	22
	Sodium	75 - 120	20	60 - 124	30
	Thallium	80 - 120	20	67 - 120	23
	Vanadium	80 - 120	20	78 - 120	20
	Zinc	80 - 120	20	70 - 121	24
	Boron	80 - 120	20	74 - 126	20
	Phosphorus	80 - 120	20	70 - 130	30
	Silicon	80 - 120	20	70 - 130	30
	Sulfide	80 - 120	20	70 - 130	30
	Tin	80 - 120	20	75 - 120	20
	Strontium	80 - 120	20	27 - 171	39
	Titanium	80 - 120	20	75 - 121	21
Soil	Aluminum	74 - 120	20	30 - 156	54
	Antimony	80 - 120	20	7 - 120	41
	Arsenic	80 - 120	20	65 - 120	38
	Barium	80 - 120	20	47 - 139	47
	Beryllium	80 - 120	20	68 - 122	28
	Cadmium	80 - 120	20	63 - 120	29
	Calcium	80 - 120	20	30 - 161	48
	Chromium	80 - 120	20	54 - 125	40
	Cobalt	80 - 120	20	50 - 124	41
	Copper	80 - 120	20	36 - 154	46
	Iron	80 - 120	20	34 - 151	48
	Lead	80 - 120	25	51 - 125	52
	Magnesium	78 - 120	20	28 - 153	46
	Manganese	80 - 120	20	45 - 152	46
	Molybdenum	80 - 120	20	62 - 120	25
	Nickel	80 - 120	20	41 - 142	44

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
	Potassium	73 - 120	20	40 - 145	35
	Selenium	80 - 120	20	63 - 120	31
	Silver	80 - 120	20	65 - 120	29
	Sodium	76 - 120	20	59 - 129	37
	Thallium	80 - 120	21	53 - 120	28
	Vanadium	80 - 120	20	48 - 140	39
	Zinc	80 - 120	20	30 - 154	50
	Boron	79 - 120	20	44 - 120	38
	Phosphorus	80 - 120	20	70 - 130	30
	Silicon	80 - 120	20	70 - 130	30
	Sulfide	80 - 120	20	70 - 130	30
	Strontium	80 - 120	20	70 - 130	51
	Tin	80 - 120	20	60 - 120	35
	Titanium	80 - 120	20	26 - 148	45

C&T internal list numbers: 73884, 73885

EPA 8015B, EPA 8015D, SW8015AZR1 QC Limits

C&T In-House Limits
effective: Jun 30, 2010

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
Water	JP-8, C10-C16	50 - 150	20	40 - 150	30
	JP-5 C10-C16	60 - 140	20	50 - 150	30
	Jet Fuel A C10-C16	60 - 140	20	22 - 120	30
	Kerosene C10-C16	50 - 150	20	40 - 150	30
	Diesel C10-C14	43 - 120	44	39 - 120	59
	Diesel C10-C20	55 - 125	49	49 - 128	60
	Diesel C10-C22	54 - 125	53	46 - 132	60
	Diesel C10-C24	54 - 125	53	46 - 131	61
	Diesel C10-C28	55 - 125	48	48 - 127	60
	Diesel C10-C40	53 - 129	42	43 - 139	52
	Diesel C12-C22	57 - 127	52	47 - 133	62
	Diesel C12-C24	57 - 127	52	49 - 129	63
	Diesel C12-C28	52 - 129	52	33 - 141	71
	Diesel C12-C32	56 - 127	49	49 - 129	63
	Diesel C12-C36	60 - 140	20	50 - 150	30
	Diesel C14-C28	54 - 134	50	48 - 125	69
	Diesel C10-C12	4 - 120	30	1 - 130	40
	Diesel C12-C16	24 - 120	28	14 - 130	38
	Diesel C16-C24	33 - 132	52	32 - 125	68
	Diesel C12-C14	60 - 140	20	50 - 150	30
	Free Product C10-C24	50 - 150	20	40 - 150	30
	Diesel C14-C16	60 - 140	20	50 - 150	30
	Diesel C16-C18	60 - 140	20	50 - 150	30
	Trimsol C12-C36	50 - 150	20	40 - 150	30
	Diesel C18-C20	60 - 140	20	50 - 150	30
	Diesel C20-C22	60 - 140	20	50 - 150	30
	Diesel C22-C24	60 - 140	20	50 - 150	30
	Motor Oil C20-C36	75 - 137	20	65 - 147	30
	Motor Oil C20-C40	50 - 150	25	50 - 150	25
	Motor Oil C22-C32	75 - 138	20	65 - 148	30
	Motor Oil C22-C36	75 - 137	20	65 - 147	30
	Motor Oil C24-C36	74 - 138	20	64 - 148	30
	Motor Oil C28-C36	69 - 141	20	59 - 151	30
	Motor Oil C28-C40	64 - 145	20	54 - 155	30
	Motor Oil C20-C50	52 - 150	20	42 - 160	30
	Hydraulic Fluid, C12-40	60 - 140	20	50 - 150	30
	Ash Creek Crude C10-C40	50 - 150	25	50 - 150	25
	Crude Oil C10-C40	50 - 150	25	50 - 150	25
	Hydraulic Fluid, C24-36	60 - 140	20	50 - 150	30
	Creosote C10-C36	50 - 150	25	50 - 150	25
	Bunker C C12-40	60 - 140	20	50 - 150	30
	Bunker C C12-50	60 - 140	20	50 - 150	30
	Transformer Oil C12-C40	50 - 150	25	50 - 150	25
	Transformer Oil C12-C50	50 - 150	25	50 - 150	25
	Fuel Oil C24-C36	50 - 150	25	50 - 150	25
	o-Terphenyl	60 - 129		60 - 129	

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
	Hexacosane	61 - 142		61 - 142	

C&T internal list numbers: 74446

EPA 8015B, EPA 8015D, SW8015AZR1 QC Limits

C&T In-House Limits
effective: Jun 23, 2010

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
Soil	JP-5 C10-C16	60 - 140	20	80 - 127	30
	JP-8, C10-C16	50 - 150	20	40 - 150	30
	Diesel C10-C14	32 - 164	20	45 - 140	55
	Jet Fuel A C10-C16	50 - 150	20	40 - 150	30
	Diesel C14-C28	36 - 156	20	21 - 158	55
	Kerosene C10-C16	50 - 150	35	50 - 150	35
	Diesel C10-C20	44 - 145	20	38 - 134	49
	Diesel C10-C22	45 - 143	20	33 - 140	52
	Diesel C10-C24	45 - 143	20	32 - 142	55
	Diesel C10-C28	45 - 145	20	24 - 154	59
	Diesel C10-C40	61 - 130	20	51 - 140	30
	Diesel C12-C22	45 - 142	20	31 - 142	55
	Diesel C12-C24	46 - 142	20	29 - 145	58
	Diesel C12-C28	46 - 135	20	19 - 149	65
	Diesel C12-C32	45 - 142	20	19 - 156	66
	Diesel C12-C36	60 - 140	20	50 - 150	30
	Diesel C10-C12	1 - 120	20	1 - 120	65
	Diesel C12-C16	5 - 120	20	2 - 120	68
	Diesel C16-C24	15 - 144	20	11 - 150	63
	Trimsol C12-C36	50 - 150	25	50 - 150	25
	Motor Oil C20-C36	49 - 150	20	39 - 160	30
	Motor Oil C20-C40	50 - 150	35	50 - 150	35
	Motor Oil C22-C32	48 - 151	20	38 - 161	30
	Motor Oil C22-C36	47 - 151	20	37 - 161	30
	Motor Oil C24-C36	57 - 144	20	47 - 154	30
	Motor Oil C24-C50	50 - 150	20	40 - 150	30
	Motor Oil C28-C36	53 - 147	20	43 - 157	30
	Motor Oil C28-C40	51 - 148	20	41 - 158	30
	Motor Oil C20-C50	50 - 150	35	50 - 150	35
	Hydraulic Fluid, C12-40	60 - 140	20	50 - 150	30
	Ash Creek Crude C10-C40	50 - 150	20	40 - 150	30
	Crude Oil C10-C40	50 - 150	20	40 - 150	30
	Hydraulic Fluid, C24-36	50 - 150	20	40 - 150	30
	Creosote C10-C36	50 - 150	20	40 - 150	30
	Bunker C C12-40	28 - 133	20	1 - 146	52
	Bunker C C12-50	27 - 127	20	1 - 137	52
	Transformer Oil C12-C40	50 - 150	35	50 - 150	35
	Transformer Oil C12-C50	50 - 150	35	50 - 150	35
	Fuel Oil C24-C36	50 - 150	35	50 - 150	35
	TPH (C12-C36)	50 - 150	35	50 - 150	35
	Diesel C12-C14	10 - 120	20	1 - 130	30
	Diesel C14-C16	8 - 120	20	1 - 130	30
	Diesel C16-C18	14 - 120	20	4 - 130	30
	Diesel C18-C20	5 - 120	20	1 - 130	30
	Diesel C20-C22	1 - 120	20	1 - 130	30
	Diesel C22-C24	60 - 140	20	50 - 150	30

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
	o-Terphenyl	45 - 130		45 - 130	
	Hexacosane	41 - 139		41 - 139	

C&T internal list numbers: 74414

EPA 8015B, EPA 8015D QC Limits

C&T In-House Limits
effective: May 24, 2010

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
Water	Gasoline C6-C10	71 - 125	23	67 - 120	20
	Gasoline C6-C12	72 - 126	25	67 - 120	20
	Gasoline C7-C12	73 - 127	27	68 - 120	20
	JP-4 C7-C12	70 - 130	20	60 - 140	30
	Gasoline C6-C8	32 - 120	20	34 - 120	30
	Stoddard Solvent C7-C12	70 - 130	20	60 - 140	30
	Gasoline C8-C10	43 - 120	20	39 - 120	30
	Trifluorotoluene (FID)	62 - 148		62 - 148	
	Bromofluorobenzene (FID)	70 - 140		70 - 140	
Soil	Gasoline C7-C12	77 - 123	26	38 - 120	56
	Gasoline C6-C10	75 - 121	26	40 - 120	55
	Gasoline C6-C12	77 - 121	25	38 - 120	56
	JP-4 C7-C12	70 - 130	20	60 - 140	30
	Gasoline C6-C8	70 - 130	20	60 - 140	30
	Gasoline C8-C10	70 - 130	20	60 - 140	30
	Aviation Gasoline C6-C10	70 - 130	20	60 - 140	30
	Aviation Gasoline C7-C12	70 - 130	20	60 - 140	30
	Trifluorotoluene (FID)	61 - 145		61 - 145	
	Bromofluorobenzene (FID)	57 - 146		57 - 146	

C&T internal list numbers: 73904, 73906

EPA 608, EPA 8081A, EPA 8081B QC Limits

C&T In-House Limits
effective: May 24, 2010

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
Water	gamma-BHC	46 - 164	38	35 - 168	48
	Heptachlor	41 - 143	34	17 - 156	44
	Aldrin	42 - 151	39	13 - 158	49
	Dieldrin	43 - 159	41	21 - 168	51
	Endrin	42 - 165	39	14 - 193	49
	4,4'-DDT	39 - 153	41	25 - 171	51
	Isodrin	52 - 155	42	36 - 158	52
	alpha-BHC	54 - 155	31	39 - 152	41
	beta-BHC	51 - 151	36	14 - 187	46
	delta-BHC	47 - 154	43	41 - 165	53
	Heptachlor epoxide	48 - 154	40	30 - 147	50
	Heptachlor epoxide B	68 - 120	37	58 - 130	47
	gamma-Chlordane	47 - 157	39	47 - 158	49
	alpha-Chlordane	49 - 147	34	52 - 130	44
	Endosulfan I	48 - 157	38	21 - 155	48
	4,4'-DDE	36 - 166	39	41 - 154	49
	Endosulfan II	41 - 165	39	45 - 128	49
	Endosulfan sulfate	43 - 153	39	24 - 157	49
	4,4'-DDD	35 - 160	41	32 - 170	51
	Endrin aldehyde	49 - 163	53	10 - 156	63
	Chlordane (Technical)	60 - 140	20	50 - 150	30
	Methoxychlor	37 - 167	45	1 - 214	55
	Endrin ketone	51 - 168	39	8 - 195	49
	Toxaphene	60 - 140	20	50 - 150	30
	TCMX	40 - 148		40 - 148	
	Decachlorobiphenyl	29 - 120		29 - 120	
Soil	gamma-BHC	51 - 128	20	43 - 140	39
	Heptachlor	44 - 129	20	35 - 139	41
	Aldrin	43 - 130	20	35 - 135	57
	Dieldrin	42 - 137	20	40 - 138	31
	Endrin	37 - 141	20	42 - 140	38
	4,4'-DDT	37 - 146	20	31 - 148	32
	Isodrin	50 - 130	20	48 - 138	42
	alpha-BHC	45 - 126	20	39 - 135	45
	beta-BHC	49 - 128	20	33 - 147	47
	delta-BHC	48 - 134	20	40 - 136	46
	Heptachlor epoxide	41 - 134	20	33 - 151	48
	Heptachlor epoxide B	37 - 129	20	39 - 130	58
	gamma-Chlordane	47 - 137	20	33 - 151	40
	alpha-Chlordane	43 - 128	20	34 - 139	34
	Endosulfan I	48 - 134	20	34 - 147	39
	4,4'-DDE	41 - 149	20	33 - 148	31
	Endosulfan II	42 - 130	20	37 - 137	39
	Endosulfan sulfate	41 - 126	20	29 - 144	48
	4,4'-DDD	43 - 144	20	37 - 155	45

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
	Endrin aldehyde	22 - 120	20	23 - 132	41
	Endrin ketone	39 - 150	20	33 - 149	34
	Chlordane (Technical)	60 - 140	20	50 - 150	30
	Methoxychlor	32 - 151	20	33 - 147	41
	Toxaphene	60 - 140	20	50 - 150	30
	TCMX	44 - 142		44 - 142	
	Decachlorobiphenyl	24 - 120		24 - 120	

C&T internal list numbers: 73914, 73915

EPA 608, EPA 8082, EPA 8082A QC Limits

C&T In-House Limits
effective: May 24, 2010

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
Water	Aroclor-1016	74 - 142	28	58 - 142	70
	Aroclor-1221	60 - 140	20	50 - 150	30
	Aroclor-1232	60 - 140	20	50 - 150	30
	Aroclor-1242	60 - 140	20	50 - 150	30
	Aroclor-1248	60 - 140	20	50 - 150	30
	Aroclor-1254	60 - 140	20	50 - 150	30
	Aroclor-1260	69 - 143	37	50 - 132	23
	Aroclor-1262	60 - 140	20	50 - 150	30
	Aroclor-1268	60 - 140	20	50 - 150	30
	TCMX	53 - 124		53 - 124	
	Decachlorobiphenyl	23 - 120		23 - 120	
Soil	Aroclor-1016	79 - 148	29	65 - 158	37
	Aroclor-1221	60 - 140	20	50 - 150	30
	Aroclor-1232	60 - 140	20	50 - 150	30
	Aroclor-1242	60 - 140	20	50 - 150	30
	Aroclor-1248	60 - 140	20	50 - 150	30
	Aroclor-1254	60 - 140	20	50 - 150	30
	Aroclor-1260	77 - 152	34	47 - 158	41
	Aroclor-1262	60 - 140	20	50 - 150	30
	Aroclor-1268	60 - 140	20	50 - 150	30
	TCMX	72 - 145		72 - 145	
	Decachlorobiphenyl	35 - 120		35 - 120	

C&T internal list numbers: 73865, 73867

EPA 624, EPA 8260B, EPA 8260C QC Limits

C&T In-House Limits
effective: May 24, 2010

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
Water	Ethanol	34 - 172	37	56 - 155	42
	Iodomethane	21 - 175	38	36 - 155	41
	1,1-Dichloroethene	72 - 138	20	80 - 134	20
	Benzene	80 - 122	20	80 - 121	20
	Trichloroethene	80 - 122	20	77 - 126	20
	Toluene	80 - 120	20	80 - 120	20
	Chlorobenzene	80 - 120	20	80 - 120	20
	Freon 12	48 - 128	20	59 - 124	20
	Chloromethane	51 - 120	23	57 - 120	29
	Vinyl Chloride	60 - 122	20	64 - 126	20
	Bromomethane	32 - 149	28	35 - 144	40
	Chloroethane	61 - 135	20	72 - 133	20
	Trichlorofluoromethane	62 - 141	20	75 - 141	20
	Acetone	43 - 137	29	47 - 120	26
	Freon 113	60 - 142	20	69 - 134	20
	Methylene Chloride	70 - 130	20	77 - 126	20
	MTBE	66 - 120	20	70 - 120	20
	Carbon Disulfide	60 - 124	20	65 - 120	20
	trans-1,2-Dichloroethene	75 - 135	20	80 - 133	20
	Vinyl Acetate	33 - 180	24	50 - 144	21
	1,1-Dichloroethane	73 - 129	20	79 - 128	20
	2-Butanone	47 - 138	22	59 - 122	23
	cis-1,2-Dichloroethene	75 - 126	20	78 - 125	20
	2,2-Dichloropropane	73 - 151	20	67 - 139	20
	Chloroform	77 - 125	20	80 - 127	20
	Bromochloromethane	80 - 128	20	80 - 127	20
	1,1,1-Trichloroethane	75 - 138	20	80 - 139	20
	1,1-Dichloropropene	80 - 129	20	80 - 129	20
	Carbon Tetrachloride	71 - 150	20	80 - 145	22
	1,2-Dichloroethane	70 - 135	20	79 - 131	20
	1,2-Dichloropropane	76 - 122	20	80 - 120	20
	Bromodichloromethane	80 - 126	20	80 - 124	20
	Dibromomethane	80 - 121	20	80 - 120	20
	Epichlorohydrin	80 - 120	20	80 - 120	20
	4-Methyl-2-Pentanone	56 - 129	20	65 - 123	21
	cis-1,3-Dichloropropene	80 - 126	20	80 - 121	20
	trans-1,3-Dichloropropene	75 - 120	20	73 - 120	20
	1,1,2-Trichloroethane	80 - 120	20	80 - 120	20
	2-Hexanone	50 - 133	22	59 - 121	21
	1,3-Dichloropropane	80 - 120	20	80 - 120	20
	Tetrachloroethene	80 - 136	20	80 - 129	20
	Dibromochloromethane	80 - 123	20	80 - 120	20
	1,2-Dibromoethane	80 - 120	20	80 - 120	20
	2-Chloroethylvinylether	1 - 132	57	1 - 120	78
	1,1,1,2-Tetrachloroethane	80 - 122	20	80 - 120	20
	Ethylbenzene	80 - 123	20	80 - 122	20
	m,p-Xylenes	80 - 126	20	80 - 123	20

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
	o-Xylene	80 - 122	20	80 - 120	20
	Styrene	80 - 123	20	80 - 120	20
	Bromoform	74 - 135	20	80 - 129	20
	Isopropylbenzene	70 - 120	20	74 - 120	20
	1,1,2,2-Tetrachloroethane	73 - 132	20	80 - 128	20
	1,2,3-Trichloropropane	73 - 126	20	80 - 120	20
	Propylbenzene	78 - 132	20	80 - 122	20
	Bromobenzene	80 - 122	20	80 - 120	20
	1,3,5-Trimethylbenzene	80 - 129	20	80 - 121	20
	2-Chlorotoluene	80 - 126	20	80 - 120	20
	4-Chlorotoluene	80 - 122	20	80 - 120	20
	tert-Butylbenzene	79 - 133	20	80 - 123	20
	1,2,4-Trimethylbenzene	80 - 127	20	80 - 120	20
	sec-Butylbenzene	78 - 139	20	80 - 127	20
	para-Isopropyl Toluene	76 - 130	20	80 - 120	20
	1,3-Dichlorobenzene	80 - 120	20	80 - 120	20
	1,4-Dichlorobenzene	80 - 120	20	80 - 120	20
	n-Butylbenzene	73 - 143	20	79 - 131	20
	1,2-Dichlorobenzene	80 - 120	20	80 - 120	20
	1,2-Dibromo-3-Chloropropane	63 - 127	20	72 - 121	24
	1,2,4-Trichlorobenzene	72 - 128	20	76 - 120	20
	Hexachlorobutadiene	63 - 157	21	75 - 133	20
	Naphthalene	61 - 141	21	71 - 130	22
	1,2,3-Trichlorobenzene	74 - 132	20	80 - 121	20
	tert-Butyl Alcohol (TBA)	45 - 152	30	57 - 142	32
	Isopropyl Ether (DIPE)	56 - 134	20	70 - 122	20
	Ethyl tert-Butyl Ether (ETBE)	60 - 124	20	71 - 120	20
	Methyl tert-Amyl Ether (TAME)	66 - 120	20	75 - 120	20
	1,4-Dioxane	70 - 130	20	60 - 140	30
	Isopropanol	40 - 164	28	59 - 150	30
	n-Hexane	60 - 213	24	73 - 187	20
	Cyclohexanone	13 - 120	28	12 - 120	35
	1-Chlorohexane	67 - 132	20	75 - 122	21
	Methyl Isothiocyanate	70 - 130	20	60 - 140	30
	Tetrahydrofuran	50 - 146	21	68 - 133	22
	Tetramethyl THF	60 - 135	20	69 - 126	20
	Gasoline C6-C10	80 - 120	20	70 - 130	30
	Gasoline C5-C12	80 - 120	20	70 - 130	30
	Gasoline C7-C12	80 - 120	20	70 - 130	30
	Dibromofluoromethane	80 - 122		80 - 122	
	1,2-Dichloroethane-d4	71 - 140		71 - 140	
	Toluene-d8	80 - 120		80 - 120	
	Bromofluorobenzene	80 - 121		80 - 121	
	Trifluorotoluene	70 - 130		60 - 140	
Soil	Ethanol	47 - 152	29	43 - 147	44
	Iodomethane	62 - 186	35	59 - 178	44
	1,1-Dichloroethene	72 - 134	20	69 - 141	35
	Benzene	80 - 125	20	71 - 125	33
	Trichloroethene	79 - 128	20	65 - 144	31
	Toluene	80 - 128	20	64 - 128	34
	Chlorobenzene	80 - 120	20	57 - 126	36
	Freon 12	48 - 125	23	46 - 127	40
	Chloromethane	54 - 131	26	47 - 127	35
	Vinyl Chloride	60 - 123	23	51 - 131	39

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
	Bromomethane	58 - 161	24	51 - 148	30
	Chloroethane	63 - 138	21	55 - 141	35
	Trichlorofluoromethane	63 - 143	20	56 - 151	41
	Acetone	55 - 167	43	31 - 194	50
	Freon 113	63 - 127	20	57 - 136	39
	Methylene Chloride	74 - 147	26	63 - 128	30
	MTBE	66 - 124	21	58 - 122	31
	Carbon Disulfide	59 - 122	20	50 - 121	35
	trans-1,2-Dichloroethene	79 - 133	20	70 - 135	32
	Vinyl Acetate	53 - 134	26	1 - 120	86
	1,1-Dichloroethane	73 - 131	20	64 - 130	29
	2-Butanone	55 - 141	32	45 - 129	39
	cis-1,2-Dichloroethene	76 - 125	20	65 - 125	30
	2,2-Dichloropropane	71 - 139	21	63 - 141	33
	Chloroform	77 - 129	20	65 - 128	27
	Bromochloromethane	76 - 130	20	68 - 125	30
	1,1,1-Trichloroethane	71 - 138	20	64 - 142	32
	1,1-Dichloropropene	77 - 133	20	68 - 139	33
	Carbon Tetrachloride	66 - 149	20	61 - 147	36
	1,2-Dichloroethane	71 - 140	20	58 - 135	26
	1,2-Dichloropropane	76 - 125	20	65 - 120	27
	Bromodichloromethane	78 - 130	20	62 - 130	28
	Dibromomethane	78 - 126	20	67 - 123	30
	2-Chloroethylvinylether	78 - 120	20	64 - 120	20
	Epichlorohydrin	80 - 120	20	60 - 120	20
	4-Methyl-2-Pentanone	60 - 131	23	54 - 121	30
	Tetramethyl THF	64 - 136	29	63 - 125	31
	cis-1,3-Dichloropropene	80 - 127	20	60 - 129	29
	trans-1,3-Dichloropropene	72 - 120	22	52 - 120	31
	1,1,2-Trichloroethane	80 - 124	21	65 - 124	29
	2-Hexanone	61 - 133	28	46 - 131	37
	1,3-Dichloropropane	80 - 126	21	67 - 123	29
	Tetrachloroethene	80 - 133	21	61 - 144	39
	Dibromochloromethane	79 - 125	20	61 - 129	33
	1,2-Dibromoethane	80 - 122	21	65 - 123	30
	1,1,1,2-Tetrachloroethane	80 - 127	20	62 - 131	37
	Ethylbenzene	80 - 129	20	58 - 134	38
	m,p-Xylenes	80 - 129	20	57 - 133	40
	o-Xylene	80 - 125	20	56 - 131	38
	Styrene	80 - 125	20	52 - 130	37
	Bromoform	74 - 128	22	55 - 132	35
	Isopropylbenzene	68 - 120	22	45 - 120	45
	1,1,2,2-Tetrachloroethane	70 - 134	28	47 - 127	42
	1,2,3-Trichloropropane	71 - 136	29	55 - 128	34
	Propylbenzene	78 - 132	21	47 - 136	38
	Bromobenzene	80 - 126	28	53 - 128	37
	1,3,5-Trimethylbenzene	80 - 129	21	46 - 137	43
	2-Chlorotoluene	80 - 131	21	48 - 134	47
	4-Chlorotoluene	80 - 127	21	45 - 129	46
	tert-Butylbenzene	77 - 129	20	46 - 140	42
	1,2,4-Trimethylbenzene	80 - 126	27	44 - 133	46
	sec-Butylbenzene	78 - 133	20	41 - 144	44
	Methyl Isothiocyanate	50 - 150	20	50 - 150	30
	para-Isopropyl Toluene	*76 - 126*	*27*	*39 - 135*	*45*
	1,3-Dichlorobenzene	80 - 126	25	43 - 128	50
	1,4-Dichlorobenzene	80 - 126	24	42 - 126	47

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
	n-Butylbenzene	75 - 140	27	34 - 144	47
	1,2-Dichlorobenzene	80 - 124	23	42 - 127	48
	1,2-Dibromo-3-Chloropropane	64 - 134	25	46 - 122	41
	1,2,4-Trichlorobenzene	70 - 134	30	21 - 128	56
	Hexachlorobutadiene	70 - 143	25	20 - 148	51
	Naphthalene	64 - 133	32	26 - 126	55
	1,2,3-Trichlorobenzene	73 - 130	29	20 - 129	51
	tert-Butyl Alcohol (TBA)	55 - 139	32	44 - 140	47
	Isopropyl Ether (DIPE)	60 - 131	20	56 - 125	24
	Ethyl tert-Butyl Ether (ETBE)	66 - 126	20	60 - 123	25
	Methyl tert-Amyl Ether (TAME)	74 - 120	20	65 - 120	24
	Isopropanol	49 - 146	34	37 - 138	43
	Cyclohexanone	1 - 149	105	1 - 120	100
	Tetrahydrofuran	57 - 143	21	51 - 128	39
	1-Chlorohexane	70 - 131	20	50 - 141	53
	1,4-Dioxane	42 - 148	20	67 - 125	30
	n-Hexane	71 - 178	28	54 - 191	44
	Gasoline C6-C10	70 - 130	20	60 - 140	30
	Gasoline C7-C12	70 - 130	20	60 - 140	30
	Dibromofluoromethane	78 - 122		78 - 122	
	1,2-Dichloroethane-d4	68 - 152		68 - 152	
	Toluene-d8	80 - 120		80 - 120	
	Bromofluorobenzene	76 - 132		76 - 132	
	Trifluorotoluene	60 - 150		60 - 150	

C&T internal list numbers: 73919, 73921

EPA 625, EPA 8270C, EPA 8270D QC Limits

C&T In-House Limits
effective: May 24, 2010

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
Water	Phenol	40 - 120	28	44 - 120	77
	2-Chlorophenol	49 - 120	28	47 - 120	79
	1,4-Dichlorobenzene	45 - 120	30	45 - 120	26
	N-Nitroso-di-n-propylamine	47 - 120	32	52 - 120	36
	1,2,4-Trichlorobenzene	49 - 120	29	52 - 120	29
	4-Chloro-3-methylphenol	47 - 120	26	50 - 120	53
	Acenaphthene	53 - 120	30	55 - 120	27
	4-Nitrophenol	40 - 120	30	44 - 120	51
	2,4-Dinitrotoluene	53 - 120	28	45 - 120	47
	Pentachlorophenol	43 - 120	32	56 - 120	42
	Pyrene	54 - 120	29	47 - 120	29
	Resorcinol	1 - 120	85	1 - 120	77
	Diphenyl ether	50 - 150	25	50 - 150	25
	Acetophenone	60 - 140	20	50 - 150	30
	Atrazine	60 - 140	20	50 - 150	30
	Biphenyl	60 - 140	20	50 - 150	30
	Benzaldehyde	60 - 140	20	50 - 150	30
	Caprolactam	60 - 140	20	50 - 150	30
	2,3,4,6-Tetrachlorophenol	57 - 120	30	56 - 120	30
	N-Nitrosodimethylamine	48 - 120	29	52 - 120	25
	Dimethyl formamide	50 - 150	40	50 - 150	40
	Pyridine	24 - 120	97	13 - 120	76
	Aniline	1 - 120	80	1 - 120	73
	bis(2-Chloroethyl)ether	52 - 120	27	55 - 120	25
	1,3-Dichlorobenzene	45 - 120	32	46 - 120	27
	Benzyl alcohol	52 - 120	31	53 - 120	27
	1,2-Dichlorobenzene	47 - 120	31	49 - 120	26
	2-Methylphenol	42 - 120	49	47 - 120	98
	bis(2-Chloroisopropyl) ether	46 - 120	34	47 - 120	24
	4-Methylphenol	41 - 120	50	45 - 120	91
	Hexachloroethane	39 - 120	34	43 - 120	34
	Nitrobenzene	53 - 120	27	33 - 120	30
	Isophorone	56 - 120	28	55 - 120	27
	2-Nitrophenol	46 - 120	29	42 - 120	99
	2,4-Dimethylphenol	34 - 120	38	42 - 120	98
	Benzoic acid	16 - 120	50	49 - 128	60
	bis(2-Chloroethoxy)methane	52 - 120	38	48 - 120	30
	2,4-Dichlorophenol	49 - 120	28	48 - 120	79
	Naphthalene	55 - 120	29	49 - 120	27
	4-Chloroaniline	24 - 120	44	23 - 120	43
	Hexachlorobutadiene	42 - 120	29	45 - 120	28
	1-Methylnaphthalene	56 - 120	28	57 - 120	29
	2-Methylnaphthalene	55 - 120	28	56 - 120	37
	Hexachlorocyclopentadiene	1 - 120	49	1 - 120	92
	2,4,6-Trichlorophenol	52 - 120	28	52 - 120	67
	2,4,5-Trichlorophenol	50 - 120	27	47 - 120	53
	2-Chloronaphthalene	54 - 120	28	52 - 120	31

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
	2-Nitroaniline	54 - 120	37	49 - 120	27
	Dimethylphthalate	54 - 120	30	55 - 120	30
	Acenaphthylene	55 - 120	31	42 - 127	27
	2,6-Dinitrotoluene	55 - 120	29	46 - 120	40
	3-Nitroaniline	40 - 120	33	26 - 120	32
	2,4-Dinitrophenol	22 - 122	33	27 - 134	54
	Dibenzofuran	59 - 120	28	55 - 120	29
	Diethylphthalate	54 - 120	30	52 - 120	27
	Fluorene	60 - 120	32	51 - 120	29
	4-Chlorophenyl-phenylether	58 - 120	32	48 - 120	29
	4-Nitroaniline	37 - 120	29	25 - 120	31
	4,6-Dinitro-2-methylphenol	35 - 120	34	26 - 132	97
	N-Nitrosodiphenylamine	52 - 120	44	46 - 120	28
	Azobenzene	53 - 120	28	53 - 120	29
	4-Bromophenyl-phenylether	55 - 120	36	48 - 120	29
	Hexachlorobenzene	57 - 120	27	57 - 120	30
	Phenanthrene	55 - 120	38	42 - 120	29
	Creosote	60 - 140	20	50 - 150	30
	Anthracene	56 - 120	28	50 - 120	41
	Carbazole	40 - 120	34	56 - 120	31
	Di-n-butylphthalate	56 - 120	28	51 - 120	28
	Fluoranthene	57 - 120	41	51 - 120	33
	Benzidine	1 - 120	107	1 - 130	117
	Butylbenzylphthalate	45 - 120	31	44 - 120	31
	3,3'-Dichlorobenzidine	27 - 120	47	1 - 120	72
	Benzo(a)anthracene	57 - 120	29	47 - 120	26
	Chrysene	54 - 120	30	43 - 120	44
	bis(2-Ethylhexyl)phthalate	48 - 124	53	47 - 120	37
	Di-n-octylphthalate	41 - 120	34	45 - 120	38
	Benzo(b)fluoranthene	55 - 120	46	54 - 120	36
	Benzo(k)fluoranthene	58 - 120	33	54 - 120	36
	Benzo(a)pyrene	51 - 120	32	36 - 120	31
	Indeno(1,2,3-cd)pyrene	47 - 120	34	29 - 120	36
	Dibenz(a,h)anthracene	50 - 120	34	30 - 121	42
	Benzo(g,h,i)perylene	48 - 125	34	18 - 135	36
	2-Fluorophenol	37 - 120		37 - 120	
	Phenol-d5	38 - 120		38 - 120	
	2,4,6-Tribromophenol	42 - 120		42 - 120	
	Nitrobenzene-d5	46 - 120		46 - 120	
	2-Fluorobiphenyl	51 - 120		51 - 120	
	Terphenyl-d14	21 - 120		21 - 120	
Soil	Phenol	43 - 120	26	42 - 120	44
	2-Chlorophenol	47 - 120	25	45 - 120	42
	1,4-Dichlorobenzene	46 - 120	24	47 - 120	35
	N-Nitroso-di-n-propylamine	41 - 120	30	39 - 120	46
	1,2,4-Trichlorobenzene	50 - 120	26	50 - 120	32
	4-Chloro-3-methylphenol	50 - 120	26	51 - 120	32
	Acenaphthene	49 - 120	26	47 - 120	32
	4-Nitrophenol	39 - 120	28	38 - 120	55
	2,4-Dinitrotoluene	51 - 120	27	48 - 120	32
	Pentachlorophenol	28 - 120	30	20 - 120	68
	Pyrene	49 - 120	28	41 - 120	40
	Diphenyl ether	50 - 150	25	50 - 150	35
	Acetophenone	60 - 140	20	50 - 150	30

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
	Atrazine	60 - 140	20	50 - 150	30
	Biphenyl	60 - 140	20	50 - 150	30
	Benzaldehyde	60 - 140	20	50 - 150	30
	Caprolactam	60 - 140	20	50 - 150	30
	N-Nitrosodimethylamine	39 - 120	34	42 - 120	37
	Pyridine	18 - 120	47	9 - 120	81
	Dimethyl formamide	60 - 140	20	50 - 150	30
	Aniline	22 - 120	61	16 - 120	59
	bis(2-Chloroethyl)ether	46 - 120	29	45 - 120	40
	1,3-Dichlorobenzene	48 - 120	26	48 - 120	35
	Benzyl alcohol	44 - 120	27	41 - 120	47
	1,2-Dichlorobenzene	48 - 120	22	48 - 120	35
	2-Methylphenol	43 - 120	22	41 - 120	48
	bis(2-Chloroisopropyl) ether	42 - 120	28	38 - 120	42
	4-Methylphenol	42 - 120	22	38 - 120	45
	Hexachloroethane	47 - 120	25	34 - 120	38
	Nitrobenzene	48 - 120	27	43 - 120	31
	Isophorone	48 - 120	26	47 - 120	41
	2-Nitrophenol	47 - 120	26	45 - 120	44
	2,4-Dimethylphenol	46 - 120	34	44 - 120	35
	Benzoic acid	1 - 120	48	10 - 120	75
	bis(2-Chloroethoxy)methane	45 - 120	25	45 - 120	34
	2,4-Dichlorophenol	50 - 120	25	47 - 120	39
	Naphthalene	52 - 120	25	49 - 120	33
	4-Chloroaniline	1 - 120	55	12 - 120	69
	Hexachlorobutadiene	46 - 120	27	47 - 120	34
	1-Methylnaphthalene	52 - 120	26	50 - 120	34
	2-Methylnaphthalene	51 - 120	25	47 - 120	35
	Hexachlorocyclopentadiene	24 - 120	52	1 - 120	77
	2,4,6-Trichlorophenol	51 - 120	24	47 - 120	43
	2,4,5-Trichlorophenol	51 - 120	26	47 - 120	44
	2-Chloronaphthalene	50 - 120	26	48 - 120	32
	2-Nitroaniline	43 - 120	41	45 - 120	30
	Dimethylphthalate	53 - 120	26	50 - 120	31
	Acenaphthylene	54 - 120	28	48 - 120	32
	2,6-Dinitrotoluene	50 - 120	25	48 - 120	31
	3-Nitroaniline	12 - 120	47	18 - 120	55
	2,4-Dinitrophenol	1 - 120	51	1 - 120	51
	Dibenzofuran	53 - 120	26	52 - 120	29
	Diethylphthalate	52 - 120	25	48 - 120	31
	Fluorene	52 - 120	24	48 - 120	31
	4-Chlorophenyl-phenylether	52 - 120	24	50 - 120	32
	4-Nitroaniline	34 - 120	35	33 - 120	34
	4,6-Dinitro-2-methylphenol	4 - 120	43	1 - 120	77
	N-Nitrosodiphenylamine	49 - 120	30	49 - 120	33
	Azobenzene	48 - 120	26	43 - 120	33
	4-Bromophenyl-phenylether	49 - 120	26	46 - 120	33
	Hexachlorobenzene	51 - 120	25	50 - 120	33
	Phenanthrene	51 - 120	25	43 - 120	36
	Creosote	60 - 140	20	50 - 150	30
	Anthracene	52 - 120	27	45 - 120	34
	Carbazole	53 - 120	24	46 - 120	31
	Di-n-butylphthalate	52 - 120	25	48 - 120	30
	Fluoranthene	54 - 120	24	43 - 120	38
	Benzidine	1 - 120	67	1 - 120	101
	Butylbenzylphthalate	42 - 120	26	44 - 120	34

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
	3,3'-Dichlorobenzidine	17 - 120	43	18 - 120	61
	Benzo(a)anthracene	52 - 120	27	41 - 120	38
	Chrysene	49 - 120	27	37 - 120	46
	bis(2-Ethylhexyl)phthalate	44 - 120	28	47 - 120	37
	Diisodecyl phthalate	60 - 140	20	50 - 150	30
	Diisononyl phthalate	60 - 140	20	50 - 150	30
	Di-n-octylphthalate	35 - 120	30	29 - 144	41
	Benzo(b)fluoranthene	49 - 120	30	41 - 120	53
	Benzo(k)fluoranthene	50 - 120	28	48 - 120	46
	Benzo(a)pyrene	44 - 120	28	40 - 120	48
	Indeno(1,2,3-cd)pyrene	46 - 120	26	22 - 120	50
	Dibenz(a,h)anthracene	47 - 120	26	26 - 120	47
	Benzo(g,h,i)perylene	44 - 120	25	15 - 120	49
	Resorcinol	34 - 131	36	36 - 120	40
	2,3,4,6-Tetrachlorophenol	49 - 120	26	45 - 120	46
	2-Fluorophenol	38 - 120		38 - 120	
	Phenol-d5	35 - 120		35 - 120	
	2,4,6-Tribromophenol	30 - 120		30 - 120	
	Nitrobenzene-d5	43 - 120		43 - 120	
	2-Fluorobiphenyl	46 - 120		46 - 120	
	Terphenyl-d14	40 - 120		40 - 120	

C&T internal list numbers: 73923, 73925

Appendix B
Buried Drums, Bottles, Jars, and Containers with Unknown Content Procedure

Appendix B

PROCEDURE FOR BURIED DRUMS, BOTTLES, JARS, AND CONTAINERS WITH UNKNOWN CONTENT

1.1 PURPOSE

The following sections outline the procedures for handling and removal of buried drums, bottles, jars and/or containers (containers) unearthered during removal actions. The procedure addresses the identification and inspection of buried containers, their recovery and removal from the excavation, Hazardous Categorization (HazCat), waste catergorization sampling, temporary staging on site and disposal.

1.2 EQUIPMENT AND MATERIALS

Specialized equipment, tools, and supplies that may be required for container removal activities include (the need for specialized equipment will be evaluated on a case-to-case basis):

- Excavator equipped with drum grappler, bladed bucket (demolition grading)
- Loader/backhoe
- Shovels
- Blast shields for personnel protection
- Non-sparking/brass hand tools
- Remote drum opener/punch
- Air monitoring equipment, flame ionization detector (FID), photoionization detector (PID), radiation meter, combustible gas indicator/oxygen meter or similar
- Level B PPE to include: saranax suits, silvershield gloves, supplied air respirators
- Over-pack containers
- Spill containment kit (pads, oil dry, etc.)
- ABC fire extinguisher
- Air/water hoses
- Pumping equipment
- Radiation detection instrumentation
- Sampling and characterization kit
- Camera
- Labeling equipment

1.3 REMOVAL SEQUENCE

The following sequence will be followed once a container is encountered during the excavation activities):

- Uncovering chemical or unknown containers
- Review previous site characterization data (see geophysical survey results)
- Mobilize recovery team for evaluation/inspection of exposed containers
- Establish work zones/containment
- Radiological screening of containers
- Material excavation and transfer
- Container sampling
- Waste compatibility screening/"HazCat"
- Over-packing or lab-packing (container selection conducted following the HazCat analysis)
- Segregation, sampling and containerization of soil impacted with chemicals from the unknown containers
- Labeling of all containers with preliminary determination and accumulation start date and staging of all containers within the 90-day accumulation area
- Pre-disposal analysis and authorization for disposal
- Final labeling of containers based on analytical results
- Preparation of manifests
- Loading, transportation and disposal

1.4 WEATHER CONSIDERATIONS

Weather conditions will be considered prior to excavation of containers. Primary weather concerns are wind direction/velocity and precipitation. Wind direction will be considered and a safe distance during the removal of unknown contaminants will be established to ensure that workers downwind are not at risk. Airborne releases may be controlled by water mists, foam blankets, airtight enclosures, covering the container with earthen materials, or other suitable means. Precipitation is a concern due to the potential for contaminant migration (including inadvertent discharge, overflow, etc.), cross contamination, and chemical reactions. The potential for cross contamination and materials migration can be controlled by berms, trenches, covers, and/or sumps.

1.5 EXCAVATION OF CONTAINERS AND SOIL

Once a container with unknown content has been uncovered, all nonessential personnel will remain at a minimum 25 feet away from the excavation area. When possible, personnel should be upwind of the excavation and behind a solid barrier such as a berm, vehicle or heavy equipment. A recovery team (team leader, technician, RCT, stand-by health and safety support personnel) in Level B PPE will be deployed to inspect the container and/or area with unknown chemicals and together with the Project Site-superintendent determine the approach for the removal.

The excavation area will be examined to determine the general condition and burial depth of the containers. Air monitoring will be performed to determine if contaminant concentrations within the excavation exceeds background readings. If radioactive materials are encountered, work will not proceed until the radiation safety officer has inspected and evaluated the situation. Removal of radioactive material and mixed waste will be carried out in accordance with the Work Plan.

Once an area with containers of unknown materials is uncovered, and after air monitoring has been conducted, the recovery team will inspect for external markings that may reveal the drum or container content and/or generator. If the container is a drum, the feasibility of using a mechanical grappler will be evaluated. If the burial site is severely decayed, the appropriateness for mass excavation of the site will also be evaluated.

Prior to physically handling any container, the following checklist will be applied:

1. Is the container radioactively contaminated?
2. Does the container appear to be intact or open/damaged? Does the container exhibit leakage or deterioration (i.e., is it unsound)?
3. Does the container exhibit apparent internal pressure?
4. Is the container empty?
5. Does the container contain markings that would indicate that the contents are potentially explosive or reactive?
6. If the container is open or broken, does the container contain radioactive material(s)?

Specific items to look for when evaluating the integrity of buried containers include corrosion, rust, scaling, leakage, crystallization, bulging, smoking, hissing, fuming, unusual discoloration, etc. If compressed gas cylinders are discovered, they will be inspected thoroughly by a competent employee prior to movement.

The primary requirement for successful movement of a container is the integrity of the container shell; if the walls or ends are decayed, lifting of the container safely may not be possible.

After the exposed face of the burial site has been examined and the approach determined, the equipment operator can begin removing the containers.

1.6 MASS EXCAVATION

Mass excavation is usually performed when containers containing solid matter are in a serious state of decay, indistinguishable from one another, the contents are compatible, and the issue of ownership has been determined or there is little possibility of finding meaningful evidence of origin or prior use.

Prior to excavation, the area will be surveyed for radioactive material as per Section 4.0 of the Work Plan, as well as inspected for compressed gas cylinders or other similar pressurized containers or surficial large containers with contents. The burial area will be excavated or removed in an orderly manner. Once the area to be excavated has been evaluated to be safe for mass excavation and clearly delineated, the removal activities can start. The excavated soil and container materials will be spread out at a temporary laydown area consisting of two 20-mil layers of HDPE, PVC liner or solid polyethylene trays as appropriate located next to the identified burial site. A recovery team in level B PPE will go through and remove containers from the excavated material. Liners will be inspected for evidence of breaches (including breaks, bubbles or distortion) on a frequent basis. If liner breaches are observed, the field team will evaluate substitution to solid trays. The excavated soil will be segregated for separate waste profile sampling and disposal. Each waste container will be sampled and analyzed for radioactive material and waste compatibility screened (HazCat). The excavated material will also be isolated from any potential source of run-on from surface water or other liquids. Areas with pooled liquids will be pumped dry and the liquids contained.

1.7 CONTAINER IDENTIFICATION NUMBERS

Prior to removal of the container, a unique container identification number will be assigned to each buried container in accordance with an established numbering system for the project. The identification number will be marked on the exterior of the container with fluorescent paint or a grease stick, by application of a label, or by other approved means. The expected duration of any anticipated temporary storage will be considered when determining the type of marking/labeling system to be employed. Some markings, such as grease pencils and fluorescent paints, may become illegible after relatively short exposures to the environment.

The following information will be recorded in the field logbook:

- Container number
- Name of person logging data
- Date and time of container removal

- Container type
- Location where container was found
- Container condition
- Container size
- Labels and markings
- Disposition of container
- Photographic documentation

Once the condition of a container has been determined, it will be removed from the excavation either individually or by mass excavation. If necessary, containers will be transferred into an over-pack container prior to removal from the excavation. Each container or over-pack will be assigned a unique number, which will be marked on the exterior using either fluorescent paint or a grease stick. The drum number will also be recorded in the TtEC site drum log. If there is evidence of container breakage or leaking, soil generated and associated with mass excavation of small containers or bottles will be segregated, analyzed and profiled for disposal.

1.8 HANDLING AND STAGING OF CONTAINERS

Moving and transporting containers will be accomplished with the use of mechanical equipment. Manual handling of containers will be kept to a minimum and only used should mechanical equipment not be practical. Remote container handling equipment may consist of a grappler-equipped backhoe or front-end loader. Container transportation will be with front-end loaders or fork lifts with modified carrying platforms. Handling and transport equipment will be equipped with full frontal and side splash shields as appropriate. Container handling equipment will be fitted with a Class ABC fire extinguisher that is immediately accessible to the operator. The size and number of extinguishers will be determined by the SHSS.

1.8.1 Special Handling

Containers exhibiting the following characteristics require special treatment in handling and sampling:

- Leaking or deteriorated drums
- Bulging drums
- Drums containing explosive or shock-sensitive waste
- Drums containing or contaminated with radioactive waste
- Packaged laboratory wastes (Lab-packs)
- Air reactive waste

When containers are moved, they will be taken to an upwind staging and sampling area located upwind of the burial site. This area will be away from other drums on the site until HazCat analysis to prevent a chain reaction from occurring between incompatible materials.

Leaking of Deteriorated Containers

If containers exhibit leakage or apparent deterioration such that movement may cause rupture (determined by the SHSS or recovery team lead), they will immediately be inspected and, if deemed appropriate, transferred to an over-pack drum.

Bulging Containers

Containers that potentially may be under internal pressure, as evidenced by bulging, will be sampled in place. Extreme care will be exercised when working with and adjacent to potentially pressurized containers. Should movement of a pressurized drum be unavoidable, they will be handled only by a grappler unit constructed for explosive containment. The bulging container will be moved only as far as necessary to allow seating on firm ground or it will be carefully over-packed.

Any open bungs or drill openings in pressurized containers will be plugged with pressure-venting caps set to a 5 pounds per square inch (psi) release to allow venting of vapor pressure as outlined in the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* [National Institute for Occupational Safety and Health (NIOSH), 1985]. Creation of explosive conditions will be avoided.

If intact compressed gas cylinders are encountered, they will be handled and removed by a specialized gas cylinder disposal subcontractor.

Containers Containing Explosive or Shock-sensitive Waste

If containers are found containing wastes that have been identified by prior sampling or are suspected by visual examination to be explosive in nature, the Site Superintendent and SHSS will be notified immediately, before the drums are handled in any way. If the Site Superintendent and/or SHSS approve handling of these drums, they will be handled with extreme caution. Initial handling will be by a grappler unit constructed for explosive containment. Containers will be palletized prior to transport to a hazardous waste interim storage area prior to disposal.

If at any time during remedial activities, an explosive, pursuant to provisions of Title 18, USC, Chapter 40 (Importation, Manufacture, Distribution, and Storage of Explosive Materials, 1975 Explosives List) is identified, it will be secured and the appropriate state and federal agencies notified. Identification of an explosive substance will be done by experienced on-site personnel. Potentially explosive materials usually may be identified by their physical characteristics (texture, color, density, etc.), as well as the way they are packaged or labeled. Most explosives

are solids. In some cases, they are packaged in water-tight containers to exclude water, while in other cases, they are packaged wet to preclude explosion.

Prior to handling or transporting containers containing explosive wastes, personnel working in the area will be removed to a safe distance (as determined by the SHSS). Continuous contact between handlers and the Site Superintendent and the SHSS will be maintained until handling or transporting operations are complete. An audible siren signal system, similar to that employed in conventional blasting operations, will be used to signify the commencement and completion of explosive waste handling or transporting activities.

Containers Containing Radioactive Waste

Containers containing radioactive or mixed wastes may be encountered at the site; however, no container will be handled until radiation and contamination levels have been determined by an initial field survey. The survey will include direct radiation and contamination measurements, as detailed in SOP HPO0-Tt-006, Radiation and Contamination Surveys, and SOP HPO-Tt-009, Sampling Procedures for Radiological Surveys.

Packaged Laboratory Wastes

If individual containers suspected of containing discarded laboratory chemicals, reagents or other potentially dangerous materials in small volume are found, the Site Superintendent and SHSS will be notified immediately, prior to any removal or opening of the containers or bottles. If the Site Superintendent and/or SHSS approve the handling or these containers, they will be handled with extreme caution. Until otherwise identified or categorized, they will be considered explosive or shock sensitive wastes and will be handled as described in the section above.

Air Reactive Wastes

If the presence of an air reactive substance is verified or suspected, as concluded by a competent person, the material will be immediately segregated and transported to a separate hazardous waste interim storage and disposal area.

Air reactive wastes may be discovered during opening or sampling operations. Air reactive substances normally require special packaging. They may be stored under water or some other liquid to minimize air contact. They may also be found in sealed ampules, corrugated drums, stainless steel canisters, or specially lined drums. If conditions become reactive, clean sand can be used to smother flammable materials.

1.9 OVER-PACKING OF DRUMS

An over-packing station will be constructed adjacent to the burial site in the temporary laydown area. Straw bales, 20-mil HDPE, PVC liner and/or solid polyethylene trays may be used for construction of this station. In situations where over-packing needs to take place outside the

excavation boundary, it will be done carried out on top of already existing pads. Only materials screened for radioactive materials may be over-packed.

When using mechanical equipment, the equipment operator will pick up a container from the burial area, move to the over-pack station and gently slide the container into the over-pack. When handling a container, whether by mechanical means or by hand, the container will be examined for any sign of collapse or excessive leaking prior to lifting. The container will only be lifted as high as necessary to clear obstacles between the point of removal and the staging/over-pack area. Safe lifting practices will be observed at all times.

After the container has been screened for radioactive materials, it can be placed into the over-pack, and the lid of the defective container can be pierced with a brass punch. The brass punch is attached to the bucket of a backhoe, or other remotely operated device. The brass punch will be surveyed for radioactive contamination after piercing the container. The purpose of this operation is to provide an access port for sampling. Following this operation, the drum is either sampled or prepared for movement to the sampling area. Preparation for movement includes placing a stopper in the access port and securely installing the over-pack drum lid.

1.10 CONTAINER SAMPLE COLLECTION PROCEDURES

Sampling activities will be coordinated with the over-packing operations or container HazCat analysis. Sampling protocols are established in the SAP. All containers will be sampled and analyzed for the presence of radioactive materials. Samples collected for radiological analyses will be collected using SOP HPO-Tt-009. Samples will be analyzed by gamma spectroscopy and for gross alpha/beta. Additional analysis may be requested based upon sample results. Smaller containers and bottles will be transported in a safe manner (see AHA - Container Removal) to the HazCat area in Building 271 for individual categorization. The term "waste compatibility screening" or "HazCat" as used in this document refers to a series of rapid, qualitative chemical and physical tests conducted to determine potential hazards, handling precautions, storage criteria and disposal classification of the material in question. Container sample material will not be shipped until waste compatibility results have been reviewed and radiological screening complete.

1.11 CONTAINER SAMPLING FOR WASTE COMPATIBILITY SCREENING/ HAZCATING

All containers or over-packs will be kept sealed and resealed after sampling to prevent the escape of vapors and possible reactions from intrusion of rainwater, air, etc.

No container sampling may be performed until the drum has been examined from a health and safety stand point. If radioactivity greater than 3 sigma above background radiation levels are not detected, the RSO in conjunction with the SHSS may then, at their discretion, issue clearance to

begin field sampling of inspected drums. If containers are deemed non-radioactive, sampling can take place.

Containers identified as containing radioactive material (radioactivity greater than 3 sigma above background) will require a RWP to be in place prior to opening or sampling.

The SHSS will continuously monitor the atmosphere around the work area before and during sample collection to ensure that sampling personnel employ an appropriate level of respiratory protection. Air sampling for radioactive particulates will also be performed.

During sampling, a thorough qualitative visual description of the contents of each container will be obtained and recorded in the Container Removal Inventory Logbook. This initial visual characterization includes noting the following:

- Any and all exterior markings (photographing if practical)
- Any unique or unusual container conditions (e.g., reinforced, lined, exotic construction materials, etc.) and the type of opening(s)
- The approximate amount of material contained in the container
- Physical state, color, clarity, viscosity, number and relative estimated volume of each identified discrete layer or phase
- Readings from real-time monitors

For liquids, samples will be extracted through the bunghole if there is one on the container. If the container contains mostly solid material rather than liquids, the entire top of the container will be removed and the contents will be sampled for chemicals in a star pattern. Sampling for radiological material will be executed in accordance with SOP HP-Tt-009, Sampling Procedures for Radiological Surveys. Using the appropriate sampling device or a combination of devices, several representative grab samples with a combined volume of approximately 250 milliliters (mL) will be withdrawn and carefully placed into a labeled, clean, clear glass sampling container with a Teflon-lined plastic lid. If a container contains more than one phase (e.g., solids and liquids or multi-phase liquids), separate samples are to be taken from each phase. If the volume of any individual phase is so small as to preclude recovery of a sufficient sample, a remark to this effect will be recorded in the Container Removal Inventory Logbook.

Information to be entered into the field logbook during sampling activities may also include the following:

- Container contents
- Physical state
- pH

- Air monitoring results
- Color
- Clarity
- Thickness of layers
- Radiological monitoring results
- Other observations

The log should be photocopied, a chain-of-custody completed, and samples delivered to a State-of California certified analytical laboratory.

Used disposable sampling equipment, paper towels or waste rags used to wipe up spills will be placed into an empty metal container for subsequent disposal. If glass tubing is used, it may be broken and left inside the container being sampled.

The bung or covers on containers will be replaced and the top of the over-pack secured, if used. Two custody seals will be affixed to opposite sides of the outermost cover, lid or across the bung opening.

The outside surface of the sample containers will be thoroughly cleaned then transferred to the HazCat area (Building 271) where the HazCat Technician(s) will carry out waste compatibility screening. The waste compatibility screening tests include:

- Water Reactivity (air or water reactive)
- Miscibility (aqueous vs. organic solubility)
- Flammability and Explosivity
- pH
- Presence of Sulfide and Cyanide
- Presence of Significant Halogen Content
- Presence of Oxidizers and Peroxides
- Field Compatibility for Uncharacterized Wastes.

1.12 SAMPLING OF INTACT EXCAVATED DRUMS AND LARGE CONTAINERS

The required method of opening drums is by remote means. Three types of equipment for opening drums remotely are available: the bung spinner, the remote-controlled drill, and the hydraulic or pneumatic drum piercer. When any of these pieces of equipment are used, the opening device is attached to the drum and the control lines are extended to their maximum length (typically 100 feet). Drum-opening personnel will operate the controls from behind sandbags, a concrete or brick structure, or other solid barriers. The contact surfaces of the drum

opening equipment will be decontaminated after each use. The drum opening equipment will be surveyed for radioactive contamination prior to chemical decontamination.

1.13 RESEALING CONTAINERS

All drums/containers opened during the sampling investigation need to be resealed to prevent the escape of vapors and any possible reactions with rainwater, air, etc. The resealing methods will depend on the opening methods used and will include the following:

- Replacing the bung, screw cap, etc.
- Replacing the lid and retaining ring
- Placing the drum in an over-pack
- Using the non-reactive special rubber or plastic plug if a hole was driller. If utilized, these plugs will be checked periodically for soundness since material within the drum may react with the plug and cause it to corrode/leak. A drum bonnet will also be used to ensure that rainwater does not seep around the plug.

These sealing methods are for the purpose of preventing leakage from containers while in storage on site. If a container is moved off site, DOT drum sealing requirements must be met. DOT regulations generally have more rigorous sealing procedures than the sealing methods listed above.

Once containers are sampled and resealed, they will be placed where they cannot react with other containers on the site. Slowly progressing chemical reactions can start when a container is moved and/or opened, as the contents have been exposed to air and/or have been disturbed by handling the drum. Such a reaction could take hours or even days to occur. Segregation of the containers will be carried out according to hazard class, to prevent any potential chemical reactions between containers. For a small number of containers, the storage area(s) may be the staging and opening area. Mixed waste will be transferred and stored in the mixed waste storage area.

Sample identification, packaging, shipment and analytical protocols are provided in the site drum log.

1.14 STAGING

Containers will be stored in a secure area according to compatibility grouping. The staging area will be located in a remote or controlled environment area away from other operations. Staging area construction usually includes: an impermeable liner, secondary containment, run-on collection systems, a roof, and a location above the floodplain. The minimum requirements may be met with double 20-mil liners, straw bales for sidewalls, a tarp cover, and caution tape.